Industrial Development Report 2013

Sustaining Employment Growth:
The Role of Manufacturing and Structural Change

UNITED NATIONS
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Foreword

Since the eruption of the financial crisis in 2008, much of the public debate has focused, after decades of silence, on development economics: how to sustain growth, create lasting jobs, generate incomes and enable the accumulation of wealth, thus eradicating the scourge of poverty and preventing social polarization and fragmentation. The rising number of unemployed people in industrialized economies, the unrest in the streets of Northern Africa, the increasingly vocal demands from voters in emerging economies and the discussion towards a new international agenda for development, all point in the same direction – at the central role that productive activities and jobs have in the life of individuals and countries.

Yet, despite a legitimate wish for the contrary, jobs simply do not fall like manna from heaven. They arise out of economic development, from private entrepreneurs and governments generating new businesses and economic activities. Sustained job creation requires structural change, or the ability of an economy to constantly generate new fast-growing activities characterized by higher value added and productivity and increasing returns to scale.

Since the industrial revolution, manufacturing has been at the core of structural change, consistently creating higher levels of output and employment, and leading to an unprecedented growth in incomes. The rising incomes led, in turn, to greater demand for manufactured goods and a relative decline in spending on agricultural products. Productivity gains raised demand further as prices of manufactures declined even more relative to those of other goods and services. Accompanying these changes were major shifts in the labour force and population from agriculture and rural areas, initially into manufacturing and to urban areas, and later into services. This experience has repeated itself across the globe, wherever countries have achieved a mature stage of economic and social development.

For developing countries aiming to maintain growth while sustaining job creation, manufacturing offers an opportunity not only to rebalance the economy towards higher value-added sectors but also to provide a relatively wide employment base with higher labour productivity. The transition from agriculture to services, especially for low-income countries, offers the opportunity to achieve only the first objective, not the second.

UNIDO's *Industrial Development Report 2013* provides a solid foundation to correctly frame the debate on jobs in the world today. Manufacturing remains an important employer, accounting for around 470 million jobs worldwide in 2009 – or around 16 percent of the world's workforce of 2.9 billion. Moreover, the report provides a detailed and largely path-breaking account of how structural change has taken place over the last 40 years.

One of the key findings of this report is that countries need to move from lower tech to higher tech sectors, from lower value-added to higher value-added sectors and from lower productivity to higher productivity sectors. The structural change analysis performed for this report indicates that while conditions may vary significantly across time and space and technological change may still bring large surprises, the trends of the past are very likely to stretch into the future. There is much to learn from understanding history and what drove it. And there is much to learn by developing countries from countries both slightly – and further – ahead of them.

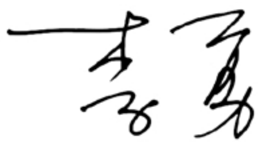
The report highlights how, nearly 40 years after Member States of UNIDO issued the Lima Declaration at the Second General Conference of the Organization in 1975, in which they expressed their firm conviction of industry's role as a dynamic instrument of growth essential to the rapid economic and social development of the developing countries, particularly the least developed countries, the underlying principles have stood the test of time: industrialization remains an indispensable route to development. Industry increases productivity and generates income, reducing poverty and providing opportunities for social inclusion. As countries further develop their industries, the motivation to increase value added drives a greater application of science, technology and innovation, encourages more investment in skills and education and provides the resources to meet broader development outcomes.

As the global community embarks on formulating a new development agenda to build on the foundation laid by the Millennium Development Goals, the report underscores the need for integrating inclusive and sustainable industrial development into this new agenda. This calls for an expansion of productive capacities and a growth of responsible value addition to encourage increased job creation and income generation, while respecting planetary boundaries and ensuring an efficient use of scarce resources. It is only through inclusive and sustainable industrial development that countries around the world, be they industrialized or developing, will be able to achieve the socially equitable and ecologically sustainable economic growth that generates employment and income, and creates the wealth to achieve wider developmental goals for health, education and human rights.

Structural transformation of the economy lies at the heart of this process, together with conscious and considered measures to encourage economic growth, enhanced productivity and the development of technology, innovation, infrastructure and trade. The report provides ample guidance on how to initiate and sustain such a process – by exploring the key drivers of structural change and providing practical policy options for governments of countries at different levels of development.

The state can use policy instruments to target key drivers. Education and skills, for example, would be underprovided in a pure market-driven environment as employers have too few incentives to allocate funds for these public goods. Similarly, limited returns on investment, lack of competitive finance and coordination failures make technology and innovation prone to market failures, resulting in underinvestment. Such market failures can be addressed through targeted policy measures to reduce input costs where the market is unable to provide a reliable supply system of low-cost and high-quality material inputs critical to local industries.

It gives me great pleasure to present this report at this early stage of my tenure as Director General of UNIDO. I am particularly pleased that the report underlines the critical need for international cooperation to achieve the structural change and economic growth required to combat poverty, and reaffirm the commitment of my Organization to fulfil its unique mandate in support of this effort. I am grateful to the UNIDO staff and the international experts that joined hands to produce this report, and look forward to seeing it become a key component in the development debate.



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Technical notes and abbreviations

References to dollars ($) are to US dollars, unless otherwise indicated.

In this report, *industry* refers to the manufacturing industry and *sectors* refers to specific manufacturing sectors.

This report defines *developed countries* or *developed economies* as the group identified as "high-income OECD countries" by the World Bank and *developing countries* or *developing economies* as all other economies. See Annex 8 for a complete list of economies by region, income level, least developed countries and largest developing economy in each region.

Components in tables may not sum precisely to totals shown because of rounding.

BIT	Bilateral investment treaty
CSR	Corporate social responsibility
EKC	Environmental Kuznets Curve
ETC	Embodied technological change
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FDI	Foreign direct investment
FIRE	Finance, insurance and real estate
GDP	Gross domestic product
GVC	Global value chain
ICSID	International Centre for Settlement of Investment Disputes
ICT	Information and communications technology
ILO	International Labour Organization
ISIC	International Standard Industrial Classification
ITA	Industrial and Technological Advancement Index
ITC	International Trade Centre
MDG	Millennium Development Goal
MVA	Manufacturing value added
OECD	Organisation for Economic Co-operation and Development
PPP	Purchasing power parity
R&D	Research and development
SME	Small and medium-size enterprise
SOE	State-owned enterprise
TVET	Technical and vocational education and training
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFSS	UN Forum on Sustainability Standards
UNIDO	United Nations Industrial Development Organization
WIOD	World Input-Output Database
WTO	World Trade Organization

Glossary

Backward linkage. Input-output production relation between suppliers and purchasers from the viewpoint of purchasers.

Bilateral investment treaties (BITs). Agreements between two countries to promote and protect investments in each other's territories.

Capital goods. Goods used in the production of other goods and services.

Commodification. Transformation of goods into undifferentiated products whose prices are increasingly determined by greater application of a market mediation characterized as perfect competition.

Corporate social responsibility. Ethical and moral responsibilities that corporations have in addition to their responsibilities to comply with law and regulations.

Decoupling. Weakening or breaking the link between environmental effects and economic activity so that output increases with a less than commensurate increase (or with a decrease) in energy consumption (Von Weizsäcker 1989; Enevoldsen, Ryelund and Andersen 2007). Absolute decoupling in industry is when the decrease in material, energy and pollution intensity is greater than the growth rate in manufacturing (OECD 2002; Spangenberg, Omann and Hinterberger 2002). Relative decoupling is when the growth rate of manufacturing value added is higher than that of industrial energy consumption.

Deindustrialization. Long-term decline in manufacturing relative to other sectors. Typically measured in terms of a share of manufacturing employment in total employment.

Elasticity. Percent change in one due to 1 percent change in another. For example, the growths of value added, employment and labour productivity as per unit increase in GDP per capita can be measured as percentage change in these variables due to 1 percentage point increase in GDP per capita. ***Income elasticity of demand*** is percentage change in demand due to 1 percentage point change in income.

Externalities. Costs or benefits that accrue to unrelated third parties. When it is a benefit reaped by third parties, it is called a ***positive externality***. When it is a cost imposed on third parties, it is called a ***negative externality***. Externality is a market failure that provides rational for industrial policy. Hausmann and Rodrik (2003, 2006) identify three main types of externalities that are particularly relevant for new activities to emerge: ***coordination externalities***, as specific new industries or activities require simultaneous, large investments to become profitable; ***information externalities***, as "discovery" of new activities requires an investment whose returns cannot be fully appropriated by the investor; and ***labour training externalities***, as firms regard labour mobility as a disincentive to invest in on-the-job training, thus reducing technological spillovers.

Gross cell product. A measure of geographical concentration, based on the output per area of 1 degree longitude by 1 degree latitude.

Induced effects. Impact on household spending due to changes in income.

Industrial energy efficiency. The ratio of the useful or desired output of a process to the energy input into a process; for a higher aggregated level (sector, economy or global), the ratio of the amount of economic activity produced from one unit of energy.

Industrial energy intensity. The amount of energy used to produce one unit of economic activity across all sectors of an economy; related to the inverse of energy efficiency but only at the sectoral, economy or global level.

Industrial policy. Any type of intervention or government policy that attempts to improve the business environment or to alter the structure of economic activity towards sectors, technologies or tasks that are expected to offer better prospects for economic growth or societal welfare than would occur in the absence of such intervention – that is, in the market equilibrium (Warwick 2013).

Informal economy. It is part of the economy that is operated outside the purview of government, thus not taxed and included in statistics.

Input-output multiplier effects. Effects leading to an increase in output, which is greater than the amount of initial final demand. For example, demand for 100 vehicles would increase total output of the economy greater than the value of 100 vehicles because the demand increases not only the output of direct inputs to vehicle production but also the output of indirect inputs (inputs to suppliers, inputs to the suppliers' suppliers and so on).

Intermediate goods. Goods used as inputs in the production of other goods and services

Labour intensity. Relative proportion of labour used in production. It is approximated in this report as the number of employment per unit of value added.

Manufacturing-related service / producer-related service. Service activities whose demands arise largely from manufacturing production. Wholesale, retail, transportation services for goods and business services (including, for example, renting services of machinery and equipment, research and development, and computer and related services) are considered major components of manufacturing-related services.

Manufacturing value added. See *value added*.

Non-manufacturing industries. Industries that comprise mining and quarrying, construction and public utilities (electricity, gas and water).

Purchasing power parity (PPP). A concept that determines the relative values of two currencies in terms of purchasing power. PPP-based GDP shows what goods and services produced in one country would cost if they were sold in the United States. Since non-tradable services of similar quality are priced lower in low-income countries than they are in the United States, their PPP-based GDPs usually become higher than their GDPs based on market exchange rates.

Private return to education. Private rate of returns to education is calculated using after-tax earnings differentials and only those educational costs actually borne by the student or their family (Amin and Awung 2005).

Process innovation. Innovation that alters the system of production to reduce costs or improve quality.

Product innovation. Innovation that alters the product mix by creating either genuinely new products or products adapted from existing designs.

Skill-biased technological change. Technological change that does not lead to proportional change in the demand for unskilled and skilled labour but results in greater demand for skilled labour.

Social return to education. Social rates of return are based on before-tax earnings differentials or total earnings and the total resources the society incurred on education (Amin and Awung 2005).

Structural change. Change in the long-term composition and distribution of economic activities. A normative perspective of structural change often emphasizes desirability in the direction of change. For example, Ocampo (2005), Ocampo and Vos (2008) and UNDESA (2006a) define structural change as the ability of an economy to continually generate new dynamic activities characterized by higher productivity and increasing returns to scale.

Technological levels of manufacturing industries. Manufacturing industries can be grouped into three technological categories – ***low tech, medium tech*** and ***high tech.*** They are based on research and development intensity relative to value added and production, following the technology classification of the Organisation for Economic Co-operation and Development (OECD 2005). In this report high tech and medium-high tech of the OECD classification are combined and called high tech, and medium-low tech industry of the OECD classification is called medium tech.

Total factor productivity. A variable that represents the amount of output not accounted for by the amount of factor inputs, such as labour and capital.

Unit labour costs. Cost of labour per unit of output. It is calculated as the ratio of labour costs to real output.

Value added. A measure of output net of intermediate consumption, which includes the value of materials and supplies used in production, fuels and electricity consumed, the cost of industrial services such as payments for contract and commission work and repair and maintenance, compensation of employees, operating surplus and consumption of fixed capital. ***Manufacturing valued added*** is the contribution of the entire manufacturing sector to GDP (manufacturing net output).

Executive summary

Sustaining employment growth: The role of manufacturing and structural change

Industrial structural change and employment

Key messages

- Manufacturing – with around 470 million jobs in 2009, or one in six jobs globally – still matters for employment generation. In 2013, there likely are more than half billion jobs in manufacturing.
- Manufacturing employment is rising in developing countries and falling in developed countries, but the declines in developed countries are mitigated by the growth of manufacturing-related services.
- Least developed countries have immense potential for industrialization in food and beverages (agroindustry), and textiles and garments, with good prospects for sustained employment generation and higher productivity.
- Middle-income countries can benefit from entering the basic and fabricated metals industries, which offer a range of products necessary for investment and are demanded by the more advanced industries and which are facing rapidly growing international demand.
- Developed countries have great possibilities for investing and innovating in high-tech industries and for sustaining jobs in these industries' related services.
- Industrialization improves not only the number of jobs but also their quality in all countries.
- Manufacturing concentrates in cities at early stages of development and "suburbanizes" at later stages. Cities thus remain crucial for industrialization in developing countries.

Jobs do not fall like manna from heaven. They arise from the process of economic development and from the efforts of entrepreneurs and governments to generate new enterprises and economic activities. Sustained job creation requires structural change, that is, the ability of an economy to constantly generate new fast-growing activities characterized by higher value added and productivity as well as increasing returns to scale. Manufacturing offers greater opportunities than other sectors to accumulate capital, exploit economies of scale, acquire new technologies and – more fundamentally – foster embodied and disembodied technological change. It is thus the core of economic growth and structural transformation.

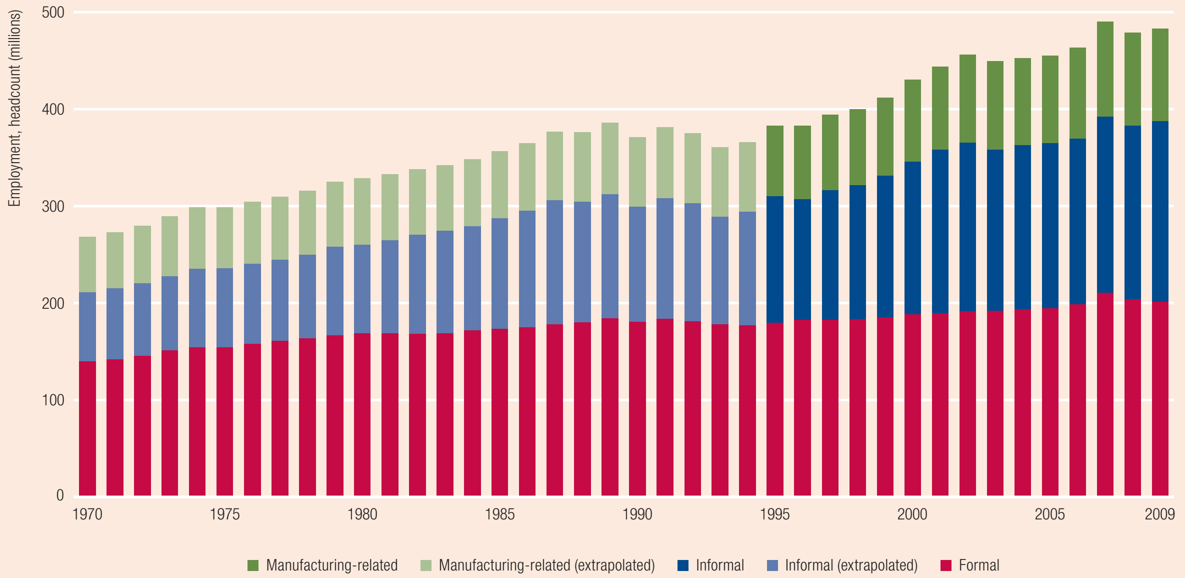
Since the industrial revolution, manufacturing has driven output and employment, sparked by improvements in mechanization and leading to unprecedented incomes. The higher incomes have led to greater demand for manufactured products and a relative decline in spending on agricultural goods. Productivity gains raised demand further as the prices of manufactures declined even more relative to those of other goods and services. Accompanying these changes were major labour force and population shifts from agriculture and rural areas into manufacturing and urban areas, and later into services.

The role of manufacturing changes as structural change evolves. At lower incomes the application of low capital-intensive technologies allows for improvements in both productivity and employment. As the capital intensity of technology increases, productivity gains dominate and employment shifts towards manufacturing-related and other services. Manufacturing remains an important employer, with around 470 million jobs worldwide in 2009 – or around 16 percent of the world's workforce of 2.9 billion – a figure far higher than many might expect (Figure S1). Manufacturing must therefore have more than half a billion jobs in 2013.

For developing countries aiming to maintain growth while sustaining job creation, manufacturing offers an opportunity not only to re-balance the economy towards higher value-added sectors but also to provide a relatively wide employment base with higher than average labour productivity. This contrasts with a direct transition from agriculture to services, especially for low-income countries. Services offer the

> **Shifts in the relative shares of industries go hand in hand with geographical shifts in the location of people, often driven by trade**

Figure S1
Number of jobs created by manufacturing industry, 1970–2009



Note: The total informal jobs before 1995 were extrapolated based on the formal-informal ratio for 1995, because there are a far larger number of missing values in country data before 1995. This made it impossible to estimate the informal employment of individual countries and sum them up to derive total informal jobs before 1995.
Source: UNIDO estimate based on ILO (2011a, 2013), UNIDO (2012a) and Timmer (2012).

opportunity to achieve only the first objective, not the second. Least developed countries, mainly in Africa, have openings in low-tech labour intensive industries like agroindustry, textiles and apparel (see also Lin 2012). Middle income countries could benefit from entering medium-tech industries such as basic and fabricated metals. Although they do not generate large amounts of employment they are high-productivity industries and can generate resources for investment. Their products include steel, bricks, cement, boilers, metallic structures, hand tools and plastics, most of them intermediate goods in high demand by more advanced industries and enjoying growing international demand. Manufacturing also offers the potential to boost wages and incomes, helping to create a domestic market.

The impact of manufacturing structural change on employment also has a spatial dimension. Shifts in the relative shares of industries go hand in hand with geographical shifts in the location of people, often driven by trade. Historically manufacturing moved from the United Kingdom to Continental Europe and to the United States and later to Japan. Today it is moving towards East Asia, including the Republic of Korea and mainland China. Yet employment is not equally distributed between emerging and traditional industrial powerhouses. And within countries manufacturing is usually more geographically concentrated in cities during the structural change from agriculture to manufacturing, reflecting agglomeration economies. However, this trend has reversed somewhat in developed economies – which are "suburbanizing" – as services become more important.

The impact of within-manufacturing structural change – the shift from low-, to medium-, to high-technology industries – on employment varies by type of industry. Low-tech industries produce vast employment opportunities and some possibilities for capital accumulation. Medium- and high-tech industries offer opportunities for capital accumulation but generate less employment than do low-tech industries. High-tech industries offer, in addition, openings for innovation and new knowledge and skill development and thus the capacity to invent new industries and

> **As developing countries move up the structural change ladder, manufacturing will continue to contribute to the quality of employment by improving wages and by providing wider opportunities for female employment**

restart the structural change cycle. It is these capacities to accumulate capital and to innovate, alongside a growing division of labour of service activities, which produce employment opportunities.

In developed countries, manufacturing remains an engine of growth in that it is the main source of financial and knowledge resources for sustaining growth and (to some extent) for creating jobs. But the bulk of new jobs are in the services for further developing manufacturing and for producing industrial goods. It is difficult to conceive of these activities as separate from manufacturing. As developing countries move up the structural change ladder, manufacturing will continue to contribute to the quality of employment by improving wages and by providing wider opportunities for female employment.

Drivers of structural change in manufacturing

Key messages

- Costs, as well as technology and demand, remain critical drivers of structural change and industrial development.
- Matching the type of skills to the structure of industry as incomes grow can drive industrial structural change.
- Product innovation results in structural transformation and generates employment through the creation of new business opportunities.
- Resource efficiency, emerging as a major driver of structural change and industrial development, will be even more important in the future.
- The impact of the drivers of structural change on sustaining employment depends on the industrial policies adopted.

Traditional and emerging drivers

The previous section depicted structural change across sectors and within manufacturing industry and the relationship to employment. But what are the drivers of this structural change? And how do they sustain employment through structural change? Certainly the interactions are extremely diverse, complex and nonlinear. This section discusses the reasons for structural change in manufacturing.

In principle, structural change in any sector in any country is governed by the conditions of demand and supply for products and services that interact with each other. Supply-side conditions generally include wages, skills, technological change, industrial organization and the overall business environment, which also determine the competitiveness of industry. Demand-side conditions include demand for imports and exports as well as foreign direct investment (FDI). Often, some of these drivers work through both demand and supply.

Wages are both a constraint on and a result of the process of structural transformation. They are a constraint in that high wages may push investors away from a project, particularly in labour-intensive industries, although most investors do not take investment decisions on wages alone but also look into other factors like productivity, infrastructure, logistical facilities and supplies (cost and availability). Too high wages may prompt a withdrawal of investment, leading to deindustrialization and falling employment, while attractive wages may generate more and new work opportunities. Wages are also a result of the process of structural change – as workers move up to higher value-added industries and raise their productivity, they receive higher salaries.

Skills need to be attuned to the structure of the industry and change over time as industrialization proceeds (Table S1). Most sophisticated industrial sectors require different types of skills than less advanced ones. Advanced industries require highly specialized manufacturing skills with a focus on technical subjects such as engineering and mathematics and strong technical and vocational education and training. Intermediate industries require a low base of

> **Skills need to be attuned to the structure of the industry and change over time as industrialization proceeds**

Table S1
Structural change, skill demand and education and training

Industrial deepening	Technological capability	Skill demand	Education and training	In-firm training	Links to other players
Low-level, simple assembly and processing mainly for domestic market	Ability to master simple assembly technologies, copy simple designs and repair machines, but no capacity to adapt processes	Literacy, numeracy and simple technical and managerial training	Formal primary education	No formal in-firm training. Informal learning through repetition and trial and error	None likely
Intermediate level, including export-oriented activities in light industry	Capability to undertake minor adaptations to processes and products, but little or no design and development capabilities	Low base of engineering and scientific skills. Small and medium-size enterprises have low skill levels	Good secondary and technical schooling and management and financial training	Some in-house training mainly by export-oriented firms	To buyers and suppliers, but very unlikely to technology institutions
Advanced and deep industrial structure mainly in technology-intensive industries	Ability to monitor, import, adapt and operate state-of-the-art advanced technologies	Highly specialized manufacturing skills with a focus on technical subjects such as engineering and mathematics	Excellent tertiary technical education and specialized industrial training by institutions of technical and vocational education and training. High numbers of university-trained managers	Large investments in formal and informal in-firm training	Strong to suppliers, buyers, consultants, universities and technology institutions

Source: Adapted from Lall (2001).

engineering and scientific skills, and early industries need literacy, numeracy and simple technical and managerial training. However, as these set of skills are cumulative, it takes time to build the skill base for structural transformation.

Improvements in technology raise productivity and hence are a major driver of structural change, yet their effect on employment is negative as they normally increase the capital intensity of industry and reduce labour needs. More generally, however, innovation usually favours structural change through shifts in production processes and the generation of new products (and eventually industries), but their impact on employment varies. Most process innovation aims to increase efficiency or save on inputs and so reduce labour, but product innovation (by creating new business opportunities) normally leads to more jobs. What matters for employment is the net effect of both dimensions.

The organization of industry affects processes of structural transformation through a mix of firm size; extent of economies of scale in production; degree of production fragmentation across value chains; and the nature of spatial distribution and clustering of production within national economies. An industrial organization geared towards large firms and sectors will make it harder for the economy to shift to more advanced industries, while a more balanced combination, which includes a significant proportion of small and medium-sized enterprises, may allow for more economic flexibility and potential for advancement as well as generate more employment.

International trade promotes structural transformation through demand-side effects including expanding the size and scope of local business, which do not need to rely solely on the domestic market to grow further. Supply-side effects include the potential for substituting imports as local producers capture markets initially served by imports; exposing local firms to foreign competition and technology, which may lead to significant productivity gains; the

> **Countries need to move from lower- to higher-tech, from lower value-added to higher value-added, and from lower-productivity to higher-productivity sectors, industries and activities if they want to develop industrially**

possibility of capturing valuable externalities and dynamic returns to scale; and by generating opportunities for attracting additional FDI. Yet the evidence suggests that the impact of international trade is ambiguous and depends on additional economic and policy conditions.

Global value chains (GVCs) help structural transformation by segmenting the production process and facilitating the relocation of production. In producing a final product in one location, there may be little scope for changing the capital–labour ratio, but once it becomes possible to fragment production into a series of stages there will inevitably be some that are more labour intensive than others and, with low transport and communication costs, it may be cost effective to locate these in a low-wage economy. Technologically, participating in value chains makes industrialization "easier and faster" but at the same time locally "less meaningful", as firms in developing countries can link to international production networks and draw on the technological and marketing prowess of the lead firms in these chains while not making the effort themselves (Baldwin forthcoming). GVCs' impact on employment tends to be positive, though it also depends on whether local production has been displaced.

FDI influences structural change by encouraging the development of clusters and exploitation of cluster economies (when domestic investment is unavailable). It promotes diversification into new sectors, particularly when it is attracted to new high-tech sectors, and through spillover effects, which make local firms more competitive and attract local firms into new activities. FDI does not, however, automatically generate structural change, as spillovers only work if local entrepreneurs are involved.

Resource constraints have traditionally not been a driver of structural change but, given the polluting impact of industrialization in the past, environmental protection will become a key driver in the future. Further, wasteful production and consumption patterns – along with continued soil degradation, deforestation and overfishing – are already exacerbating water shortages and escalating prices for food, energy and other commodities. Efficient use of inputs, therefore, has clear economic advantages, boosting competitiveness and generating resources for investing in further growth and structural transformation.

Drivers as necessary conditions

As said at the start of this report, jobs do not fall like manna from heaven – and neither of course is structural change imposed this way. Yet one of the key themes of this report is that countries need to move from lower- to higher-tech, from lower value-added to higher value-added, and from lower-productivity to higher-productivity sectors, industries and activities if they want to develop industrially. The structural change analysis for this report indicates that while conditions may vary greatly across time and space and that technological change may still throw up huge surprises, the regularities from the past are very likely to stretch into the future. There is much to learn from understanding history and what drove it. And developing countries can learn much from countries that are ahead of them – far ahead or even just slightly.

The impact of drivers on structural change, however, has not been, and will not be, unambiguous. Wages can support – or hinder – employment generation depending on how they are set. The timing of the availability of skills seems to be crucially important to support the emergence of new jobs. Technology sheds labour if it is process oriented but generates labour if it is product oriented. International trade does not always lead to a virtuous circle of structural change and employment, as the contrasting experiences of East Asia and Latin America illustrate. A simple examination of each of the drivers will reveal that their impact may go in either direction, which is complicated by the fact that drivers often interact with each other before generating an impact.

The state (alongside the private sector) needs to work hard at ensuring that the drivers have a positive impact on employment generation while transforming the economy. Through government policy targeting key drivers, such as education and skills,

> **By promoting positive structural change at all development stages and by overseeing close coordination with other policies so that there is consistency in action, governments can have a major impact on sustaining employment generation**

appropriability and/or international trade, governments can set in motion a virtuous rather than a vicious circle involving structural change. Well-run interventions can promote industrial growth and employment, as confirmed by the results of recent impact evaluations for high-income countries. By promoting positive structural change at all development stages and by overseeing close coordination with other policies so that there is consistency in action, governments can have a major impact on sustaining employment generation. But developing countries should not simply emulate high-income countries, and may well benefit from showing flexibility in experimenting, learning and evaluating.

Drivers are thus necessary conditions for successful structural change but will require a good set of well-coordinated government policies in order to make industrialization work for employment generation.

National and international industrial policy

Key messages

- Achieving sustained employment generation requires industrial policies to focus on the structural transformation of the economy.
- The state can promote industrial policy either as a regulator, financier, producer or consumer. It should oversee close coordination with other policies as they can undermine the objectives of industrial policy if they are misaligned.
- For industrial policy to be effective, the policy-making process is as important as the policy content.
- International cooperation in the areas of labour standards, investment and sustainable economic development targets after 2015 is key to ensure that industrialization generates much needed high-quality jobs.

Promoting structural change

Industrial policy – the main objective of which is to "anticipate structural change, facilitating it by removing obstacles and correcting for market failures" (Syrquin 2007) – should seek to promote such change at each stage of development, in four main ways: as a regulator establishing tariffs, fiscal incentives or subsidies; as a financier influencing the credit market and allocating public and private financial resources to industrial projects; as a producer participating directly in economic activity through, for example, state enterprises; and as a consumer guaranteeing a market for strategic industries through public procurement programmes (Peres and Primi 2009).

At an early stage of industrialization (from agriculture to low-technology manufacturing), industrial policy should primarily aim to align agricultural and industrial policies and create or support labour-intensive and resource-based manufacturing with low entry barriers; towards the middle-income stage, by improving manufacturing's efficiency and productivity and through diversifying and upgrading the economic structure; and at an advanced stage through technological innovation, pursuing both differentiation by raising quality and innovation by launching new products and services, including green technology.

Targeting key drivers of structural change

The state can use policy instruments to target key drivers. Education and skills, for example, would be underprovided in a pure market-driven environment as employers have too few incentives to provide funds for them. Similarly, limited appropriability, lack of competitive finance and coordination failures make technology and innovation prone to market failures, resulting in underinvestment (Martin and Scott 2000). And as a reliable supply system of low-cost and high-quality material inputs is critical to local industries, countries sometimes use policy instruments to reduce input costs.

The targeting of key drivers requires close coordination with other policies – notably on competition,

> **Coordination is particularly important because competition and industrial policies are often viewed as mutually conflicting**

trade and FDI, and exchange rates – that play an important complementary role to industrial policy. Failure to ensure synergies may counteract policy objectives. Coordination is particularly important because competition and industrial policies are often viewed as mutually conflicting, as the former typically aims to foster rivalry between firms in an industry (for greater efficiency and economic welfare), while the latter frequently gives a market advantage over competitors to favoured domestic sectors or industries.

Coordination among trade and FDI policies helped, for example, former low-income countries such as the Republic of Korea to catch up, and today despite restrictions imposed by bi- and multilateral trade policy agreements, governments still have some space to use trade-related instruments for industrial policy, especially non-tariff barriers (Chang 2003). They can also use export-promotion instruments that support exporters' access to competitive financing, research and development (R&D) and training.

Measures such as close monitoring of the real exchange rate and keeping it undervalued to support the tradable sector, primarily manufacturing (including manipulation of the nominal exchange rate), have featured in almost all successful catch-up countries (for example, Rodrik 2008a). They are also crucial in preventing the current account deficit from becoming unsustainable (McCombie and Thirlwall 2004).

Developing skills

Most governments agree that human capital is a crucial driver of economic growth. Some of the elements in successful skill policies are: appreciating the complexity of industrial skill needs; matching short-term needs and long-term goals; creating skills gradually and sequentially; matching supply and demand; and aligning skill policies with the broader socio-economic agenda.

At the "hard end", manufacturing employers are not just looking for technical skills but also for cognitive, social and behavioural skills. Some consider team work and problem solving key for blue-collar workers, and critical thinking crucial for white-collar workers (Bodewig 2012). Many of these soft skills have to be developed at an early age, hence the importance of supporting policies that establish the learning foundations of the future workforce. Beyond that stage, the last few decades have seen a strong emphasis on technical and vocational education and training (TVET) to meet the demand for industrial skills. Private sector involvement – through, for example, inter-firm linkages and university–private sector collaboration, including on-the-job training – is crucial because this is the most efficient way to link skills to the labour market (DFID 2011).

Still, lack of financing for high-quality TVET remains a bottleneck, but it remains important to produce training for the informal sector, both to develop that sector and to strengthen the link between the informal and formal sectors, making it easier for workers to move to the latter.

Getting industrial policy to work

Carefully chosen and implemented interventions can promote industrial growth and employment, as confirmed by evidence from the results of impact evaluations for high-income countries published in 2010 and 2012. For instance, subsidies to manufacturing firms can increase employment at comparably very low cost per job (Criscuolo et al. 2012). Well-allocated firm-level subsidies can also boost total factor productivity (Aghion et al. 2012), and tariffs that account for the varying skill levels among industries have the potential to boost economic growth (Nunn and Trefler 2010).

These types of studies must be interpreted with great caution, however. First, many were not performed thoroughly enough and hence an assessment of their internal validity suggests that causal relationships between policy instruments and observable impacts are hard to establish. Second, the findings on the achievements or failures that can be distilled from international experiences cannot easily be generalized because of country heterogeneity.

One upshot, though, is that evidence-based and realistic industrial policy run in a consensual way, which is key for effectiveness, irrespective of the

> Each country has to go through its own learning process – combining industrial policy experimentation with rigorous impact evaluation to generate an evidence base on which industrial policy measures work

concrete instruments used. Thus those making such policy should:

- *Use – do not fight – the political system.* A fact of political life is that no policy will be underwritten unless those in power agree to it.
- *Strengthen political leadership.* This will set a national transformation agenda that aims, in low-income countries, to create and nurture productive activities or, in middle-income countries, to advance technologically.
- *Encourage public–private dialogue.* This will help both in designing interventions that draw on expert knowledge in the private sector and in ensuring that all key stakeholders support decisions.
- *Boost industrial policy management capabilities.* These have to be strengthened considerably among key actors in developing countries in a pragmatic and concentrated way.

International experience with policy instruments can provide interesting lessons, but developing countries are unlikely to succeed with simple emulation of high-income economies because a strategic approach to forming industrial policy has to be tailored to national circumstances. Each country has to go through its own learning process – combining industrial policy experimentation with rigorous impact evaluation to generate an evidence base on which industrial policy measures work, and which do not, in a given context.

Cooperating internationally

International cooperation on structural change is required to prevent any "race to the bottom", where firms in rich countries could be tempted to relocate to low-income countries with lower labour costs, less restrictive labour laws, and weaker monitoring of labour conditions and environmental impacts. At the same time, to address these challenges, national regulators need a measure of policy autonomy, a position that may be at odds with international cooperation through trade agreements.

Cooperation is also required for the fairly new area of "private sustainability standards", which emerged once social activists discovered that reputation was a firm's tangible asset that they could easily harm. Another key legal instrument for international cooperation is the bilateral investment treaty, which can allay concerns of expropriation.

As the world examines how to move beyond the Millennium Development Goals after 2015, it can look to build a framework with goals anchored in the three dimensions – economic, social and environmental – of sustainable development. Generating new employment is a pivotal global social concern as well as challenge, and the post-2015 agenda offers a new opportunity for states to recouple considerations for sustainable manufacturing and employment with the focus on human development.

Trends in manufacturing valued added and in manufactured exports

Manufacturing value added

The world's manufacturing value added (MVA) reached an all-time high of $8,900 billion in 2012 (16.7 percent of global GDP), recovering fully from the sharp contraction of 2008–2009 caused by the global economic and financial crisis. MVA's share in GDP in industrialized countries fell from 16.4 percent in 1990 to 15.0 percent in 2012, when it rose from 16.5 percent to 21.3 percent in industrializing countries. (See Annex 8 for classification of industrialized and industrializing economies.)

Between 1992 and 2012 global MVA nearly doubled, averaging 3 percent annual growth. While industrialized countries' MVA expanded by a mere 1.8 percent a year, below their 2.1 percent GDP growth for the period, MVA in industrializing countries rose more than three-fold, at an annual rate of 6.4 percent, faster than their 5.0 percent GDP growth rate (Table S2). The outcome was a near-doubling in industrializing countries' share in world MVA, from 18 percent in 1992 to 35 percent in 2012 and a mirroring retreat of industrialized countries from the world's

“Manufacturing in industrializing countries is geographically highly concentrated, with the five leading economies accounting for 70.9 percent of total production in 2012

Table S2

Manufacturing value added in industrializing countries, by industrialization level, region and income group, 1992, 2002 and 2012

	Manufacturing value added (constant 2005 $ billion)			Share of manufacturing value added (percent)		
	1992	2002	2012	1992	2002	2012
World	4,960	6,590	8,900	100	100	100
Industrialized economies	4,050	5,070	5,800	82	77	65
Industrializing economies	904	1,520	3,110	18	23	35
By industrialization level						
Emerging industrial economies	778	1,340	2,820	86	88	91
Other industrializing economies	111	157	240	12	10	8
Least developed countries	14	22	44	2	1	1
By region						
East Asia and the Pacific	267	684	1,810	30	45	58
Excluding China	87	149	253	10	10	8
Europe	92	106	186	10	7	6
Excluding Poland	74	68	97	8	4	3
Latin America and the Caribbean	320	391	517	35	26	17
Excluding Mexico	214	246	340	24	16	11
Middle East and North Africa	96	134	221	11	9	7
Excluding Turkey	49	71	107	5	5	3
South and Central Asia	81	143	294	9	9	9
Excluding India	32	49	89	4	3	3
Sub-Saharan Africa	48	62	84	5	4	3
Excluding South Africa	20	25	37	2	2	1
By income group						
High income industrializing	175	273	495	19	18	16
Upper middle income industrializing	57	91	163	6	6	5
Lower middle income industrializing	657	1,140	2,410	73	75	78
Low income industrializing	15	21	41	2	1	1

Source: UNIDO estimate based on UNIDO (2013c).

manufacturing scene, underscoring the structural changes taking place in both groups.

Manufacturing in industrializing countries is geographically highly concentrated, with the five leading economies accounting for 70.9 percent of total production in 2012, up from 52.7 percent in 1992. The high and sustained MVA growth in China over this period (11.4 percent on average) is behind its emergence as the factory of the world: in 2012, 50 percent of industrializing-country manufactured goods was produced in China. Of all other large industrializing-economy manufacturers, only India (7.4 percent average annual MVA growth) kept pace with China's expansion. It gained MVA share to become the second leading manufacturer among industrializing economies, superseding Mexico and Brazil, which saw their MVA shares fall by more than half from 11.7 percent and 10.5 percent in 1992 to 5.7 percent and 4.9 percent in 2012. Turkey's steady MVA growth (4.5 percent on average a year over 1992–2012) enabled it to preserve its position as the fifth largest manufacturer among industrializing economies.

> **World exports grew by 6.4 percent annually between 2007 and 2011 to reach $16.7 trillion in 2011, more than 80 percent of it consisting of manufactured products**

Manufactured exports

A feature of the current organization of manufacturing is the increased use of international production networks to carry out different stages of the production process across borders, made possible by large scales of production, advances in technology (especially microelectronics) and affordable transport costs.

The result of this production sharing has been a larger increase in trade than the corresponding increase in MVA. World exports grew by 6.4 percent annually between 2007 and 2011 to reach $16.7 trillion in 2011, more than 80 percent of it consisting of manufactured products. In the same period, world output expanded on average by just 1.5 percent a year, as many countries were hit hard by the economic crisis in 2008–2009.

In 2011 world manufactured exports peaked at $13,469 billion, growing faster than MVA and GDP over 2007–2011 (Table S3). They recovered fully from the contraction that followed the crisis, due mainly to the expansion in exports from large industrializing countries such as China and India.

Industrialized countries' manufactured exports grew by just 3.7 percent annually over 2007–2011,

Table S3
World manufactured exports by industrialization level, region and income group, 1997–2011, selected years ($ billions)

	1997	2002	2007	2011
World	4,473	5,254	10,861	13,469
Industrialized economies	3,850	4,301	8,189	9,483
Industrializing economies	623	952	2,672	3,985
By industrialization level				
Emerging industrial economies	548	833	2,417	3,646
Other industrializing economies	69	110	232	321
Least developed countries	6	10	24	18[a]
By region				
East Asia and the Pacific	269	446	1,454	2,232
Excluding China	106	143	287	407
Europe	60	92	292	402
Excluding Poland	39	56	170	237
Latin America and the Caribbean	182	239	459	639
Excluding Mexico	89	99	250	370
Middle East and North Africa	42	77	224	274
Excluding Turkey	19	45	127	154
South and Central Asia	44	65	171	327
Excluding India	16	23	46	75
Sub-Saharan Africa	25	33	73	112
Excluding South Africa	10	16	31	54
By income group				
High income industrializing	120	175	399	629
Upper middle income industrializing	39	72	217	289
Lower middle income industrializing	457	696	2,032	3,052
Low income industrializing	7	10	25	15

a. About half the least developed countries have yet to report 2011 data.
Source: UNIDO estimate based on UN (2013a).

"The higher dynamism of industrializing economies is also reflected in the increase in their share in world manufactured exports, from 13.9 percent in 1997 to 29.6 percent in 2011

reaching $9,483 billion in 2011, as they struggled to recover from the dip in economic activity brought about by the crisis. In industrializing countries, manufactured exports grew by 10.5 percent annually over the same period, to a peak of $3,985 billion in 2011.

The higher dynamism of industrializing economies is also reflected in the increase in their share in world manufactured exports, from 13.9 percent in 1997 to 29.6 percent in 2011. It was the emerging economies, including China and 31 other fast-growing, high and higher MVA per capita economies, that accounted for most of this increase, their world share more than doubling from 12.3 percent in 1997 to 27.1 percent in 2011.

Together, the combined manufactured exports of the largest country in each industrializing region – China, India, Mexico, Poland, South Africa and Turkey – accounted for 67.5 percent of the industrializing countries' total in 2011, up from 59.9 percent in 2002 and 55.1 percent in 1997, confirming the higher dynamism of the larger countries and a worrying widening gap with the smaller economies.

Part A

The role of manufacturing and structural change

Ever since the industrial revolution, manufacturing has been the "engine of growth" for output and employment, sparked by major technological change and mechanization and leading to unprecedented and sustained long-term economic growth and rising incomes. The higher incomes led to an increase in demand for manufactured products and a relative decline in spending on agricultural goods. Productivity gains raised demand further as prices of manufactures declined even further relative to other goods and services. Accompanying these changes were major labour force and population shifts from agriculture and rural areas, initially into manufacturing and to urban areas, and later into services. This self-reinforcing industrial development process lasted for decades, if not centuries, as a result of which what have become today's developed economies generated hundreds of millions of jobs in industry.

Indeed, manufacturing still matters greatly for employment today: broadly defined to include formal and informal activities and manufacturing-related services, it accounted for around 470 million jobs in 2009 – or one out of six jobs on the planet.

In this first section, three chapters look at the elements that make manufacturing an engine of growth. Chapter 1 analyses the trends of structural change (also called structural transformation) over the last 50 years. Chapter 2 then focuses on spatial differences among countries and regions, and within countries. And Chapter 3 looks more closely at structural change in manufacturing itself.

Some key findings are that manufacturing employment is growing in developing countries and decreasing in developed countries, though that decline is mitigated by growing manufacturing-related services employment. And while many developing countries have immense potential to industrialize in agroindustry, textiles and garments – industries that offer prospects for sustained employment generation and productivity gains – developed countries have great scope for pursuing high-tech innovation and sustaining related services jobs.

Chapter 1

Structural change and employment trends

This chapter attempts to make sense of the trends of structural change over the last 50 years. Structural change unfolds over time but is best analysed through the structure of countries' economies with the same income level, even if that is attained at different points in time. The structural change of an economy is not just associated with the growth of that economy, but lies at its very core, because it corresponds to a transition from lower to higher productivity sectors. Up to roughly the income level of advanced economies, one can grasp such a transition by looking at shifts from one sector to another (mainly from agriculture to industry and services), but at higher incomes, average employment-to-output ratios converge and further evidence of structural change can only be seen within sectors.

For developing countries aiming to maintain growth while creating sustainable jobs, manufacturing offers an opportunity not only to rebalance the economy towards higher value-added sectors but also to provide a relatively wide employment base with higher labour productivity. This contrasts with a direct transition from agriculture to services, especially for low-income countries, which offers the opportunity to achieve only the first objective, not the second. Manufacturing can be an important absorber of labour while paying above-average wages.

The employment effect of manufacturing is stronger than conventional statistics derived from industry surveys suggest, which usually count only formal sector jobs in firms above a certain size and exclude self-employed and unregistered workers. Nor do those statistics cover manufacturing-related jobs in services, notably those jobs that have been unbundled from manufacturing and that statistically used to be counted in manufacturing but are now in services. At most, the conventional data caught half the total number of jobs directly and indirectly created by manufacturing, but when the sector is broadly defined to include formal, informal and manufacturing-related services, manufacturing worldwide in 2009 provided almost 470 million jobs, employing around 16 percent of the world's workforce of 2.9 billion, a figure far higher than many commentators might expect.

The quality of jobs – wages, conditions of work and rates of female employment – is also an important contribution of manufacturing. The chapter closes with a review of manufacturing's comparative performance in these areas.

Industrialization, structural change and economic growth

Industrialization in the long run

The United Kingdom in the 18th century was the first country to develop manufacturing. Only in the early 19th century (after the United Kingdom had already demonstrated significant increases in productivity) did Belgium, France and Switzerland, followed by the United States, enter their own paths of manufacturing development. After this a few other latecomers (notably Germany, Japan and Russia) joined the group of industrializing nations, while the developing world (colonies and non-colonies) remained oriented towards primary production (Gerschenkron 1962; Maddison 2007).

This sustained process lasted for decades, even centuries, for the United Kingdom (Box 1.1), with data suggesting that manufacturing jobs in factories grew from around 22 percent of total employment in 1841 to more than 35 percent in 1960 (Matthews, Feinstein and Odling-Smee 1982). In the United States – where data can be traced back even further – manufacturing employment grew from around 6 percent of total employment in 1800 to around 36 percent in 1960, a period when the population increased 33-fold. Moreover, not only did the rate of employment rise, but its quality in terms of wages, labour conditions and skill levels also improved.

At the start of the 20th century, the world economy was already divided into industrial rich economies and

> **Manufacturing can be catalytic in transforming the economic structure of agrarian societies**

Box 1.1
Self-reinforcing industrial development

Manufacturing has been the engine of growth for output and employment since the industrial revolution. The mechanization of manually based economic activities – such as the production of textiles or iron making – as well as increasing power generation, and growing regional and international trade facilitated by improvements in transport, led to unprecedented, sustained long-term economic growth and rising incomes. Continually rising incomes, in turn, led to greater demand for manufactured products and relatively lower outlays on agricultural goods.

The manufacturing industry began to benefit from scale factors and from continued technological change, resulting in a rapid rise in productivity. Productivity gains raised demand as prices of manufactures declined even further relative to other goods and services. Manufacturing employment initially grew in the newly mechanized economic activities as unit costs of labour fell. Later, as the income elasticity of demand for textiles and iron products decreased and their capital intensity grew, labour shifted to other emerging industries, which saw rising demand and productivity growth. Accompanying these trends were major labour force and population shifts from agriculture and rural areas, initially into manufacturing and to urban areas, and later into services.

Source: Industrial Development Report 2013 Team.

agricultural poor economies. Industrialization had become synonymous with wealth, economic development, technological leadership, political power and international dominance (Szirmai, Naudé and Alcorta 2013). Countries failing to industrialize or, even more significantly, countries experiencing deindustrialization, such as India prior to independence, were perceived to be on an unsustainable development trajectory.

After World War II more countries began to enter the catch-up phase, thanks to the greater opportunities for technology transfer and the industrial policies of "developmental states". Countries that failed to maintain robust growth of the manufacturing sector or where industrial policies were deliberately reversed, as in Latin America, failed to keep the momentum behind the catch-up phase, curtailing broader social welfare gains (Bértola and Ocampo 2013).

Structural change and economic development

A large body of empirical evidence shows that manufacturing can be catalytic in transforming the economic structure of agrarian societies. In fact, the very concept of economic development is intrinsically linked to the changes in the structure of economic activity that take place as countries become richer.

But the concept of structural change is open to many interpretations and has been used extensively in the literature without a clear consensus on its meaning. From a strictly positive perspective, structural change would be defined as any long-term change in the composition of an aggregate. This would typically refer to the relative importance of sectors in the economy or to changes in the location of economic activity (Syrquin 2010).

The term has also been approached from a normative perspective that emphasizes desirability in the direction of change. Desirability might be defined according to different sectoral characteristics, among which the level and dynamism of productivity and the scope for technological opportunities are typically the most important. Authors such as Ocampo (2005), Ocampo and Vos (2008) and UNDESA (2006a) define structural change as the ability of an economy to constantly generate new dynamic activities characterized by higher productivity and increasing returns to scale. On this second approach, structural change emerges as a central feature of the development process and an essential element in explaining the rate and pattern of growth. It can impede growth if its pace is too slow or its direction inefficient but can contribute to growth if it improves the allocation of resources (Syrquin 2010). As Justin Yifu Lin points out: "All countries that remain poor have failed to achieve structural change, that is, they have been unable to diversify away from agriculture and the production of traditional goods into manufacturing and other modern activities" (Lin 2012, p. 3).

All countries that remain poor have been unable to diversify away from agriculture and the production of traditional goods into manufacturing and other modern activities

In the rest of this subsection we will stick to the first, positive definition and analyse the patterns of the last half century, looking exclusively at the changing contribution to gross domestic product (GDP) of the major sectors: agriculture, non-manufacturing industries,[1] manufacturing industries and services. In the next subsection we will focus on manufacturing's role in economic development, and therefore interpret structural change from the normative perspective, as the reallocation of resources from low-productivity activities towards manufacturing.

A first approach is to analyse the changing importance of these four sectors' shares in GDP at different points in time for different countries (Table 1.1).

The last two rows provide a general impression of the main trends of structural change over the last half century in 68 developing and 21 advanced economies.

In 1950 almost 40 percent of developing countries' GDP originated in agriculture and only 12 percent in manufacturing. Fifty-five years later the share of agriculture had dropped to just 16 percent of GDP. In the interim, manufacturing industries had first increased their share in GDP (peaking at around 17 percent in the early 1980s) but that share later fell. Throughout these years services showed a steady increase, gaining more than 10 percentage points.

In contrast, in 1950 advanced economies were already based heavily on manufacturing (at almost 30 percent of GDP) and agriculture accounted for only a minor share (16 percent). These economies, too, became much more services oriented, but manufacturing showed a steady decline and by 2005 it had almost the same share as in developing countries.

One feature that stands out in Table 1.1 is the wide variety of patterns, even within developing countries. At mid-century in China, Indonesia, the Republic of Korea, Malaysia and Thailand, for example, agriculture accounted for at least 40 percent of GDP, and manufacturing for 14 percent at most. Fifty-five years later, agriculture accounted for only 3–13 percent of GDP and manufacturing for more than 25 percent, underlining the huge shift from agriculture to manufacturing.

Other developing countries took a different path. In the largest Latin American economies – Argentina, Brazil and Mexico – the structure shifted from agriculture towards services (and to a lesser extent, non-manufacturing industries). Taking the period's end points, manufacturing's share remained unchanged, but throughout the period it showed an inverted U shape (Tregenna 2013).

This difference is seen in two developing economies that in 1960 had the same GDP per capita: the Republic of Korea and Ghana (Figure 1.1). In 1960 their structures were quite similar (the main difference was that manufacturing's share in the Republic of Korea was 5 points higher than in Ghana, and agriculture's share was 6 points lower).

Forty-five years later, these structures had changed radically. The Republic of Korea had transformed its structure, heavily reducing agriculture's share by increasing that of manufacturing, but in Ghana agriculture remained the largest sector. Tellingly, and in line with a more normative understanding of structural change, the economic performance of the two countries was radically different, such that in 2005 Ghana's GDP per capita was only a tenth of that of the Republic of Korea. The country that changed the structure of its economy saw far stronger GDP per capita growth than the one that did not.

The above suggests two conclusions. First, any average across a heterogeneous sample of observations (such as resource-rich countries, small countries, large countries or regional groups) lends itself to identifying a pattern over time that is not particularly representative of any single country's performance. Second, and more significant, the degree of heterogeneity inside the sample may become even greater as time passes, precisely as an outcome of structural change.

It is therefore instructive to look at how structural change takes place by looking at the changing importance of sectors at different incomes instead of different moments in time. The approach now proposed in this subsection provides a way to visualize structural change by controlling for important features that shape differently the pattern of structural change of

Table 1.1
Gross value added in agriculture, industry (including manufacturing) and services as a share of GDP at current prices, selected countries and regional averages, 1950–2005 (percent)

	1950[a]				1960[b]				1980				2005[c]			
	AG	NMI	MAN	SER	AG	NMI	MAN	SER	AG	NMI	MAN	SER	AG	NMI	MAN	SER
Bangladesh[d]	61	0	7	32	57	2	5	36	32	7	14	48	20	10	17	53
China	51	7	14	29	39	5	27	29	30	9	40	21	13	14	34	40
India	55	4	10	31	43	6	14	38	36	8	17	40	18	12	16	54
Indonesia	58	2	7	33	51	6	9	33	24	29	13	34	13	19	28	40
Korea, Rep. of	47	4	9	41	35	6	10	48	16	13	24	47	3	12	28	56
Malaysia	40	8	11	41	35	12	8	46	23	19	22	36	8	20	30	42
Pakistan	61	0	7	32	46	4	12	38	30	9	16	46	21	8	19	51
Philippines	42	9	8	41	26	8	20	47	25	13	26	36	14	9	23	54
Sri Lanka	46	8	4	42	32	5	15	48	28	12	18	43	17	12	15	56
Taiwan Province of China	34	7	15	45	29	8	19	44	8	10	36	46	2	4	22	72
Thailand	48	3	12	37	36	6	13	45	23	7	22	48	10	9	35	46
Turkey	49	5	11	35	42	9	13	36	27	3	17	54	11	5	22	63
Argentina	16	10	23	52	17	7	32	44	6	12	29	52	9	13	23	55
Brazil	24	5	19	52	21	7	30	42	11	11	33	45	6	12	18	64
Chile	15	9	17	59	12	16	25	47	7	15	22	55	4	26	16	53
Colombia	35	4	13	48	32	7	16	46	20	8	24	48	12	18	16	53
Mexico	20	4	17	59	16	6	15	64	9	12	22	57	4	8	18	70
Peru	37	13	15	35	21	12	20	47	12	23	20	45	7	19	16	58
Venezuela, Bol. Rep. of	8	37	11	45	7	32	11	50	6	30	16	49	4	37	18	40
Congo, Dem. Rep. of	31	25	9	35					27	20	15	38	46	20	7	28
Côte d'Ivoire									26	7	13	54	23	7	19	51
Egypt	44	4	8	44	30	10	14	46	18	25	12	45	15	19	17	49
Ghana									58	4	8	30	37	16	9	37
Kenya	44	6	11	39	38	9	9	44	33	8	13	47	27	7	12	54
Morocco	37	15	15	33	32	13	13	42	18	14	17	50	13	12	17	58
Nigeria	68	8	2	22	64	4	4	28	21	38	8	34	23	53	4	20
South Africa	19	19	16	47	11	18	20	51	6	26	22	45	3	12	19	67
Tanzania, United Rep. of	62	6	3	20	61	5	4	30					46	10	7	37
Zambia	9	68	3	19	12	63	4	21	15	23	19	43	23	19	11	47
Averages																
Asia (15)	49	14	10	36	37	22	14	41	23	33	22	44	14	33	22	53
Latin America (25)	29	25	15	46	23	29	17	48	16	32	20	51	10	31	15	59
Middle East and North Africa (10)	31	23	9	46	23	27	11	49	12	39	14	49	11	33	13	52
Africa (18)	43	22	11	34	42	21	8	37	29	28	12	43	28	27	10	45
Developing countries (68)	37	22	12	42	31	25	13	44	21	32	17	47	16	31	15	53
Advanced economies (21)	16	40	29	45	12	41	30	47	4	35	23	60	2	27	16	71

AG is agriculture; NMI is non-manufacturing industries; MAN is manufacturing; SER is services.

a. Earliest year for which data are available: 1950, except for West Germany, Italy, Morocco, Norway, Taiwan Province of China and Thailand, 1951; China, Japan and the United Republic of Tanzania, 1952; Belgium and the Republic of Korea, 1953; Malaysia and Zambia, 1955; Ghana and Côte d'Ivoire, 1960.

b. China, 1962; proportions for 1960 not representative due to the collapse of agriculture in the "Great Leap Forward" of 1958–1960; Morocco, 1965; manufacturing share Tanzania, 1961.

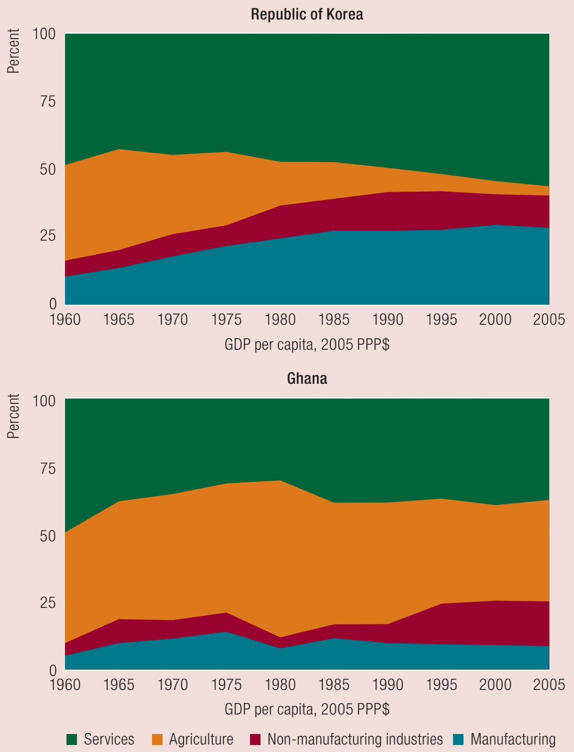
c. Canada, 2003; Bolivarian Republic of Venezuela, 2004.

d. Bangladesh, 1950–1959, as Pakistan.

Source: Adapted from Szirmai (2009) and Szirmai, Naudé and Alcorta (2013).

“As incomes rise, even in the initial stages of development, manufacturing and services’ share keeps growing and agriculture’s declines

Figure 1.1
GDP composition by sectors, Republic of Korea and Ghana, 1960–2005



Source: Adapted from Szirmai (2009) and Szirmai, Naudé and Alcorta (2013).

countries as they become richer. A complementary view to the more traditional analysis of structural change over time, it has the advantage of providing a unique picture to illustrate the general pattern of structural change, without averaging the important differences in structure that arise from different incomes and two country-specific characteristics (natural resources and population).

This approach pools countries together not according to any prior definition of development (such as advanced versus developing) but according to their income at any point in time (Box 1.2). Structural change can then be seen as the set of transformations that takes place as countries become richer, regardless of the time it occurred and its speed. With our previous example, the Republic of Korea and Ghana would be pooled together in 1960 (when they had similar incomes and economic structure) but not in 2005 (with a 10-fold difference in GDP per capita and dissimilar structures).

At very low incomes (for some countries in the sample a contemporary feature, for others a feature of the early 1960s), agriculture accounts for a relatively high share of GDP, typically larger than manufacturing and non-manufacturing industries together. This situation is reversed as income grows: manufacturing starts gaining ground and reaches a peak of about 20 percent of GDP at roughly $14,000.[2] In other words economic development is associated with a near tripling of the share of manufacturing in the economy, largely at the expense of agriculture, whose share shrinks dramatically (Figure 1.2).

After the peak the share of manufacturing starts declining and at very high incomes is comparable to earlier stages of development (describing an inverted U shape). As incomes rise, even in the initial stages of development, services’ share keeps growing and agriculture’s declines. Non-manufacturing industries show a sharp increase at very low incomes, but after peaking at around $4,000 they maintain a stable share. Overall, the graph does not display significant changes at higher incomes or for high-income countries.

A key point is that structural change viewed at such an aggregate level with only sectors masks important features of what happens inside each sector (manufacturing is discussed in Chapter 3), including important breaks and heterogeneities within the timespan and sample of countries considered. Regression results reveal significant time breaks over 1963–2007 and the significance of population size and natural resources on the patterns of structural change (Chapter 3). The masking of these features should not be read as invalidating the underlying econometric analysis, but their omission from the analysis would. The above figure depicts a pattern with all else being equal – if time, population size and resource endowments are kept constant. The following figures depict what happens when they are not.

To begin with, according to our econometric results, the following periods seem to have shown a

> **The patterns of structural change significantly shifted twice in the 1980s but seem to have remained statistically stable for the 20 years before and after that**

Box 1.2
A few methodological issues

The approach used can be challenged on methodological grounds. First, criticisms might be raised over comparing different countries at different points in time. Second, the pattern of structural change might itself change over time, especially over half a century. Finally, pooling together countries that are extremely heterogeneous by population size and natural endowments might draw a misleading picture in which important characteristics that shape a country's structure are averaged, ruling out the possibility of seeing the detail of structural change within each sector.

To tackle the first issue, each country's income at each point in time is assessed using a measure that strips out the impact of inflation (constant prices rather than current prices) and in a manner that enables comparison across countries where costs of living are very different[1] and may reflect short-term distortions in exchange rates (countries are characterized by income according to their GDP per capita in 2005 purchasing power parity dollars). So despite its limits, this approach should minimize the potential biases of comparing the income of, say, a country in 1963 and another in 2007.

The second and third issues are more problematic, and can only be addressed through econometric techniques that allow a statistical test for the significance of a wide range of variables. In the following analysis, the sectoral shares of GDP at different incomes are calculated using regression analysis, which allows for exploring whether these countries can be pooled together, and whether there are some time- or country-specific characteristics that should be considered when evaluating the general patterns of structural change. This approach allows for studying whether these patterns are stable over time and across countries with different characteristics.

The analysis is undertaken for a large panel dataset of 100 countries over 1963–2007, though not all countries are represented for all years. Fixed effects are introduced to account for the fact that each country enters the sample several times and that the observations for some countries (especially high-income ones) are more numerous. For reasons of space, the details on the econometric approach and main regression results are not presented here.[2] The focus instead is on the resulting charts, which show each economic sector's estimated share at different per capita incomes, and thus the main structural transformations as countries become richer.

Notes

1. Largely stemming from differences in the price of nontradable goods such as personal services, commerce and construction.
2. Results are available on request.

Source: Industrial Development Report 2013 Team.

significantly different pattern of structural change across incomes: 1963–1980, 1981–1990 and 1991–2007. In other words the patterns of structural change significantly shifted twice in the 1980s but seem to have remained statistically stable for the 20 years before and after that. Readers familiar with global economic trends will not be surprised by such a conclusion, as many of the features of economic globalization picked up strongly in that decade.[3]

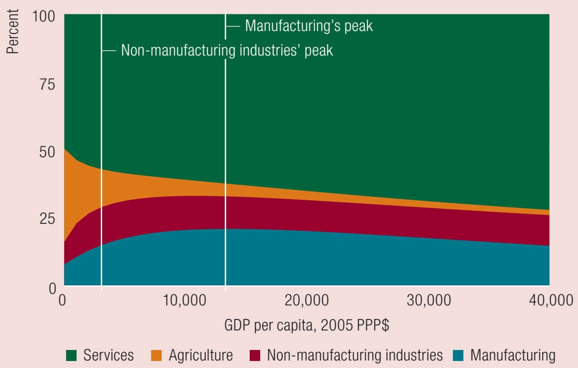
For the exposition's sake, we show only the figures for the two end points, 1963–1980 and 1991–2007, and we focus on incomes up to $25,000, as that allows us to concentrate on the earlier, more interesting, part of the graph.

Most important for this chapter, the patterns in the two periods in Figure 1.3 are strikingly in line with that in Figure 1.2: structural change remained a process with broadly comparable features – with slight differences. In the earlier period (1963–1980) manufacturing reached its peak at a lower per capita income than in the second period (1991–2007), at $14,000 instead of $16,000. Moreover, manufacturing's share at this earlier period peak was much higher, at 24 percent of GDP instead of 20 percent. But looking at the lowest incomes (less than $3,000 per capita), industrialization seems to set in faster in the more recent period.

Taken together, these elements appear to suggest that, bar the lowest income countries, industrialization has become more elusive in the new international context, a fact also documented in the literature (see, for example, Fagerberg and Verspagen 2002 and Szirmai and Verspagen 2010). In addition, the role of manufacturing in a country's economy seems

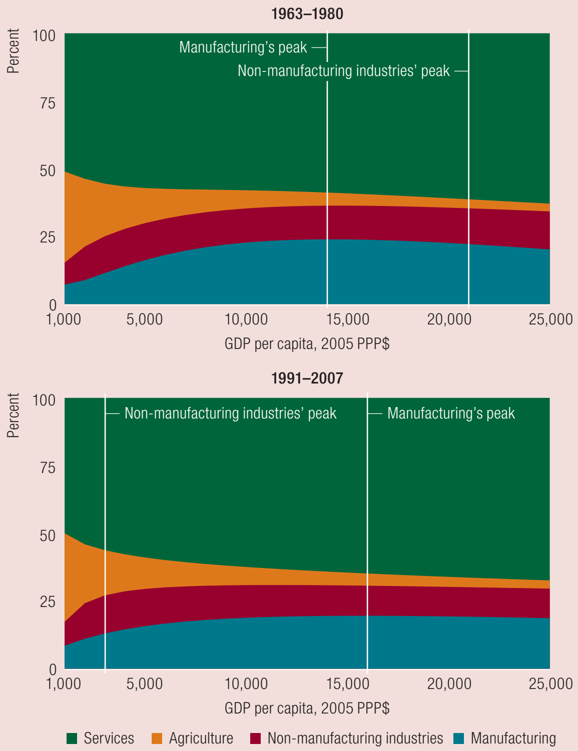
“With natural resource–rich countries, the importance of manufacturing at any level of income is lower than in the aggregate picture

Figure 1.2
GDP composition by income and sector, 1963–2007



Note: Pooled data for 100 countries.
Source: UNIDO estimate based on CIC (2009) and World Bank (2013b).

Figure 1.3
GDP composition by income and sector (up to $25,000), 1963–1980 and 1991–2007



Note: Pooled data for 100 countries.
Source: UNIDO estimate based on CIC (2009) and World Bank (2013b).

to have eroded over the last half century, which is again compatible with the widely held idea of global deindustrialization.

Two other characteristics specific to the countries in the large sample are natural resource endowments and population size. As stressed in the literature, these elements might have an important impact on the pattern of structural change. To study them, we have to split the regression sample to avoid analytical problems. Countries are identified as rich in natural resources based on a proxy variable calculated as the difference between exports and imports of crude natural resource commodities and expressed in per capita terms.[4] Countries with at least $4,000 on this measure are defined as rich in natural resources.[5] Countries with a population of more than 12 million are classified as large.

Our analysis supports the idea that these particular country characteristics are important. Both natural resource endowments and population size seem to have a significant impact on the transformations that take place in the productive structure as countries become richer (Figure 1.4).

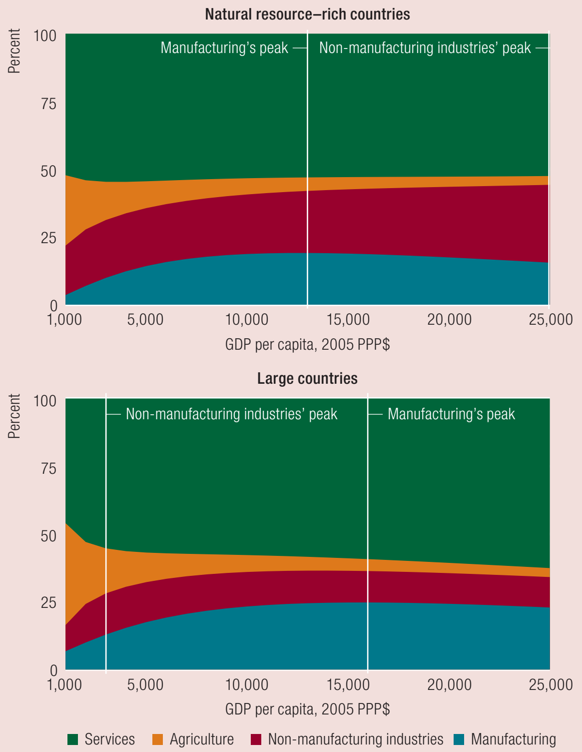
Once more, the patterns are in line with the aggregate picture. Both cases see a shift from agriculture towards services and industry at low incomes; later, industry starts declining and services become dominant. The importance of manufacturing and the income level at which the turning point takes place are quite different though.

With natural resource–rich countries, the importance of manufacturing at any level of income is lower than in the aggregate picture. The decline in its share starts at much lower income ($13,000). The importance of non-manufacturing industries is larger. And the maximum is only reached at very high income ($25,000). These trends are in line with a large body of literature that highlights the potential bottlenecks arising from a rich natural resource base, where the economy's incentives might be biased towards non-manufacturing industries (or agriculture), to manufacturing's detriment, leading to a “natural resource curse” or “Dutch disease” (see, for example, Palma 2005).

Large economies show exactly the opposite trend: manufacturing accounts for a much higher share of

> **Manufacturing provides greater opportunities to accumulate capital, exploit economies of scale, acquire new technologies and – more fundamentally – foster embodied and disembodied technological change**

Figure 1.4
GDP composition by income, sector and country group (up to $25,000), 1963–2007



Note: Pooled data for 100 countries. See text for definitions of "natural resource rich" and "large".
Source: UNIDO estimate based on CIC (2009) and World Bank (2013b).

GDP at all incomes and the turning point is reached only at $24,000, when manufacturing accounts for almost 25 percent of GDP. This pattern is sustained with a lower share of services at all incomes. The greater importance of manufacturing in large economies is probably related to their larger domestic market, which enables them to exploit economies of scale even at low levels of development.

Manufacturing and economic growth

Although the positive perspective simply refers to a change in the composition of an aggregate (in this case, the sectoral composition of GDP), the normative perspective expands this definition by including the notion of desirability in the direction of that change. Shifts in the economy from low-productivity activities with limited opportunities for technological change and value-added gains towards high-productivity activities with larger opportunities for innovation and value-added expansion would thus become the core of structural change and – more broadly – economic development.

Once structural change is understood from this latter perspective, manufacturing becomes one of the main engines of economic growth, and thus any shift of resources from low-productive activities (such as rural agriculture or urban informal services) towards manufacturing entails an important structural change bonus, in what some authors have labelled "growth-enhancing structural change" (McMillan and Rodrik 2011).

The literature presents several arguments to support the idea that manufacturing is the main engine of economic growth. Perhaps the most influential came from Nicholas Kaldor in the 1960s. In his view the capacity to generate dynamic, increasing returns and thus greater productivity through expanded production was at the core of manufacturing.

Following this line it has been argued that manufacturing is the main driver of productivity growth. Compared with other sectors, manufacturing provides greater opportunities to accumulate capital, exploit economies of scale, acquire new technologies and – more fundamentally – foster embodied and disembodied technological change. So, not only the level but also the dynamism of productivity is higher in manufacturing than in other sectors and thus the shift of resources into manufacturing entails static and dynamic structural change bonuses (Szirmai, Naudé and Alcorta 2013).

The dynamism of manufacturing also has key effects on the rest of the economy. Manufacturing has a pulling effect on other sectors arising from productive linkages. Its development stimulates, for example, the demand for more and better primary goods (in agriculture, forestry, fishing and mining) and services (such as banking, insurance, communications, trade and transport).

Manufacturing also generates externalities in technology development, skill creation and learning that

“For developing countries growth and development are not about pushing the technology frontier but rather about changing the structure of production towards activities with higher productivity

are crucial for competitiveness. For instance, manufacturing is the main vehicle for technology development and innovation (Chapter 4), representing today’s hub for technical progress. Empirical evidence shows that manufacturing is the sector receiving by far the most investment in research and development (Lavopa and Szirmai 2012). It is well established that this type of investment has positive externalities that go far beyond the productivity gains achieved in the same sector, contributing widely to productivity growth in other sectors and thus fuelling overall economic growth. Locational externalities (agglomeration effects – Chapter 2) arising through spillovers on the labour market, supplier networks and other areas of knowledge are also more likely to arise from manufacturing than from other sectors (Weiss 2013).

The above theoretical arguments are backed up by a large body of empirical studies that has demonstrated a close positive link between economic growth and structural change towards manufacturing. Econometric evidence from 131 developing countries in 2000–2005 suggests that economic growth is correlated with manufacturing value-added growth (UNIDO 2009). A more sophisticated analysis of 89 developed and developing countries in 1950–2005 found that the share of manufacturing is positively related to economic growth and that this effect is more pronounced for poorer countries, confirming the “manufacturing as an engine of growth hypothesis” (Szirmai and Verspagen 2010; Figure 1.5). The findings from these authors are in line with those reported by Rodrik (2007), which indicate that growth accelerations are closely associated with rapid increases in the share of manufactures in total exports or with an increase in the share of manufacturing employment in total employment.

A clear positive correlation is seen between the rate of per capita growth and of the increase in manufacturing’s share in total GDP. The country groups that achieved the fastest growth during the period are the countries where the shift towards manufacturing has been most intensive. China, the first Asian newly industrialized economies and South-East Asia are

Figure 1.5
Economic growth and changes in the share of manufacturing value added in GDP, selected regions and country groups, 1970–2007

Note: The values have been calculated as simple average across the countries included in each group. Sub-Saharan Africa: Cameroon, Ethiopia, Kenya, Mozambique, Tanzania, Uganda and Zimbabwe. Central America and the Caribbean: Costa Rica, Dominican Republic, Guatemala and Jamaica. Low- to middle-income Latin America: Bolivia, Ecuador and Peru. Semi-industrialized countries: Argentina, Brazil, Chile, Colombia, Mexico, South Africa, Turkey and the Bolivarian Republic of Venezuela. South Asia: Bangladesh, India, Pakistan and Sri Lanka. South-East Asia: Indonesia, Malaysia, Philippines, Thailand and Viet Nam. First-tier newly industrialized economies: Republic of Korea, Singapore and Taiwan Province of China. Middle East and Northern Africa: Algeria, Egypt, Islamic Republic of Iran, Jordan, Morocco, Saudi Arabia, Tunisia and Yemen. Commonwealth of Independent States: Russian Federation and Ukraine. Eastern Europe: Bulgaria, Czech Republic, Hungary, Poland and Slovakia.
Source: Adapted from UNDESA (2006a) based on CIC (2009) and World Bank (2013b).

examples. Though for a shorter period (1995–2007), transition economies also seemed to adjust to this pattern: they showed steep increases in their share of manufacturing in GDP while growing very fast. At the other extreme are country groups (mainly in Latin America) that show exactly the opposite trend: they deindustrialized during the period and achieved very modest rates of GDP per capita growth.

The above analysis confirms a pattern familiar to economic thinking and explored in the *World Economic and Social Survey 2006* (UNDESA 2006a). For developing countries growth and development are not about pushing the technology frontier but rather about changing the structure of production towards activities with higher productivity. Economies can achieve this type of structural change by absorbing

“Manufacturing plays a fundamental role in sustained rapid growth

existing technologies, producing manufacturing goods and services for world markets and rapidly accumulating physical and human capital.

Slightly more recent empirical work also suggests that manufacturing plays a fundamental role in sustained rapid growth. The Report of the Commission on Growth and Development identified 13 economies that managed to sustain very rapid growth of at least 7 percent for 25 years or more after World War II: Botswana (1960–2005), Brazil (1950–1980), China (1961–2005), Hong Kong SAR China (1960–1997), Indonesia (1966–1997), Japan (1950–1983), the Republic of Korea (1960–2001), Malaysia (1967–1997), Malta (1963–1994), Oman (1960–1999), Singapore (1967–2002), Taiwan Province of China (1965–2002) and Thailand (1960–1997; World Bank 2008).

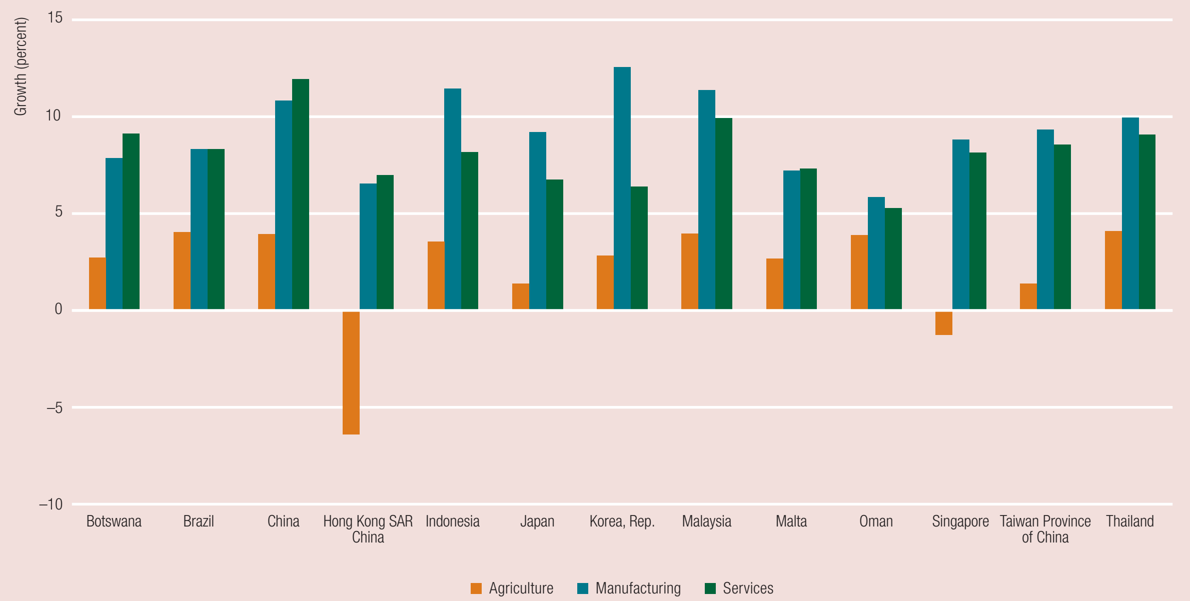
The sample is remarkably diverse, including countries from all developing regions, some rich in natural resources, others not; some among the most populated countries in the world, others with a population below 500,000 (World Bank 2008). Yet despite these differences, a striking fact – surprisingly not mentioned in the report – is that all but three were driven by manufacturing industries (Figure 1.6).[6]

In 8 of the 13 economies manufacturing shows the fastest growth, implying that this sector has increased its share in total GDP over the period – that is, the economy has shown a structural change towards manufacturing. In Brazil and Malta manufacturing and services grew at almost the same rate, and in only Botswana, China and Hong Kong SAR China did manufacturing show slower growth than services. These success stories reinforce the above argument for the key role of manufacturing industries in sustaining growth.

Manufacturing and productivity

We now turn to look in more detail at a particular feature at the core of the special role of manufacturing

Figure 1.6
Growth rates by sector, 13 long-term fast-growing economies



Note: Many of the calculations apply to different periods than given in the text for data-consistency reasons: Botswana (1965–2006); Brazil (1950–1980); China (1965–2010); Hong Kong SAR China (1974–1997); Indonesia (1966–1997); Japan (1953–1983); Republic of Korea (1960–2001); Malaysia (1970–1997); Malta (1970–1994); Oman (1988–1999); Singapore (1967–2002); Taiwan Province of China (1965–2002) and Thailand (1960–1997).

Source: Adapted from World Bank (2008) based on World Bank (2013b) and Groningen Growth and Development Centre (2013). See Timmer and de Vries (2009) for the underlying methodology of the database.

Manufacturing is the engine of growth because of its larger opportunities for productivity gains compared with other sectors of the economy

as the engine of growth – its larger opportunities for productivity gains compared with other sectors of the economy. We analyse how the relative productivity of each major sector (here taken to be agriculture, manufacturing, non-manufacturing industry and services) evolves as countries develop.

Relative productivity is here simply defined as the ratio between the output–labour ratio of each sector and that of the whole economy. This coefficient is obtained by dividing the share of manufacturing in GDP by the share of manufacturing in total employment.[7]

To get figures of this coefficient by income, we estimate the average (weighted) shares of each sector in GDP and total employment for all countries and years that fall in that income range (Table 1.2). In the light of the previous evidence showing structural breaks over the last 50 years, we restrict the analysis to the last two decades.[8] Moreover, since our econometric exercise showed that countries with natural resource wealth follow a rather peculiar path of structural change, we excluded from the sample the countries richest in such resources.[9] (See *Effects of time, demographic and geographical conditions on manufacturing development* in Chapter 3.)

Due to space limitations, we show only specific shares in the range of $1,000–$15,000, real purchasing power parity (PPP) per capita. Three average shares are also presented for three groups of countries: low and lower middle income, upper middle income and high income.[10]

Based on the above share values, the ratios in Figure 1.7 have been derived.

The relative nature of the indicators used in Figure 1.7 gives a straightforward rule to determine which is the best direction of structural change at

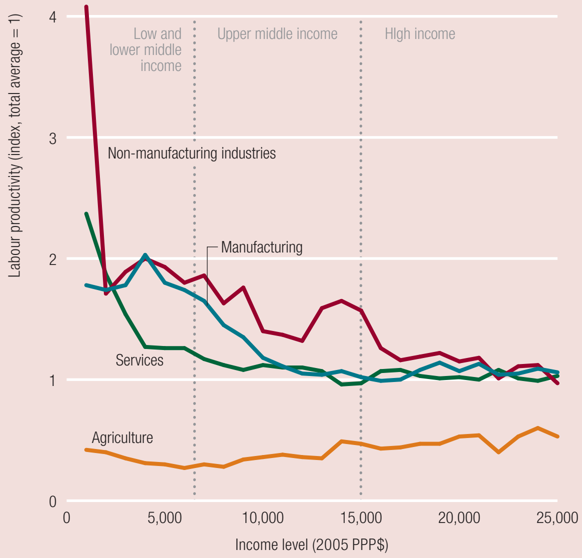
Table 1.2
Shares of value added and employment by income group and sector, 1991–2010 (percent)

	Value-added share				Employment share			
$ real PPP per capita	AG	NMI	MAN	SER	AG	NMI	MAN	SER
Low- and lower middle-income economies	16	14	26	44	50	7	14	29
0–1,000	30	9	13	48	70	2	8	20
1,000–2,000	23	11	22	44	57	7	12	24
2,000–3,000	17	14	24	45	50	7	13	29
3,000–4,000	14	15	28	43	45	8	14	34
4,000–5,000	12	15	29	44	41	8	16	35
5,000–6,000	11	14	30	45	39	8	17	35
Upper middle-income economies	7	14	20	60	23	9	16	53
6,000–7,000	10	15	28	47	35	8	17	40
7,000–8,000	7	12	19	62	24	7	13	55
8,000–9,000	8	13	18	61	23	8	14	56
9,000–1,0000	7	12	18	62	20	9	16	56
1,0000–11,000	7	13	19	62	17	9	17	56
11,000–12,000	5	13	19	63	15	10	18	57
12,000–13,000	6	15	19	60	16	9	19	56
13,000–14,000	6	18	19	57	12	11	18	59
14,000–15,000	5	18	18	59	10	11	18	61
High-income economies	2	9	18	72	4	9	18	69

AG is agriculture; NMI is non-manufacturing industries; MAN is manufacturing; SER is services.
Note: Pooled data for 108 countries, excluding natural resource–rich countries.
Source: UNIDO estimate based on World Bank (2013b) and Groningen Growth and Development Centre (2013). See Timmer and de Vries (2009) for the underlying methodology of the database.

Some argue that the "middle-income trap" is fundamentally a failure to achieve this sort of structural change within sectors

Figure 1.7
Relative labour productivity by income and sector, 1991–2010



Note: Pooled data for 108 countries, excluding natural resource–rich countries. Total economy average of productivity = 1.
Source: UNIDO estimate based on World Bank (2013b) and Groningen Growth and Development Centre (2013). See Timmer and de Vries (2009) for the underlying methodology of the database.

each level of development. The higher the series, the better the productivity gains: reallocation of resources (labour in this case) from one sector below to another above will lead to aggregate productivity gains.

As expected, non-manufacturing industries show the highest relative productivity at all levels of development, mainly driven by the high capital intensity of mining and public utilities. But the size of this sector is limited, as is its capacity to absorb labour. In most ranges of income the second-highest relative productivity is achieved by manufacturing industries, especially at GDP per capita of $2,000–$10,000 PPP, which underlines the importance of manufacturing in middle-income economies. And at very low income ($2,000–$4,000 PPP), the relative productivity of manufacturing rises while that of agriculture and services falls, revealing that manufacturing delivers dynamic as well as static productivity gains.[11]

At initial stages of development, services show extremely high relative productivity, most probably driven by non-market services such as public administration, health or education. But immediately thereafter, this coefficient drops dramatically, mainly in line with the increase of low-productive services such as wholesale and retail trade and personal services. Subsequently, the relative productivity of services converges to the national average.

At high incomes ($17,000 and above) in fact, the relative productivity of the three major sectors (manufacturing, non-manufacturing industries and services) converge to the national average. At this stage, agriculture's share is already too small for this inter-sectoral structural change to drive productivity, and so structural change within sectors becomes fundamental. The key at this stage is not shifting resources further towards manufacturing but achieving productivity growth within manufacturing (from low- to high-tech industries – Chapters 3 and 4). By the same token structural change within services also becomes a leading driver of productivity growth. (As we see next, development also entails an important structural shift from lower productivity non-tradable services towards higher productivity tradable services.)

Some argue that the "middle-income trap" is fundamentally a failure to achieve this sort of structural change within sectors. Recent evidence suggests that countries that have shown rapid growth at low incomes but are unable to move towards more sophisticated industries or services tend to be stuck at middle-income levels and incapable of joining the rich nations (see, for example, Felipe, Abdon and Kumar 2012 and Lee 2013).

This subsection ends with a sectoral comparison of relative labour productivity in which the service aggregate is opened further to disentangle – at least partially – its heterogeneity. The service subsectors range from highly productive, tradable information and communications technology (ICT) professional services to low-productive, self-subsistence, non-tradable personal services such as street vending. In particular, we distinguish three subgroups in the International Standard Industrial Classification (ISIC) Revision 3: tradable services, non-tradable services and non-market services.[12]

Manufacturing manages to combine high relative productivity with a strong capacity to absorb labour

But the information needed to analyse the relative productivity at such a disaggregated level within services is unavailable in the data source used so far in this subsection. Therefore, the analysis is restricted to a sub-sample of 40 countries with data from the World Input-Output Database (Timmer 2012). This database provides comparable value added and employment data by sector at the ISIC two-digit level for 14 emerging countries and 26 advanced economies.[13]

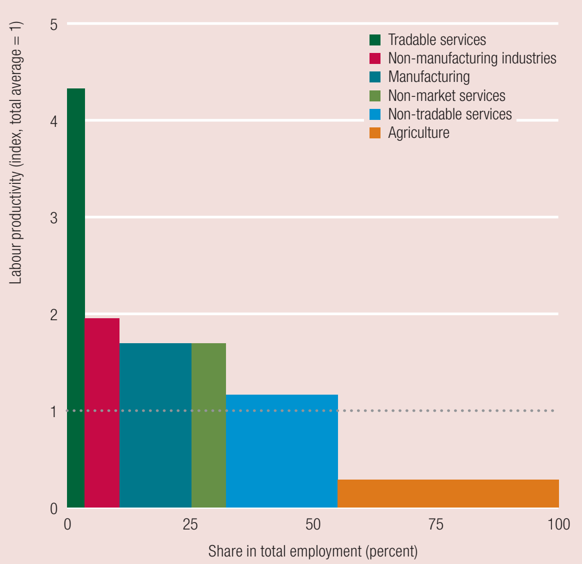
Figures 1.8 and 1.9 also indicate the relative size of each sector in the whole economy, which is depicted by the width of each bar and defined by the number of workers of each country.

Figure 1.8 shows that in the 14 emerging economies the service aggregate disguises heterogeneous subsectors. The most productive jobs of the economy are in extremely modern tradable services (mainly finance and professional activities) and – to a lesser extent – in some non-manufacturing industries (typically capital-intensive mining or public utilities). These sectors absorb a small (sometimes negligible) share of workers, however. After these sectors, manufacturing has the highest relative productivity while employing a substantial number of workers. That is, manufacturing manages to combine high relative productivity with a strong capacity to absorb labour. At the other extreme are the largest labour-absorbing sectors, agriculture and non-tradable services, but they show much lower relative productivity.

In a scenario such as in Figure 1.8, labour shifts from agriculture and non-tradable services towards manufacturing and tradable services will entail a structural change bonus and gains in aggregate productivity – the core of the structural change pattern described above. As countries develop, however, relative productivity across sectors tends to converge to the national average (see Figure 1.7). The more disaggregated pattern for the restricted sample of advanced economies confirms this pattern (Figure 1.9).

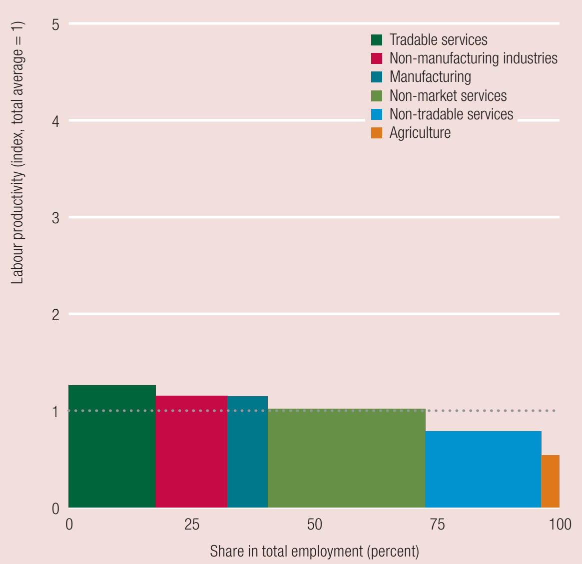
Differences in relative productivity are now almost negligible, though the ordering of sectors is very similar to that of the 14 emerging countries'. In these advanced economies the share of tradable services in employment increases dramatically, even surpassing

Figure 1.8
Relative labour productivity and share in total employment by sector, 14 emerging economies, 2005



Note: Weighted averages. Total economy average of productivity = 1.
Source: UNIDO estimate based on Timmer (2012).

Figure 1.9
Relative labour productivity and share in total employment by sector, 26 advanced economies, 2005



Note: Weighted averages. Total economy average of productivity = 1.
Source: UNIDO estimate based on Timmer (2012).

> **Manufacturing jobs tend to be more productive than others, and so tend to be better paid and to offer better labour conditions**

manufacturing in labour absorption. Agriculture accounts for an insignificant share of employment.

It may be easy to grasp intuitively the importance of manufacturing in economic growth and structural change, but the sector's role in job creation is less straightforward, as will be shown below.

Manufacturing growth and employment

Structural change can be achieved in various ways, but using three themes most commonly explored in the growth-accounting literature, it is seen to be triggered by a shift in labour from the lower to the higher productivity sector (labour-intensive structural change), by a shift in capital (through an increase in the capital–labour ratio), or by an improvement in overall technology (understood broadly as total factor productivity) – or a combination of all three. A cursory look at Table 1.2 shows, for example, that the direct absorption of workers by manufacturing is quite limited, as its share in total employment oscillates at 10–20 percent of total employment.

Despite this, manufacturing is still fundamental to the labour market. Manufacturing jobs tend to be more productive than others, and so tend to be better paid and to offer better labour conditions, such as security and employment benefits. This particular feature of manufacturing lies at the heart of the growth-enhancing structural change argument. Further, manufacturing's strong productive linkages with other sectors lead to a much greater impact on employment creation due to indirect effects. A job in manufacturing is typically associated with more jobs in other sectors.

Beyond that are the "induced effects" – among the most important means for manufacturing to stimulate jobs – broadly defined as the external effects of investment in manufacturing other than productive linkages. These external effects take place on the demand and supply sides. On the demand side the net increases in incomes received by workers in jobs directly or indirectly created through investment in manufacturing are re-spent, generating Keynesian-type multiplier effects that in turn contribute to higher demand and additional employment. On the supply side, by stimulating aggregate growth, especially through knowledge spillovers, manufacturing has additional impacts on overall employment creation (Lavopa and Szirmai 2012).

Direct jobs created in manufacturing: formal and informal

This subsection aims to quantify the number of jobs created in manufacturing around the world over the last 40 years, but faces two methodological problems. First, sector-disaggregated employment data are limited, especially in developing countries and over a long period. Second, even when there are data, comparability among countries may be affected by different definitions for employment status, type of occupation, coverage and so on. Still, two main sources of information can be used: industry surveys and general household surveys.

Most countries carry out industry surveys. They typically provide reliable data on the number of manufacturing employees working in formal enterprises and over a long period. But depending on country they may well cover only those firms employing at least 5 or 10 workers, and exclude self-employed workers and unregistered employees, thus heavily underestimating the real number of jobs created in manufacturing.

The number of manufacturing jobs can also be estimated from household surveys (or population censuses). They generally cover all types of jobs but their data reliability on coverage and international comparability, as well as the number of countries using them, are much more patchy. The estimates in this subsection combine both sources to provide a picture as close to reality as possible for manufacturing jobs (Box 1.3; Figure 1.10).

At the beginning of the period the global formal sector in red had around 140 million jobs, and showed a steady increase until the end of the 1980s. After an interruption of five years (between 1990 and 1995) when manufacturing jobs stagnated, the series continued growing up to a peak in 2007, before the global

> **By stimulating aggregate growth, especially through knowledge spillovers, manufacturing has additional impacts on overall employment creation**

Box 1.3
Estimating manufacturing jobs

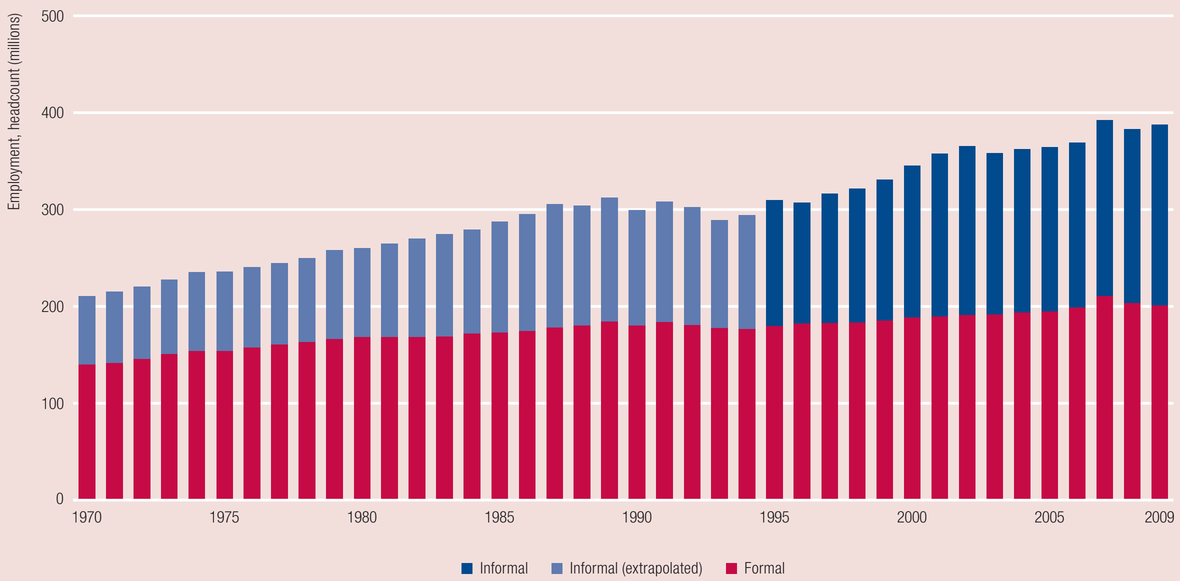
We first calculate, for each year, the number of manufacturing jobs according to the UNIDO Database (UNIDO 2012a), which comprises data based on industry surveys for 166 countries back to the 1960s. The jobs obtained using this source could be generally described as formal manufacturing jobs, because they are typically in the formal part of the economy. The estimates are then complemented with data from household surveys and population censuses, as published in the International Labour Organization databases LABORSTA (ILO 2011a) and ILOSTAT (ILO 2013), to calculate a rough estimate of the number of jobs not captured by the first source.

For every country and year with data, the difference between the two sources is calculated to give the number of what may be termed informal manufacturing jobs. Yet this method gives only a very rough approximation of the true number of informal jobs – by definition very hard to capture – and refers to a definition of informal that goes far beyond unregistered jobs. In fact, many of the jobs captured by this procedure are registered workers in small enterprises, which are not captured in industrial surveys as these generally include firms above 10 employees.

Because International Labour Organization data are far weaker before 1995, we only estimate informal jobs for 1995–2009. For earlier years we extrapolate back using the formal–informal ratio for 1995. But even within the period with more reliable data (1995–2009), more than half the countries are still missing. In these cases gaps have been filled using the closest available data (in terms of formal–informal ratio), either from the same country in a different year or, if missing, from a different country with similar characteristics (region or income).

Source: Industrial Development Report 2013 Team.

Figure 1.10
Number of jobs created by manufacturing industry, 1970–2009



Note: For calculation method of formal and informal jobs, see Box 1.3.
Source: UNIDO estimate based on ILO (2011a, 2013) and UNIDO (2012a).

crisis hit. By 2009 formal manufacturing employed more than 201 million workers around the world. Average annual growth in formal jobs was 1 percent over 1970–2009.

The group in shades of blue can be broadly associated with informal activity, with different shades used to mark the estimates of informal jobs before and after 1995 to emphasize that simple extrapolation

> A broader understanding of the interconnections between manufacturing and producer services is necessary to fully assess the impact of manufacturing in employment creation

was used before that year. The estimates suggest that focusing exclusively on formal jobs leaves out a large (and increasing) portion of all jobs created in manufacturing. In 1995 there were some 130 million informal jobs, at around 40 percent of the total; by 2009 the figure had climbed to 187 million and the share to 48 percent. Jobs in this case involve much more than what a traditional definition of "informal" would contain, because workers not subject to labour legislation are included as are those working in small and medium enterprises and the self-employed. The rise of many emerging economies as new hubs in the world production of manufactures (Chapter 2) is an important factor in this trend.

Taken together, formal and informal manufacturing jobs accounted for almost 388 million jobs worldwide in 2009, having grown at an average annual rate of 1.6 percent since 1970.

Manufacturing-related jobs in services

Failure to capture informal jobs in manufacturing is not the only way by which manufacturing jobs are typically underestimated. Perhaps more important, in view of the global economic transformations of the last few decades, is the unbundling of certain production processes that statistically used to be included in manufacturing but are now included in services.

In fact, it could be argued that the very distinction between manufacturing and services has become blurred (Manyika et al. 2012). Not only are manufacturing firms increasingly outsourcing their non-core operations, such as warehousing, transport, human resource management and information technology, but manufactured products are increasingly bundled with a host of services and after-market functions (such as telephone help-lines, extended warranty and repair and retail services). Indeed, the function of services in the manufacturing process has been sorely neglected in historical and contemporary accounts of economic development.

These operations partly reflect the move by companies towards a "core competence" model of organization (Prahalad and Hamel 1990). Manufacturing firms have tended to shed many of their service functions, which became separate entities in their own right and thus appear in the national accounts under "producer services" instead of being previously concealed under "manufacturing" itself. These "outsourced" service firms co-produce and provide services for other manufacturing firms, thus improving the efficiency and diffusion of service knowledge to a wider variety of client firms.

A broader understanding of the interconnections between manufacturing and producer services is necessary to fully assess the impact of manufacturing in employment creation. With these interactions considered, manufacturing employment becomes more important than often appreciated.

Take the automotive industry. Logistics and warehousing, once the preserve of the car manufacturers themselves, have been outsourced to such an extent that the manufacturers now fully depend on a wide array of third-party service firms. These companies provide the support to distribute parts and warehouse components, transport parts and finished products to the international market, and cope with changes in production such as just-in-time manufacturing. And this is before the burgeoning business of advanced car sales operations, which provides after-market services ranging from repair to maintenance and to purchase finance, is taken into account.

The following section attempts to quantify the type of manufacturing-related jobs in services just described. Once again, the accuracy of estimates depends heavily on data availability. Precise estimates would demand industry- and country-specific case studies, which go far beyond the scope of this report. Instead, a more pragmatic approach is used, though undoubtedly less exact and based on input-output tables at country level. In particular, the proportion of inputs going to manufacturing industries from different service activities are used to calculate the share of employment in these activities that could be regarded as manufacturing-related jobs. For instance, if 20 percent of the business service industry's output goes to manufacturing, 20 percent of that industry's employment is computed

Any assessment of the scale of manufacturing's employment creation based purely on data from industry surveys will heavily undercount the true size

as manufacturing related, thus excluding any indirect job creation due to multiplier effects.[14]

For the transport and wholesale industries, we included both the proportion of their services due to manufacturing and their services due to receipt of manufacturing inputs in calculating their manufacturing-related employment (for example, transport in delivering natural resource commodities to manufacturing as well as delivering manufacturing goods to retailers) because these services depend highly on manufacturing activities.

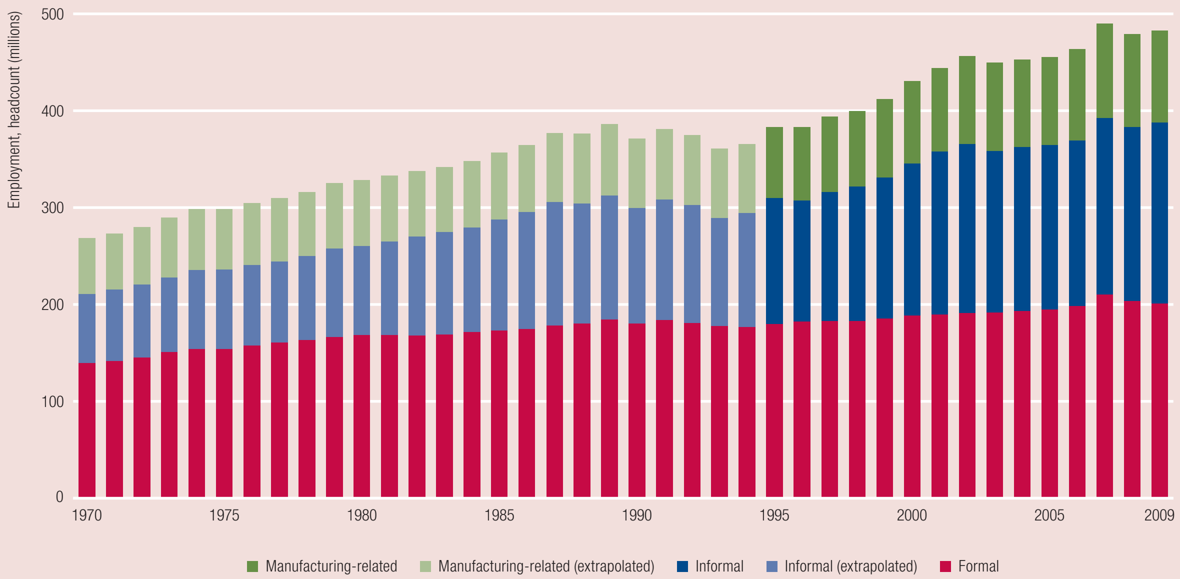
The proportion of inputs used to calculate the manufacturing-related jobs in services is taken from the World Input-Output Database, which provides detailed input-output data for 40 countries from six regions between 1995 and 2009 (Timmer 2012).[15] Based on this source we estimated the number of manufacturing-related jobs created for each direct job in manufacturing, by country and region. We then applied the regional ratios to the total formal manufacturing jobs by region from the UNIDO database (UNIDO 2012a) and obtained figures for the total number of manufacturing-related jobs in services. We summed the regional figures to obtain the global total. Since the data from this source are only from 1995, for previous years (as previously) we extrapolated back, applying the ratio of formal jobs to manufacturing-related jobs of 1995 to the total formal jobs between 1970 and 1994 (Figure 1.11).

In 1995 manufacturing-related jobs in services employed 73 million workers. Over 1995–2009 these jobs grew much faster than those in direct formal manufacturing (reflecting the outsourcing approaches discussed above) reaching 95 million by 2009.

Thus manufacturing – broadly defined to include formal, informal and manufacturing-related services– offered almost 470 million jobs in 2009, employing around 16 percent of the world's workforce of 2.9 billion (477 million in the peak year of 2007 over 1995–2009).[16]

One key message from this exercise is that any assessment of the scale of manufacturing's employment creation based purely on data from industry surveys will heavily undercount the true size. Employment data from this type of source represent, at best, half the total number of jobs directly and

Figure 1.11
Number of jobs created by manufacturing industry and manufactured-related services, 1970–2009



Note: For calculation method of formal and informal jobs, see Box 1.3.
Source: UNIDO estimate based on ILO (2011a, 2013), UNIDO (2012a) and Timmer (2012).

> **Manufacturing is also important for absorbing workers with modest skills and providing them with stable jobs and good benefits – as the sector where the world's middle classes take shape and grow**

indirectly created by manufacturing (and see *Regional shifts in manufacturing-related services* in Chapter 2 and *Manufacturing-related services employment* in Chapter 3).

Scattered evidence gathered in Lavopa and Szirmai (2012) suggests that manufacturing is the sector with much stronger linkages and much larger employment multipliers in an economy: for every job created in manufacturing, their evidence points to two or three created outside manufacturing. This is much higher than our estimates on manufacturing-related jobs in services, because we intentionally calculated them more conservatively: they include only certain sectors, do not include second- or third-round effects (input-output multiplier effects) and do not include income-induced effects.

We can thus conclude that the real impact of manufacturing on employment creation is much higher than portrayed in Figure 1.11.

Quality of jobs

Manufacturing jobs possess some characteristics that make them more desirable than other types of employment, including higher productivity from a macroeconomic viewpoint and higher wages, better working conditions, more opportunities for skill upgrading and many jobs for women from a social viewpoint.

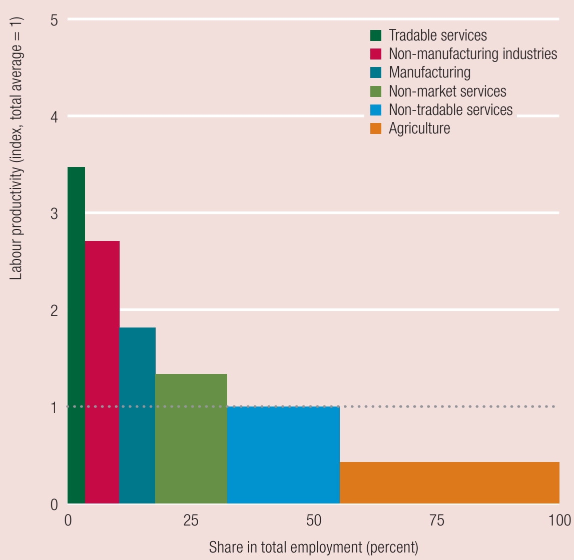
Higher productivity jobs are normally associated with higher wages. Historical evidence for the advanced economies and the successful newly industrialized countries shows that wage gains associated with industrializing structural change have greatly helped pull large sections of the population out of poverty (Weiss 2013). Manufacturing is also important for absorbing workers with modest skills and providing them with stable jobs and good benefits – as the sector where "the world's middle classes take shape and grow" (Rodrik 2011).

Some employment-intensive industries seem particularly well suited for this purpose, such as garment industries in many low-income countries (Fukunishi et al. 2006; Fukunishi 2012; Chapter 4). These industries provide wages that are generally higher, rural opportunities with low entry barriers for less educated workers (especially females) and a relatively easy promotion to better positions.

Many individuals see manufacturing as a major source of good jobs. Besides offering higher wages, it typically provides better employee benefits and security than jobs in other sectors and tends to develop higher skills than equivalent jobs in the rest of the economy (Lavopa and Szirmai 2012).[17]

Returning to the 14 emerging economies discussed above (see Figure 1.8), manufacturing is the largest sector for employment, paying above-average wages (Figure 1.12). Although mean labour incomes are much higher in tradable services, the sector employs only a small portion of the workforce. Non-market services and non-manufacturing industries also pay very good wages, but their capacity to absorb labour is also limited. Non-tradable services and agriculture are the main employers of the economy, but their labour incomes are much lower than in other sectors. Manufacturing thus possesses the advantage of being

Figure 1.12
Relative labour income and share in total employment by sector, 14 emerging economies, 2005



Note: Weighted averages. Total economy average of income = 1.
Source: UNIDO estimate based on Timmer (2012).

> **“Manufacturing is an important source of good jobs for women**

at the same time an important absorber of labour while paying above-average wages.

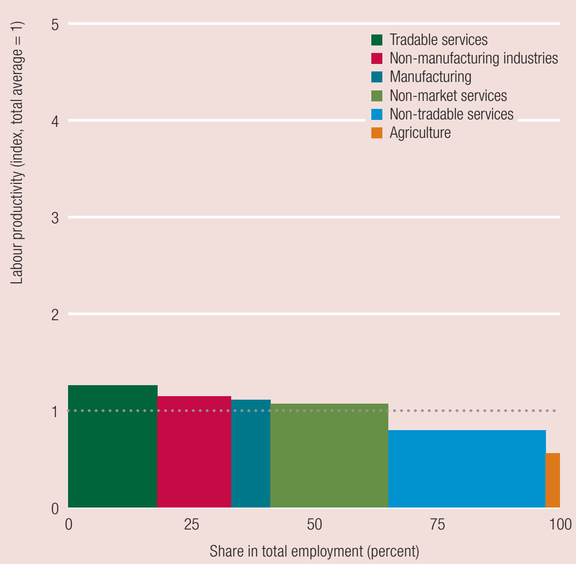
The picture is less clear for the 26 advanced economies. Although manufacturing still pays above-average wages (and is second on relative labour incomes), tradable services are a larger employer that pays even better wages (Figure 1.13).

These figures stress again the potential benefits (in this case, wages) that arise from the movement of labour from agriculture and non-tradable services into manufacturing, especially at low and lower middle incomes.

Female employment in manufacturing

Manufacturing industries can foster jobs for women: 33 percent of manufacturing workers are female, a higher share than in agriculture (28 percent) and non-manufacturing industries (9 percent), though lower than in services (47 percent; Figure 1.14). In view of manufacturing’s often better labour conditions, these data suggest that manufacturing is an important source of good jobs for women.

Figure 1.13
Relative labour income and share in total employment by sector, 26 advanced economies, 2005

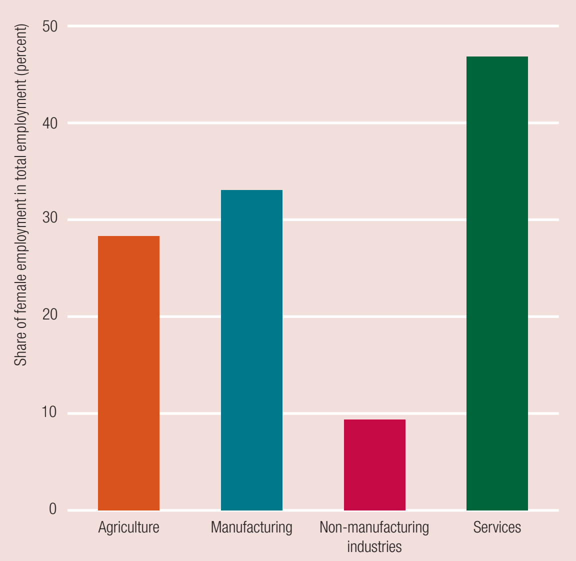


Note: Weighted averages. Total economy average of income = 1.
Source: UNIDO estimate based on Timmer (2012).

During the 1980s the female share in manufacturing rose in all regions (apart from four non-European high-income economies). But from the mid-1990s it started to decline in higher income economies and in the Middle East and North Africa, though it continued growing in the lower middle- and middle-income economies of Latin America and the Caribbean as well as in South Asia (Table 1.3). The share remained constant or declined from the mid-1990s in highly export-oriented manufacturing sectors in East Asia, including the more mature and higher income exporters (Hong Kong SAR China, the Republic of Korea, Singapore and Taiwan Province of China) as well as followers Indonesia, Malaysia and the Philippines (but not Thailand).[18]

This East Asian “defeminization”, commented on by many observers, is explained by technological change as part of an upgrading progress while exporters move into technologically more sophisticated and higher value goods. This shift typically requires higher capital–labour ratios and a higher ratio of skilled to unskilled workers. It can be explained either as a response to perceived demand

Figure 1.14
Share of female employment in total employment by sector, 94 countries, 2005



Source: UNIDO estimate based on ILO (2013) and World Bank (2013a).

> **High export growth based on labour-intensive goods can have a potentially strong initial effect on female employment**

Table 1.3
Female employment share in manufacturing by region, selected periods, 1985–2007 (percent)

	1985–1995		1996–2007		1985–2007	
Region	Average[a]	Growth[b]	Average	Growth	Average	Growth
East Asia and the Pacific	43.2	0.32	39.5	–0.79	41.8	–0.12
Latin America and the Caribbean	29.5	0.88	37.9	1.79	32.1	1.65
Other industrialized countries	31.8	–0.20	29.3	–0.52	31.2	–0.31
Europe and Central Asia	—	—	37.5	1.24	31.0	1.24
Western Europe	28.5	0.12	27.8	–0.24	28.5	–0.09
Middle East and North Africa	21.0	4.46	16.7	–2.04	19.8	0.28
South Asia	10.7	2.60	17.4	3.74	13.1	3.04

— is not available.
Note: Coverage is uneven due to lack of data. Sub-Saharan Africa is not represented, South Asia covers only India and Pakistan, and the Middle East and North Africa covers only Egypt and Morocco. China is not included.
a. Average share of females in total employment over the period.
b. Average annual change.
Source: Adapted from Tejani and Milberg (2010) based on International Labour Organization data.

or to competition from lower wage economies.[19] The link between upgrading and declining female employment shares occurs either where female workers have less access to skill training and education or where a form of gender discrimination exists, when firms prefer to train or employ male workers for specific tasks.

The impact of technology on female employment trends is ambiguous, however, as some evidence suggests that recent trends in technology-creating economies may be shifting towards greater use of female rather than male workers on the grounds that cognitive skills are more valuable than physical skills and that skill-intensive (typically ICT-based) technologies may gradually increase the relative demand for female labour. (See, for example, the analysis of the United States labour market in Welch 2000.) How long any such trends will take to emerge in technology-importing economies is unclear. The evidence suggests that high export growth based on labour-intensive goods can have a potentially strong initial effect on female employment, but that as the export product mix moves into more technologically sophisticated goods this employment effect weakens.

Unlike East Asia, in South Asia (India and Pakistan) as well as in Latin America and the Caribbean, female employment shares continued to rise in most countries until 2007. For South Asia the dominant explanation seems to be that manufacturing exports stayed at modest levels of technological sophistication, with continuing expansion of simple labour-intensive exports. For the Latin America and the Caribbean it was the relative lack of success of export manufacturing because, in the context of low-productivity growth, firms attempted to reduce costs by replacing male workers with lower wage female workers (Tejani and Milberg 2010). Some reasons for these variations are grounded in the changing geography of manufacturing employment, examined in detail in the next chapter.

Notes

1. Non-manufacturing industries comprise the following sectors: mining and quarrying, construction and public utilities (electricity, gas and water).
2. This is about the per capita income at which countries transition from the middle-income to the high-income category in the World Bank's classification. See Annex 8 for the World Bank's country classification by income.
3. As the sample will have further data covering the period after the global financial crisis, a further break may appear but any analysis is premature at this stage.

4. The commodities included are those categorized under Standard International Trade Classification Revision 1 in code 2 (crude materials, inedible, except fuels), 32 (coal, coke and briquettes), 331 (petroleum, crude and partly refined) and 3411 (gas, natural).
5. Following this procedure 48 countries of our sample were classified as natural resource rich: Afghanistan, Australia, Bahamas, Benin, Bolivia, Burkina Faso, Cambodia, Cameroon, Canada, Central African Republic, Chile, Republic of Congo, Côte d'Ivoire, Denmark, Egypt, Estonia, Ethiopia, The Gambia, Georgia, Guatemala, Haiti, Honduras, Indonesia, Kuwait, Lao People's Democratic Republic, Latvia, Liberia, Malawi, Mongolia, Mozambique, New Zealand, Nigeria, Norway, Oman, Papua New Guinea, Paraguay, Qatar, Russian Federation, Saudi Arabia, Swaziland, Syrian Arab Republic, United Republic of Tanzania, Trinidad and Tobago, Uganda, United Arab Emirates, Viet Nam, Yemen and Zimbabwe.
6. This figure is an updated version of Figure 1.8 in World Bank (2008, p. 114). The data have been updated using other sources to make the periods of the figure as close as possible to the growth periods defined for each country. On data availability, however, in most cases the periods shown in the figure are shorter (see the figure note).
7. Formally,

$$RelPty_i^c = \frac{Pty_i^c}{Pty_T^c} = \frac{VA_i^c / L_i^c}{VA_T^c / L_T^c} = \frac{VA_i^c / VA_T^c}{L_i^c / L_T^c} = \frac{VAsh_i^c}{Lsh_i^c}$$

where *Pty* stands for labour productivity, *VA* for value added and *L* for labour, the superscript *c* refers to the country, the subscript *i* refers to the sector and the subscript *T* refers to the total economy. $VAsh_i^c$ and Lsh_i^c represent the share of sector *i* in total GDP and total employment, respectively. As discussed later, the growth accounting literature identifies several routes to increase production, labour productivity being only one of them.

8. Further, only countries with adequate statistics on the share of each sector in total GDP and employment were selected, leading to a loss of coverage. For this reason the results from the table should not be compared with those in Figure 1.3, which are also based on a far more refined estimation technique and thus more robust and reliable.
9. Including these countries in the sample does not change the main results. The main difference is that the series on non-manufacturing industries' relative productivity shows a rather strange peak at $21,000 per capita (mainly reflecting the high productivity in this sector of the major oil exporters).
10. The definition of these groups has been made following the income thresholds defined by the World Bank for 2012 (http://data.worldbank.org/about/country-classifications). The original thresholds, however, are defined in terms of gross national income per capita at current (Atlas method) dollars. Because our income levels are defined in terms of GDP per capita at constant 2005 PPP values, a correspondence has been done to establish thresholds that deliver the most similar classification of countries as the World Bank's definition. These thresholds are: low and lower middle income, $6,500 or less; upper middle income, $6,500–$15,000; and high income, more than $15,000.
11. Tradable services: ISIC divisions I (Transport, storage and communications) excluding subsector 60 (Land transport; transport via pipelines), J (Financial intermediation) and K (Real estate, renting and business activities) excluding subsector 70 (Real estate activities). Non-tradable services: ISIC divisions G (Wholesale and retail trade), H (Hotels and restaurants), O (Other community, social and personal service activities), P (Private households with employed persons) and subsectors 60 (Land transport; transport via pipelines) and 70 (Real estate activities). Non-market services: ISIC divisions L (Public administration and defence), M (Education), N (Health

and social work) and Q (Extra-territorial organizations and bodies).

12. For the list of countries classified by income (PPP) see Annex 8.
13. Emerging economies: Brazil, Bulgaria, China, Cyprus, India, Indonesia, Latvia, Lithuania, Malta, Mexico, Romania, Russian Federation, Taiwan Province of China and Turkey. Advanced economies: Australia, Austria, Belgium, Canada, Czech Republic, Germany, Denmark, Estonia, Finland, France, Greece, Hungary, Ireland, Italy, Japan, Republic of Korea, Luxembourg, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, United Kingdom and United States.
14. The methodology only looks at direct input-output relationship between services and manufacturing and does not take indirect (Leontief multiplier) effects into account.
15. The 14 emerging and 26 advanced economies listed earlier.
16. Number obtained from World Bank (2013b) for the same sample of countries.
17. Employee benefits include retirement plans, paid holidays and so forth. Security benefits include life insurance and health insurance.
18. The female employment share continued rising (Tejani and Milberg 2010).
19. Tejani and Milberg (2010) show that across their sample, rising capital intensity in manufacturing is associated with a falling female employment share.

Chapter 2

Structural transformation and the changing geography of manufacturing employment

As countries develop over time, the structure of their economy (and thus employment) changes, as seen in Chapter 1. This chapter looks at the spatial shifts in manufacturing employment between regions and countries, as well as within countries, stemming from the structural transformation or change. With developed countries becoming richer and many less developed countries being lifted out of poverty, recent decades have seen an important shift in the distribution of manufacturing around the globe. Although North America, Industrialized Europe and Japan still account for around 40 percent of global manufacturing value added, the rise of value added in East Asia and the Pacific, particularly China, over the last few decades has been dramatic – a shift even more prominent than in manufacturing employment (World Bank 2013b; for a list of countries see Annex 8).

Although these trends generally confirm the prediction that the share of manufacturing should first rise and then decline with income, other forces such as comparative advantage also affect how quickly or slowly structural change takes place in a given country. Trade and comparative advantage may explain, for example, why some high-income countries such as Germany maintain an important manufacturing sector. The scope of trade in shaping the geographical distribution of manufacturing activity has become more prominent in recent decades with the entry of some important middle-income countries such as China and the Russian Federation into the World Trade Organization, and the increasing fragmentation of the value chain.

As relative productivity is an important driver of specialization and trade, agglomeration economies are important in explaining how manufacturing locates across space. The emergence of some countries like China, the Republic of Korea and Singapore as manufacturing hubs is related to agglomeration economies at the country level. Yet this type of spatial clustering is usually more prominent within countries, because some forces that encourage geographical concentration are much stronger at the small geographical scale of regions, cities or towns than at the large geographical scale of countries. Within the United States, for instance, the Midwest used to be an important manufacturing region before turning into a "Rust Belt" and being replaced by other regional clusters, such as China's eastern seaboard. (Not all of China is becoming a factory; many of its regions remain based on agriculture.)

When looking within countries, manufacturing tends to become geographically more concentrated during the structural change from agriculture to manufacturing, but the trend reverses when services become more important, for two main reasons. First, agriculture is land intensive, but this is less true of manufacturing and even less so of services. So when manufacturing replaces agriculture, manufacturing tends to cluster, but when services become more important manufacturing tends to disperse.

Second, the structural change is driven partly by productivity gains and innovation. In the early stages of industrialization, when there are high gains from knowledge clusters, manufacturing concentrates. Later, as manufacturing matures, those gains become smaller, and it often moves to areas where land is cheaper. For example, in the last half century in advanced economies such as the United States and Western Europe, manufacturing has been relocating to less congested areas, making it geographically more dispersed. In less advanced economies this is less true, and manufacturing continues to have a strong presence in urban areas. There is thus a link between a country's level of development and the geographical concentration of its manufacturing.

The overall trend of manufacturing to move to less congested areas in advanced economies needs to be qualified in three ways. First, although manufacturing firms are moving out of cities, they are "suburbanizing" rather than "ruralizing". They still have a strong motive to stay quite close to cities. Second, not all manufacturing subsectors are moving out of cities – the cost

> **Economic development leads to urbanization, and urbanization leads to economic development**

of remoteness is greater in high-tech than in low-tech manufacturing. Third, the increasing fragmentation of the value chain implies that specialization is becoming more functional than sectoral. This fragmentation allows the more complex parts of manufacturing to remain in cities and the more routine-like parts to relocate to cheaper places. Once again, cities remain attractive for the knowledge-intensive part of manufacturing.

Of course, it is not only economic development that leads to spatial concentration or urbanization – the opposite is true as well. Cities are laboratories for learning and knowledge creation. Wages are higher in urban environments because people are more productive. And the longer people stay in cities, the more productive they become. The highly interactive environment stimulates knowledge acquisition – most young, innovative firms are in dense economic clusters and a disproportionate share of patents is generated in cities. All of this leads to a self-reinforcing process in which economic development leads to urbanization, and urbanization leads to economic development.

But urbanization does not only have to do with productivity. People may also prefer living in cities because they enjoy the amenities there, and in some African countries, for example, we are witnessing rising urbanization without a structural transformation. This reflects cities being not just production centres but also consumption centres.

Shifts in manufacturing employment between regions and countries

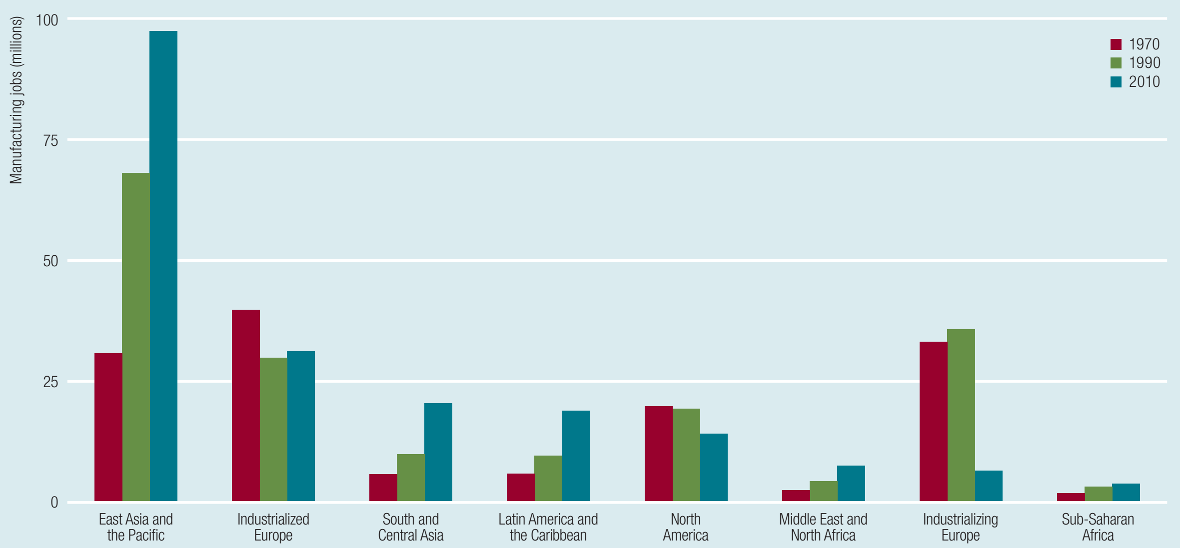
One region has been the big winner in the employment shifts in direct manufacturing, based on the "traditional" approach to counting jobs in the sector – East Asia and the Pacific.[1] But the view for jobs in manufacturing-related services is more nuanced.

Shifts between regions in direct manufacturing

In Industrializing Europe, which includes transition economies, formal manufacturing jobs fell by more than half from about 33 million in 1970 to 7 million in 2010 (Figure 2.1). Industrialized Europe shows a less dramatic rate of decrease in the period, from 40 million to 31 million. In North America the drop was similar, from nearly 20 million to 14 million.

Countries in East Asia and the Pacific are the big winners (Box 2.1): they gained around 66 million

Figure 2.1
Trends in formal manufacturing employment by region, 1970, 1990 and 2010



Source: UNIDO estimate based on UNIDO (2012a).

> **“In some African countries we are witnessing rising urbanization without a structural transformation**

Box 2.1

Automotive and textile and apparel industries – a global shift to Asia

Two major global employers – automotive (high-tech) and textiles and apparel (low-tech) – show similar geographical shifts to Asia in manufacturing jobs, though at a different pace and for different reasons.

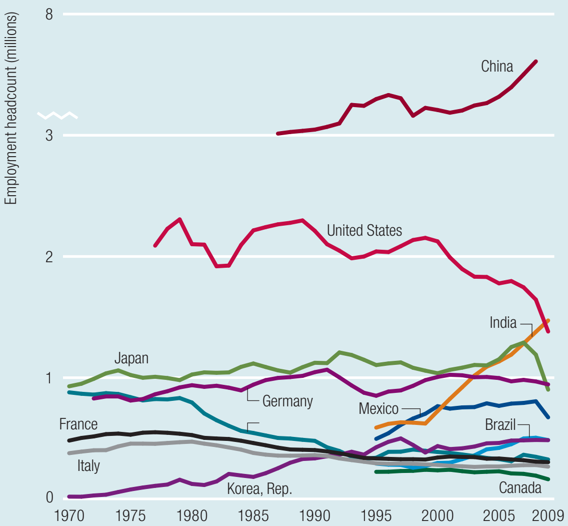
The automotive industry, which here covers the manufacture of motor vehicles, trailers and semi-trailers as well as of other transport equipment (34+35 ISIC Revision 3), is still strongly represented in industrialized countries, having shifted fewer jobs to developing regions (Box Figure 1), though the trend to low-cost countries is picking up. In absolute terms North America and Industrialized Europe are still generating a good many automotive jobs but relatively are losing to countries such as China and India, which show rapidly rising employment.

The textile and apparel industry is the more labour intensive, tradable and easily accessible of the two due to its low entry costs and simple production technology, which has led to a more dramatic employment shift. (The industry refers here to the manufacture of textiles as well as the manufacture of apparel, and dressing and dyeing of fur – 17+18 ISIC Revision 3.) Jobs had already moved from North America and Industrialized Europe to Japan in the 1950s; in later decades the shift continued to low-income countries, notably those in East Asia and the Pacific, South and Central Asia and Latin America and the Caribbean (Box Figure 2). The phasing out of the Multifibre Arrangement (replaced in 1995 by the World Trade Organization Agreement on Textiles and Clothing) intensified the shift.

The reasons for the shift between the two industries differ – mainly the drive to conquer large emerging markets in the automotive industry (see Chapter 3) and cheap labour in textiles and apparel (Staritz 2011).

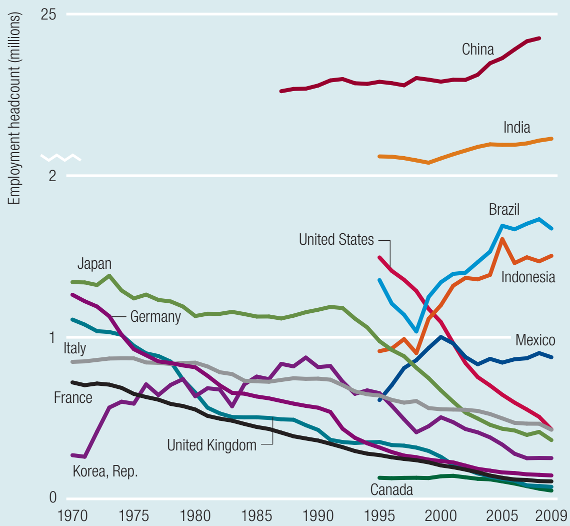
For both, most higher value activities like product development, design and branding have stayed put. This may change in the coming years, however, in response to a growing tendency for the more complex activities to move to emerging markets as they upgrade their skills and technology. Automotive multinationals, for instance, have been allowed to set up design and engineering centres in China on the condition of technology sharing and can thus comply better with local customer requirements (in line with different preferences and purchasing conditions). In textiles and apparel the Indian industry is increasingly carrying out original design manufacturing – that is, it is covering all steps involved in production, including design, purchasing, cutting, sewing, trimming, packing and distributing (Frederick and Gereffi 2010).

Box Figure 1
Automotive industry employment, selected countries, 1970–2009



Note: Data for Brazil, Canada, China, India, Indonesia, Mexico and the United States are only available for 1995–2009.
Source: UNIDO estimate based on Timmer (2012) and World KLEMS (2013). See O’Mahony and Timmer (2009) for the underlying methodology of the database.

Box Figure 2
Textile and apparel industry employment, selected countries, 1970–2009



Note: Data for Brazil, Canada, China, India, Indonesia, Mexico and the United States are only available for 1995–2009.
Source: UNIDO estimate based on Timmer (2012) and World KLEMS (2013). See O’Mahony and Timmer (2009) for the underlying methodology of the database.

Source: Industrial Development Report 2013 Team.

> **The positive impact of manufacturing on output and employment in services has increased in recent decades, especially in industrialized countries**

formal manufacturing jobs (from 31 million in 1970 to 97 million in 2010). Jobs in South and Central Asia shot up from around 6 million to 20 million and in Latin America and the Caribbean from 6 million to 19 million.[2]

Shifts between countries in direct manufacturing

This subsection looks at the data at a more disaggregated level. The top 10 countries by share of global formal manufacturing jobs accounted for around 70 percent of the total throughout the period, though this fairly constant share masks underlying geographical shifts (Table 2.1).

China, which replaced the Soviet Union at the top in 1990 and kept that spot in 2010, increased its share hugely, from 10 percent in 1970 to 34 percent in 2010, for an increase of about 55 million formal jobs. India moved up from eighth in 1970 to third in 2010, nearly doubling its share to 6 percent by adding about 7 million formal jobs. Brazil, which started at number 13 in 1970, moved into the top five by 2010, having more than doubled its share from 1.5 percent to 4.0 percent, and increased jobs by about 5.6 million.[3] Other countries moving into the top 10 include Bangladesh, Indonesia and Viet Nam.

In the other direction, France, Germany, Japan, Italy, Poland, the Russian Federation and the United Kingdom fell within or even out of their top 10 slots. The Russian Federation, for example, lost nearly 23 million formal manufacturing jobs between 1991 and 2010 (given the break-up of the Soviet Union any comparison with 1970 would be meaningless), and by 2010 had only around 8 million formal workers in manufacturing. Its global share dropped from 11 percent to 4 percent in this period. The United Kingdom lost around 5.7 million formal manufacturing jobs between 1970 and 2010 (its share falling from 6 percent to only 1 percent), and Japan gave up 3.6 million (losing half its share, from 8 percent to 4 percent). The losses in France, Germany and Poland were more modest. The United States continued to hold second position but still lost nearly 5.5 million formal manufacturing jobs as its share fell by more than half from 13 percent in 1970 to 6 percent in 2010.

Regional shifts in manufacturing-related services

The positive impact of manufacturing on output and employment in services has increased in recent decades, especially in industrialized countries. This greater service intensity of manufacturing stems from greater demand for coordination across locations (because of outsourcing, for example) and from changes in technology and organization (Falk and Jarocinska 2010). If we thus take a broader view of manufacturing and include manufacturing-related services, the decline of manufacturing in industrialized countries is mitigated somewhat, as will be shown below. Table 2.2 shows that manufacturing-related services have seven subcategories.

Based on the typology of services that identifies their relation to manufacturing, renting of machinery and equipment and other business activities (ISIC: 71–74) – or business services for short – seems to be most closely linked to manufacturing production, followed by trade, financial intermediation and transport and inland transport (ISIC: 51, J, 52, 60) with a medium linkage to manufacturing. Real estate activities, post and telecommunications, other supporting and auxiliary transport activities as well as sale, maintenance and repair of motor vehicles and motorcycles (ISIC: 70, 63, 64, 50) show a low linkage to manufacturing, whereas hotels and restaurants as well as air and water transport (ISIC: H, 62, 61) show the lowest linkage.[4]

Manufacturing-related services still play an important role in industrialized countries (Figure 2.2): their jobs remained stable at around 32 million during 1995–2009. Business services especially, such as design, research, engineering, branding, advertising and marketing, are still increasing and mitigate the decline of manufacturing employment in industrialized countries. Looking at the share of employment in manufacturing-related services, industrialized economies have increased their share from 24 percent in

This greater service intensity of manufacturing stems from greater demand for coordination across locations and from changes in technology and organization

Table 2.1
Shares in global formal manufacturing employment by country, 1970, 1990 and 2010

1970

Ranking	Country	Manufacturing employment (millions)	Global share of manufacturing employment (percent)
	World	139.7	100.00
1	Soviet Union	27.1	19.41
2	United States	18.2	13.03
3	China	14.2	10.13
4	Japan	10.9	7.79
5	Germany, Fed. Rep.	8.2	5.87
6	United Kingdom	8.0	5.69
7	France	5.2	3.72
8	India	4.7	3.40
9	Poland	3.5	2.48
10	Italy	3.3	2.35
13	Brazil	2.1	1.48
27	Korea, Rep. of	0.8	0.59
33	Indonesia	0.5	0.35
47	Bangladesh	0.2	0.15
83	Viet Nam	0.04	0.03

1990

Ranking	Country	Manufacturing employment (millions)	Global share of manufacturing employment (percent)
	World	180.3	100.00
1	China	42.4	23.53
2	Soviet Union	30.4	16.83
3	United States	17.5	9.71
4	Japan	11.2	6.20
5	India	7.2	3.98
6	Germany, Fed. Rep.	7.1	3.95
7	United Kingdom	4.8	2.66
8	Brazil	4.2	2.32
9	France	3.1	1.72
10	Poland	3.0	1.67
11	Korea, Rep. of	3.0	1.64
12	Italy	2.8	1.53
13	Indonesia	2.6	1.47
24	Bangladesh	1.0	0.57
60	Viet Nam	0.2	0.12

2010

Ranking	Country	Manufacturing employment (millions)	Global share of manufacturing employment (percent)
	World	200.3	100.00
1	China	68.8	34.34
2	United States	12.7	6.36
3	India	11.8	5.88
4	Russian Federation[a]	7.8	3.90
5	Brazil	7.7	3.84
6	Japan	7.3	3.63
7	Germany	6.2	3.10
8	Bangladesh	5.1	2.53
9	Viet Nam	4.4	2.20
10	Indonesia	4.2	2.11
11	Italy	3.3	1.66
14	France	2.9	1.45
16	United Kingdom	2.3	1.13
17	Poland	2.0	1.01
27	Korea, Rep. of	1.3	0.64

a. The Russian Federation had 30,352,000 manufacturing jobs in 1991 and was second between China and the United States with a share of 11 percent.
Source: UNIDO elaboration based on UNIDO (2012a) and World Bank (2013b).

> **Regional employment growth patterns in manufacturing-related services confirm that manufacturing and manufacturing-related activities are shifting geographically to Asia**

Table 2.2
Composition of manufacturing-related services

Group	Sectors included: World Input-Output Database	Sectors included: International Standard Industrial Classification Revision 3
Business services	29, 30	K
Financial intermediation	28	J
Manufacturing	3–16	D
Other services	31–35	L–P
Transport	23–27	I
Wholesale	19–22	G–H
Aggregated service employment	19–35	G–P

Source: Timmer 2012; UNSD 2013.

1995 to 29 percent in 2009 (of total manufacturing and manufacturing-related services employment).

Within the same period (1995–2009), the industrializing countries show a strong increase from nearly 34 million to around 51 million manufacturing-related services jobs (see Figure 2.2). East Asia and the Pacific, especially China, is the "power region" within the industrializing countries, as their manufacturing-related services jobs increased from nearly 24 million jobs in 1995 to more than 31 million jobs in 2009 (see Figure 2.2). The region showed strong gains in all categories (except financial intermediation), notably in business services and transport. Increasing transport could also be linked to rising intra-regional trade and the increasing participation of regional countries in international production sharing.

Although growth of direct manufacturing employment in Latin America and the Caribbean is not as pronounced as in some other regions, particularly Asia, the growth in manufacturing-related services employment there has been quite dynamic, possibly because it uses such employment more for manufacturing production than other regions (see Figure 2.2). Business services, wholesale, transport and financial intermediation made strong gains during 1995–2009.

Overall, regional employment growth patterns in manufacturing-related services confirm that manufacturing and manufacturing-related activities are shifting geographically to Asia, particularly to East Asia and the Pacific. At the same time, however, business services in Industrialized Europe and North America have stayed fairly stable, mitigating a little the drop in direct manufacturing jobs in those regions (see Figure 2.2).

Shifts among regions and countries in manufacturing trade

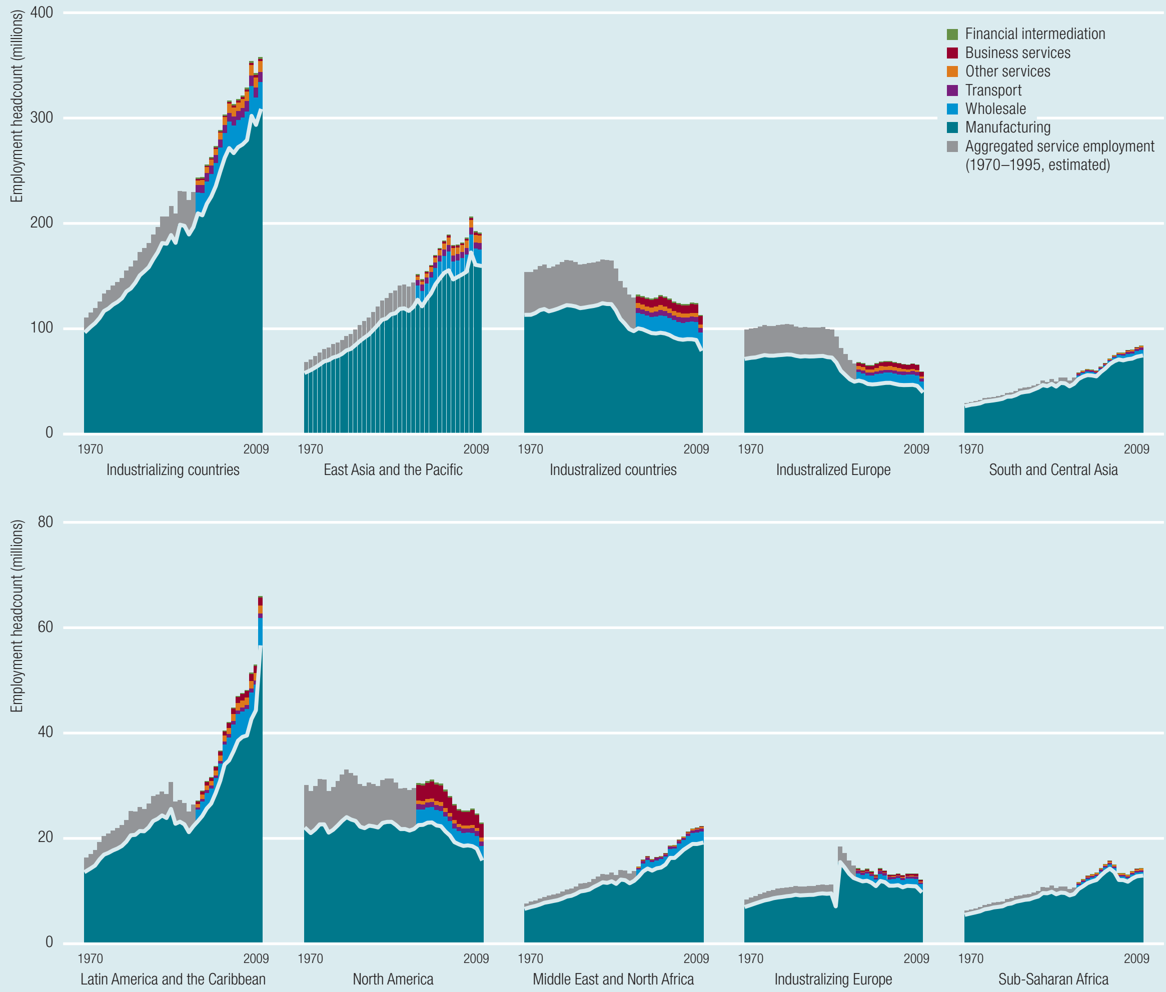
The evolution of net manufactured exports among regions and over time confirms the broad employment patterns presented above. (The relationship between manufacturing trade and employment is considered in greater detail in Chapter 5.) Over 1970–2011 net manufactured exports of East Asia and the Pacific soared from $2 billion to $653 billion (Figure 2.3). Another region that saw dramatic gains was Industrialized Europe (from $14 billion to $359 billion). But North America saw the balance of its net manufactured exports crash from a positive $4 billion to a $814 billion deficit. Industrializing Europe, Latin America and the Caribbean, the Middle East and North Africa, South and Central Asia and Sub-Saharan Africa also recorded widening net deficits, though less dramatically.

These trends not only reflect structural transformation and changing comparative advantage but also changing trade balances, and so have to be interpreted with caution. Regions that were running increasing trade surpluses, such as East Asia and the Pacific, may be increasing net exports in general and not just in manufacturing. Similarly, regions with widening trade deficits may see decreasing net exports across the board.

Changes in the country distribution of manufactured exports have been largely led by China, which moved from 12th place in 1990 to the top spot in 2011, vastly increasing its net manufactured exports from nearly $1 billion to $604 billion (Table 2.3). Again, this reflects not only China's emergence as

“Over 1970–2011 net manufactured exports of East Asia and the Pacific soared from $2 billion to $653 billion

Figure 2.2
Main types of services employment in manufacturing production by region, 1970–2009



Note: Some countries of the former Soviet Union are categorized after 1990 in South and Central Asia and Middle East and North Africa (Tajikistan, Georgia, Kazakhstan and Kyrgyzstan), others in Industrializing Europe (Albania, Latvia, Moldavia, Romania, the Russian Federation and Ukraine) and in Industrialized Europe (Estonia, the Russian Federation and Lithuania), which explains the jump in the corresponding regional graphs. Manufacturing includes formal and informal jobs. (See Box 1.3 in Chapter 1.)
Source: UNIDO estimate based on UNIDO (2012a) and Timmer (2012).

a manufacturing powerhouse but also its widening trade surplus with the rest of the world.

Strong increases in net manufactured exports are also displayed by Thailand and some high-income countries, such as Germany, Japan and the Republic of Korea, and to a lesser extent by Italy and the Netherlands. These are all countries whose pace of structural change out of manufacturing and into services has been slower than expected given their GDP, probably still retaining some advantage in manufacturing and thus allowing them to maintain a strong manufacturing export sector. Some of these countries, such as Germany and Japan, have thus suffered smaller losses in manufacturing employment than other countries with similar incomes.

Technological composition of net exports

The composition of net exports by region reiterates the broad global patterns observed so far, and extends to medium- and high-technology products, which seem

"The geographical shift in manufactured exports has been boosted by the worldwide fragmentation of production, increasingly organized along global value chains and global production networks

Figure 2.3
Trends in net manufactured exports by region, 1970, 1990 and 2011

Source: UNIDO estimate based on UN (2013a).

Table 2.3
Net manufacturing exports, 1970, 1990 and 2011 ($ billions)

Ranking	Country	1970	Ranking	Country	1990	Ranking	Country	2011
1	Germany	13.4	1	Japan	136.9	1	China	603.7
2	Japan	7.1	2	Germany	87.8	2	Germany	336.7
3	United States	3.4	3	Italy	24.5	3	Japan	203.9
4	Italy	3.0	4	Brazil	8.2	4	Korea, Rep. of	181.2
5	United Kingdom	2.9	5	Korea, Rep. of	8.2	5	Italy	81.6
6	France	1.7	6	Belgium–Luxembourg	6.8	6	Netherlands	66.3
7	Belgium–Luxembourg	1.1	7	Sweden	6.8	7	Ireland	64.6
8	Czechoslovakia	0.9	8	Argentina	3.0	8	Singapore	59.2
9	Sweden	0.9	9	Finland	2.2	9	Thailand	48.1
10	Canada	0.3	10	Ireland	2.0	10	Switzerland	36.6
58	Korea, Rep. of	–0.7	12	China	0.9			
62	Netherlands	–1.0						
54	Singapore	–0.6						
59	Thailand	–0.8						

Note: China is not included in 1970. The Russian Federation is not included in 1970 and 1990.
Source: UNIDO estimate based on UN (2013a).

to require ever larger volumes of resource-based products (Figure 2.4).

East Asia and the Pacific increased its low-, medium- and high-tech net exports, lifting its trade surplus by some 50 times over 1970–2011, and showing a large deficit in resource-based net exports in 2011 (a 60-fold widening). North America displays trade deficits in all technological categories over

The rise of global value chains and the global pattern of production is readily seen in trade in intermediate goods

Figure 2.4
Trends in manufactured exports by region and technological classification, 1970, 1990 and 2011

Note: China is not included in 1970. The Russian Federation is not included in 1970 and 1990.
Source: UNIDO estimate based on UN (2013a).

the same period, but most in high-tech net exports. Industrialized Europe has the expected picture of a small trade deficit in low-tech net exports in 2011 and a large surplus in resource-based (mainly due to Russia's high surplus), medium- and high-tech net exports. South and Central Asia in 2011 shows a surplus in low-tech net exports and a deficit in resource-based, medium- and high-tech net exports.

Shifts in the global structure of production and trade through global value chains

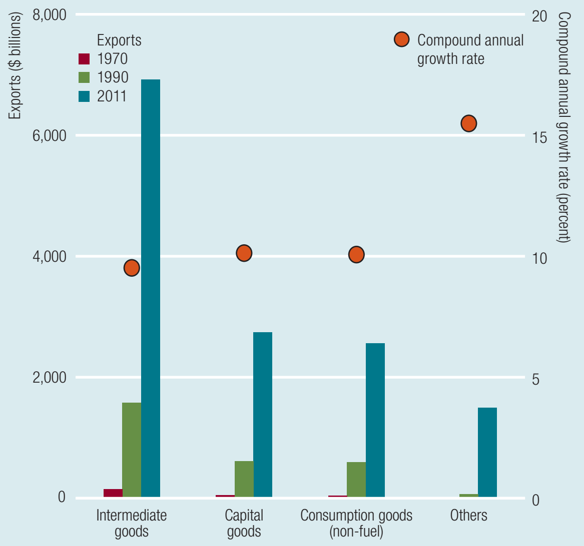
The geographical shift in manufactured exports has been boosted by the worldwide fragmentation of production, increasingly organized along global value chains (GVCs) and global production networks.[5] A value chain can be thought of as the "full range of activities that firms and workers do to bring a product from its conception to its end use and beyond" (Gereffi and Fernandez-Stark 2011, p. 4). Different tasks, such as product design and development, production, and marketing and distribution, are carried out in different countries that, rather than specialize in different final goods, specialize in different tasks or stages of the production process (Grossman and Rossi-Hansberg 2008).

The rise of GVCs and the global pattern of production is readily seen in trade in intermediate goods, a widely used indicator of participation in GVCs. Such trade accounted for half of global trade in 2011, reflecting an increase over 1970–2011 from around $152 billion to $6,922 billion, or nearly 10 percent annually (Figure 2.5).

By region the shares of Industrialized Europe and North America declined by 25 percentage points during 1970–2011 (Figure 2.6). The share of East Asia

> **The more pronounced role of Asia in global manufacturing production and trade is largely driven by China**

Figure 2.5
Trends of world non-fuel exports by type of good, 1970, 1990 and 2011



Note: China is not included in 1970. The Russian Federation is not included in 1970 and 1990.
Source: Adapted from IDE-JETRO and WTO (2011) and UN (2013a).

and the Pacific increased – reflecting rising manufacturing capacity and related trade in intermediates – from 13 percent in 1970 to 35 percent in 2011.

The more pronounced role of Asia in global manufacturing production and trade is largely driven by China (Figure 2.7). China, the largest exporter and importer of intermediate goods in Asia, shows very high growth rates, far above the regional average, both for exports (with the Republic of Korea) and for imports (with Hong Kong SAR China and India).

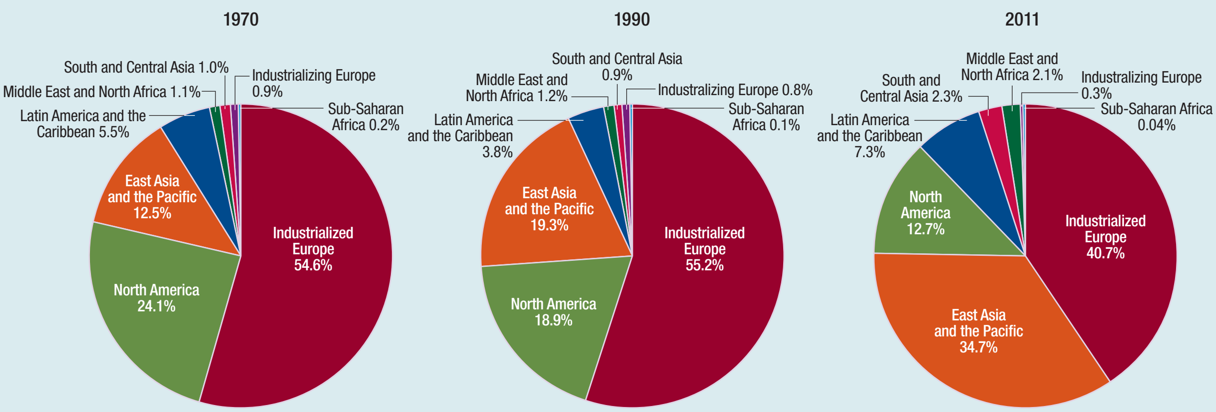
Shifts in manufacturing employment within countries

The structural change leads to shifts in manufacturing activity not only between regions and countries but also within countries.

Structural change and geographical concentration

According to Marshall (1920), agglomeration economies have three possible sources. First, information and knowledge are more easily transmitted at short distances. These localized knowledge spillovers make it more attractive for firms to locate close to each other. Second, the geographical concentration of industry generates a localized market for specialized skills. This labour-market pooling gives further incentives to firms to locate near each other. Third, the spatial clustering of a particular industry creates a market for specialized suppliers, which in turn increases the productivity of all the cluster's firms. These three

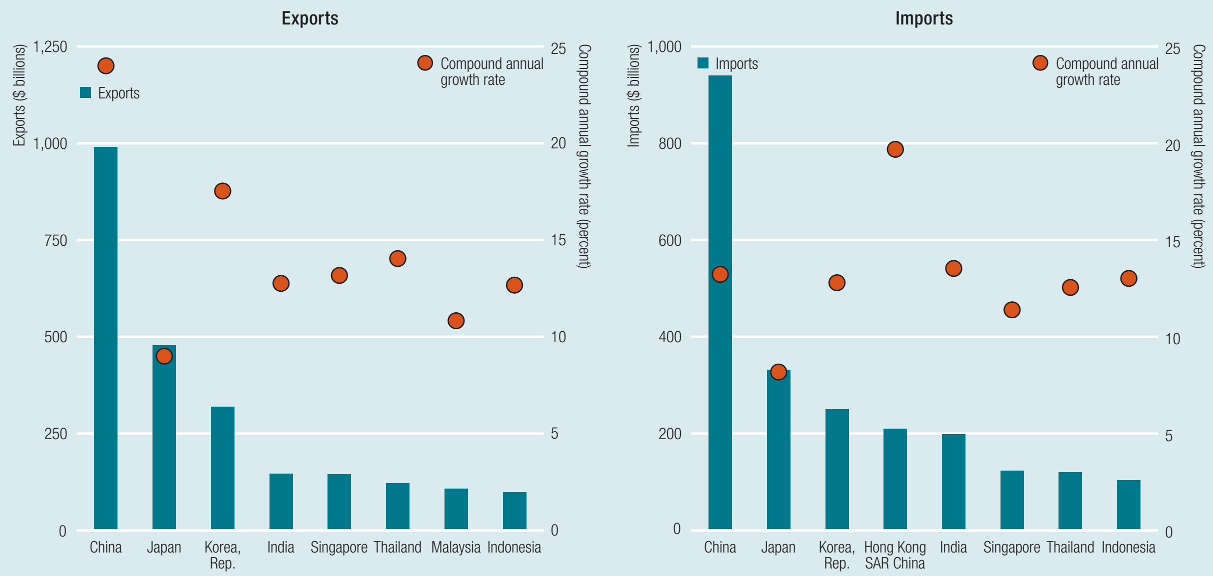
Figure 2.6
Shares in exports of global intermediate goods by region, 1970, 1990 and 2011



Note: China is not included in 1970. The Russian Federation is not included in 1970 and 1990.
Source: Adapted from IDE-JETRO and WTO (2011) and UN (2013a).

There is a strong positive correlation between structural change and urbanization

Figure 2.7
Intermediate goods exports and imports by key Asian trading economies, 1970–2011



Source: Adapted from IDE-JETRO and WTO (2011) and UN (2013a).

centripetal forces generally work simultaneously when industries cluster.

During the structural change out of agriculture, manufacturing tends to become geographically more concentrated. In advanced economies services are now replacing manufacturing in urban areas as industrial production plants move out to less congested areas. So to analyse the relation between structural change and geographical concentration in countries, we need to look at manufacturing and services together, because both are associated with increases in urbanization.

Urbanization as proxy

With urbanization as a proxy for geographical concentration, the relation between the non-agricultural employment share and the degree of urbanization is positive and linear (Figure 2.8).[6] On a linear regression the slope is equal to 0.8. This implies that a 1 percentage point increase in the share of manufacturing and service employment is associated with a 0.8 percentage point increase in urbanization. Thus, there is a strong positive correlation between structural change and urbanization.

If we focus exclusively on the share of manufacturing, the relation with urbanization has an inverted U shape (Figure 2.9). Countries with intermediate levels of manufacturing employment have the highest urbanization: these correspond to the advanced economies in which the structural change into services has led to a decrease in the share of manufacturing employment. Countries with low or high shares of manufacturing employment are less urbanized, but the effect is not symmetric: the least urbanized have the lowest shares of manufacturing, and are usually the countries still heavily based on agriculture.

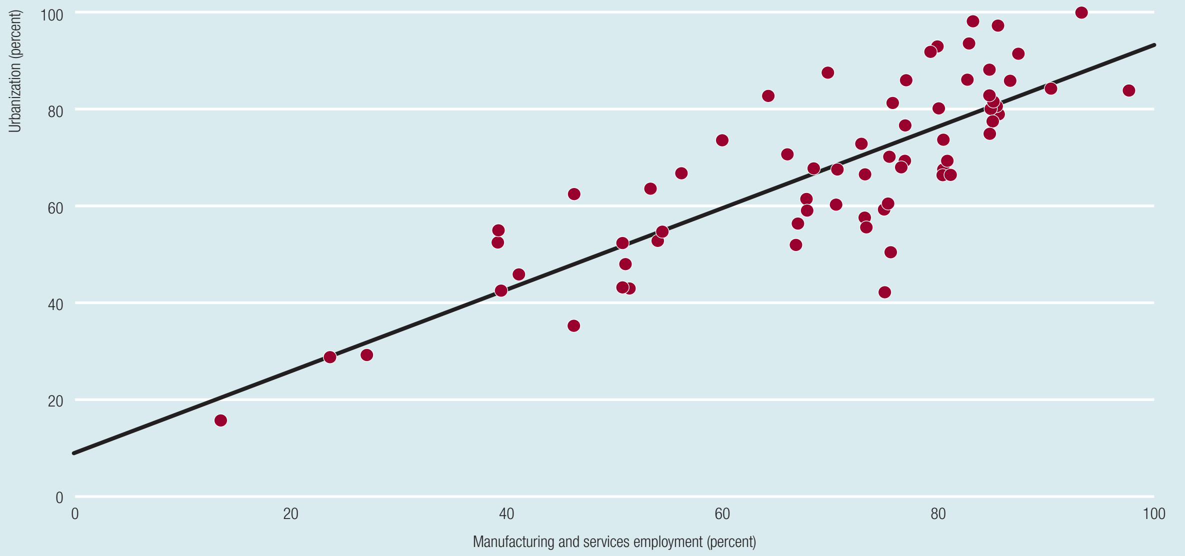
Rather than comparing the degree of geographical concentration in different countries at different stages of their structural change, we can also follow a country over time. The prediction is that as a country moves through its first and second transformations, the degree of geographical concentration increases.

Gross cell product

A more direct measure than urbanization for geographical concentration comes from the G-Econ research project at Yale University. For a large number

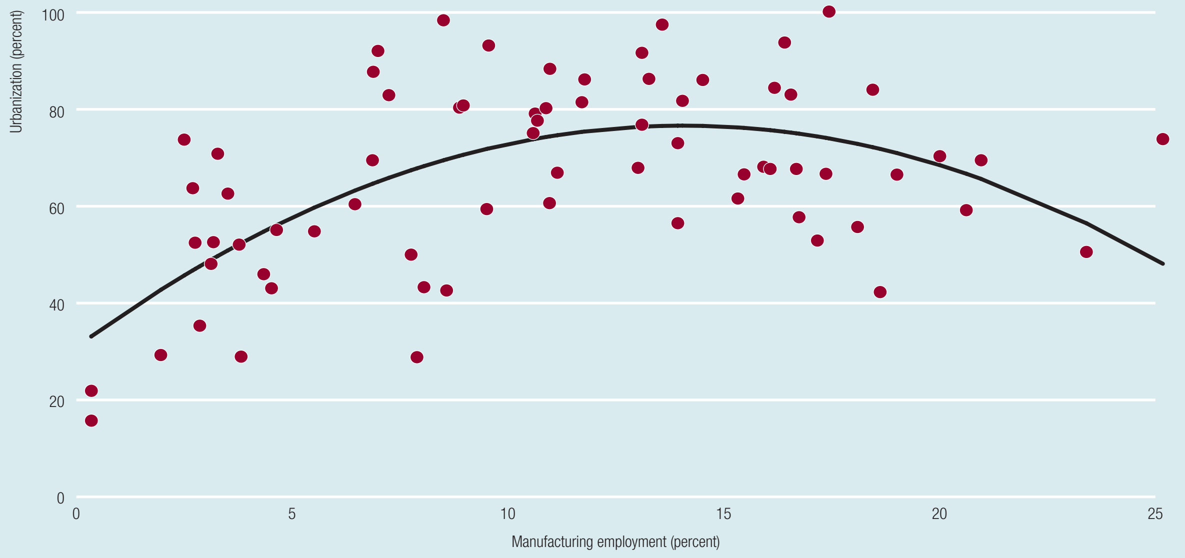
Countries with a larger share of manufacturing and services in value added are geographically less dispersed

Figure 2.8
Urbanization and shares of manufacturing and services in employment by country, 2005



Source: UNIDO estimate based on UNDESA (2012) and World Bank (2013b).

Figure 2.9
Urbanization and share of manufacturing in employment by country, 2005



Source: UNIDO estimate based on UNDESA (2012) and World Bank (2013b).

of countries the project has estimated "gross cell product", which is equivalent to GDP but measured at a 1 degree longitude by 1 degree latitude resolution.[7] Using this information, we computed the share of a country's total land area needed to produce 80 percent of its GDP. The higher the share, the greater the geographical dispersion of economic activity. Figures for Pakistan, Argentina and the United States come

> **The structural change is thus associated with greater spatial concentration of economic activity**

out at 0.57, 0.43 and 0.14, respectively (meaning that Pakistan, for example, produces 80 percent of its GDP on 57 percent of its land).

Given the evidence on structural change and urbanization presented earlier, we would expect the relation between structural change and geographical dispersion of GDP to be negative, which is indeed the case (Figure 2.10).[8] Countries with a larger share of manufacturing and services in value added are geographically less dispersed. The structural change is thus associated with greater spatial concentration of economic activity.

Geographical concentration in different industries

Manufacturing and services

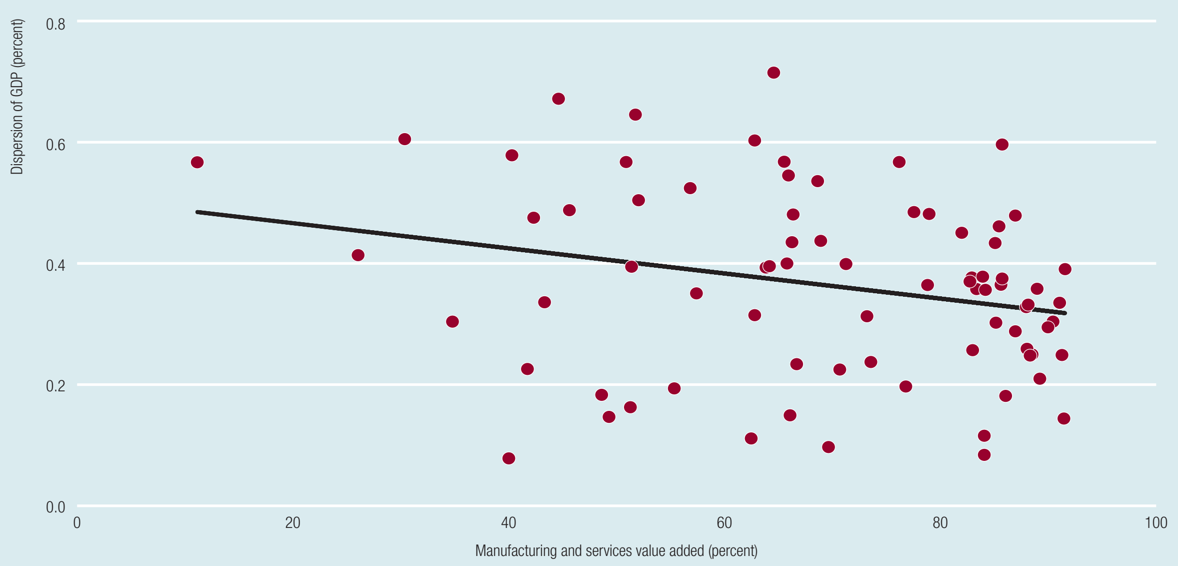
As innovation is a particularly important driver of the spatial concentration of economic activity, the tendency towards clustering is stronger in sectors that benefit more from innovation. Recent evidence for the United States, for example, shows that services, which benefit more than manufacturing from information and communication technologies (ICTs; Hobijn and Jovanovic 2001), have become more concentrated in the past few decades, unlike more mature industries, which have become increasingly dispersed (Table 2.4 and Box 2.2).

For example, in 1970 a county in the United States at the 70th percentile had 81 percent more manufacturing employment than a county at the 30th percentile, but by 2000 this difference had fallen to 74 percent, suggesting that manufacturing employment was becoming increasingly dispersed in the United States. But in services the difference between the counties at the 70th and 30th percentiles rose from 29 percent to 52 percent, indicating that services were becoming more concentrated. Thus although manufacturing is still more concentrated than the various service industries, the difference is narrowing (Desmet and Rossi-Hansberg forthcoming).

Producer-related services

The increased spatial dispersion of manufacturing is less dramatic when we account for "producer-related services", such as wholesale, retail, and finance,

Figure 2.10
Geographical dispersion of GDP and shares of manufacturing and services in employment by country, 2005



Source: UNIDO estimate based on World Bank (2013b) and Yale University (2011).

The incentive to locate in cities and other high-density locations depends on the strength of agglomeration economies and the importance of congestion costs

Table 2.4
Spatial concentration of employment in the United States, 1970 and 2000

	1970	2000
Log employment		
Difference 70th percentile–30th percentile		
Manufacturing	1.81	1.74
Services	1.29	1.52
Standard deviation		
Manufacturing	2.05	1.89
Services	1.40	1.52

Source: Bureau of Economic Analysis 2013.

insurance and real estate (FIRE), which are important partly because of demand from manufacturing. These services included, it is no longer true that all activity (in the United States at least) is moving to less congested areas (Table 2.5).

Manufacturing employment: patterns of dispersion

As economic activity becomes more clustered, land rents increase, giving rise to congestion costs. This caps the size of geographical clusters and cities. The incentive to locate in cities and other high-density locations thus depends on the strength of agglomeration economies and the importance of congestion costs.

In advanced economies, as seen, agglomeration forces in manufacturing have become weaker, giving an incentive to manufacturing firms to move out of cities to cheaper areas – "suburbanizing". But in less

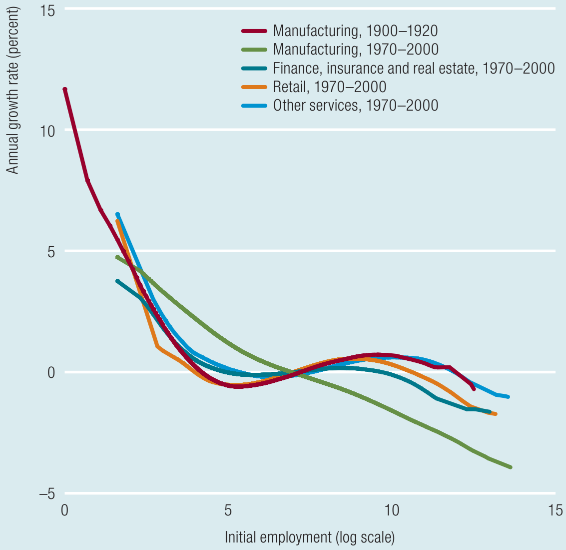
Box 2.2
The dynamo and the computer

The title of this box draws on the work of David (1990), which compared the many similarities between electricity and ICT. Electrification in the early 20th century spawned important productivity gains and innovation in manufacturing, whereas ICT in the late part of the century proportionately benefited services. As the incentive to geographically cluster is greater in highly innovative sectors, we would thus expect a tendency towards spatial concentration in manufacturing in the early 20th century and in services in the late 20th century.

And this is exactly what we do see. For the United States in 1900–1920 manufacturing's spatial growth pattern is almost identical to that of services in recent decades – and very different from that of manufacturing today (Desmet and Rossi-Hansberg 2009). Focusing on medium-size locations, the upward-sloping curve for manufacturing in 1900–1920 and for services in 1970–2000 suggests a tendency towards greater geographical concentration: larger locations grow faster than smaller locations (Box Figure 1). In more mature industries, such as manufacturing in 1970–2000, the incentive to cluster is much weaker. Thus we see spatial dispersion, as larger locations grow more slowly than smaller locations.

The US wholesale sector exhibits similar behaviour to that of manufacturing: it is becoming more dispersed. In contrast, retail and FIRE are becoming spatially more concentrated. In FIRE, a sector closely connected to ICT, the difference in employment between the county at the 70th percentile and that at the 30th increased from 38 percent in 1970 to 48 percent in 2000, indicating an increase in geographical concentration.

Box Figure 1
Employment growth in US counties by sector, selected periods



Source: Desmet and Rossi-Hansberg (2009) based on UVL (2004) and Bureau of Economic Analysis (2013).
Source: Industrial Development Report 2013 Team.

"If firms have an incentive to set up in cities, people follow. But sometimes jobs follow people

Table 2.5
Spatial concentration of employment in producer-related services in the United States, 1970 and 2000

	1970	2000
Log employment		
Difference 70th percentile–30th percentile		
Wholesale	1.59	1.51
Retail	1.25	1.60
Finance, insurance and real estate	1.38	1.48
Standard deviation		
Wholesale	1.78	1.65
Retail	1.40	1.59
Finance, insurance and real estate	1.40	1.52

Source: Bureau of Economic Analysis 2013.

developed economies this is less true, as they are not as far along in the process of structural change.

Suburbanizing manufacturing jobs in advanced economies

In the United States and other advanced economies manufacturing has been relocating to less expensive places, giving rise to geographical dispersion. This is related to manufacturing becoming a more mature activity, so that learning spillovers and agglomeration economies have become less important.

But it does not mean that manufacturing is moving to the "middle of nowhere". Data for United States counties for 1972–2000 suggest that manufacturing employment growth was slower in manufacturing clusters but higher in areas 40–50 kilometres away (Desmet and Fafchamps 2005). Manufacturing employment growth was also lower in areas with high employment in general (not just in manufacturing), and higher in areas 40–60 kilometres away. The finding that manufacturing firms are moving out of clusters but staying relatively close to them suggests that a cost of remoteness remains. One would expect this cost to be especially important for manufacturing subsectors that benefit most from knowledge spillovers.

And indeed, Fallah and Partridge (2012) find that remoteness is particularly costly in high-tech activities. Their results show that being close to high-density locations benefits employment growth in general, but more so for high-tech sectors. Arauzo-Carod and Viladecans-Marsal (2009) find similar results for Spain. In a study of new entrants over 1992–1996, they estimate that in high-tech manufacturing 47.3 percent of new entrants located in the central city. In contrast, in intermediate- and low-tech manufacturing a lower 31.9 percent and 30.2 percent did. The fact that remoteness remains costly, and more so for high-tech sectors, is consistent with the link between the age of an industry and its geographical concentration. For highly innovative young industries there are powerful reasons to cluster, as knowledge spillovers are an important driver of a firm's performance in those industries.

Geographical concentration of employment growth in developing countries

In advanced economies growth in innovative sectors is typically concentrated in medium–high-density locations. The evidence is more mixed for many developing countries. In some developing countries growth is concentrated in the largest, densest cities, while in others the picture is closer to that in the United States. Box 2.3 focuses on the world's largest two developing countries, India and China, and examines what is the case there.

Cities as centres of consumption – and learning

As shown above, the geographical distribution of employment is closely correlated with the geographical distribution of population. If firms have an incentive to set up in cities, people follow. But sometimes jobs follow people. Many people prefer living in an urban environment because they enjoy the consumption amenities these environments offer. Evidence from the United States shows that population growth has been increasingly concentrating in cities with good weather, proximity to water and a wide range of cultural services (Glaeser, Kolko and Saiz 2001). Fast-rising urbanization in many African countries, often in the absence of structural change, points in the same

> **People may move to cities as an investment in their future, regarding them as centres of learning that help them acquire knowledge**

Box 2.3

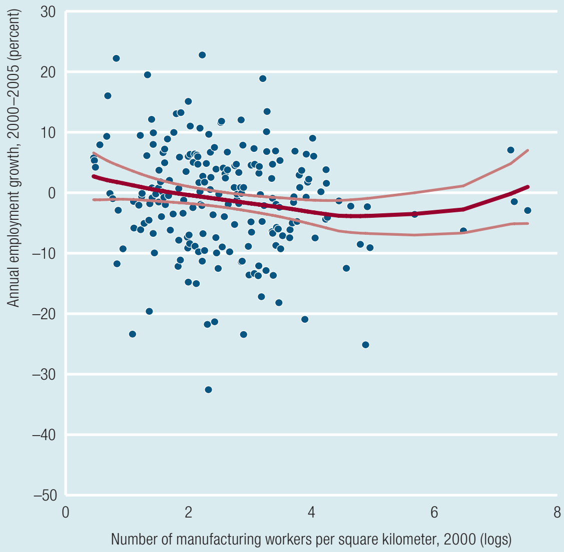
Manufacturing employment growth in India and China

For Indian districts, Box Figure 1 plots annual employment growth in manufacturing between 2000 and 2005 as a function of initial manufacturing employment density in 2000. Although there is much heterogeneity among districts, what stands out is that medium-density locations are predicted to grow less than high-density locations. Some of the densest districts, such as Kolkata, with a manufacturing employment density of more than 1,000 employees per square kilometre, continue to grow surprisingly fast. This picture differs from what we would expect, given the US experience when it went through its structural change out of agriculture.

India's experience cannot, however, be generalized to all developing countries. The corresponding chart for China (Box Figure 2) shows prefecture-level cities and likewise plots annual employment growth in manufacturing in 2000–2005 as a function of initial manufacturing employment in 2000. In contrast to India, the highest density cities grow somewhat more slowly than the medium-density cities, including Shanghai and Shantou. These findings are consistent with Au and Henderson (2006) who find that some of the larger prefecture-level cities are increasingly turning towards services.

What is striking is that when we compare China and India, agglomeration economies are strongest in China at an employment density of around 3.5 in log terms (about 30 employees per square kilometre), similar to the employment density for which agglomeration economies are weakest in India. In that sense manufacturing in China looks more like that in the United States in the early 20th century, but manufacturing in India looks very different. This suggests that certain barriers are preventing India's medium-density locations from growing faster – one may be poor access to infrastructure.

Box Figure 1
Manufacturing employment growth in India by district, 2000–2005



Source: Desmet et al. (2013), based on data from the National Sample Survey, the Labour Force Survey and the Annual Survey of Industries.

Box Figure 2
Manufacturing employment growth in China by city, 2000–2005

Source: Desmet et al. (2013), based on data from China Statistical Yearbooks.
Source: Industrial Development Report 2013 Team.

direction: cities are consumption centres as well as production centres. If people like to live in cities, firms will follow people, rather than the other way around.

People may also move to cities as an investment in their future, regarding them as centres of learning that help them acquire knowledge. It has long been known that people in large cities earn more than people in small cities. Those are the standard agglomeration economies: the high density of cities improves the productivity of firms, implying higher wages.

What is less known is that someone who spends some time in a large city and then moves to a small

> Despite the many problems associated with cities, such as congestion and pollution, there are powerful reasons for people to continue flocking to them

city also earns more than someone similar who did not spend time in a large city. This suggests that big cities allow workers to accumulate valuable experience and knowledge that they can take with them when they move away (Glaeser and Mare 2001). In principle this could simply be due to positive sorting: larger cities may attract workers who are already more productive in the first place.

De la Roca and Puga (2012), however, by following workers over their life time, control for such sorting and still find a positive effect of large cities on learning. In a study of Spain they show that someone who has spent 10 years working in Madrid (the country's largest city) and then moves to Santiago (the country's median city by size) continues to earn on average 13 percent more for the rest of their working life than someone who never left Santiago. A similar finding holds for someone who spends 10 years in Seville (one of the country's medium–large cities) rather than Madrid, and then moves to Santiago, although as expected the effect is smaller.

Whatever the reason – whether firms are looking for knowledge spillovers in dense urban environments, whether people are attracted by urban amenities, or whether workers go to large cities in search of experience and learning – urbanization is continuing, with more and more mega-cities appearing around the world.

Many policy-makers wonder whether these mega-cities are becoming too large, yet evidence from Au and Henderson (2006) and Desmet and Rossi-Hansberg (2013) point to the contrary. In China, for example, there may be further welfare gains from having more spatial concentration of economic activity in large cities. So, despite the many problems associated with cities, such as congestion and pollution, there are powerful reasons for people to continue flocking to them.

Notes

1. For datasets used see Chapter 1.
2. Looking at regional informal manufacturing employment data for 1995–2009, we can observe similar patterns for formal manufacturing employment, except in Industrialized Europe. While this region was characterized by a slight increase of formal manufacturing jobs over 1990–2010, the informal jobs decreased slightly over 1995–2009. Among the top three rankings of informal manufacturing employment, East Asia and the Pacific holds first position in 2009 with 59.8 million informal manufacturing jobs, followed by South and Central Asia with 56.7 million and Latin America and the Caribbean with 40.3 million.
3. Brazil almost doubled its formal manufacturing jobs over 1990–2010. This sharp rise could be a result of two subsequent reclassifications from ISIC Rev. 2 to ISIC Rev. 3 (1990–1995) and from ISIC Rev. 4 to ISIC Rev. 3 (2008–2010). Between 1996 and 2007 the employment figures were reported in ISIC Rev. 3. Further, the number of establishments reporting relevant figures rose from 6,094,000 in 1990 to 29,368,000 in 2010 establishments.
4. The thresholds are established based on the average backward linkage coefficient calculated using input-output techniques on the World Input-Output Database (Timmer 2012). The thresholds are the following: high-coefficients – higher than 0.1; medium – between 0.05 and 0.1; low – between 0.01 and 0.05; and very low – coefficients lower than 0.01.
5. In line with Shepherd and Stone (2013, p. 4), "the concept of GVCs is closely related to those of global production networks". The main difference is that the GVC concept is inherently non-linear, as it is based on complex network interactions.
6. Urbanization measures the share of the population living in urban areas. The positive correlation between non-agricultural employment and urbanization may be partly driven by the definition of urbanization, which in some countries is related to the relative absence of primary sector employment. For a complete definition of

urbanization in the different countries of the United Nations dataset, see UNDESA (2012).

7. 1 degree latitude is just around 111 kilometres; 1 degree longitude varies: it is close to 111 kilometres at the equator and 0 kilometre at the poles.
8. The data on the share of manufacturing and services in value added come from the World Development Indicators (World Bank 2013b). To maximize the number of countries, the data on the geographical dispersion of GDP are for 1990 and the data on value added for 2000, but because the geographical dispersion changes only gradually, the results are unlikely to be affected significantly.

Chapter 3
Structural change in manufacturing

Building on the discussion of the overall economic structural change in the previous chapters, this chapter illustrates structural change within manufacturing in detail. It shows that at relatively low incomes manufacturing value added, productivity and employment tend to grow fast. Then, as countries achieve higher incomes, manufacturing employment slows because its major sources (labour-intensive, low-tech industries) start curtailing employment. This slowdown and eventual decline in employment usually occur while manufacturing value added and productivity keeps increasing.

At an advanced stage of industrialization, industries with a higher technological level grow faster than others, and some of them could sustain their fast growth of value added even at very high GDP per capita. But such industries with high growth potential are usually more capital and technology intensive, and in terms of employment each one of those industries will create a fraction of the jobs of a labour-intensive industry. Unlike value added, most manufacturing industries start reducing employment before the economy reaches $25,000 GDP per capita (at 2005 purchasing power parity dollars).

Still, as countries develop, manufacturing's potential to create employment in manufacturing-related services increases. Thus even in industrialized countries, manufacturing makes a bigger contribution to employment than the direct manufacturing statistics might indicate. Most of those service jobs pay wages comparable to those in manufacturing.

Although this relationship between income and manufacturing structure has some elements of universality since countries more or less follow a similar path of structural change as income rises, comparable to structural change for the whole economy (Chapter 1), country-specific conditions are important: geographical and demographic conditions give countries natural advantages or disadvantages in developing certain industries (Katz 2000). There is also space for countries to shape the structure autonomously, which is why history, culture and policy also matter to a country's development (Lin and Chang 2009).

Three labour-intensive industries – wearing apparel, textiles, and food and beverages – are particularly important for industrialization to take off. They create a large number of formal, better paid jobs in manufacturing, absorbing the unemployed and underemployed rural workforce from less productive activities. Later, the manufacturing structure needs to be continually upgraded, and if that is successful, entry into more technology- and knowledge-intensive industries could both compensate for the decline in jobs in labour-intensive industries and enhance the quality of manufacturing jobs. Medium-tech industries perform a bridging role for industrialization: although their employment generation capacity is not as large as labour-intensive industries, they are crucial for generating investment goods and funds for further industrial upgrading. While each higher tech industry does not usually create as many jobs as a labour-intensive one, the successful development of the multiple higher tech industries could enhance the skills, technology and knowledge base of a country's manufacturing sector, leading to higher manufacturing productivity and wages.

Manufacturing development in low- and middle-income countries could also improve women's social and economic status as labour-intensive manufacturing industries often employ more female than male workers. But their continuing concentration in these industries works against the sustained gains in women's economic welfare when manufacturing becomes more technology intensive.

Manufacturing, structural change and economic development: selected country experiences

Shifts in manufacturing and economic growth

Four country examples illustrate the relationship between the changes in manufacturing structure

> **The speed of exploiting the advantage in existing industries and laying the foundation for emerging industries through investment becomes key for fast economic growth**

and economic development. The value added and employment data are available at the manufacturing subsector level for 1963 and 1998 for four countries from different regions – Colombia, Hungary, Kenya and the Republic of Korea. In 1963 the GDP per capita of Kenya and the Republic of Korea were about the same and the lowest among the four. Hungary and Colombia had 3.7 times and 1.7 times higher GDP per capita than the other two, respectively.

After 35 years the country that changed its structure the most also increased its GDP per capita the most: the Republic of Korea completely transformed its manufacturing structure from low- to high-tech industries and increased GDP per capita eight times, transforming itself from one of the poorest to the richest of the four (Figure 3.1). Over the same period Kenya did not change its manufacturing structure much – nor its GDP per capita.

Hungary already had fairly high value-added shares in low/medium and high-tech industries as well as a high GDP per capita in 1963 (see Figure 3.1). Over the 35 years it further increased the share of higher tech industries but not to the same degree as the Republic of Korea, and experienced a slower increase in GDP per capita. Finally, Colombia increased the shares of some medium-tech industries and chemicals but not the shares of other high-tech industries, and it only doubled its GDP per capita.

While country-specific conditions might make a difference as to which industries within different technology groups develop more than others, such differences do not seem to override the relationship between the shift in the overall manufacturing structure and economic development.

The speed of development

If the transformation of the manufacturing structure has a strong association with a country's economic development, the speed of exploiting the advantage in existing industries and laying the foundation for emerging industries through investment becomes key for fast economic growth. To illustrate, Figure 3.2 shows the estimated development patterns of industries in value added per capita (food and beverages, wearing apparel, basic metals, and electrical machinery and apparatus) and the actual development paths of the Republic of Korea, Malaysia and Sri Lanka (Box 3.1).

The three countries have advantages in different industries that reflect their stage of development. Sri Lanka's is in relatively labour-intensive industries, such as food and beverages and wearing apparel, and thus rapid growth in these industries is foreseen. Malaysia has already lost its advantage in these industries, but can still expect continuing growth for some time in basic metals as well as long-term growth in electrical machinery and apparatus. The Republic of Korea has already lost, or is about to lose, its advantage in basic metals, but should keep its advantage in electrical machinery and apparatus for the foreseeable future.

Despite similar development trajectories, the speeds at which these three countries have exploited their advantages – and thus increased their income and, possibly, shifted their advantage from one industry to another – differ (Table 3.1). All four industries developed much faster in the Republic of Korea than in Malaysia even during a similar stage of economic development: in wearing apparel around 20 times faster, and in basic metals and in electrical machinery and apparatus about 10 times faster. Sri Lanka's industries lagged behind Malaysia's, apart from wearing apparel.

Productivity increases are crucial in accelerating development. The higher the growth of labour productivity, the faster a country moves along the development trajectories (Haraguchi 2012; Annex 1). Productivity growth is especially important in explaining the speed of transformation of high-tech industries; productivity and other factors, such as wages, may be associated with the growth of low-tech industries (Chapter 4).

The Republic of Korea has experienced a fast manufacturing transformation in pursuit of raising

The higher the growth of labour productivity, the faster a country moves along the development trajectories

Figure 3.1
Changes in value added by manufacturing industry, selected countries, 1963 and 1998

Note: The names of the low-, medium- and high-tech industries are in red, green and blue, respectively. Constant GDP per capita, PPP, in 1963 and 1998, respectively: Republic of Korea $1,940 and $15,586; Kenya: $1,835 and $1,918; Hungary: $7,030 (estimated) and $11,826; and Colombia: $3,323 and $6,837.
Source: UNIDO estimate based on CIC (2009) and UNIDO (2012a).

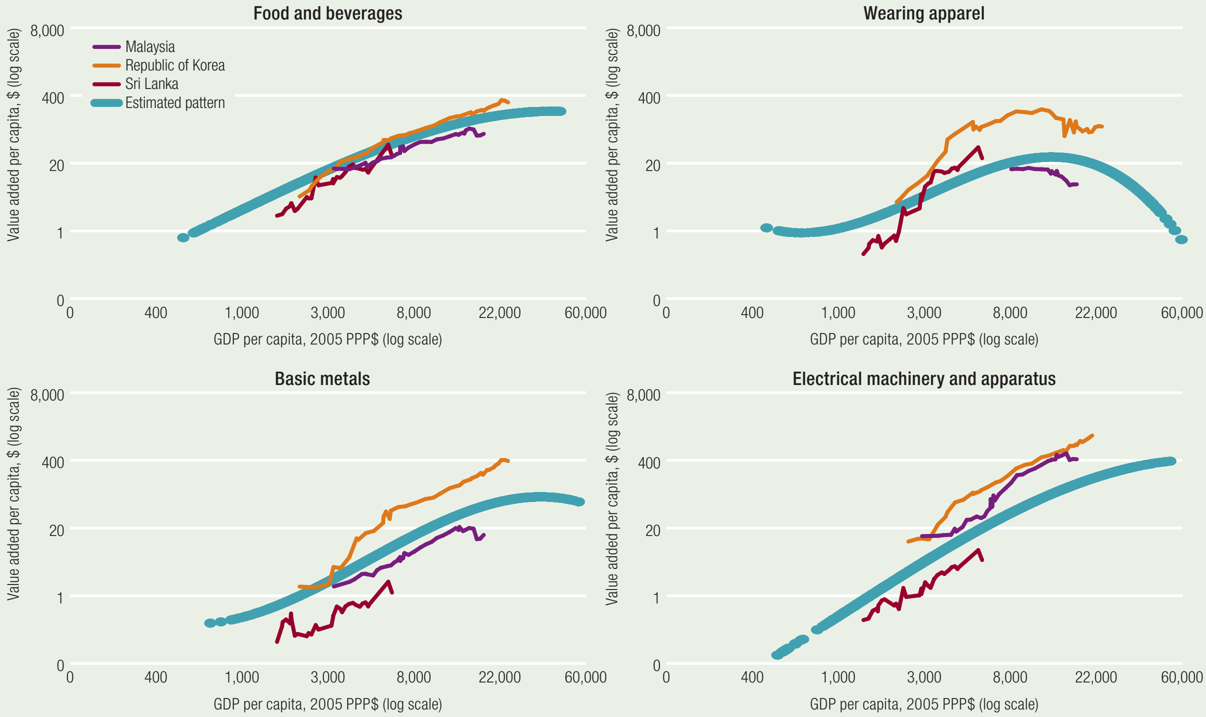
living standards, and was much – perhaps two or three times – faster than the advanced countries that preceded it (Box 3.2). Stagnant countries, conversely, may stay with the same structure and income for decades.

Patterns of structural change and employment generation within manufacturing

Given the important relationship between manufacturing structural transformation and economic

Of three main factors shaping manufacturing development – a country's stage of development, its given geographical and demographic conditions and its autonomously created conditions – the first usually has the strongest influence

Figure 3.2
Changes in per capita value-added by income and manufacturing industry, the Republic of Korea, Malaysia and Sri Lanka, 1963–2007



Note: Data and estimation method are explained in Box 3.3.
Source: UNIDO estimate based on CIC (2009) and UNIDO (2012a).

Box 3.1
The choice of three countries

The Republic of Korea, Malaysia and Sri Lanka were selected because all three belong to the same group of large countries and have relatively long time-series data, allowing us to investigate their development trajectories. They also have an overlapping range of GDP per capita, letting us compare average annual growth of per capita value added at similar development stages.

Source: Industrial Development Report 2013 Team.

Table 3.1
Speed of manufacturing development, the Republic of Korea, Malaysia and Sri Lanka

Industry	Korea, Rep. of	Malaysia	Sri Lanka
Food and beverages	4.74	1.46	0.64
Wearing apparel	13.37	0.66	1.43
Basic metals	3.62	0.38	0.03
Electrical machinery and apparatus	7.53	0.78	0.10

Note: The speed is expressed as an increase in value added per capita over the range of GDP per capita, PPP, from $3,000 to $4,500 divided by the number of years taken. This range was selected because the countries overlap in this range in UNIDO (2012a).
Source: UNIDO estimate based on CIC (2009) and UNIDO (2012a).

development indicated by the above four country experiences, this subsection presents the general patterns of manufacturing development and structural transformation. Of three main factors shaping manufacturing development – a country's stage of development (proxied by income), its given geographical and demographic conditions and its autonomously created conditions – the first usually has the strongest influence. Thus in this subsection we discuss general patterns of this development based on income to see how industries evolve and how manufacturing's structure changes as a country develops. Then in the next

Sustained economic growth entails structural change at a disaggregated level within manufacturing through technological upgrading and diversification, and then possibly specialization later

Box 3.2
Speed of manufacturing transformation

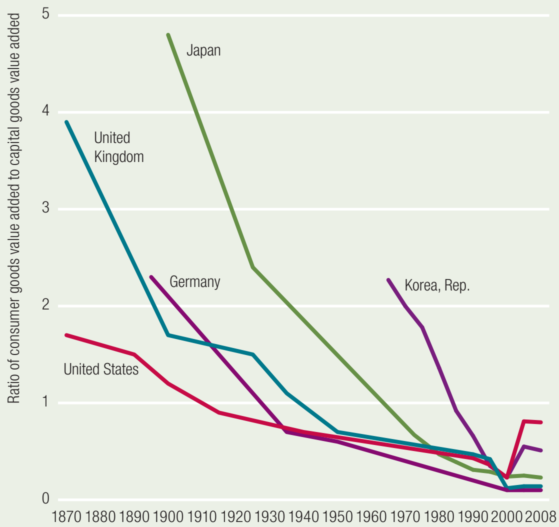
Hoffmann (1958) identified the periods in which various countries reached different stages of industrialization based on the ratio of value added of consumer-goods industries (food, drink and tobacco, clothing including footwear, leather goods and furniture) to capital-goods industries (ferrous and non-ferrous metals, machinery, vehicle building and chemicals). His study showed a gradual but steady decline of the ratio in the United Kingdom and the United States and a faster decline of the ratio in Germany and Japan as industrialization progressed.

The study went up only to 1960 and so did not include the Republic of Korea. To put that case in historical perspective and compare it with past industrialization patterns, the same ratio was calculated for the country (Box Figure 1) alongside Hoffmann's results.

The Republic of Korea transformed its manufacturing structure much faster than early industrialized countries, as seen in its steeper downward slope. It took around 40 years for the United Kingdom and 30 years for Germany and Japan to reduce the ratio from two to one, but the Republic of Korea only 15. The country has had the fastest structural change of manufacturing among countries with time-series data in the last 50 years.

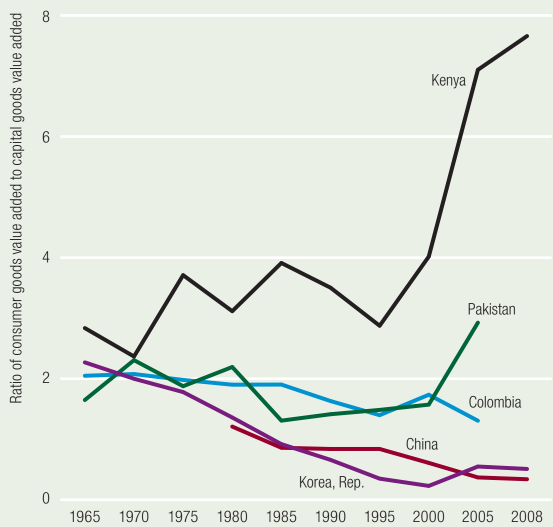
Other countries vary (Box Figure 2). China seems to match the Republic of Korea while others have industrialized slowly, seen little structural change and increased the weight of consumer-goods industries rather than industrial-goods industries.

Box Figure 1
Long-term speeds of manufacturing transformation, selected countries, 1870–2008



Source: UNIDO estimate based on Hoffmann (1958) and UNIDO (2012a).

Box Figure 2
Recent speeds of manufacturing transformation, selected countries, 1965–2008



Source: UNIDO estimate based on UNIDO (2012a).

Source: Industrial Development Report 2013 team based on Hoffmann (1958) and UNIDO (2012a).

subsection we use these general patterns to assess the effects of a country's specific conditions.[1]

Development of manufacturing industries with different technology levels

Sustained economic growth entails structural change at a disaggregated level within manufacturing through technological upgrading and diversification, and then possibly specialization later (Imbs and Wacziarg 2003). Based on three technology groups in manufacturing industries, countries generally have a high share of low-tech industries at low incomes (Table 3.2). As countries increase their GDP per capita, that share rapidly declines while the shares of medium-tech

> **As countries increase their GDP per capita, the share of low-tech industries at low incomes rapidly declines while the shares of medium-tech and high-tech groups increase**

Table 3.2
Classification of manufacturing industries by technology group

International Standard Industrial Classification full description	Abbreviation used in this report	International Standard Industrial Classification code Revision 3	Technology group
Food and beverages	Food and beverages	15	Low tech
Tobacco products	Tobacco	16	Low tech
Textiles	Textiles	17	Low tech
Wearing apparel, fur, leather products and footwear	Wearing apparel	18 and 19	Low tech
Wood products (excluding furniture)	Wood products	20	Low tech
Paper and paper products	Paper	21	Low tech
Printing and publishing	Printing and publishing	22	Low tech
Furniture; manufacturing, not elsewhere classified	Furniture, not elsewhere classified	36	Low tech
Coke, refined petroleum products and nuclear fuel	Coke and refined petroleum	23	Medium tech
Rubber and plastic products	Rubber and plastic	25	Medium tech
Non-metallic mineral products	Non-metallic minerals	26	Medium tech
Basic metals	Basic metals	27	Medium tech
Fabricated metal products	Fabricated metals	28	Medium tech
Chemicals and chemical products	Chemicals	24	High tech
Machinery and equipment, not elsewhere classified; office, accounting and computing machinery	Machinery and equipment	29 and 30	High tech
Electrical machinery and apparatus; radio, television and communication equipment	Electrical machinery and apparatus	31 and 32	High tech
Medical, precision and optical instruments	Precision instruments	33	High tech
Motor vehicles, trailers, semi-trailers and other transport equipment	Motor vehicles	34 and 35	High tech

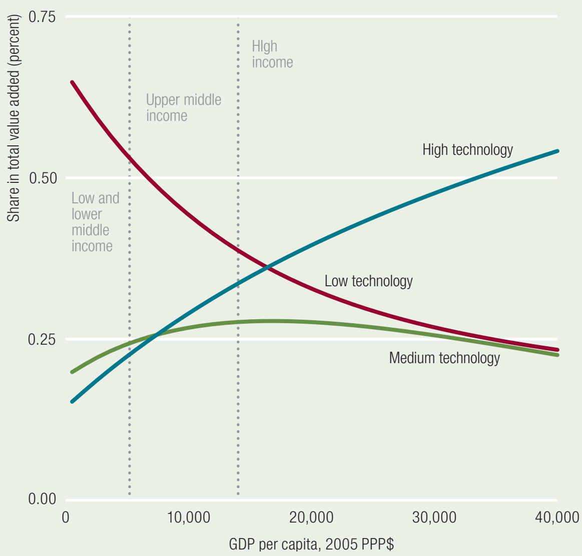
Note: Shaded rows represent the manufacturing industries analysed. The three groups follow the technology classification of the Organisation for Economic Co-operation and Development (OECD) based on research and development (R&D) intensity relative to value added and gross production statistics. The OECD classifies manufacturing industries into four categories of high-tech, medium-high-tech, medium-low-tech and low-tech industries. In this report high-tech and medium-high-tech industries are combined and called high-tech industries, and medium-low-tech industry is called medium-tech industry. The classification reflects the average R&D intensity of industries, so there might be products of different R&D intensity in each technology category.
Source: UNIDO estimate based on UNIDO (2012a).

(mostly capital-intensive, resource-processing industry) and high-tech (mostly capital- and technology-intensive industry) groups increase (Figure 3.3). Although the medium-tech industries have a higher value-added share than high-tech industries at low income, the share of the former increases only slowly and hits the peak before reaching $20,000 GDP per capita. Then, only high-tech industries increase the value-added share at the expense of the shares of low- and medium-tech industries.

To investigate the details of manufacturing development underlying the above structural change, the following analysis looks at the changes in the levels of the development of 10 out of 18 manufacturing industries at the two-digit level of International Standard Industrial Classification Revision 3 (Box 3.3). For this analysis, value added per capita and employment–population ratio are used because, unlike shares, they are not influenced by the ups and downs of other industries and so are better able to expose industrial characteristics (such as growth rates).[2] The 10 industries are representative of manufacturing as a whole, comprising industries of different technological content and stages of development. The 10 industries usually account for more than 75 percent of value added and employment in manufacturing. They include three low-tech, three medium-tech and four high-tech industries with different degrees of labour intensity (Annex 2).

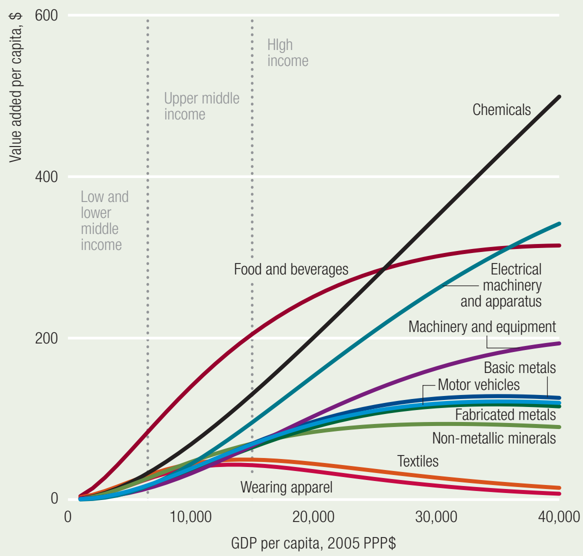
“Manufacturing employment does not show continuous growth: it displays a rapid surge at low and lower middle incomes, but at high incomes no manufacturing industries are likely to sustain employment growth

Figure 3.3
Changes in the shares in manufacturing value added by income and technology group, 1963–2007



Source: UNIDO estimate based on CIC (2009) and UNIDO (2012a).

Figure 3.4
Changes in value added per capita by income and manufacturing industry, 1963–2007



Note: Pooled data for 74 countries.
Source: UNIDO estimate based on CIC (2009) and UNIDO (2012a).

The following estimated patterns show how manufacturing industries with different levels of technology emerge as countries’ GDP per capita increases. The patterns for value added and for manufacturing employment differ (Figures 3.4 and 3.5). For value added, many manufacturing industries continue to grow at high incomes, and some accelerate their growth. But manufacturing employment does not show continuous growth: it displays a rapid surge at low and lower middle incomes, but at high incomes no manufacturing industries are likely to sustain employment growth.

Box 3.3
A note on data

Manufacturing

Most figures in this chapter have been produced based on the UNIDO Industry Statistics Database at the International Standard Industrial Classification (ISIC) Revision 3 for the estimations of manufacturing development patterns (UNIDO 2012a). The dataset has unbalanced data on employment and value added for 23 manufacturing industries at the ISIC two-digit level for 1963–2007.

The 23 industries were consolidated into 18 industries because many countries reported some of the industries together – often grouping ISIC 18 and 19; 29 and 30; 31 and 32; and 34 and 35. To make the structural change analysis consistent and reliable, these pairs were combined and indicated by the first industry of each pair (such as 18 for the combined 18 and 19) for the combined industry throughout this chapter.

The maximum number of 74 countries for value added and 95 countries for employment are included for the estimations. The Index of Industrial Production is used to approximate real value added per capita, and fixed effects are applied to the regression analysis.

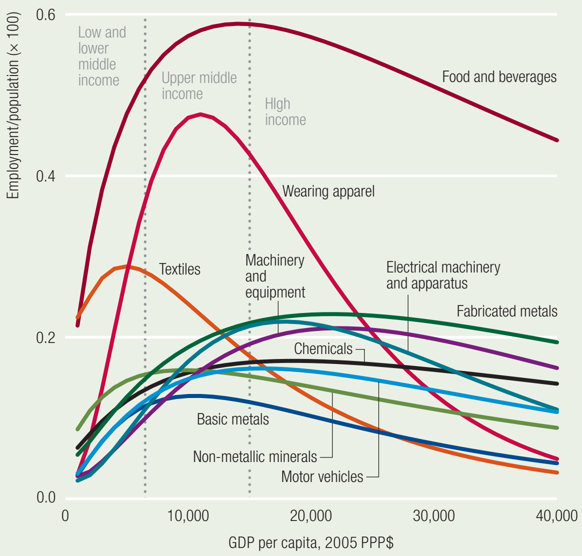
Income groups

The income levels that divide countries into low and lower middle, upper middle and high income are based on the definition in Chapter 1.

Source: Industrial Development Report 2013 Team.

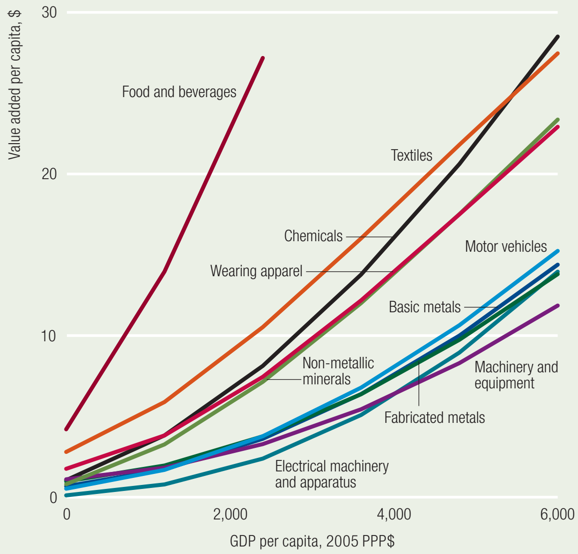
> **Among the labour-intensive, low-tech industries, the food and beverage industry is the only one that sustains value-added growth as countries develop to upper middle and high incomes**

Figure 3.5
Changes in employment by income and manufacturing industry, 1963–2007



Note: Pooled data for 95 countries.
Source: UNIDO estimate based on CIC (2009) and UNIDO (2012a).

Figure 3.6
Changes in value added per capita by income, low- and lower middle-income countries, 1963–2007



Note: Pooled data for 74 countries.
Source: UNIDO estimate based on UNIDO (2012a).

Within these general patterns, different industries have distinct patterns of development owing to differences in technological level and speed of technological change. The following discussion looks at three groups of industries classified by broad technology characteristics: labour-intensive, low-tech industries; medium-tech industries; and high-tech industries.

Labour-intensive, low-tech industries

Among the 10 industries selected, food and beverages, textiles, and wearing apparel belong to this category.[3] These three industries, relating to humans' basic necessities, are distinguished by their higher levels of value added at relatively low incomes, as seen in Figure 3.6 (which magnifies the development patterns at low and lower middle incomes in Figure 3.4). Due to their labour-intensive production processes, as they develop, these industries also employ much more labour than other industries, contributing to the creation of formal manufacturing jobs with decent wages in often mainly agrarian economies (see Figure 3.5).

Among the labour-intensive, low-tech industries, the food and beverage industry is the only one that sustains value-added growth as countries develop to upper middle and high incomes (see Figure 3.4), attributable to the industry's relatively higher labour productivity growth and longer growth of employment, which are expressed in elasticity (Box 3.4).

Box 3.4
A note on income elasticities of value added per capita, employment–population ratio and labour productivity

The income elasticity describes the effect of a change in income on the three variables of industry, given a percentage change in income *Y*:

$$\frac{\text{% change value added per capita } i\text{, employment–population ratio } l\text{, or labour productivity } i}{\text{% change in } Y}$$

An elasticity of greater than 1 indicates growth faster than GDP per capita growth while less than 0 indicates decline.

Source: Industrial Development Report 2013 Team.

Labour-intensive industries seem to be crucial in sustaining employment at low incomes and are the main reason for manufacturing's overall role in employment generation at early stages of structural change

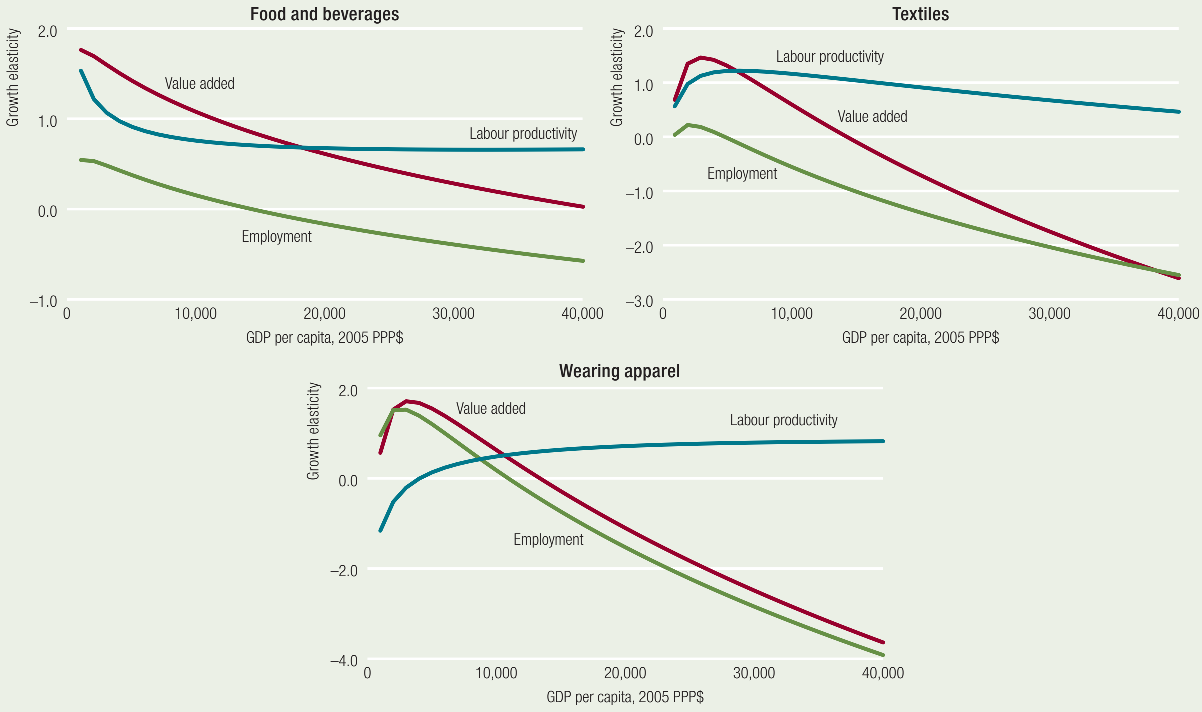
The food and beverage industry retains a decent level of labour productivity growth and shows a slower decline in employment than textiles and wearing apparel, helping maintain high value added and employment across all incomes (Figure 3.7).

Textiles and wearing apparel both reduce value added and employment as countries move into upper middle and high incomes, but the industries differ in their ability to substitute capital for labour. The textile industry can prolong the growth of value added after it starts reducing employment due to its greater ability to substitute capital for labour, as seen in a higher elasticity of labour productivity than in wearing apparel (see Figure 3.7). In contrast, low-wage labour is the key factor input for production in wearing apparel, where the growth rates of employment and value added decline almost in parallel, indicating limited room for the industry to substitute capital for labour. This characteristic implies that once countries lose the labour-cost advantage, they tend to lose competitiveness in wearing apparel quite fast, though labour costs are not always the sole determinant of cost competitiveness (see Box 4.1 in Chapter 4).

Labour-intensive industries thus seem to be crucial in sustaining employment at low incomes and are the main reason for manufacturing's overall role in employment generation at early stages of structural change. As the population begins shifting from agriculture, setting up labour-intensive industries may be the only option to absorb productively the many people seeking jobs. There are also opportunities for capital accumulation, and these are largely restricted to food and beverages and to textiles.

Labour-intensive, low-tech industries provide significant opportunities for entry in low- and lower middle-income countries. African economies, as well as some Asian economies, can use these industries as a stepping stone towards industrialization. In addition

Figure 3.7
Growth elasticities of value added, employment and labour productivity by income, low-tech industries, 1963–2007



Source: UNIDO estimate based on CIC (2009) and UNIDO (2012a).

> **Medium-tech industries share some common development patterns in emerging economies as prominent manufacturing industries during the upper middle-income development stage, but show slower growth than high-tech industries at high incomes**

to being attractive thanks to their capacity to generate employment and productivity, these industries exhibit low barriers to entry and initially cater to local tastes. Low-tech industries do not require huge capital outlays, and factories can be set up with workers who have fairly low skills. Local markets play a key role at the early stage of development, resulting in low information and learning costs. While some of these industries are highly competitive, particularly textiles and garments, new producers in lower income developing countries can benefit from continuous changes in international market conditions, particularly cost conditions, and thus at least can temporarily attract investment to their shores.

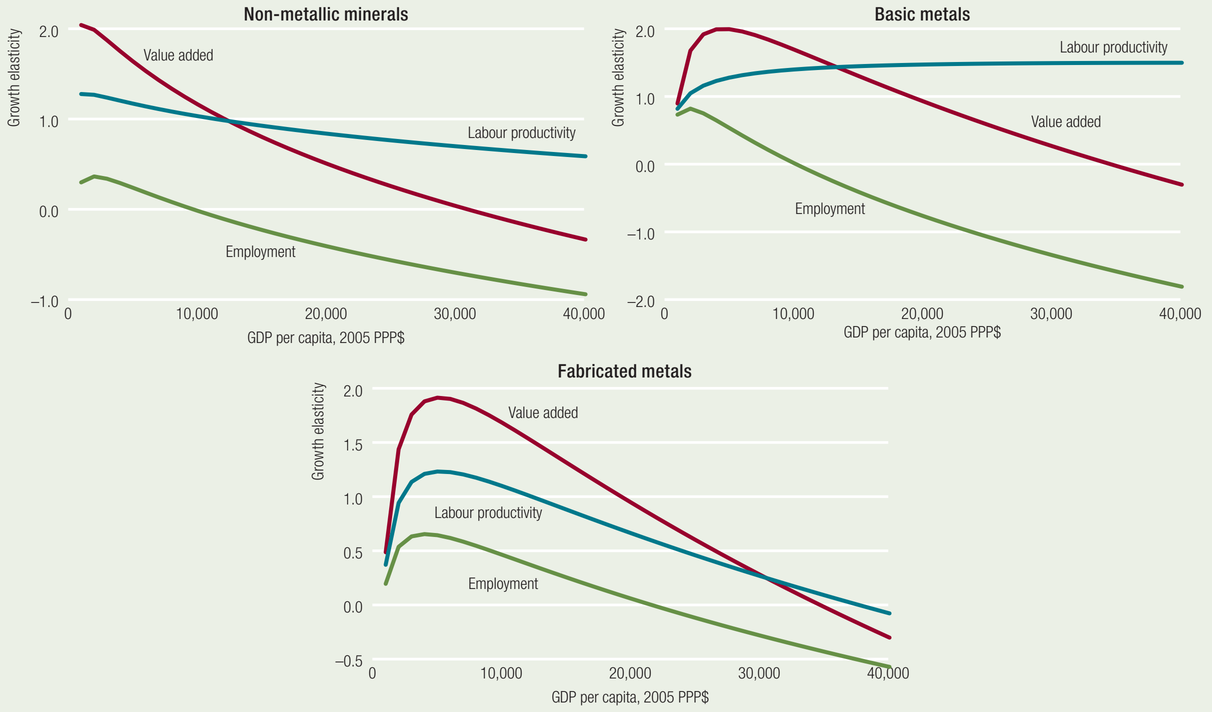
Medium-tech industries

Medium-tech industries share some common development patterns in emerging economies as prominent manufacturing industries during the upper middle-income development stage, but show slower growth than high-tech industries at high incomes. Non-metallic minerals, basic metals and fabricated metals fall into this category (see Table 3.2).

The non-metallic mineral industry is driven largely by domestic demand, producing bricks, cement and glass mainly for construction. The industry, like labour-intensive, low-tech industries, develops at quite low incomes. But the industry can sustain value-added growth longer than the textile and wearing apparel industries due to its slower decline in employment growth while keeping similar or higher labour productivity than these low-tech industries (Figure 3.8).

Basic metals and fabricated metals have a similar development pattern in value added per capita, but the relationships between the rates of growth of labour productivity and employment, which underlie the changes in their per capita value added, differ markedly between them (see Figure 3.4). Basic metals tend

Figure 3.8
Growth elasticities of value added, employment and labour productivity by income, medium-tech industries, 1963–2007



Source: UNIDO estimate based on CIC (2009) and UNIDO (2012a).

> **High-tech industries emerge at a fairly late stage of development and make a major contribution to manufacturing value added, usually after countries reach an upper middle-income level**

to see a fairly rapid decline in employment growth, but the rapid increase in labour productivity helps sustain the growth of value added (see Figure 3.8). The fabricated metal industry decreases both the rate of labour productivity and the employment growth rate, but the slower decline of the latter prolongs the growth of industry's value added (see Figure 3.8).

Thus, while both industries produce metals, the basic metal industry as it develops employs a much more capital-intensive production process, which leads to higher labour productivity. The fabricated metal industry seems to be located further downstream in the production value chain linking material and product producers, which involves more customization and less-automated production processes.

Medium-tech industries offer investment potential for middle- and upper middle-income developing countries. Although they do not generate significant employment, they are high-productivity industries and can generate resources for investment. Further, their products include steel, bricks, cement, boilers, metallic structures, hand tools and plastics, most of which are intermediate goods in high demand by more advanced industries. Global markets for industrial inputs are growing fast, underpinned by the demand of emerging industrial powerhouses in East Asia, so these industries can also become important sources of foreign exchange.

High-tech industries

Chemical products, machinery and equipment, electrical machinery and apparatus, and motor vehicles are classified as high-tech industries.[4] Except for chemical products, they emerge at a fairly late stage of development and make a major contribution to manufacturing value added, usually after countries reach an upper middle-income level. Their contribution to manufacturing value added is much more significant than it is to manufacturing employment because any of these high-tech industries are unlikely to reach the peak employment level of the three above labour-intensive industries – food and beverages, textiles and wearing apparel. Chemicals, machinery and equipment, and electrical machinery and apparatus are often the only ones that can sustain growth faster than GDP per capita growth at high incomes.

These three industries have fast growth of value added (elasticity greater than 1) over a wide range of incomes, mainly due to their rapid increase in labour productivity growth from upper middle incomes (Figure 3.9). Electrical machinery and apparatus and to a lesser extent machinery and equipment seem to undergo considerable technological change. These industries have an extensive expansion stage at lower middle-incomes, where increasing their employment growth rates is the key contributing factor to their value added growth. Then, from the upper middle-income stage, development is based more on rising labour productivity, which sustains the fast growth of value added during the slowdown of employment growth (and later even a reduction of the labour force).

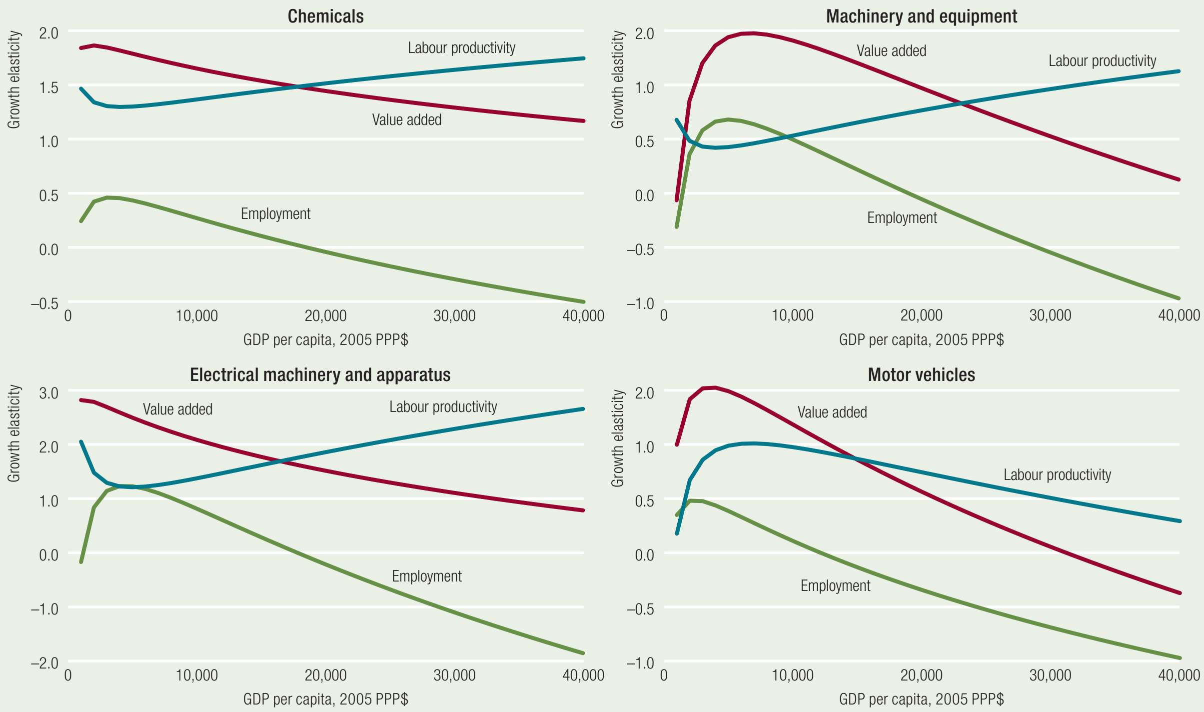
The chemicals industry seems to share the characteristics of domestic-oriented industries, such as food and beverages, non-metallic minerals, machinery and equipment, and electrical machinery and apparatus. Although it belongs to the high-tech group, it often emerges at an earlier stage of a country's development due to demand for soap and basic chemical products such as colouring matters and tanning agents. Further, like the two domestic-oriented industries, it reduces its level of employment very slowly after reaching the peak. But at high incomes chemicals can increase value added rapidly through fast growth of labour productivity, similar to machinery and equipment and to electrical machinery and apparatus. These mixed characteristics of the chemical industry seem to reflect the fact that it includes the production of a broad range of products with diverse technological content.

Finally, the motor vehicle industry is one of a few industries that show markedly different patterns of development between large and small countries (see Figure 3.9). For this reason the development characteristics of the industry are introduced in the subsection *Country size* below, which discusses the impact of that variable on manufacturing development.

❝ Employment growth takes place over a narrower range of income in all manufacturing industries compared with value-added growth

Figure 3.9

Growth elasticities of value added, employment and labour productivity by income, high-tech industries, 1963–2007



Source: UNIDO estimate based on CIC (2009) and UNIDO (2012a).

High-tech industries perform a less important role in sustaining employment at higher incomes, as they only partly compensate for job losses in labour-intensive industries. But they are critical for capital accumulation, skill development and improving the knowledge base of countries – and thus for improving productivity and, as will be seen, wages.

Changing elasticities of value added and employment

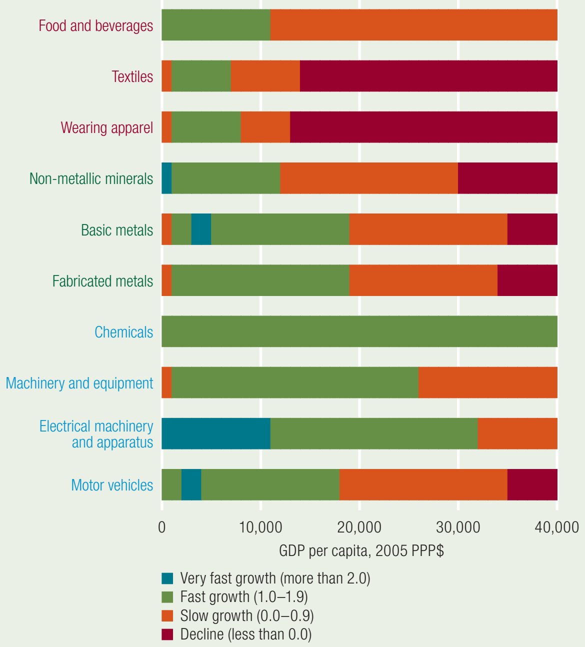
This subsection compares changes in the elasticities of value added and employment as real GDP per capita increases across industries (Figures 3.10 and 3.11). As in the development patterns of low-tech industries, economies generally experience fast growth of value added before reaching a high income. Among the three low-tech industries here, only food and beverages sustain growth over a long period, though it falls slowly. In contrast, the value added of textiles and wearing apparel declines relatively soon after the end of their fast-growth periods, and faster than in other industries.

Medium-tech industries maintain fast growth over a wider income range than low-tech industries. They also have a longer slow-growth range before decline (shown in orange in Figure 3.10), indicating that their growth rates decrease much more gradually than those of textiles and wearing apparel. Among the three technology groups, high-tech industries grow fast over the longest income range. Chemicals especially, as well as machinery and equipment, and electrical machinery and apparatus, sustain their growth up to very high incomes, and are unlikely to experience a decline of value added before reaching $40,000 GDP per capita.

Employment growth takes place over a narrower range of income in all manufacturing industries compared with value-added growth (see Figure 3.11). Industries that start with a relatively high level of

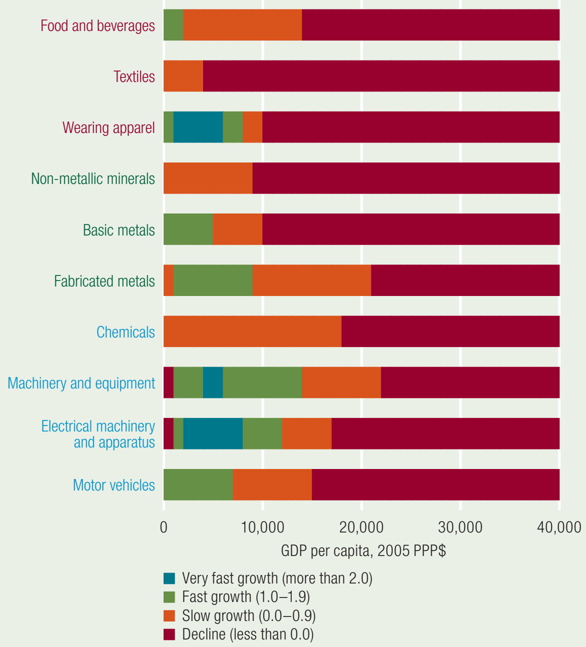
Food and beverages and textiles are the two major industries for both employment and value added at low incomes. The trajectories of the two industries diverge, however, as countries industrialize

Figure 3.10
Changes in growth rates of value added by income and manufacturing industry, 1963–2007



Note: The numbers in the legend indicate elasticity. The names of the low-, medium- and high-tech industries are in red, green and blue, respectively.
Source: UNIDO estimate based on CIC (2009) and UNIDO (2012a).

Figure 3.11
Changes in growth rates of employment by income and manufacturing industry, 1963–2007



Note: The numbers in the legend indicate elasticity. The names of the low-, medium- and high-tech industries are in red, green and blue, respectively.
Source: UNIDO estimate based on CIC (2009) and UNIDO (2012a).

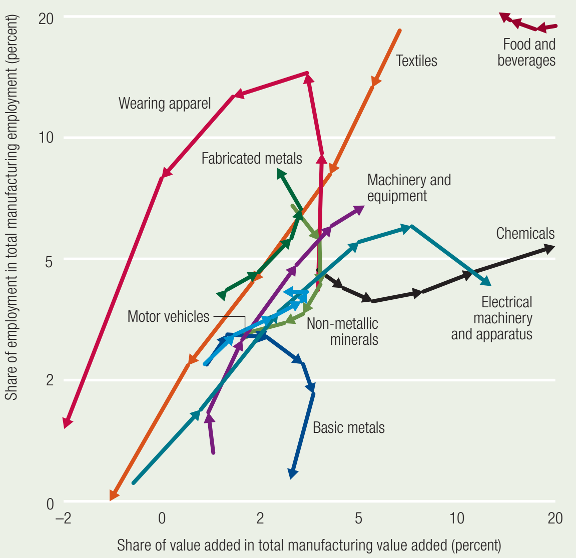
employment, such as food and beverages, textiles, non-metallic minerals and chemicals, see little fast growth in employment as they develop. At low incomes, wearing apparel can increase employment significantly, but once growth starts slowing, it does so sharply and starts declining within a short income range. Some high-tech industries, such as machinery and equipment and electrical machinery and apparatus, can continue fast employment growth after reaching an upper middle income, but they also slow their employment growth significantly, usually before hitting $15,000 GDP per capita, and nearly all manufacturing industries reduce their levels of employment at very high incomes of above $25,000 GDP per capita.

Figure 3.12 illustrates manufacturing structural change by showing how the shares of employment and value added in the manufacturing total for each industry change as country incomes rise. Food and beverages and textiles are the two major industries for both employment and value added at low incomes. The trajectories of the two industries diverge, however, as countries industrialize. Although textiles reduce both the value added and employment shares continuously (as seen in the movement of arrows towards the bottom left corner), food and beverages increase the share of employment at higher incomes after an initial decline, though the value-added share keeps declining. This U shape for food and beverages is mainly due to the rapid decline and then increase in the employment share.

For long-term manufacturing development, key industries for value added, besides food and beverages, are machinery and equipment, chemicals, and electrical machinery and apparatus – and for employment, machinery and equipment, fabricated metals, and rubber and plastic. Machinery and equipment similarly increases both value-added and employment shares as countries develop, reflected by its 45-degree line.

Medium-tech industries generate a higher proportion of manufacturing-related services jobs relative to manufacturing jobs

Figure 3.12
Changes in value added and shares in employment by income and manufacturing industry, 1963–2007



Source: UNIDO estimate based on UNIDO (2012a).

Employment in manufacturing-related services

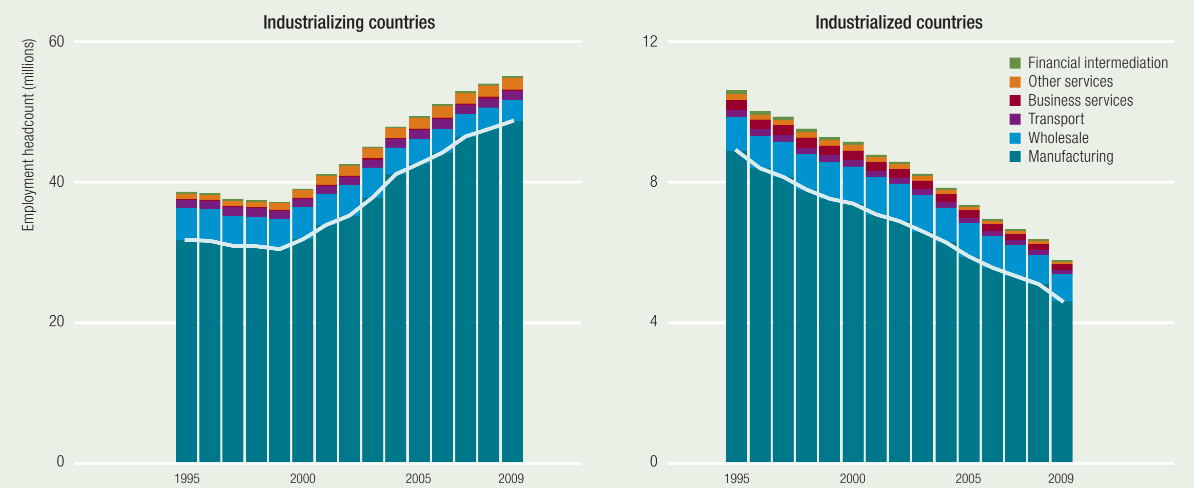
The development impact of manufacturing is not confined to value added and employment within the sector. This subsection examines how different service industries depend on the demands of manufacturing industries, and how these relationships change as countries develop.[5]

Labour-intensive, low-tech industries such as textiles and wearing apparel generate a large number of jobs in countries at low incomes, but such employment generates fewer related services jobs (Figure 3.13). In industrialized countries textiles and wearing apparel are steadily cutting manufacturing and related services employment.

Although medium- and high-tech industries do not generate as many jobs as low-tech industries, their contributions to creating related services jobs are much higher. Figure 3.14 shows that medium-tech industries such as non-metallic minerals and basic and fabricated metals generate a higher proportion of manufacturing-related services jobs relative to manufacturing jobs. Increases in manufacturing-related services employment often compensate (or more than compensate) for the reduction in manufacturing jobs.

Countries at high incomes could sustain fast growth of some high-tech industries, such as chemicals and motor vehicles (for large countries; Figure 3.15). These industries also make significant contributions

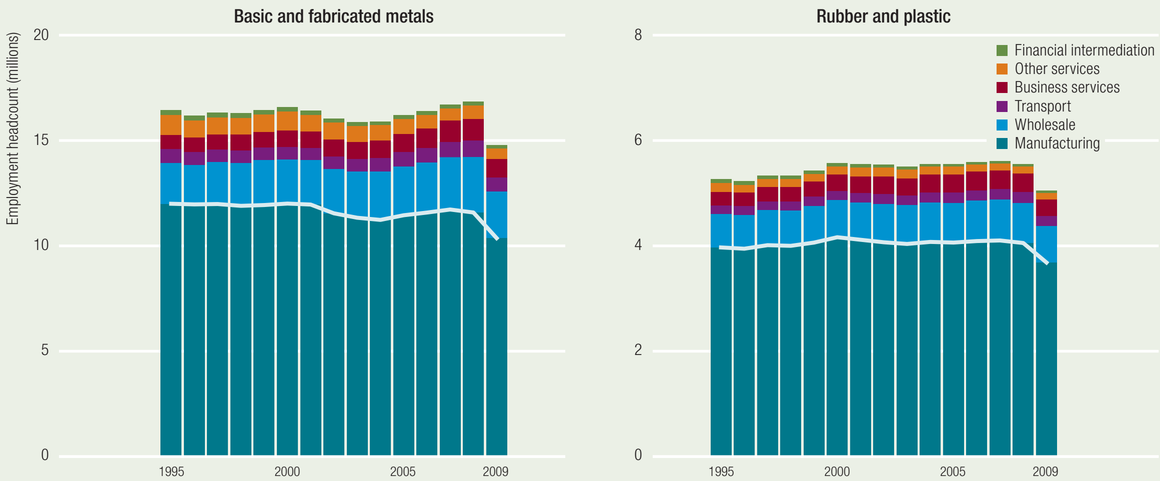
Figure 3.13
Number of jobs required for the production and delivery of textiles and textile products, 1995–2009



Note: Manufacturing employment here comprises only formal employment.
Source: UNIDO estimate based on Timmer (2012).

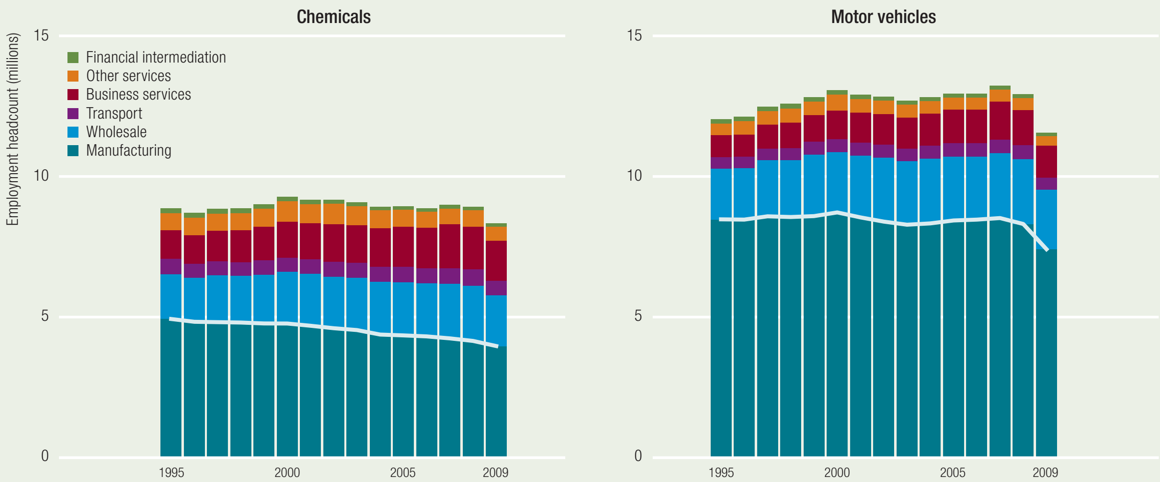
Increases in manufacturing-related services employment often compensate (or more than compensate) for the reduction in manufacturing jobs

Figure 3.14
Number of jobs required for the production and delivery of medium-tech industry products in industrialized countries, 1995–2009



Note: Manufacturing employment here comprises only formal employment.
Source: UNIDO estimate based on Timmer (2012).

Figure 3.15
Number of jobs required for the production and delivery of high-tech industry products in industrialized countries, 1995–2009



Note: Manufacturing employment here comprises only formal employment.
Source: UNIDO estimate based on Timmer (2012).

to manufacturing-related services employment, especially business services.

Thus, if we take employment in manufacturing-related services into account, manufacturing's contribution to job creation is more sustained than Figure 3.5 suggests. Although the decline in labour-intensive, low-tech industries reduces manufacturing jobs as countries reach high incomes, medium- and high-tech industries, especially those sustaining value-added growth at high incomes, create a relatively high proportion of jobs in manufacturing-related services. These contributions are important not only for making up for declining manufacturing jobs but also for generating modern service jobs, which are likely to

> **Manufacturing structural change offers employment opportunities for high-income countries as they transit from high-tech manufacturing production to manufacturing-related services**

play a crucial role in linking high-tech manufacturing industries with innovative service activities that support growth of increasingly service-oriented high-income countries.

Beyond service employment directly dependent on manufacturing production, employment is generated throughout the production chain due to backward linkages and multiplier effects of production. If these full production effects are included, manufacturing-related employment increases a further 10–30 percent.

In short, manufacturing structural change offers employment opportunities for high-income countries as they transit from high-tech manufacturing production to manufacturing-related services. Developed countries aiming to increase value added while generating employment may thus find it optimal to focus on innovation and marketing, if they are not doing so already, to compensate partly or fully for the loss of such production jobs.

Effects of time, demographics and geography on manufacturing development

Changing characteristics in individual manufacturing industries over time

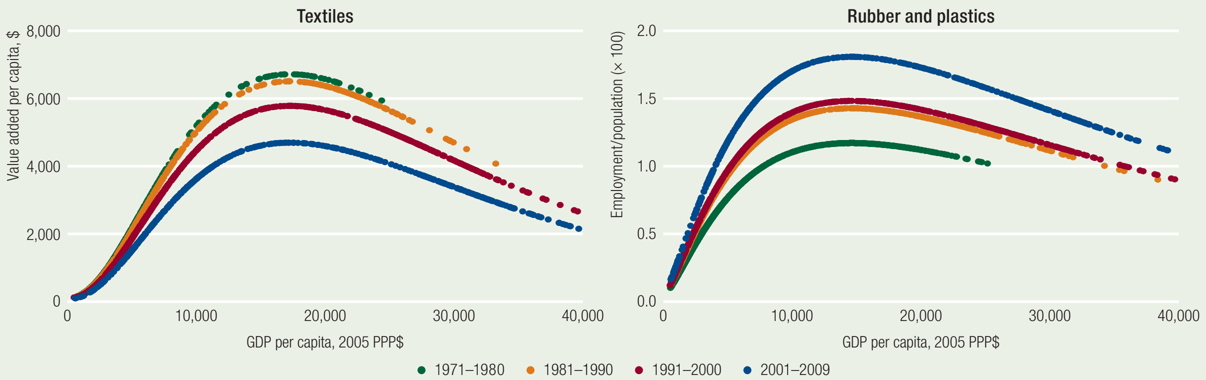
The broad pattern of industrialization by income (as in Figure 3.3) is unlikely to change drastically in future and if at all only slowly, taking historical studies as evidence (see, for example, Chenery and Syrquin 1975, Clark 1957, Hoffmann 1958, and Kuznets 1966). But individual manufacturing industries do change their characteristics over the years.

For example, the value added pattern of the textile industry has shifted downward over the years, in contrast to the employment pattern of the rubber and plastic industry for small countries (Figure 3.16).[6] This means that rubber and plastics can generate more employment for a country at the same income as 10 years previously. This shift adds a dynamic element to the analysis, allowing us to assess how technology, demand and other factors that evolve over time change the course of manufacturing development.

To identify the emerging characteristics of the 18 manufacturing industries in Table 3.2, the trends of both the levels of value added and employment have been studied for each industry since 1980. The results are categorized under five headings (Table 3.3).

The results show that a large number of industries are increasing their capital intensity.[7] The seven industries intensifying capital use have added value without increasing or even while decreasing employment. This is an industry-wide trend, so it characterizes the situation of those industries across countries at different incomes. The results seem to point to rising

Figure 3.16
Shifts in value added and employment development patterns in two industries by income, selected years, 1971–2009



Source: UNIDO estimate based on CIC (2009) and UNIDO (2012a).

"Many medium- and high-tech industries have become capital intensive since the 1980s, increasing value added without adding much labour

Table 3.3
Emerging trends of manufacturing industries since 1980

Emerging trend	Industry
Rising	Rubber and plastic
Declining	Tobacco Textiles
Intensifying capital use	Paper Chemicals Non-metallic minerals Basic metals Fabricated metals Electrical machinery and apparatus Motor vehicles
Intensifying labour use	Furniture
Stable	Food and beverages

Note: When value added and employment show a statistically significant increase in all three decades since 1980, the industry is classified as "Rising". When an industry constantly sees declines in both variables, it is "Declining". If an industry increases value added while decreasing (or at least not increasing) employment, it is "Intensifying capital use". When there is evidence of an increase in employment and a decrease or no change in value added, it is "Intensifying labour use". If there is no significant change in value added and employment, it is "Stable". Industries exhibiting ambiguous trends are excluded; they are wearing apparel, wood products, printing and publishing, coke and refined petroleum, machinery and equipment, and precision instruments.
Source: UNIDO estimate based on CIC (2009) and UNIDO (2012a).

mechanization and standardization of production processes in many medium- and high-tech industries.

Only two industries, rubber and plastics and furniture, are increasing employment (the former, value added as well). Tobacco and textiles are declining industries as they have been reducing value added and employment, though this does not necessarily imply that their output volume or demand for their products has been decreasing in absolute terms, as production volume may still rise alongside a declining price trend.

Finally, food and beverages have been remarkably stable (and in fact is one of the key industries for both value added and employment in countries across different incomes and different geographical and demographic conditions). This stability no doubt stems from the nature of its products, which serve the basic needs of human beings in differentiated national markets.

Thus many medium- and high-tech industries have become capital intensive since the 1980s, increasing value added without adding much labour.

Changes in manufacturing structure over time

As individual manufacturing industries change their characteristics over the years, the industries' relative importance and the structure of manufacturing also evolves. This subsection discusses how the development potential of manufacturing industries has changed since the 1960s.[8]

In the 1960s and 2000s in value-added terms, high-tech industries developed more than medium-tech industries, which reached higher levels of development than low-tech textiles and wearing apparel (Figure 3.17). Divergence tends to occur in the upper middle-income stage when high-, medium- and low-tech industries start experiencing faster, slower and negative growth, respectively. But in the 2000s the development potential of high-tech industries is much higher than in the 1960s, while there are not noticeable differences in the development patterns of low-tech and medium-tech industries. Among high-tech industries, chemicals and electrical machinery and apparatus have greatly increased their development potential relative to other industries, by increasing per capita value added and accelerating their growth rates.

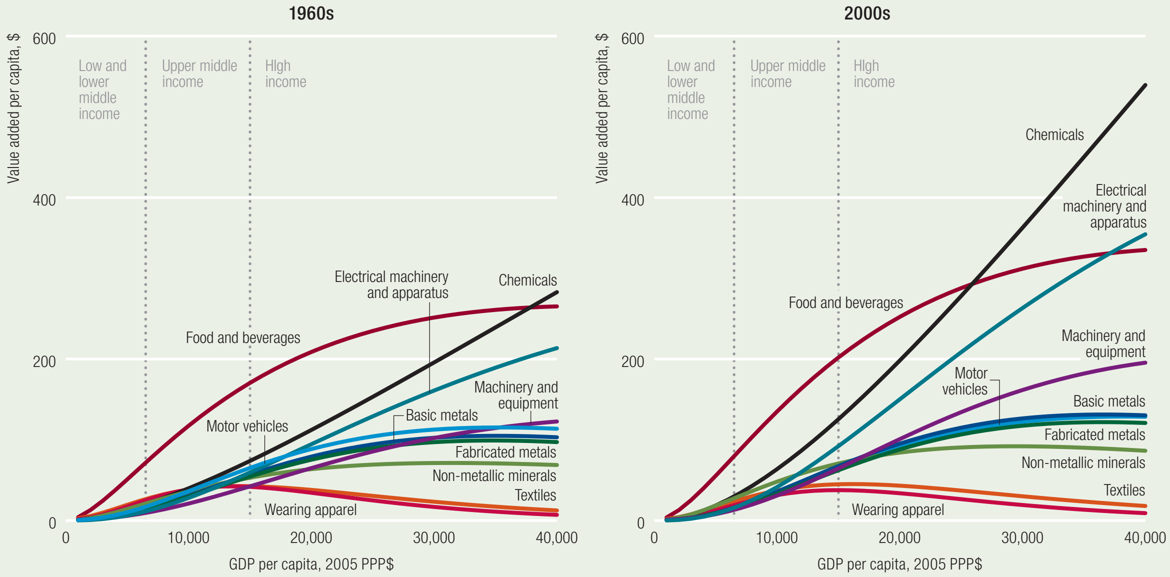
Employment patterns have changed less than value added between the two periods (Figure 3.18). Among low-tech industries, employment in textiles has been markedly lower in recent years while food and beverages and wearing apparel slightly increased and decreased, respectively, their potential for job creation. Another difference in employment patterns between the 1960s and the 2000s is the slower decline of employment in high-tech industries at high incomes: they now have greater ability to keep employment over a wider range of incomes.

Effects of country size, population density and natural resource endowment

Income is usually the most influential determinant of manufacturing structure, as seen, but countries with different geographical and demographic conditions, history and policies – country-specific attributes – may pull away from its influence somewhat. For example, the endowment of abundant natural resources

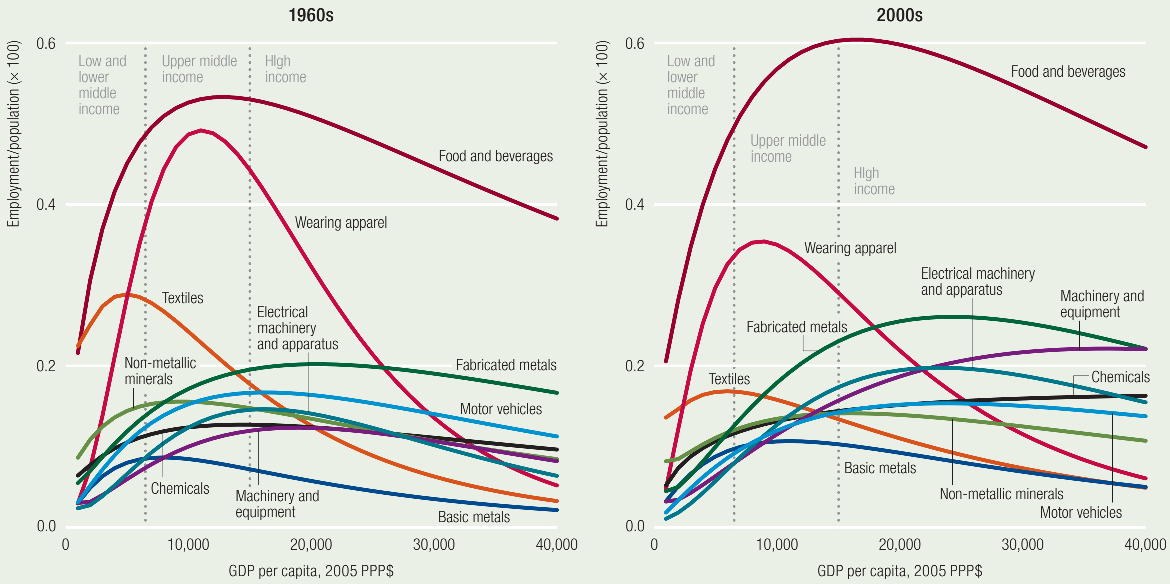
> **A country's population size tends to have overarching influence on economic structural change**

Figure 3.17
Changes in value added by income and manufacturing industry, selected years



Source: UNIDO estimate based on CIC (2009) and UNIDO (2012a).

Figure 3.18
Changes in employment by income and manufacturing industry, selected years



Source: UNIDO estimate based on CIC (2009) and UNIDO (2012a).

normally works against manufacturing development, holding other conditions constant (Haraguchi and Rezonja 2011; UNIDO 2012c).

This subsection looks at how demographic conditions – over which the government does not have much control in the short to medium term

"Exports of resource commodities often lead to currency appreciation and make tradable manufacturing products less competitive

– and geographical conditions affect manufacturing structure. It shows that a country's population size – based on the maximum likelihood test for identifying structural breaks, large countries are defined as having more than 20 million people, and small countries fewer than that – tends to have overarching influence on economic structural change (Chenery and Taylor 1968).

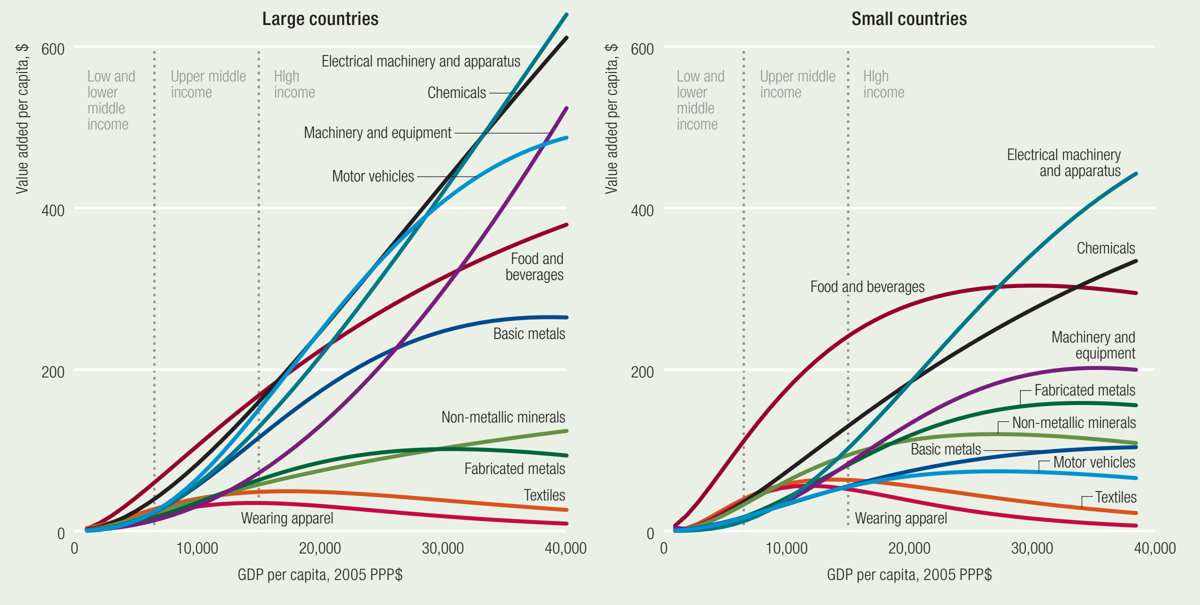
Densely populated countries, owing to a negative association with availability of mineral wealth, arable land and other natural endowments per head, are likely to specialize more in manufacturing and in less resource-intensive manufacturing industries. Such countries may also draw advantages from lower transport and coordination costs (Keesing and Sherk 1971). Exports of resource commodities often lead to currency appreciation and make tradable manufacturing products less competitive.

Country size

Chapter 1 showed that a larger population is generally conducive to manufacturing development. Figure 3.19 confirms that small countries generally have lower value added in manufacturing than large countries. There are also differences in structural change within manufacturing between large and small countries. Large countries, at higher incomes, tend to have a divergent pattern of thriving and other industries, while in small countries, growth in most manufacturing industries slows at higher incomes. By industry, small countries are likely to develop food and beverages much earlier than large countries, but that industry's growth in those countries is not as sustainable as in large countries: growth in food and beverages starts slowing at around $10,000 GDP per capita and continues to slow, or even decline, at higher incomes.

Another difference is in motor vehicles. In large countries it is one of the key industries leading industrialization from an upper middle-income stage. (Other key industries are electrical machinery and apparatus, chemicals, machinery and equipment, and food and beverages.) In small countries the industry's development prospects are limited. The difference may stem from a lack of the economies of

Figure 3.19
Changes in value added by income and manufacturing industry, 1963–2007



Source: UNIDO estimate based on CIC (2009) and UNIDO (2012a).

“Higher population density is associated with positive impacts on value added in mainly medium- and high-tech industries

scale within the domestic market needed to put the industry on a long-term growth path. It may also be because multinational automotive companies often localize production in countries with a large domestic market and serve smaller countries through exports from them.

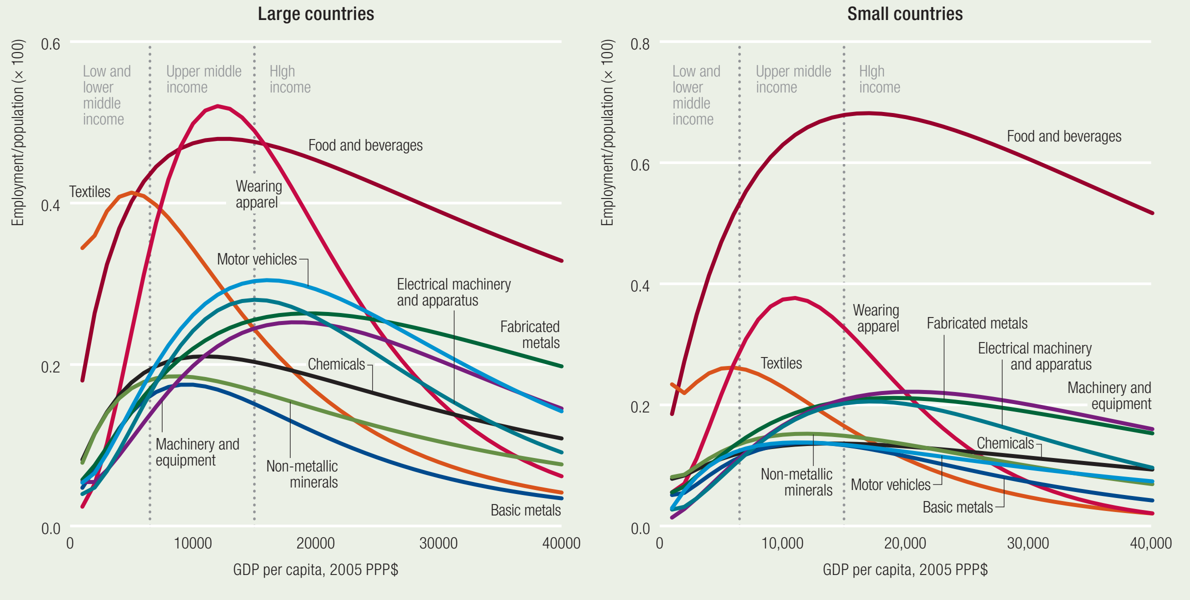
As with value added, emerging patterns of subsector manufacturing employment are similar between large and small countries (except for food and beverages and for motor vehicles), but employment in small countries is generally lower across industries (Figure 3.20). Food and beverages is the single most important manufacturing employer across different incomes for small countries, but in large countries three industries – textiles, wearing apparel and food and beverages – together create a major portion of manufacturing employment up to upper middle-income level. Then, machinery and equipment, motor vehicles and electrical machinery and apparatus generate substantial employment at high incomes up to around $30,000 GDP per capita. At this stage in large countries the motor vehicle industry can become one of the top five sources of manufacturing employment (but is insignificant for small countries).

Population density and natural resources

Higher population density is associated with positive impacts on value added in mainly medium- and high-tech industries, characterized as relatively capital and technology intensive, a finding largely expected (Figure 3.21). The strong impact on chemicals, motor vehicles and machinery and equipment may reflect the importance of distribution systems and production agglomerations.

The effect of natural resource endowments on manufacturing valued added is also clear (Box 3.5; see Figure 3.21), and largely confirms the economy-wide results seen in Chapter 1 (see Figure 1.4). High endowments do not have a positive effect on a single industry, but they have particularly strong negative effects on electrical machinery and apparatus, motor vehicles (for large countries) and chemicals, which are key in deepening and sustaining industrialization from the upper middle-income stage. Thus for

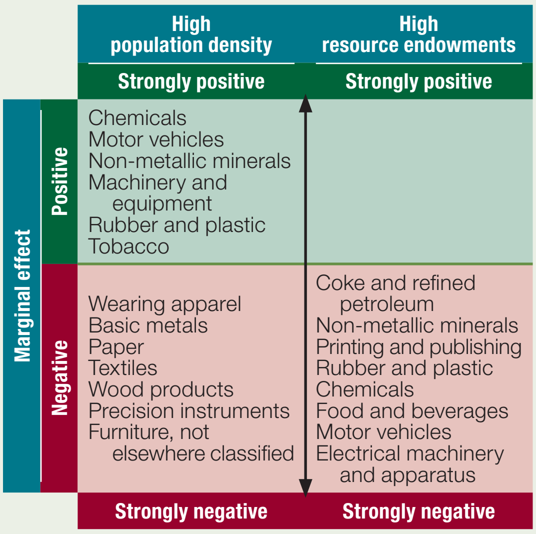
Figure 3.20
Changes in employment by income and manufacturing industry, 1963–2007



Source: UNIDO estimate based on CIC (2009) and UNIDO (2012a).

"Natural resource endowments have positive effects on several industries, primarily intensive users of such resources in production

Figure 3.21
Effects of population density and natural resource endowments on manufacturing value added, 1963–2007



Note: Only industries with statistically significant results at the 90 percent confidence level are shown.
Source: UNIDO estimate based on UNIDO (2012a).

Box 3.5
Proxying natural resources

A proxy variable for natural resource endowment was calculated as the difference between exports and imports of crude natural resource commodities and expressed in per capita term. The commodities included are those categorized under SITC Revision 1 in code 2 (crude materials, inedible, except fuels), 32 (coal, coke and briquettes), 331 (petroleum, crude and partly refined) and 3411 (gas, natural).

Source: Industrial Development Report 2013 Team.

long-term manufacturing development, countries with abundant natural resources need prudent institutions to manage revenues from resource exports so as to avoid undue currency appreciation and underinvestment in physical and human capital.

On the employment side, population density has favourable effects on many industries, but tends to undermine the development of wood products. Natural resource endowments, unlike value added, have positive effects on several industries, primarily intensive users of such resources in production (Figure 3.22).

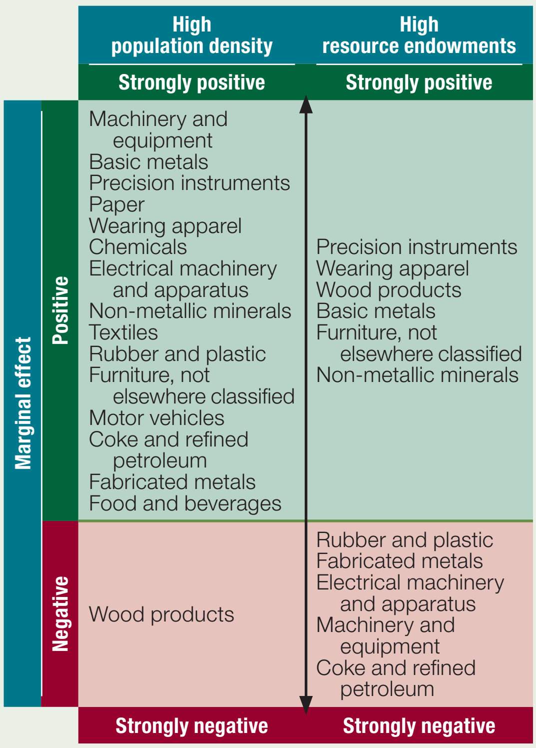
Quality of manufacturing employment

Manufacturing's contribution to employment cannot be fully assessed unless one also considers qualitative aspects, particularly, wages and aspects of female employment.

Manufacturing generally offers a competitive wage relative to the whole economy's average (see Figures 1.12 and 1.13 in Chapter 1). But wages between industries vary, making employment in some more favourable than others for poverty reduction, better living standards and a country's economic development in general.

An analysis of 63 countries (based on 2009 data for 47 countries, 2008 data for 13 and 2007 data for 3)

Figure 3.22
Effects of population density and natural resource endowments on manufacturing employment, 1963–2007



Note: Only industries with statistically significant results at the 90 percent confidence level are shown.
Source: UNIDO estimate based on UNIDO (2012a).

> **Labour-intensive, low-tech industries employ larger shares of female workers than the average, especially wearing apparel and textiles**

from different regions and at different incomes shows a positive correlation between wages and labour productivity relative to the manufacturing sector's average (Table 3.4; Nübler 2013a).[9] Industries with high labour productivity pay high wages, those with lower labour productivity (mainly labour-intensive, low-tech industries) pay below the average manufacturing wage (Box 3.6).

The table also shows female employment relative to the manufacturing average. Labour-intensive, low-tech industries employ larger shares of female workers than the average, especially wearing apparel and textiles, both of which have low productivity and wages. Precision instruments and electrical machinery and apparatus, in which manual dexterity is particularly valued, tend to have higher female employment than the average.

The following two subsections look further into wages and female employment by countries' income group.

Box 3.6
Why low wages are the norm for wearing apparel

The wearing apparel industry has limited room for substituting capital for labour or the potential to raise labour productivity through capital investment because labour-intensive production processes with low-wage workers are the key contributing factor in the industry's success. While in a short to medium term, productivity increase might help keep production cost low (see Box 4.1 in Chapter 4), in the long term, once countries lose their wage advantage, the industry cannot usually sustain growth and tends to move on to new, lower wage countries. This characteristic explains why wearing apparel has the lowest wage and productivity among manufacturing industries.

Source: Industrial Development Report 2013 Team.

Wages

Among low-, middle- and high-income countries, low-income countries have the largest wage differences among manufacturing industries (Figure 3.23).

Table 3.4
Wage, value added and female employment

Manufacturing industry	Wages	Labour productivity	Female employment
Wearing apparel	0.65	0.50	1.77
Wood products	0.72	0.65	0.46
Furniture	0.75	0.72	0.69
Textiles	0.76	0.60	1.30
Rubber and plastic products	0.89	0.82	0.79
Food and beverages	0.91	1.03	1.05
Fabricated metals	0.93	0.80	0.47
Precision instruments	1.00	0.72	1.26
Printing and publishing	1.07	0.87	1.01
Non-metallic minerals	1.07	1.10	0.44
Electrical machinery and apparatus	1.10	0.91	1.12
Paper products	1.11	1.19	0.90
Machinery and equipment	1.12	1.03	0.88
Motor vehicles	1.13	0.99	0.54
Basic metals	1.40	1.50	0.40
Chemicals	1.50	1.95	1.08
Tobacco	1.84	2.62	0.95
Coke and refined petroleum	1.87	3.20	0.53

Note: Wages, labour productivity and female employment are relative to the manufacturing average, which is 1. The low-, medium- and high-tech industries are coloured in red, green and blue, respectively.
Source: Adapted from Nübler (2013a) based on UNIDO (2012a).

“Low-income countries have the largest wage differences among manufacturing industries

Figure 3.23
Wages relative to manufacturing average by income group and manufacturing industry, 2006

Note: The names of the low-, medium- and high-tech industries are in red, green and blue, respectively.
Source: UNIDO estimate based on UNIDO (2012a).

As textiles and wearing apparel are two of the three largest sources of manufacturing employment for these countries (food and beverages are the other – see Figure 3.5), many people are in low-wage manufacturing employment there, which coexists with fewer jobs paying far higher wages than the manufacturing average.

This wage structure does not necessarily work against a country’s development as long as the wages of this majority of manufacturing employment are

> **As countries develop, differences in wage levels among manufacturing industries tend to narrow due to the rise in labour productivity in low-wage jobs**

higher than in the main sources of employment – that is, agricultural, subsistence and informal activities. This is usually the case as is often seen in the large internal migration from rural to urban areas during early industrialization. Thus the emergence of low-tech manufacturing industries and the creation of a large number of jobs that require only basic skills can help substantially reduce poverty in countries at this income.

At higher incomes the manufacturing structure shifts from labour intensity to skill intensity, and the weight of medium- and high-tech industries in manufacturing employment grows (see Figure 3.5). While medium- and high-tech industries do not create as many jobs as food and beverages, textiles and wearing apparel, their wages are usually higher than in those low-tech industries. In addition, as countries develop, differences in wage levels among manufacturing industries tend to narrow due to the rise in labour productivity in low-wage jobs (see Figure 3.23). Manufacturing employment may thus lose headcount attractiveness as incomes rise, but the sector's structural change helps raise its wages.

Female employment

Employment in manufacturing, as in other sectors, is not gender neutral, though data are scarce.[10] Due to alleged and actual differences in physical abilities, divergent social norms and expectations for men and women, differences in access to training and education and outright discrimination, some manufacturing sectors are feminized, others are not.

Female employment tends to concentrate in low-tech, export-oriented and labour-intensive industries (Figure 3.24). In low-income countries the female share of employment is nearly 50 percent in tobacco, textiles and electrical machinery and apparatus. Relative to other country-income groups, these economies often have high female labour force participation rates – though still lower than male rates – among the various manufacturing industries. This is partly because at an early stage of industrialization, manufacturing industries (regardless of type) are much more labour intensive than at later stages (Haraguchi 2012).

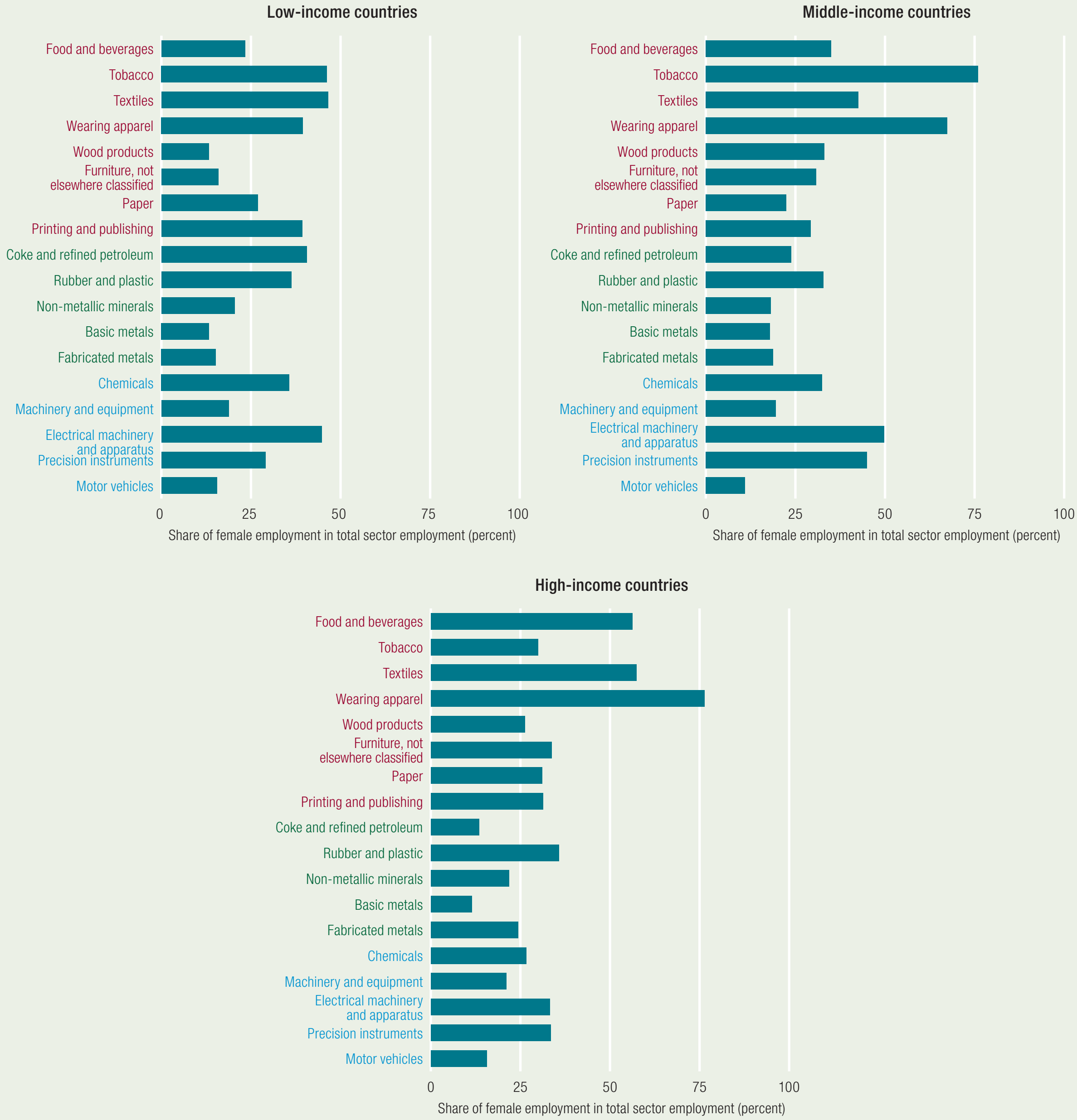
In low- and middle-income countries food and beverages, textiles and wearing apparel are the major sources of formal manufacturing employment. Women's participation in that workforce may not be far behind (or is even higher than) men's participation in textiles and wearing apparel during manufacturing's incipient and take-off stages. Since women tend to allocate their incomes more to food and education than men, manufacturing development has important implications not only for improving women's economic and social status but also for alleviating poverty (World Bank 2013a). But women have less access than men to high-paying jobs, which are far fewer than labour-intensive manufacturing jobs in low- and middle-income countries but which are found in some medium- and high-tech industries.

Manufacturing in industrialized countries may have been less conducive to improving women's economic status than the earlier stage of industrialization. Although higher paying jobs become more available in high-tech industries in countries with high incomes, it seems that women are stuck in industries with lower compensation. Even in the high-tech industry of electrical machinery and apparatus, where women have quite high participation in the low- and middle-income stages of development, they lose out on employment to men (see Figure 3.24). This is probably related to the change in the nature of the industry from relatively labour-intensive, assembly-type activities to more technology-driven activities as countries develop.

Thus regardless of a country's stage of development, women's manufacturing employment is skewed towards labour-intensive jobs, which derive their competitiveness from flexibility and cost rather than skills. This tendency might help lift women's economic status when a country has few formal manufacturing jobs because in such circumstances labour-intensive manufacturing jobs allow people without skills to get a formal job, which is often superior to the alternative jobs on wages and security.

Women's manufacturing employment is skewed towards labour-intensive jobs, which derive their competitiveness from flexibility and cost

Figure 3.24
Female employment share by income group and manufacturing industry, 2005



Note: The names of the low-, medium- and high-tech industries are in red, green and blue, respectively.
Source: UNIDO estimate based on UNIDO (2012a).

But as industrialization advances, continuing concentration of female employment in labour-intensive work is a concern because such work usually pays less than jobs in other manufacturing industries that become more common as countries develop.

Notes

1. In this chapter the patterns of structural change in manufacturing value added and employment are estimated based on the UNIDO Industry Statistics Database Revision 3 (UNIDO 2012a).

The database includes unbalanced panel data of 74 countries for value added and 95 countries for employment for 1963–2007. Employment data included in the database are mostly formal employment, including employees of firms with at least 10 employees.

2. Value added per capita of a manufacturing industry indicates the development level of the industry in an internationally comparable manner, as GDP per capita does for a country's economy. For the employment–population ratio, because employment divided by population tends to be a very small number, it is multiplied by 100.
3. There are low-tech industries not considered labour intensive, such as tobacco. As the three low-tech industries included in this section are all labour intensive (Annex 2), they are labelled here labour-intensive, low-tech industries.
4. The motor vehicle industry includes assembly as well as production of parts and accessories.
5. The analysis in this section uses the World Input-Output Database (Timmer 2012). Here manufacturing-related services employment is defined as employment in the services sector, required for producing and delivering manufacturing products.
6. Value added is proxied by value added per capita and employment by the employment population ratio.
7. Here, this characterization applies to an industry-wide trend as opposed to structural change along income level. The former, industry-wide, trend points to the fact that the same industry across all countries (for example, the basic metals industry, in countries with a GDP per capita of $2,000 and $25,000) has become capital intensive over the last 30 years. The latter case, structural change along income level, differs from this section's analysis. For example, it refers to the situation in which the level of an industry's capital intensity rises as income increases (this is usually the case for all industries, including furniture and wearing apparel).
8. Figure 3.17, which shows the recent pattern of manufacturing development in the 2000s, is quite similar to Figure 3.4, which is based on the data since 1963 because recent data are more available than the data from earlier years in UNIDO (2012a).
9. Nübler (2013a) conducted a regression analysis on the correlation between relative wages and relative value added. The relationship was statistically significant with R^2 of 0.43.

   Each of the three indicators was calculated for a particular sector in a particular country by normalizing and making the average value of the entire manufacturing sector 1. Then the value of each sector was calculated as the average of the countries, for which the indicator was calculated for each sector.
10. Employment data by gender at the manufacturing subsector level are very limited, so the few countries for which data are available are included in each income group. For Figure 3.24, 2005 is selected to maximize the number of countries while comparing different income groups for the same year. The following countries are in each income group. Low-income countries: Eritrea, Ethiopia, Kyrgyzstan and Tanzania. Middle-income countries: Azerbaijan, Bulgaria, Ecuador, India, Indonesia, Islamic Republic of Iran, Jordan, Kazakhstan, Lithuania, Malaysia, Morocco, the Philippines and Turkey. High-income countries: Croatia, Cyprus, Japan, the Republic of Korea, Malta and Oman. Data for the same sets of countries for 1998 and 2000 show structures of female employment shares in manufacturing largely similar to the 2005 figures.

Section 2 Drivers of manufacturing structural change and employment generation

This section first looks at what drives the structural change and industrial development analysed above. The drivers' interactions are extremely diverse, complex and non-linear but what stands out is that costs, as well as technological and demand conditions, remain crucial. In principle, structural change in any sector in any country is governed by the conditions of demand and supply for products and services that interact with each other. Supply-side conditions generally include wages, skills, technological change, firm size, location of production facilities and the overall business environment, which also determine industry's competitiveness and organization. Demand-side conditions include demand for imports and exports as well as foreign direct investment.

This section then looks at trade. Trade openness is an opportunity – and a threat – for low-income countries because it has not enhanced structural change in all regions. East Asia has become one of the most important manufacturing production networks, aided by liberalization, while Latin America and Sub-Saharan Africa have been largely left behind. Trade is underpinned by global value chains, and although these value chains may play less of a role in the future, technological upgrading is the best long-term strategy for a country to stay in them.

Finally, one emerging driver that deserves closer analysis is the efficient use of natural resources, both to keep costs down and preserve the environment. The paradigm of continually increasing demand of finite resources must be shifted as the past abundance of relatively inexpensive natural resources, such as energy, water, and materials, is coming to an end. Approaches towards this "green structural change" will include adopting industries more technologically advanced and with higher labour and capital productivity. The key thus lies in decoupling natural resource use and environmental impacts from economic activity.

Chapter 4

Cost and supply-side structural change drivers

This chapter looks at five main supply-side drivers of structural change in manufacturing: wages, skills, technological change, industrial organization and the overall business environment. Figure 4.1 shows the main supply and external demand drivers discussed in this and the following chapters. The list is by no means exhaustive, and not all the possible combinations of interactions have been included, due to a limited availability of evidence, but some of the key drivers of structural change and their interrelationships are discussed here.

Wages, sometimes considered the most important factor for the supply of manufactured goods, determine the cost of employment and through this the competitiveness of the industry. They also feed back into aggregate demand for manufactured products on the domestic market. Neoclassical theory suggests that, other things equal, rising wages cause individual producers to limit or cut back on employment because they will tend to replace labour by investing in equipment and technology or ceasing production of goods that can no longer be manufactured profitably. The resulting argument is that lower wages stimulate production in manufacturing. But this view does not consider that low wages come with low labour productivity and high wages with higher productivity, which can stimulate increased production. Further, there is now enough evidence to suggest that high labour costs are often compensated for by advantages in infrastructure, logistics, cost and availability of supplies as well as the business environment. Wage costs remain, however, a main element of costs in most activities, and in a few labour-intensive sectors are the main drivers determining overall unit production costs.

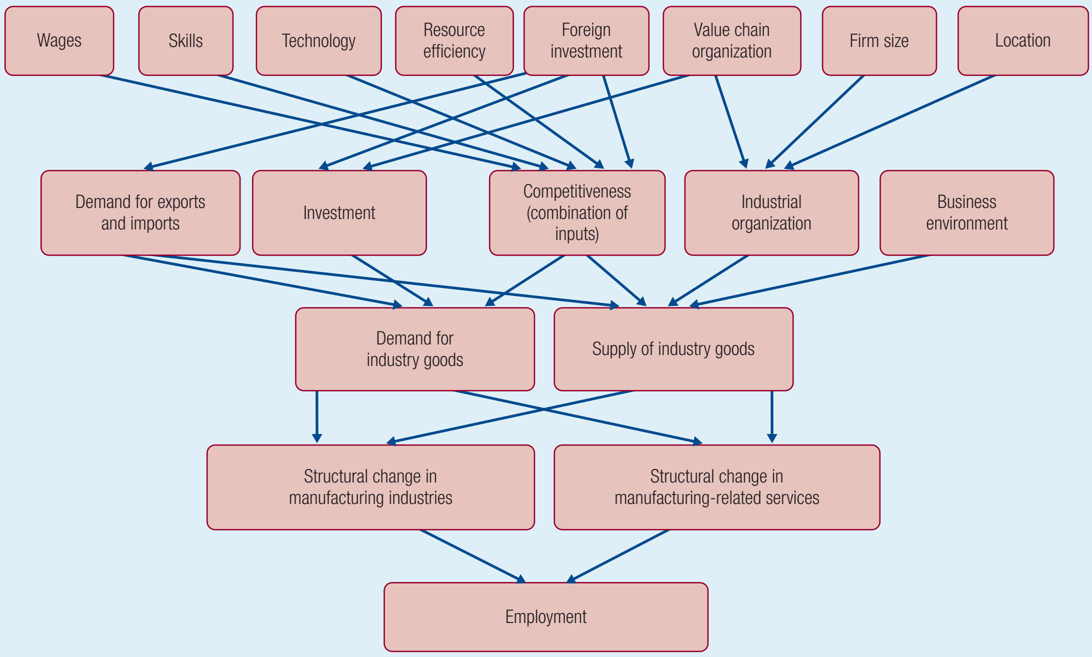
Industrial development unfolds according to the labour force's capacity to develop the appropriate skills in manufacturing. Such skills determine the competitiveness of an industrial sector and the structural change that occurs within it. Skills for manufacturing change, and every stage of industrial development requires its particular skill set. The most sophisticated sectors require a high order of technical skills. But investing in a pool of highly educated university graduates does not help in a developing country context – it is too early. Over long periods change in manufacturing has been biased towards using more skilled labour, which has widened wage inequality and weakened the relationship between output and employment growth in manufacturing in low- and lower middle-income countries.

Technological change is at the heart of structural change. Technology has important implications for the productivity of industrial processes and thus on the scale and scope of industrial production. Gains in technology raise productivity – and so fewer workers (and often fewer other resources) are required to create the same output. A useful distinction can be made between process innovation based on capital investment, which saves labour (machines replace workers), and product innovation based on research and development (R&D), which leads to new and better products and often creates new jobs by extending production to penetrate new markets. So it is far from inevitable that technological change reduces manufacturing employment in total. It will depend on the choices made – and the incentives provided – by society.

Industrial organization is another driver. It covers firm size and economies of scale in production, the way that production is organized across domestic and global value chains and the spatial distribution of production within national economies. For example, smaller firms on the international stage have generated fast employment growth but slower productivity growth, when controlling for other factors like firm age. Fragmentation of the production process along national and global value chains provides incentives for producers to engage in location-specific labour-intensive segments of manufacturing. Agglomeration effects arising from clusters of productive enterprises

Wage costs contribute to structural change in manufacturing as they determine overall production costs and competitiveness

Figure 4.1
Drivers of structural change in manufacturing



Source: Industrial Development Report 2013 Team.

are important in improving competitiveness and raising employment, but clusters alone cannot guarantee these gains, which require supportive infrastructure and supplier networks and good managerial capacity.

Finally, there is the business environment, more an underlying condition than a driver. It includes access to energy, water and transport facilities, as well as institutional aspects related to government support, regulations, taxes and corruption, all of which influence production cost. In many countries access to finance is particularly critical, and can become a key constraint to structural change.

But the impact of supply-side drivers on structural change has not been unambiguous. Wages can support employment generation or hinder it depending not only on their level and how they are set but also on the availability of infrastructure. The timing of the provision of the required skills seems to be crucially important for them to perform a positive role in supporting new job creation. Technology sheds labour if it is process oriented but generates employment if it is product oriented. It is the state (alongside the private sector) that needs to work hard to ensure that the drivers support employment generation while transforming the economy (a point taken up further in Chapter 7).

Wages: important, but not the only driver

Wage costs contribute to structural change in manufacturing as they determine overall production costs and competitiveness. But the advantage of low wage costs can be offset by low labour productivity or cost disadvantages for infrastructure, input supplies or regulations and taxes affecting the business environment, as well as by macroeconomic problems leading to inflation and an overvalued exchange rate.

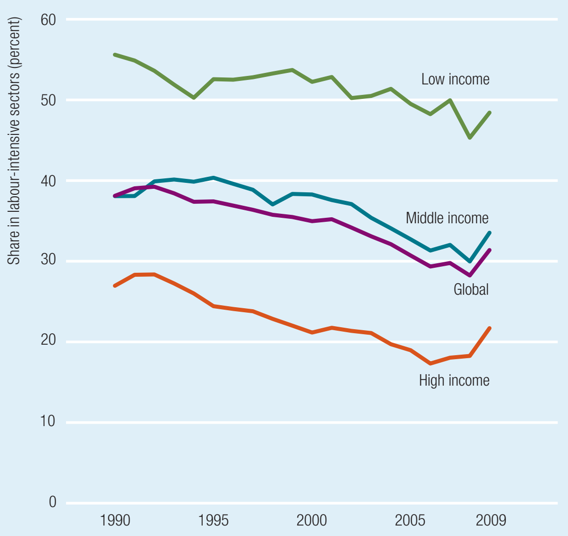
A wage advantage is more important in some areas of manufacturing than others depending on the labour intensity of production (Annex 2 lists labour-intensive manufacturing industries).[1] Three labour-intensive industries – wearing apparel, textiles, and food and beverages – are particularly important for

“Low-wage economies cannot necessarily compete with China or other low-cost suppliers simply with wages, even in simple labour-intensive activities

industrialization to take off (see *Patterns of structural change and employment generation within manufacturing* in Chapter 3). Globally, these three industries account for 30 percent of manufacturing value added, but the share varies by income: low-income countries have a 15–20 percent higher share than the global average, and high-income countries a 10–15 percent lower share (Figure 4.2). All country income groups have, however, been reducing their share of labour-intensive industries in manufacturing value added over the last 20 years.

Costs per worker vary hugely around the world but low wages are no guarantee of cost competitiveness even in labour-intensive tradable sectors. There is considerable evidence that economies with low absolute wages in dollar terms, such as most of Sub-Saharan Africa, are still uncompetitive in many light-manufacturing industries. Producers can stay competitive only if productivity gains match wage increases, as illustrated by survey data of formal firms in China, Ethiopia, the United Republic of Tanzania, Viet Nam and Zambia

Figure 4.2
Share in global manufacturing value added, selected labour-intensive industries, 1990–2009



Note: The value added share of food and beverages includes tobacco production because these two industries at the International Standard Industrial Classification two-digit level are combined in the data source.
Source: UNIDO estimate based on World Bank (2013b).

from 2009/10 (Dinh et al. 2012).[2] For most products and processes analysed (polo shirts, wooden chairs, leather loafers and wheat processing), the advantage of low wages was offset by lower labour productivity, as well as by higher input and logistics costs, such that for factory-gate costs African firms in all countries could compete with China only on leather goods.

This point is further backed up by Clarke (2012) whose analysis of World Bank Enterprise Surveys since 2006 shows African firms paying wages well below those of East Asian exporting economies. But once one controls for per capita income across countries, wages in Africa are higher than expected relative to those in surveyed firms in economies at similar incomes. Because of the productivity differences, unit labour costs in East Asia (China, Indonesia, Malaysia and the Philippines) are an estimated 20 percent lower than in Africa (Clarke 2012).

These examples confirm that low-wage economies cannot necessarily compete with China or other low-cost suppliers simply with wages, even in simple labour-intensive activities. Instead, industries can be set up and jobs created when unit labour costs are low – and costs of other production factors are favourable. There is scope for policy intervention and infrastructure investment by public and private sectors. Wages are only one piece in the puzzle for where it makes sense to locate (Box 4.1).

Skills: an often underrated driver

Skill formation shapes the capacity to produce industrial goods competitively. Crucial for industrial development, it is expected to positively affect economic growth as a whole (DFID 2011; Box 4.2; also see Chapter 8).

Many studies support the argument that education has a positive impact on economic growth. Bassanini and Scarpetta (2001) and Sianesi and van Reenen (2003) report, for example, that a one-year increase in average education raises per capita income 3–6 percent. Topel (1999), analysing labour productivity, finds that a one-year increase in the average years of schooling of the labour force raises output per worker 5–15 percent. Skill development not only

“ **Manufacturing is a major employer of engineering graduates**

Box 4.1
Wages and productivity in low-income garment-producing countries

A study based on firm-level data from Bangladesh, Cambodia, Kenya and Madagascar for 2002 and 2008 finds that despite having similarly low wages, the four countries have very different pathways for increasing productivity and developing their garment industry (Fukunishi and Yamagata 2013). All low-income countries, they experienced rapid growth in garment exports to developed countries. The Bangladeshi industry started to grow in the early 1980s, followed by that of Madagascar in the beginning of 1990s, based on investment from Mauritius. The Cambodian industry started exports in the late 1990s underpinned by a bilateral trade agreement with the United States. The Kenyan industry saw rapid growth in the early 2000s, triggered by duty-free access to the US market.

Wages in each country in 2008 were well below those in China and in middle-income exporters like Mexico and Turkey, suggesting that wages were driving competitiveness. But Bangladesh, Cambodia and Kenya saw substantial wage increases over 2002–2008, with nominal wage growth ranging from 36.5 percent to 65.8 percent. Unit costs were broadly similar in Bangladesh, Cambodia and Madagascar, as higher productivity in Cambodia and Madagascar offset their higher wages than those in Bangladesh.

Cambodian firms fared particularly well against those in Bangladesh, achieving steep productivity gains, while firms in Bangladesh had stagnant productivity. Cambodia achieved its productivity growth through several channels: a high rate of firm turnover facilitated the closure of unproductive firms and the entry of productive companies, and among those that continued operating, process innovation and greater educational attainment of workers came into play. Fukunishi and Yamagata found no evidence of product upgrading.

Cambodian garment firms thus successfully mitigated the adverse effect of increased wages on competitiveness by lifting productivity, while the Bangladeshi firms absorbed rising costs by reducing the large profit margin that they had enjoyed under the Multifibre Arrangement (MFA), which allowed it preferential exports to developed countries. In Kenya, where wages were higher than in the other countries, many garment firms closed after the MFA ended in 2005, suggesting that the country found it hard to maintain competitiveness with its rising wages.

The overall conclusions are two-fold. First, employment in the garment industry provides a good income opportunity for the less educated. Even after trade liberalization and the end of the MFA, real wages have increased and working conditions improved. Second, productivity growth is the key to expanding production and employment and upgrading job quality, even when wages are rising.

Source: Fukunishi and Yamagata 2013.

affects individual's employability, but it also allows him or her to increase wages and helps ensure better job quality and labour conditions (Vandenberghe and Debande 2004). Increased skills are related to higher rates of labour force participation, especially among women (Table 4.1).

Social and private returns to education

A number of studies have calculated returns on investment in education. Psacharopoulos and Patrinos (2004a) found that social returns (which take into account externalities, as other people benefit from knowledge spillovers of an individual's higher education) and private returns on investment in education were positive, especially for less developed countries (Table 4.2).[3] Their results emphasize that primary education is more important in regions with lower development, particularly in Sub-Saharan Africa, where the portion of educated people is much lower than in other regions. For countries at higher levels of development the importance of higher levels of educational attainment increases.

Manufacturing is a major employer of engineering graduates. The returns on investment for those who have studied engineering at a university seem to be higher than the average for tertiary education. They seem to be higher in developing than industrialized countries, and the gap is bigger for social than private returns (Table 4.3).

A skilled labour force in manufacturing is also expected to boost international competitiveness. For example, investing in education has a considerable positive effect on the growth of exports (UNIDO 2011a), and a more skilled workforce is generally

"A skilled labour force in manufacturing is also expected to boost international competitiveness

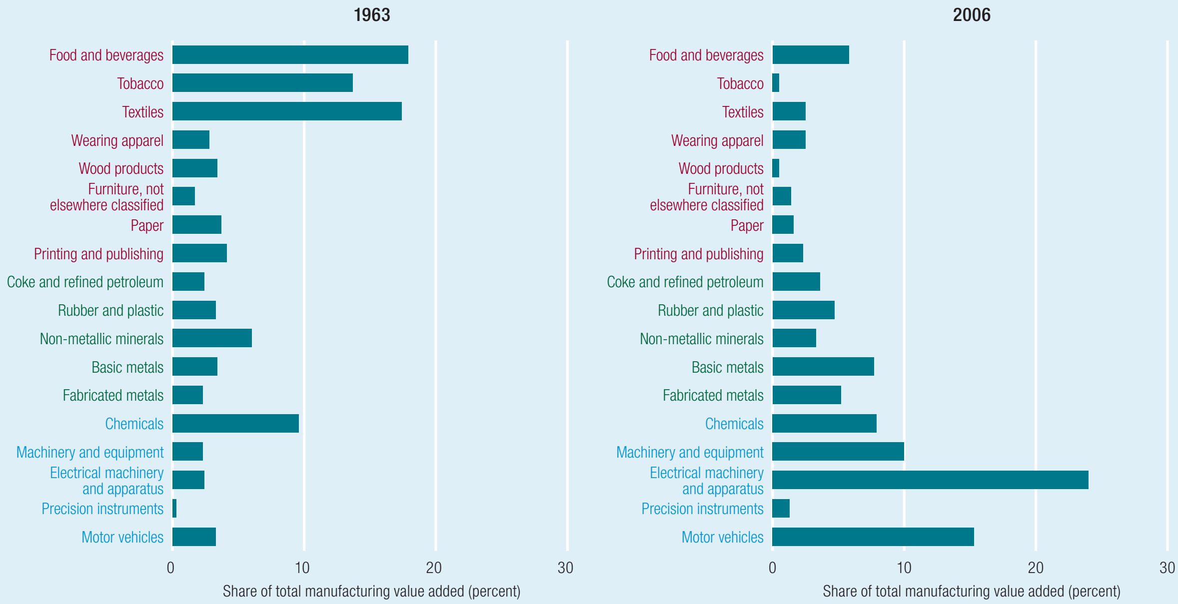
Box 4.2
Education and economic growth in the Republic of Korea and Pakistan

The Republic of Korea and Pakistan started with roughly the same per capita income in 1950. But over 1950–2010 Pakistan's per capita income in constant prices grew three-fold, that of the Republic of Korea 23-fold. This discrepancy in economic performance has been attributed largely to the differences in their educational development. Even in 1950 the East Asian country had an advantage in years of schooling, but by 2010 its educational development reached nearly 12 years of schooling, equivalent to the average adult having completed secondary schooling, whereas Pakistan's had not yet reached 6 years of schooling, a minimum for literacy.

Similarly, both Ghana and the Republic of Korea had a GDP per capita of roughly $300 in 1955. By 1990 in real terms, the Republic of Korea's GDP had increased to $7,500, while Ghana remained at its 1955 level. A third of the Republic of Korea's growth was thanks to rapid increases in educational attainment (Banerji et al. 2010), during a period in which the country transformed manufacturing from a low-tech to a more capital- and technology-intensive structure (Box Figure 1).

Manufacturing's slower structural change reflects Pakistan's slower educational development (Box Figure 2). In 1963 the country had a similar manufacturing structure to that in the Republic of Korea, but in 2006, while Pakistan had a more than 50 percent share of manufacturing value added in low-tech industries, most value added in the Republic of Korea came from high-tech industries.

Box Figure 1
Manufacturing structure in the Republic of Korea, 1963 and 2006



Note: The names of the low-, medium- and high-tech industries are in red, green and blue, respectively.
Source: MIT, POPC and UNIDO 2012.

(continued)

related to a higher share of manufactured exports in total merchandise exports (Figure 4.3).[4]

Mismatch between skill demand and supply

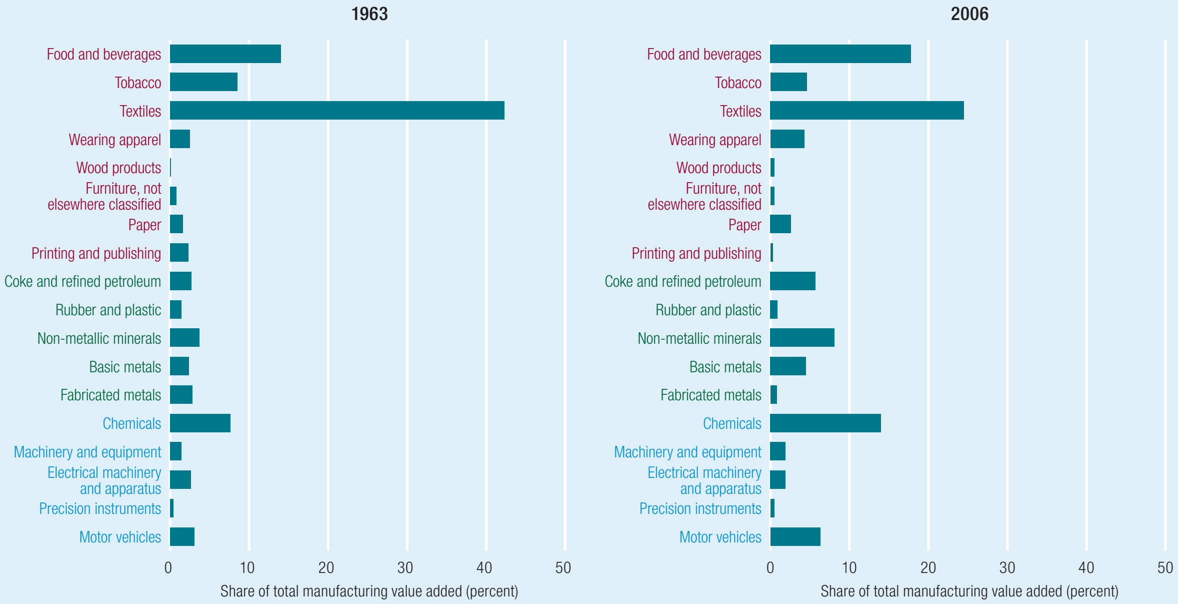
Nearly all labour markets have unemployment and shortages of certain skills at the same time. Such a mismatch is due to the limited perspective of workers on job opportunities, the time lag between basic skill development and employment, and the effects of structural change on employment.

Take India. It has many more university graduates with a degree in arts than the labour market can absorb,

“Nearly all labour markets have unemployment and shortages of certain skills at the same time

Box 4.2 (continued)
Education and economic growth in the Republic of Korea and Pakistan

Box Figure 2
Manufacturing structure in Pakistan, 1963 and 2006



Note: The names of the low-, medium- and high-tech industries are in red, green and blue, respectively.
Source: MIT, POPC and UNIDO 2012.

Source: Industrial Development Report 2013 Team based on MIT, POPC and UNIDO (2012).

and graduates who have studied mechanical engineering and electricity are also mismatched as many do not find work in the industry (Banerji et al. 2010). In Tunisia half of university graduates in chemistry are mismatched in their jobs, while in Lebanon 40 percent of the workforce is in jobs where they do not use their skills (Almeida, Behrman and Robalino 2012).

Table 4.1
Education and labour force participation in the European Union among men and women (percent)

Education	Labour force participation: Men	Women
Primary or below	52	35
Lower secondary	66	47
Upper secondary	79	64
Post-secondary, non-tertiary	84	73
Tertiary first degree	84	78
Tertiary MA, PhD	88	81

Note: Averages for 21 countries in the European Union.
Source: Adapted from table A5.1b from OECD (2013), *Education at a Glance 2013: OECD Indicators,* OECD Publishing, http://dx.doi.org/10.1787/eag-2013-en

Supply of skilled labour may not always match demand for two reasons. First, by the time demand has unfolded, it may be too late for firms to develop them internally in their own workforce. Second, demand is inadequate because firms have not well defined their real needs because of deficiencies in developing innovation strategies. In Tanzania some firms may have the potential to start innovating in manufacturing, but because they have not developed a strategy they fail to hire key staff in certain areas (MIT, POPC and UNIDO 2012).

Changing the nature and delivery of skills

The skills required for industrial production change with time. When economies undergo the structural

Structural change triggers a significant shift from unskilled to skilled labour

Table 4.2
Returns to investment in education by level and region (percent)

Region	Social			Private		
	Primary	Secondary	Higher	Primary	Secondary	Higher
Asia[a]	16.2	11.1	11.0	20.0	15.8	18.2
Europe, and Middle East and North Africa[a]	15.6	9.7	9.9	13.8	13.6	18.8
Latin America and the Caribbean	17.4	12.9	12.3	26.6	17.0	19.5
Organisation for Economic Co-operation and Development	8.5	9.4	8.5	13.4	11.3	11.6
Sub-Saharan Africa	25.4	18.4	11.3	37.6	24.6	27.8
World	18.9	13.1	10.8	26.6	17.0	19.0

a. Non–Organisation for Economic Co-operation and Development countries.
Source: Adapted from Psacharopoulos and Patrinos (2004a).

Table 4.3
Average returns to investment in university, engineering graduates (percent)

Country	Year	Private	Social
Brazil	1962	—	17.3
Canada	1985	23.0	11.7
Colombia	1976	33.7	24.8
Denmark	1964	—	8.0
France	1974	17.5	—
Greece	1977	12.2	8.2
India	1961	21.2	16.6
Iran, Islamic Rep. of	1964	30.7	18.2
Korea, Rep. of	1980	20.0	—
Malaysia	1968	13.4	—
Norway	1966	—	8.7
Philippines	1969	15.0	8.0
Sweden	1967	—	7.5
Thailand	1987	22.0	10.7
United Kingdom	1967	—	11.4
Venezuela, Bol. Rep. of	1984	20.3	—

— is not available.
Source: Adapted from Psacharopoulos and Patrinos (2004b).

change from agriculture to industry, a new set of skills is required – as is another change in skills when manufacturing shifts to R&D activities (Trilling and Fadel 2009). Evidence from the European Union shows that industrial diversification and deepening lead to a growing need for medium- and high-skilled professionals (CEDEFOP 2008). The trend is similar for Brazil, China and India, where the rapid transition towards knowledge-intensive manufacturing is expected to create shortages of both high-skilled workers (such as engineers and scientists) and medium-skilled workers (such as technicians and factory workers) by 2030 (Manyika et al. 2012).

Structural change triggers a significant shift from unskilled to skilled labour. But is it possible to identify the changes in the skill profile of a country that has

Agroindustry, often considered a low-tech low-skill sector, has fish and meat processing requiring very low skill intensity, while manufacture of wines, liquors and malt require very high skill intensity

Figure 4.3
Education and manufactured exports

Source: Adapted from ILO (2008).

moved from low- to high-tech production? Although in overall terms this can be done, we are confronted with a major constraint: huge sectoral heterogeneity for skill intensity can lead to unrealistic and misleading generalizations. Evidence shows that activities within the same product group can have very different skill intensities. For instance, Bruno et al. (2009) argue that at the International Standard Industrial Classification two-digit level, 8 of 24 sectors embody either unskilled or skilled activities. Agroindustry, often considered a low-tech low-skill sector, has fish and meat processing requiring very low skill intensity, while manufacture of wines, liquors and malt require very high skill intensity. Similarly at the most sophisticated end of manufacturing – electronics – skill intensity varies hugely from assembly to design.

Still, the requirements for skill development generally change by a firm's industrial deepening – low, intermediate and advanced. Each level calls for specific technological capabilities and skills, which can be developed with formal education and skill formation through technology-based training (Table 4.4).

The sectors likely to be present at each level are as follows:

- *Low level, simple assembly and processing.* Sectors here tend to be labour-intensive with stable, well-diffused technologies embodied mainly in capital equipment, having low R&D spending and simple skill requirements. Labour costs are often a major element, and barriers to entry are quite low. The market as a whole tends to grow slowly, with an income elasticity of less than one. Particular consumer products have high-quality segments where brand names, skills, design and technological competence are very important, but products of major interest to developing countries are in the lower quality segments, based on simple technologies and price rather than quality competition. The most representative sectors include textiles, garments, footwear and agroindustry.
- *Intermediate level.* Sectors at this level are the heartland of industrial activity of catching-up countries, comprising the bulk of skill and scale-intensive technologies in capital goods and

> **As countries move from simple assembly technologies to being able to import, adapt and operate state-of-the-art technologies, the skill profile gradually evolves from basic production skills to highly specialized professional skills**

Table 4.4
Structural change, skill demand and education and training

Industrial deepening	Technological capability	Skill demand	Education and training	In-firm training	Links to other players
Low-level, simple assembly and processing mainly for domestic market	Ability to master simple assembly technologies, copy simple designs and repair machines, but no capacity to adapt processes	Literacy, numeracy and simple technical and managerial training	Formal primary education	No formal in-firm training. Informal learning through repetition and trial and error	None likely
Intermediate level, including export-oriented activities in light industry	Capability to undertake minor adaptations to processes and products, but little or no design and development capabilities	Low base of engineering and scientific skills. Small and medium-size enterprises have low skill levels	Good secondary and technical schooling and management and financial training	Some in-house training mainly by export-oriented firms	To buyers and suppliers, but very unlikely to technology institutions
Advanced and deep industrial structure mainly in technology-intensive industries	Ability to monitor, import, adapt and operate state-of-the-art advanced technologies	Highly specialized manufacturing skills with a focus on technical subjects such as engineering and mathematics	Excellent tertiary technical education and specialized industrial training by institutions of technical and vocational education and training. High numbers of university-trained managers	Large investments in formal and informal in-firm training	Strong to suppliers, buyers, consultants, universities and technology institutions

Source: Adapted from Lall (2001).

intermediates. They have relatively complex technologies, moderate R&D spending and need some scientific skills. The most representative sectors include engineering, transport equipment, chemicals and other processing industries.

- *Advanced and deep industrial structure.* These sectors have fast-changing technologies, with high R&D spending, high skills and prime emphasis on product design. The most innovative technologies require advanced-technology infrastructure and close interactions among firms and between firms and research institutions. The most representative sectors include electronic and electrical products, precision instruments, pharmaceutical and automobiles.

The shift from low-level industrial deepening to advanced industrial structures entails changes in technological capabilities and skill demand. The general trend is that as countries move from simple assembly technologies to being able to import, adapt and operate state-of-the-art technologies, the skill profile gradually evolves from basic production skills to highly specialized professional skills.

This course also involves changes in skill acquisition through formal education and in-firm learning. Broadly, a solid primary and secondary education is fundamental for countries and low and intermediate levels. Although some forms of technical training may be needed, the emphasis is on developing basic literacy and numeracy skills to operate simple technologies. There is informal in-firm learning through repetition and through trial and error but no deliberate effort by firms to invest in skill development. Salaries at this level are low and workforce turnover high. Although there may be links to buyers and suppliers at the intermediate level, the interaction does not generate learning spillovers.

The structural change towards advanced industrial structures requires skills to deal with progressively more complex and fast-changing technologies. Countries excelling in technology-intensive industries need a highly qualified labour force with a strong

> **As the pattern of skills required to compete in modern manufacturing changes, so must the institutions and methods for skill formation**

technical background – there is an emphasis on university enrolment in technical subjects such as science, mathematics, engineering and manufacturing. Romijn and Albaladejo (2002) show that specialized knowledge and experience in science and engineering matter more than general managerial capabilities and intermediate-level technical skills in explaining innovation excellence by high-tech firms. At this end, firms invest heavily in skill development through in-firm training and through direct involvement in apprenticeship programmes. In particular, specialized training by semi-public technical and vocational education and training institutions helps firms co-share training costs while guaranteeing the applicability of skills in the workplace.

Box 4.3
Tacit knowledge – not embodied in designs or blueprints

Tacit knowledge is in the minds of scientists, specialist workers and industry entrepreneurs. Accessing it requires direct contacts feasible only where firms are located close together. Tacit knowledge is more important in some industries that others, but is typically important in the early stages of highly innovative industries before product and process designs become codified and standardized. Key mechanisms for transmitting tacit knowledge include start-ups by researchers or employees of other firms, labour mobility between firms and joint research initiatives.

Source: Industrial Development Report 2013 Team.

As the pattern of skills required to compete in modern manufacturing changes, so must the institutions and methods for skill formation. Most traditional methods of education and training are inadequate today. In the traditional setting, industrial development in technologically less-developed sectors often only entailed improving the quantity and quality of primary and secondary schooling and developing basic technical skills through on-the-job training. In the emerging competitive setting, greater emphasis is placed on high-level, specialized training, with more formalized on-the-job training and vocational education, featuring closer interaction between educational institutions and industry (UNIDO 2011a). Important here is developing the tacit knowledge (as opposed to formal or codified knowledge as taught in formal education – Box 4.3) that is difficult to transfer to other users, such as using manufacturing equipment. Firms that provide training are more likely to have higher levels of technology and skills (CEDEFOP 2012).

Educational attainment structures

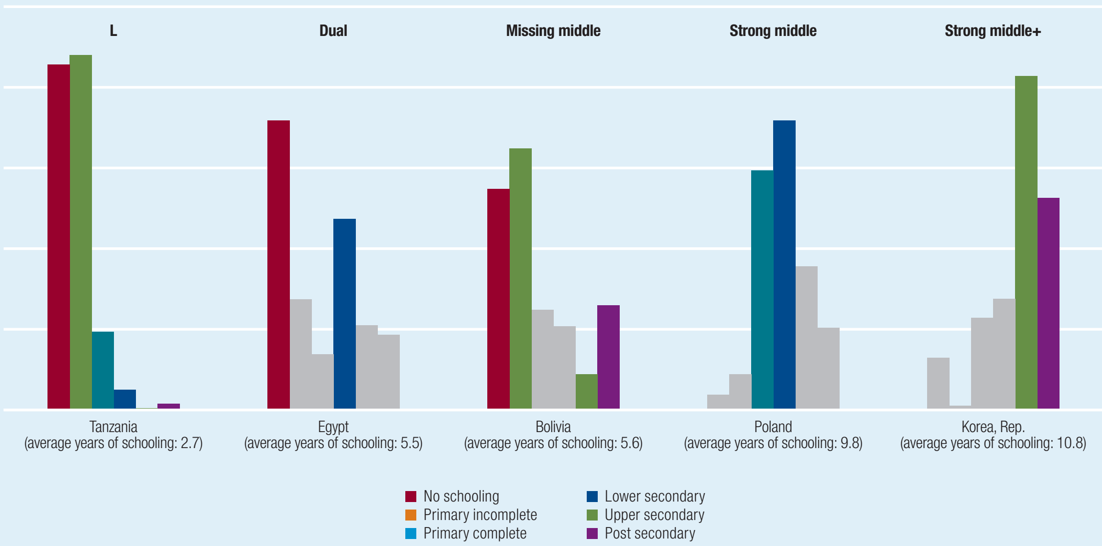
While industrialization requires a labour force with progressively higher levels of skills and knowledge (with commensurately longer years of schooling), levels of skills and schooling educational attainment structures are also important for industrial transformation and diversification into higher value added products (Nübler 2013b). The educational attainment structure shapes the mix, diversity and complexity of the social knowledge structure, thus determining the options space for structural and technological change. Based on the Barro-Lee dataset that provides information on the share of the labour force (older than 15 years) with no schooling, incomplete primary, complete primary, lower secondary, upper secondary and post-secondary as highest educational attainment, Nübler (2013b) developed a typology of educational attainment structures that allows for analysing a country's options space. By sorting these seven educational categories in increasing order, the different lengths of the six bars suggest five different educational structures (Figure 4.4; Box 4.4).

Empirical analysis of educational attainment structures shows that the strong middle structures (SM, SM+) provide the highest options for productive transformation, characterized by both industrial widening (broadening the manufacturing base) and industrial deepening (diversification into higher technology products; Nübler 2013c).

The study used the Industrial and Technological Advancement Index (ITA) developed by UNIDO (2005) to measure the level of industrial and manufacture development. Ranging from 0 (the lowest industrial and technological advancement) and 1 (the

> **The educational attainment structure shapes the mix, diversity and complexity of the social knowledge structure, thus determining the options space for structural and technological change**

Figure 4.4
Main educational attainment structures



Note: For definition of educational attainment structures, see Box 4.4.
Source: Nübler (2013b) based on Barro and Lee (2000).

Box 4.4
Typology of educational attainment structures

L-shape educational structures with the median category being non-schoolers or (complete and incomplete) primary education show extremely low shares of upper and post-secondary education. *L+* structures have the shape of an L-curve but with higher shares of upper and post-secondary education.

Dual structures may be described as the composition of distinct education structures of two groups (such as rural and urban). It shows high levels of non-schoolers and incomplete primary education, but low shares of primary (like the L). Secondary and post-secondary categories show a structure more similar to the strong middle structure – that is, it includes high shares of lower, upper and post-secondary education.

Missing middle (MM) structures demonstrate high shares of primary and lower secondary education, very low shares of upper secondary education and high shares of post-secondary. MM countries have a bimodal structure with very low shares of lower and upper secondary education. *MM+* countries show a trimodal structure, differing from the MM structure, with significantly higher shares of lower secondary education, but lower shares of incomplete primary education.

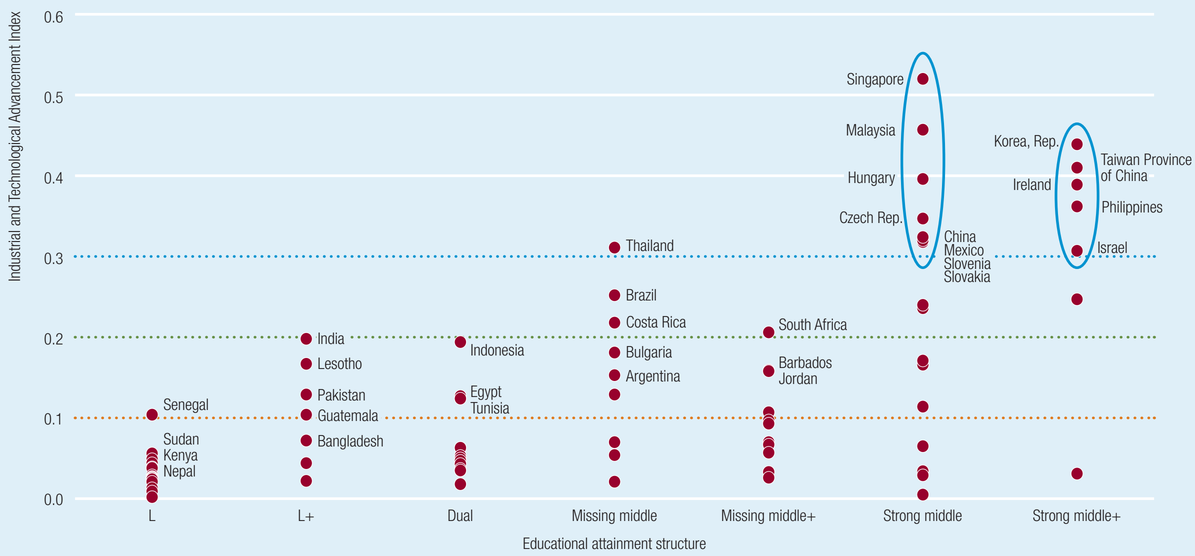
Strong middle (SM) structures take the form of a bell curve with the median on primary, lower (medium categories) or upper secondary (high categories) education. As countries increase levels of average years of schooling, the median is shifted from primary to lower (SM) to upper secondary education (SM+).

Source: Nübler (2013b) based on Barro and Lee (2000).

highest), the ITA is a composite index based on the share of manufacturing in total production and exports and share of medium and high technology products in total production and exports. Analysis of educational attainment structures and the ITA shows that countries with strong middle education structures (SM, SM+) achieved ITA levels above 0.3 (Figure 4.5). Countries with ITA levels below this threshold are mainly small economies and transition countries that have either specialized in the services sector or on resource-based industries. By contrast, missing middle education structures (MM, MM+) define tighter boundaries and limited options for industrial and technological expansion. This is indicated by the lower ITA values of countries

“Technological change and greater pressures to compete have put a premium on high-level technical skills

Figure 4.5
Educational attainment structures and industrial development



Note: For definition of educational attainment structures, see Box 4.4.
Source: Nübler (2013b) based on Barro and Lee (2000) and UNIDO (2005).

with such structures, mainly ITA levels of below 0.2. Further, countries with L, L+ and dual education structures face the fewest options to industrialize. ITA values for all countries remain below 0.2. While countries with the L structure are almost exclusively below the 0.1 ITA threshold, the L+ and the dual structures with their higher shares of secondary and post-secondary education can pass this threshold. But these countries developed competitiveness mainly in the garment and textile industries at low-tech levels.

Skill-biased technological change

Technological change (discussed in the next subsection) and greater pressures to compete have put a premium on high-level technical skills. This trend started early in the 20th century, causing a bias in technological change for technology that uses skills, suggesting that where skill-using industries are located, better jobs are created. (This was in direct contrast to 19th century technological change, which was largely focused on skill saving or de-skilling as tasks previously undertaken by skilled artisans were replaced by repetitive factory-based operations.)

Accompanying this demand for skills was higher capital investment, so that skilled labour and capital became complements not substitutes. Conte and Vivarelli (2007), among others, tested the complementarity between technological innovation and labour skills. They used a dataset of almost 5,000 observations from 28 manufacturing sectors in 23 countries. They found that capital deepening (a rising capital–labour ratio) was responsible for a relative shift in demand towards skilled labour.

The trend towards a skills bias during most of the 20th century intensified from the late 1970s with the revolution in information and communications technology (ICT); the spread of computers and computer-based production systems; and the changes in organization practice and design of products and processes that all this has allowed. Spitz (2004) reports that from 1979 to 1999 employment in the Federal Republic of Germany shifted from manual labour to more analytical jobs. She considered that this change accounted for around half the educational upgrading during these years. And she found that skills in computer technology were complementary to analytical and interactive skills.

> **There are two main sources of innovation – R&D investment and embodied technological change, where the innovation is embodied in new equipment**

ICT has been described as a "general purpose technology" with pervasive effects across the economy, creating a continual process of technological improvement leading to falling costs for users and a continual process of innovation (Bresnahan and Trajtenberg 1995).[5] This is the equivalent of the key technological breakthroughs of earlier times like the printing press, steam power and electricity and also reflected in the similar patterns of spatial distribution between manufacturing in the early 20th century and services in the late 20th century (see Box 2.2 in Chapter 2).

ICT and computerization more widely – in increasing demand for inputs of non-routine cognitive and manual tasks and shifting the relative demand for labour – have created a "polarization effect" in the employment structure of higher income economies (Autor, Levy and Murnane 2003). These countries generally show a falling employment share taken by middle-skill and middle-wage occupations, as the adoption of computer-based technologies has increased demand for educated and skilled workers (who can do non-routine abstract tasks) and for low-wage, low-skill workers (who have manual flexibility and adaptability; Acemoglu and Autor 2010).

This skill bias has been explained by the rising supply of skilled workers in the technology-creating economies and may partly account for the fall in real wages of low-skilled workers (Jaumette and Tytell 2007). In developed economies it is now fairly well established that technological change in a skill-biased direction has been a key factor in creating a falling labour share in GDP, as unskilled jobs are replaced by capital. The significance for developing countries – as technology importers – is that the technology transferred to them has been created in response to market conditions in advanced economies.

The effect of such change has been put forward as one of the explanations as to why, unexpectedly, trade liberalization has only rarely been associated with the one of the key predictions of standard trade theory – a rise in relative wages for unskilled labour in low-income countries (Arbache, Dickerson and Green 2004; Robbins 2003). If firms in developing countries are forced by competition and induced by trade liberalization to import best-practice technology – where there is little scope for factor substitution – this will raise the demand for skilled labour over unskilled and import a skill bias into the economy.

But skill-biased technological change is not automatic in all industries in all developing countries. It did not, for example, occur in the sewing segment in the garment industry in Bangladesh (Fukunishi and Yamagata 2013).

Technology: a dominant driver of structural change

Technology determines overall output and productivity as well as labour productivity specifically. Although labour productivity can be improved by using technologies more efficiently over time, trends in its growth are closely linked to how new technology is applied and modified, and to what extent it creates or displaces jobs.

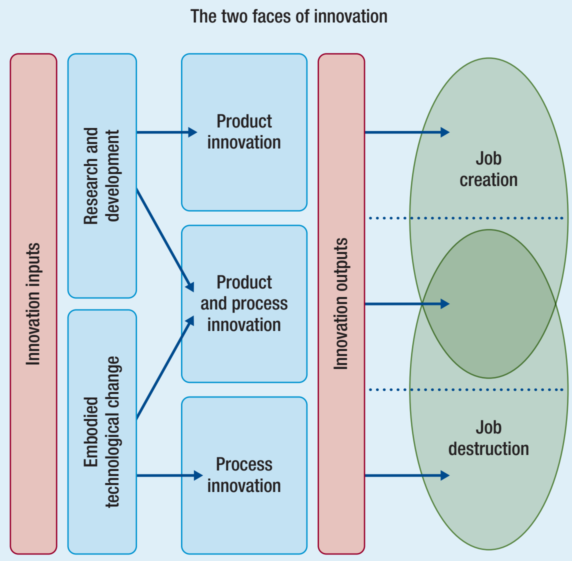
Job creation and destruction

Most of the debate on innovation's impact on job numbers has focused on higher income economies. There are two main sources of innovation – R&D investment and embodied technological change (ETC), where the innovation is embodied in new equipment. There are also two main types of innovation outputs: product innovation – altering the product mix by creating either genuinely new products or products adapted from existing designs; and process innovation – altering the system of production to reduce costs or improve quality (Figure 4.6).

Although the distinction is not precise, the literature on innovation suggests that only complex product innovation (delivered mainly by large firms in high-tech sectors) relies on formal R&D, while process innovation – where it is not so easy to single out pure innovation, diffusion and imitation – is much more related to ETC acquired by investment in new machinery and equipment and by purchasing external technology incorporated in licences, consultancies and know-how.[6] Again generalizing, R&D is most

> **Product innovation creates jobs through the emergence of new markets, and process innovation creates a direct labour-saving effect**

Figure 4.6
Innovation inputs and outputs and their impact on employment



Source: Vivarelli 2013.

crucial in large firms and more advanced sectors, while ETC assumes a dominant role in small and medium-size enterprises (SMEs) and more traditional sectors.

Thus theoretically innovation has two inputs and two outputs, with R&D mainly (but not only) related to product innovation and ETC mainly (but not only) related to process innovation, with the possibility of some overlap in mixed activities which entail both product and process innovation.

The main implications of the distinction for employment are that product innovation creates jobs through the emergence of new markets, and that process innovation creates a direct labour-saving effect, mainly related to introducing machines that allow the same output to be produced with fewer workers.

Although the expectation is that developing new markets through product innovation will create new jobs, this has to be balanced against the potential loss of jobs in the sectors producing the displaced products. Many process innovations are intended to be labour saving but a number of dynamic "compensating mechanisms" exist that may offset these labour-saving effects in whole or in part, making it difficult to calculate the exact net employment outcome of technological change (Box 4.5).

But none of these mechanisms compensating for the direct displacement effect on jobs is automatic, and to work they require particular conditions to hold. Economic theory has no precise answer for the ultimate employment impact of process innovation.

Box 4.5
Labour-compensating mechanisms of technological change

Through new machines. The same process innovations that displace workers in the product industries where the new machines are introduced create new jobs in the capital industries where the new machines are produced.

Through decreases in prices. Although innovations involve the displacement of workers, these innovations lead to a decrease in the unit costs of production, and in a competitive market this effect leads to decreasing prices; in turn, decreasing prices stimulate new demand for products and so additional production and employment.

Through new investments. In cases where the competitive convergence is not direct, during the gap between the decrease in costs – due to technological progress – and the consequent fall in prices, extra-profits may be accumulated by innovative entrepreneurs. These profits are invested, creating new output and new jobs.

Through declines in wages. Where there is demand for labour, the direct effect of job-destructive technologies may be compensated within the labour market. Assuming free competition and full substitutability between labour and capital, technological unemployment implies a decrease in wages and this should induce a reverse shift back to more labour-intensive technologies.

Through increases in incomes. Trade unions may redistribute part of the innovation rent back to the workforce and thus a portion of the cost savings due to innovation can be translated into higher wage income and hence higher consumption. This increase in demand leads to an increase in employment, which may compensate for the initial job losses due to process innovations.

Source: Vivarelli 2013.

> **Innovators were found to employ a greater number of unskilled and female workers than non-innovators**

Price and income mechanisms can counterbalance the direct job destruction caused by process innovation, but their effectiveness depends on many parameters such as the degree of competition, demand elasticity and the way business expectations are shaped.

Empirical studies of the innovation–employment links have focused largely on higher income economies and tend to show that product innovations are usually associated with employment growth, while the effect of process innovations is often negative. R&D spending has been shown to have a positive employment effect, principally in high-tech sectors.[7] Net employment usually rises with innovation, and government support for product development rather than technological change is more likely to lead to employment generation.

Work on a large database created from the World Bank Enterprise Surveys of 2002–2006 and covering more than 26,000 manufacturing establishments in 71 countries confirms the employment–innovation link (Dutz et al. 2011). Firms that introduced a product or process innovation (judged by their own responses in the survey) had employment growth of 2.9 or 2.1 percentage points, respectively, above that of non-innovating firms (controlling for all other factors). Process innovation had a positive employment effect overall, but not for the largest enterprises (more than 200 workers). Product innovation had a positive employment effect, which was larger than that for process innovation and was significant for all size categories.

Innovators were also found to employ a greater number of unskilled and female workers than non-innovators. But the link between process innovation and unskilled employment growth was weaker than with product innovation, and there is some evidence that non-process innovators may have had a stronger link with employment of unskilled labour. Female employment in developing countries was strongly linked to innovation, while across the whole sample of countries it appeared to be linked to innovation only in new and medium-size enterprises.

Industrial organization: the underlying driver

The way an industry is organized has a profound influence on structural change through shifts in output, productivity, growth and employment. Important elements to be considered are firm size, production fragmentation, and spatial distribution and clustering.

Firm size

Average firm size in the manufacturing sector, measured by formal sector employees, declined in 1981–2007 in all country income groups except for low-income countries, reflecting the fact that smaller firms dominated start-ups and employment growth (Table 4.5). Further, across almost all branches of manufacturing, average firm size is lowest in high-income countries and highest in low-income countries, reflecting the trend for the proportionate share of SMEs to rise with per capita income.[8] The larger average firm size in the low-income group is likely to reflect the dualistic manufacturing structure there, with formal manufacturing dominated by large producers and a relatively large informal sector (not covered in the table), with many very small firms.

Table 4.5
Average firm size by country income group, selected periods, 1981–2007 (number of employees)

	High income: OECD	High income: non-OECD	Upper middle income	Lower middle income	Low income
1981–1985	202	138	317	147	187
2001–2007	58	175	127	112	208

OECD is Organisation for Economic Co-operation and Development.
Note: Average employees per firm calculated as simple average of International Standard Industrial Classification two-digit branches.
Source: UNIDO estimate based on UNIDO (2012a).

While SMEs have proved a key driver of employment growth, they have not been a driver of productivity improvements within manufacturing in most cases

Several formal analyses of the performance of SMEs have been conducted using detailed databases compiled from the World Bank Enterprise Surveys. Defining SMEs as formal sector enterprises up to 250 workers, Ayyagari, Beck and Demirguc-Kunt (2003) found that in the sample of up to 76 countries for the 1990s manufacturing SMEs accounted for 32 percent of total employment for the low-income group, compared with 54 percent for the middle-income and 64 percent for the high-income groups. Regression analysis of these data (controlling for country characteristics and the starting level of per capita income) finds that the size of the SME sector is positively associated with economic growth, though it does not support the interpretation that size causes higher growth. It seems that in the 1990s a rising share of SMEs in employment and income was a characteristic of fast-growing economies.

The same database provides estimates of informal unregistered economic activity, which shows a clear tendency to decline as a share of national income as economies grow. Thus the rising share of SMEs is partly a result of declining informal activity, as previously unregistered firms shift into formal manufacturing. Perceived obstacles to the expansion of small firms, like constrained access to credit and the costs of starting a business, are associated with smaller shares of SMEs in economic activity at the country level.

Across all countries, firm size is a significant determinant of employment growth and where there are more SMEs, regressions suggest that there is higher employment growth. Nurturing SMEs is conducive to employment growth. There is a slight tendency for this to be stronger at the smaller end of the SME scale (up to 100 workers), but a dummy for the size group 101–250 is also significant. In countries with employment increases over the period covered by the surveys the vast majority of new jobs are created by SMEs (defined in the broadest way as up to 250 employees). This negative association between size and employment growth holds even when controlling for the age of firms, unlike a recent finding for the United States (Haltiwanger, Jarmin and Miranda 2010). Thus it is not the case that the employment effect is due to new firms taking on more workers and tending to start as SMEs. But SMEs have a significant negative association with productivity growth (again controlling for firm age). In addition, new smaller firms, as well as small mature firms (more than six years) tend to have lower productivity growth, allowing for the sector in which they operate (Ayyagari, Demirguc-Kunt and Maksimovic 2011). The results do not differ between groups of countries when they are separated by size of the informal sector.

Thus it appears from this database that while SMEs have proved a key driver of employment growth, they have not been a driver of productivity improvements within manufacturing in most cases. Promoting industrial SMEs to generate employment should be accompanied by efforts to upgrade them technologically, so that these firms also perform a positive role in capital accumulation.

The databases discussed above exclude informal and micro firms (fewer than five employees) and so do not capture much manufacturing in low-income countries. There, the informal economy forms the bulk of manufacturing employment, and growth of informal employment is usually due to new start-ups rather than to the expansion of informal firms (Sandefur 2006). In such countries few informal enterprises appear to graduate to formal status and of those that do even fewer grow to become medium-size enterprises. Efforts to link the size of the informal sector to business environment conditions – like the cost of starting a business and enforcing a contract, and rigidity of employment laws – have found some association, though it is clear that other factors, such as difficulty in accessing credit and general macroeconomic conditions, also work to explain the size of informal activity.

Production fragmentation

Structural change is driven by the extent to which firms can segment the production process and locate production to minimize unit production costs. Producing a final product in one location may offer little scope for changing the capital–labour ratio. But

> **Product fragmentation through the spread of global and domestic production networks allows the retention of manufacturing jobs in industry segments where such jobs might otherwise have been lost**

once it becomes possible to fragment production into a series of stages, some stages will inevitably be more labour intensive than others and, with low transport and communication costs, it may be cost-effective to move these to a low-wage area.

The parts of the production process where wage costs become the critical determinant of location are simple assembly of parts or simple forms of product processing, which are largely manufacturing by hand. Assembly can relate to technologically simple products like toys or sports goods and processing to the sewing of materials for clothing. Highly sophisticated electronic products, such as iPhones, are also assembled in low-wage areas (see *The role of global value chains* in Chapter 5).

Over time with higher savings in these economies the capital–labour ratio will rise again, and jobs will move to locations with the lowest unit labour costs. But in the short run the impact in depressing prices of labour-intensive manufactures and in increasing competition among producers of such goods is substantial. Thus product fragmentation through the spread of global and domestic production networks allows the retention of manufacturing jobs in industry segments where such jobs might otherwise have been lost through substitution through process innovation.

Spatial distribution and clustering

Structural change and the move from low to high tech are driven by the way firms are distributed spatially and able to collaborate and cluster. Geographical proximity between producers as a means of maximizing spillovers and other external effects, like labour availability, has received prominence in discussions relating to agglomeration effects and provides a rationale for creating special economic zones and related measures to encourage firms to cluster. A higher level of population density is positively associated with a higher level of manufacturing employment for 15 of 16 industries (see Figure 3.22 in Chapter 3). Key potential advantages for a firm being close to other producers are:

- Access to a pool of skilled labour drawn to the area by the presence of similar firms.
- Spillovers though the sharing (or copying) of technological or marketing knowledge and the sharing of access to equipment and other facilities.
- Joint learning and developing of innovations through continuous interaction and working on the same problem.
- Opportunities for jointly marketing products and benefiting from buyers that can source all product from one location.
- A network of specialist suppliers drawn to the area by enough user firms near the suppliers to reduce transport costs, to help ensure timely delivery and to reduce coordination difficulties.

A distinction has been drawn between localization (agglomeration) effects of clusters of similar producers and urbanization effects of clusters of diverse producers. The hypothesis is that agglomeration effects are more important for standardized and mature industries, while urbanization effects are more important for newer industries where producers in different subsectors but similar technological needs can benefit from the dynamic environment created by a diversity of activities (World Bank 2009).

In developed economies clusters of relatively small firms have been at the forefront of some breakthrough technologies (Audretsch 2002). Many small-firm innovations have been concentrated in fairly narrow areas (such as those around Boston and San Francisco in the United States). This tight localization has been put down to the critical importance of tacit knowledge (see Box 4.3). Such an explanation for the United States has parallels in China, the Republic of Korea, Taiwan Province of China and Thailand. But even in activities not highly innovative, small firms in some developing countries – chiefly in Asia and Latin America – have found it advantageous to group in clusters. Sectors include footwear (Brazil and Mexico), metalworking, simple engineering and electronics (India), textiles (India and the Republic of Korea), surgical goods (Pakistan), furniture (Indonesia) and software development (India, Uruguay and more recently Kenya; Weiss 2011).

“Agglomeration effects associated with clusters can be an important driver for development and structural change in industry

Empirical work reveals a raft of experiences among 10 clusters in low- and lower middle-income countries (UNIDO 2009). Collaboration between firms varies greatly from the casual exchange of tools and information to direct collaboration in sharing orders and training. In some cases clear specialization emerges with some firms as parts and components suppliers to other cluster-based firms; in others growing firms cease to rely on external suppliers and start to make some of the components they need. In some clusters social networks and cultural cohesion remain important; in others these are replaced by impersonal market relationships with external agents or traders stimulating links between firms.

Successful clusters allow small firms to expand and increase employment and even larger and more technologically sophisticated firms may benefit from being in a cluster. Yet success depends partly on the wider economic climate as well as firm-specific characteristics and the operating environment. In reviewing the evidence on clusters in Africa, Dinh et al. (2012) suggest that only the cluster in Mauritius has been an unqualified success for employment and growth. They highlight problems: targeting of inappropriate activities for the cluster, poor choices of location, poor infrastructure inside and outside the cluster, implementation difficulties and lack of long-term policy credibility for continued support.

The success of special economic zones in East Asia, particularly China, as an institutional arrangement to support clusters has been well documented. But such success with zones elsewhere has been mixed – especially disappointing in Africa. Sonobe and Otsuka (2011), contrasting experiences in Africa and Asia, find that Africa’s clusters are mainly “survival clusters” generating low incomes and lacking innovation and dynamism. They suggest that successful clusters are based on “multi-faceted innovation” that incorporates improvements in product quality, branding, use of reliable input suppliers and effective distribution, combined with an appropriate management system to allow cluster-based firms to control stocks, labour and financing. Developing the argument further using case studies, Sonobe, Higuchi and Otsuka (2012) regard a shortage of managerial capacity as one of the distinguishing features of unsuccessful clusters, especially in Africa.

The conclusion is that agglomeration effects associated with clusters can be an important driver for development and structural change in industry if the manufacturing process can be segmented and if optimal low-cost production opportunities can be found in different locations.

Business environment: a basic driver for structural change

The business environment has been highlighted as a key influence on enterprise growth and employment – for example, by *World Development Report 2005* (World Bank 2005). The investment climate has been defined as “the many location-specific factors that shape the investment opportunities and incentives for firms to invest productively, create jobs and expand” (World Bank 2005, p. 2). It covers aspects of regulation and corruption linked to the cost of doing business, as well as broad issues like the quality of infrastructure, the skill base, the difficulty of accessing sources of finance and aspects of the labour market – all crucial in low-income economies.

The effectiveness of the court system in enforcing contracts is important, particularly once countries reach a threshold per capita income. At lower incomes where transactions may be less complex, a weak legal system can be replaced by personal relationship-based transactions that enable business development. But at all country incomes it appears that risk of expropriation of a firm’s profits through informal payments and bribes is a negative influence on growth.[9] Small firms have been found to be more hindered by regulations than medium-size and large enterprises, for which access to finance and good-quality infrastructure are more important (Aterido, Hallward-Driemeier and Pagés 2007).

Barriers to entry such as minimum capital requirements, delays in obtaining permits and multiple procedures have been shown to have negative

> **Governments, working alongside the private sector, can help use key drivers, such as wages, technology, and education and skills, to change manufacturing industry and so boost employment generation while transforming the economy**

effects on start-up numbers and productivity. They are expected to have the most deleterious impact in frontier sectors (where technological change is most rapid) and in sectors where natural barriers to entry (for example, due to initial investment requirements) are relatively low (Djankov 2009). There is evidence that modest changes to the business environment have little impact on firm behaviour, particularly in highly regulated environments, and that reforms undertaken as a package have a stronger impact than reforms undertaken independently or sequentially (Klapper and Love 2010). A common example in the context of combining reforms relates to the removal of the investment licensing system in India, where a positive growth and employment effect was only found in states with less restrictive labour markets (Aghion, Algan and Cahuc 2008; Aghion et al. 2008).

Poor infrastructure is a major constraint on employment growth in low-income economies, particularly for export activities, as shown in a wide range of survey data. Infrastructure can drive structural change in industries through the costs they cause. But in less developed countries it is simply the existence (or absence) that shapes change in industries. From surveys of firms in Bangladesh, China, Ethiopia and Pakistan, measures of infrastructure (such as power losses and days to install a telephone line) dominate business environment indicators in an analysis of firm performance (Dollar, Hallward-Dreimeier and Mengistae 2005).

Recent analysis based on the large database created by the World Bank Enterprise Surveys reveals that aspects of the investment climate are important for employment growth across manufacturing firms in different size categories and countries. Controlling for these characteristics, Aterido and Hallward-Dreimeier (2010) find that employment growth in low-income countries is significantly related to reduced power outages and access to finance. Measured corruption and regulation (as proxied by management time spent with officials) have no significant impact on industrial development.

Dinh, Mavridis and Nguyen (2010) used the same large database to assess the most binding constraint on employment growth. They asked respondents to rate different constraints on a scale of 1 (minor) to 4 (severe). Overall labour regulation appeared as only a minor obstacle with electricity, taxation, corruption and access to finance the most severe.[10]

In conclusion, while regulations and control may impede growth in manufacturing in some circumstances, particularly in low-income Sub-Saharan countries, they are less central than the quality of infrastructure and the system of financial intermediation. More generally, governments, working alongside the private sector, can help use key drivers, such as wages, technology, and education and skills, to change manufacturing industry and so boost employment generation while transforming the economy.

Notes

1. For example, Manyika et al. (2012) suggest they are most important in the category of labour-intensive tradables, which are activities with a high labour intensity (up to 35 hours per $1,000 of value added) where price competition is strong and the ability to respond to market trends quickly is critical. For developing countries as a group, labour-intensive tradables are estimated at 10 percent of value added.
2. To be wholly accurate, comparisons such as these should use long-run equilibrium real exchange rates to convert local wage costs to a common foreign currency. These World Bank efficiency calculations test for the effect of real exchange rate changes.
3. Private returns to education are calculated based on incremental earnings. They normally exceed estimated social returns because in most countries individuals do not meet the full costs of their education. Wider externalities from education are difficult to incorporate in these calculations.
4. This argument applies less to Latin American economies where educational attainment is

relatively high but natural resource–based exports are a fairly high proportion of total exports. Similarly, Bangladesh and Pakistan also appear to be exceptions, where export expansion has been based on relatively low-skill products; see Machin and van Reenen (1998).

5. The diffusion of ICT still varies considerably even between higher income economies; see Castaldi et al. (2009).
6. Conte and Vivarelli (2005) found robust and significant evidence that R&D increases the likelihood of introducing product innovation.
7. Bogliacino, Piva and Vivarelli (2012) using a panel of European firm data find a positive employment effect of R&D in these sectors but not in technologically more mature manufacturing sectors.
8. In three two-digit branches (18, 31, 33) average firm size is highest in lower middle-income countries as opposed to low-income countries; even in the latter in 11 of 18 branches, average firm size has fallen since the early 1980s.
9. Beck, Demirguc-Kunt and Levine (2005) find that speed of courts in resolving disputes has no impact on firm performance while managerial time spent dealing with regulators and bribes paid has a negative effect. Similarly, Acemoglu and Johnson (2005) find protection from expropriation (what they term "property rights institutions") always to be statistically significant in explaining firm performance.
10. This analysis covers nearly 40,000 establishments in 98 countries.

Chapter 5

Trade and foreign direct investment as external drivers of structural change

Trade in manufactured goods is a key driver of structural change through four mechanisms: revenues from trade (generating resources for high-tech investments); pressure from buyers (accelerating learning and productivity); access to technology; and imports of capital goods.

But trade liberalization has not enhanced structural change in all regions: while East Asia has become one of the most important manufacturing production networks, aided by liberalization, Latin America has seen deindustrialization and growth-reducing structural change in the 1990s and 2000s.[1] In East Asia industrial policies were key to transform opportunities coming from the global market into structural change–driven industrialization. But as the outcome of trade openness policies can be so different depending on the effectiveness of state intervention, a sample of 44 countries on different continents offered only modest empirical evidence of a strong relationship between trade openness and structural change.

Trade openness is thus an opportunity – and a threat for low-income countries. Excessive specialization in low-tech manufacturing may be a risk if these countries have too much exposure to international markets, which increases volatility of export revenues and presents a consequent higher risk of non-sustained growth. Countries with a diversified manufacturing portfolio and the capacity to produce high-tech goods with few competitors, reflecting a high level of past structural change, are better equipped to absorb this risk.

The impact of trade openness on employment generation through manufacturing structural change is mediated by two mechanisms: labour-saving techniques and the extent of mechanization of production processes; and whether developing country exports are facing demand from buying countries that cannot be sustained in the long run. But the negative impact on employment of manufacturing structural change based on labour saving or volatile demand can be compensated for by industrial policies that achieve one or more of the following: ensuring that output growth in higher productivity sectors is strong enough to make up for the downward effects of employment growth; diversifying business activities towards more (highly productive) sectors and thus broadening the range and volume of total output; and leading to productivity changes that significantly stimulate local economic activity through multiplier effects.

Global value chains (GVCs) now underpin international trade. A country's production structure is determined by its ability to join, stay part of or move up GVCs, and technological upgrading is the best long-term strategy for preserving a country's participation in them. Still, despite growing product fragmentation and increasing international trade, the role of GVCs may be narrower in the future because of physical limits to product fragmentation and transaction costs.

Structural change can work to derail any "race to the bottom", where firms in rich countries are tempted to relocate to low-income countries with lower labour costs, less restrictive labour laws and weaker monitoring of labour conditions and environmental impacts. Governments – especially in low- and middle-income countries – should steer trade to stimulate productivity through knowledge diffusion, research and development (R&D) and learning-by-doing spillover effects. Bilateral investment treaties and multilateral cooperation can help ensure that cross-border investment and trade are conducive to low-income countries (see Chapter 9).

Finally, as with trade openness, foreign direct investment (FDI) is not a one-way bet: it can be a major force in promoting manufacturing structural change through diversifying production and exports, generating spillovers, creating more backward and forward linkages and improving local business conditions (see Box 9.1 in Chapter 9). Yet only when it is properly integrated with local economies can they reap the benefits.

An increase of trade openness is a growth opportunity for a country only if local resources can be deployed in adequate quantities to produce goods for the external market

Trade as a likely driver of structural change

Demand for manufactured goods from advanced countries represented the engine of growth in East Asia and many other developing regions adopting an export-led structural change approach. Expanding trade increases business opportunities for low- and middle-income countries. As pointed out by Freund (2009), the elasticity of trade to income rose from 1.77 in the 1960s to 3.69 in the 2000s, but not all developing countries outside East Asia took advantage of the market expansion.

Weiss (2005) suggested several factors conducive to structural change based on trade openness:

- Manufactures face an initial stage of import substitution when domestic production can capture the market served by imports.
- Growth of manufacturing output is more valuable at the margin than the same growth of agriculture or services, due to externalities and dynamic increasing returns to scale.
- Export-oriented growth may lead to further FDI and growth.
- Exporting exposes firms to foreign competition, technology and marketing, leading to productivity gains that would not be obtained from sales on the domestic market.

Trade in turn improves technology and productivity in four main ways. First, the increase in revenues from trade integration induces exporters to upgrade technology (Bustos 2011). Second, it exposes firms to forms of competition not present in the domestic market. Third, it improves quality standards and raises the efficiency of production processes to international levels as foreign suppliers exert pressure over domestic suppliers (Weiss 2005). Fourth, it provides access to advanced capital equipment and R&D, and thus knowledge, as modern technologies are produced by a few developed economies. Empirical studies present evidence of this (such as Coe and Helpman 1995).

But trade cannot be the only driver of structural change, according to much theoretical work and anecdotal evidence. Even Wacziarg and Welch (2008), who argued that that open trade regimes experienced average annual growth about 1.5 percentage points faster after than before liberalization, acknowledge that trade openness works only if countries have the right business conditions. Political stability, commitment to trade policies, the non-existence of counteractive policies and the right macroeconomic conditions are all factors that may help make trade liberalization a success. The creation and strengthening of institutions protecting property rights, maintaining macroeconomic stability, regulating market participants and managing conflicts are also essential to boost technological upgrading and productivity (Rodrik 2001). Ocampo and Taylor (1998) add that an increase of trade openness is a growth opportunity for a country only if local resources can be deployed in adequate quantities to produce goods for the external market. Domestic production capabilities have to be already in place in order to respond to international competition, improve technology and exploit trade opportunities from increased liberalization.

In sum, the literature suggests that trade liberalization is not a precondition for structural change, and that its impact depends on the economic context and quality of industrial policies.

When trade works

In 1960 the Republic of Korea was poorer than many countries in Sub-Saharan Africa. It now leaves African countries far behind. Most explanations of the wider East Asian "growth miracle" stress export orientation and structural change towards high-tech exports, which climbed steeply during 1985–1998 (Table 5.1).

Beyond trade openness, industrial policy also played a crucial role in the East Asian miracle, steering structural change through manufactured exports. Many governments in the region implemented policies to improve the competitiveness of firms and promote export-led growth. They provided credit through state-supported banks, restricted competition from imports, constrained new domestic competitors and developed export-marketing institutions (Stiglitz and Charlton 2006).

> **Domestic production capabilities have to be already in place in order to respond to international competition, improve technology and exploit trade opportunities from increased liberalization**

Table 5.1
Share of manufactured exports by technological classification, 1985 and 1998 (percent)

	Resource-based		Low tech		Medium tech		High tech	
Economy	1985	1998	1985	1998	1985	1998	1985	1998
Korea, Rep. of	8.6	10.7	41.4	21.0	37.2	38.5	12.8	29.8
Taiwan Province of China	9.9	5.5	52.9	30.4	21.1	27.5	16.2	36.6
Singapore	43.5	14.1	8.6	7.0	23.4	18.7	24.5	60.2
Malaysia	53.7	16.7	8.0	11.0	11.4	20.3	26.9	52.1
Thailand	37.9	19.3	35.4	25.3	22.0	20.5	4.7	34.8
Philippines	56.0	7.2	24.1	14.5	0.9	10.9	11.0	67.4
Indonesia	75.2	38.8	15.5	33.0	6.4	18.5	3.0	9.7
Hong Kong SAR China	3.2	4.5	63.0	56.3	19.1	13.2	14.8	26.0

Source: Lall 2000.

When trade does not work

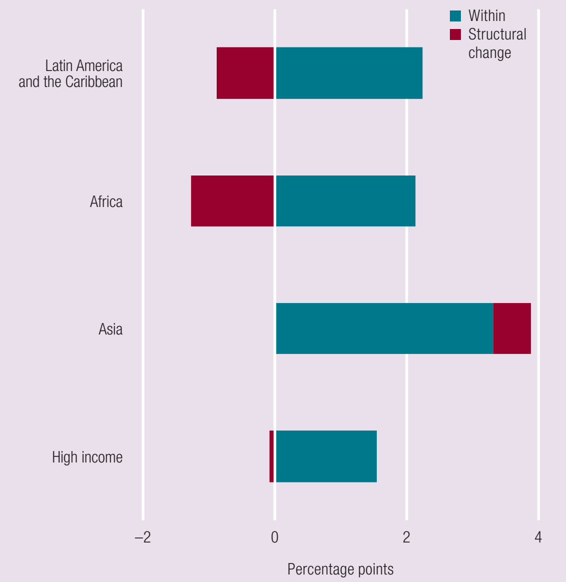
Pieper (1998) argues that Brazil formally started implementing trade liberalization policies in 1990. Until then its manufacturing sector absorbed labour with employment growth rates above the national average at about 4 percent a year, associated with negative annual rates of productivity growth. After trade liberalization manufacturing stopped absorbing labour, and gains in manufacturing productivity were associated with overall growth stagnation.

Jobs released from the restructuring of industry prompted by trade liberalization in Latin America (and in Africa) created two different negative mechanisms. First, the excess labour was absorbed by less-productive activities, such as agriculture and the informal sector (or even fed into unemployment), and for this reason the contribution of structural change to productivity was negative (Figure 5.1). Second, especially in poor countries, structural change often moved activities towards sectors with a low labour intensity (albeit with a high productivity) such as mining and quarrying. In poor countries with a mining sector that has weak links to the rest of the economy, few people are employed with very high labour productivity – labour productivity is 136 times larger in mining than in agriculture in Malawi, for example (McMillan and Rodrik 2011).

Cimoli and Katz (2003) argue that these factors, alongside undervalued exchange rates, may have hampered Latin America's attempts to upgrade its industrial value chain through liberalizing its trade policies. The region's economies failed to secure a sustainable pattern of technological accumulation or a narrowed productivity gap with the United States and Europe.

McMillan and Rodrik (2011) identify several factors that cause structural change to either enhance or

Figure 5.1
Decomposition of productivity growth by region, 1990–2005



Note: High income comprises Denmark, Finland, Italy, Japan, the Netherlands, Spain, Sweden, the United Kingdom and the United States.
Source: Adapted from McMillan and Rodrik (2011).

“The rigidity of the labour market reduces the absorption of released labour when trade openness pushes non-competitive firms out of the market

hamper growth and employment. The larger the share of agricultural employment, for example, the larger the opportunities for growth-enhancing structural change, as many people can be shifted from lower to higher productivity activities. Similarly, policies to overvalue the exchange rate may also be beneficial, stimulating export diversification and growth. Conversely, specialization in the production and export of commodities does not represent an incentive to upgrade, while the rigidity of the labour market reduces the absorption of released labour when trade openness pushes non-competitive firms out of the market.

Some evidence about the trade openness–structural change relationship

To garner some evidence about this complex relationship, data for the openness of trade in manufacturers (expressed as the ratio between manufactured imports and exports and GDP) and for structural change[2] (expressed as the value added in high-tech manufacturing divided by the value added in medium-tech and low-tech manufacturing) was plotted for 44 countries for 1997 and 2007 (Figures 5.2–5.5). All figures are divided into quadrants by a horizontal and a vertical line representing the average structural change index and the average trade openness index in the sample in 1997 and 2007 for four continents (Asia, the Americas, Africa and Europe).

The relationship between trade openness and structural change is in fact weak. A regression analysis between structural change and trade openness with the 1997 and 2007 data revealed a statistically insignificant relationship, even though the data suggested the existence of a positive correlation (0.17 in 1997 and 0.19 in 2007).[3] Countries are scattered in all four segments of the trade openness/structural change diagram.

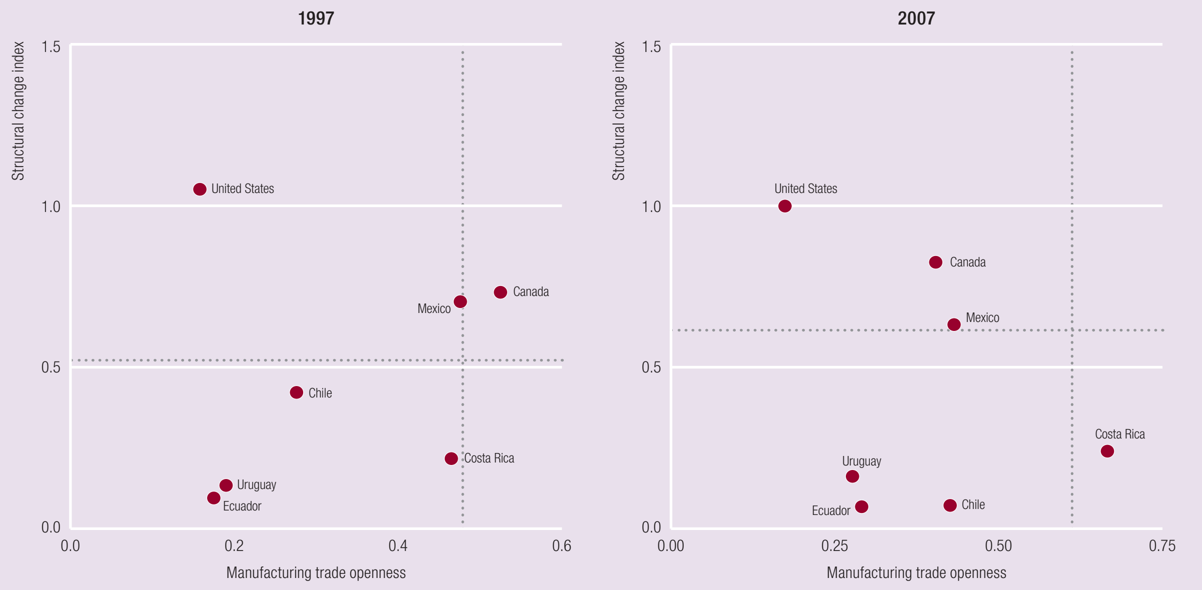
The upper-left quadrant encompasses countries that were successful in upgrading their economies towards high-tech manufacturing and that are not heavily exposed to trade in manufactures, as such trade (exports plus imports normalized by GDP) represents a share of national GDP below the average. This group includes the Republic of Korea (see Figure 5.2) and the United States (see Figure 5.3), with high production of capital-intensive sectors and fairly low exposure to trade openness.

Figure 5.2
Manufacturing trade openness and structural change index, Asia

Source: UNIDO estimate based on UN (2013a), UNCTAD (2013a) and UNIDO (2012a).

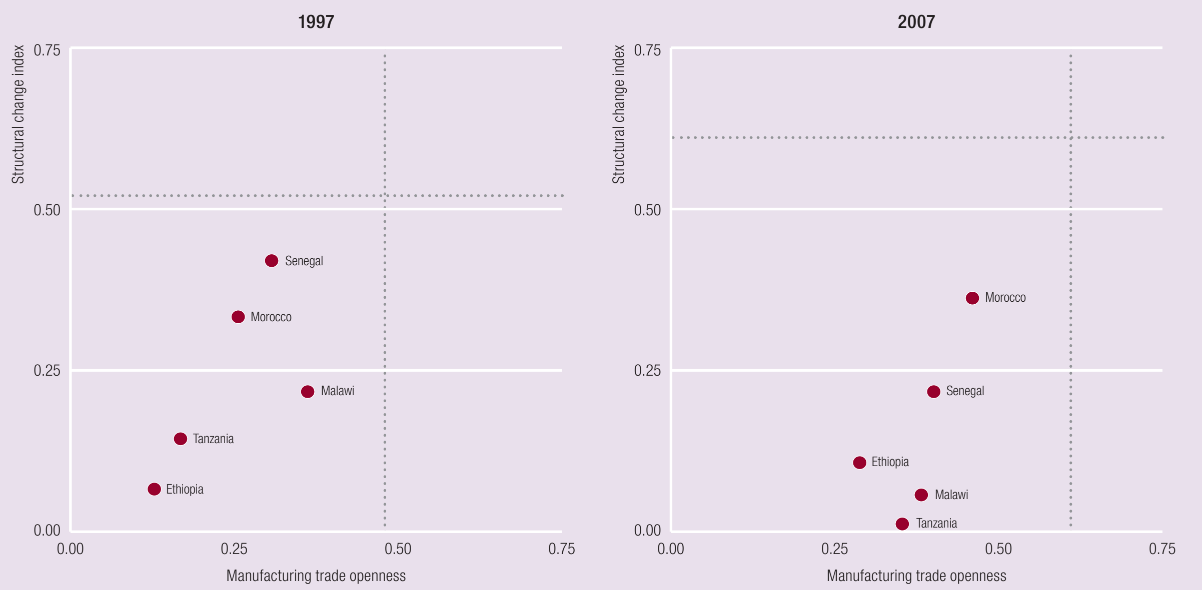
"No Latin American countries upgraded their industrial production despite the increasing trade openness over time

Figure 5.3
Manufacturing trade openness and structural change index, Americas



Source: UNIDO estimate based on UN (2013a), UNCTAD (2013a) and UNIDO (2012a).

Figure 5.4
Manufacturing trade openness and structural change index, Africa

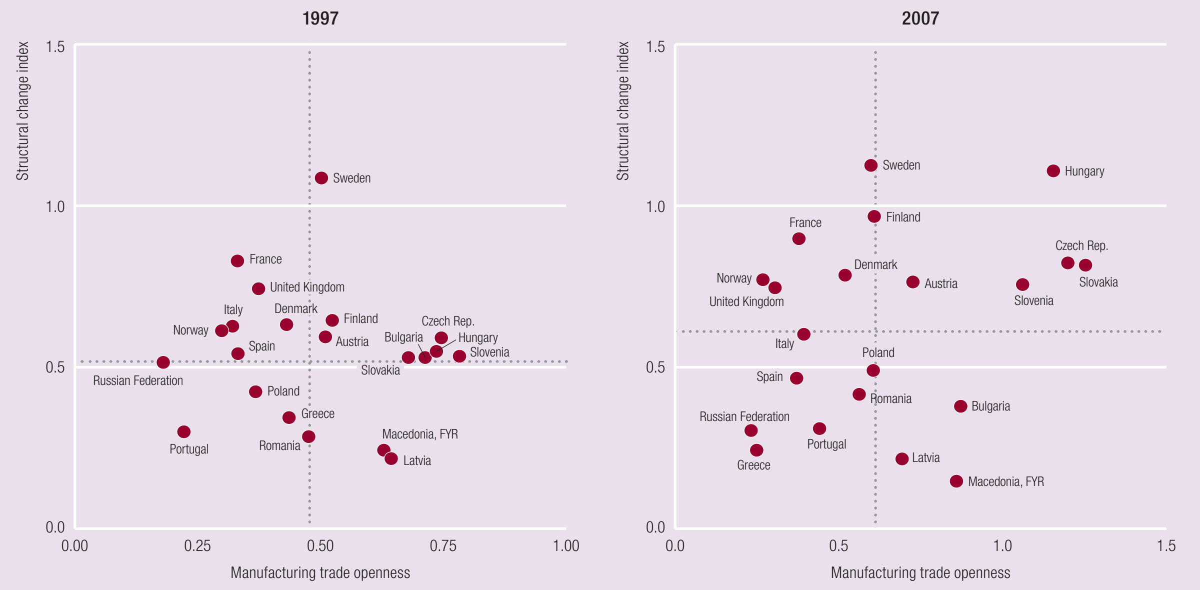


Source: UNIDO estimate based on UN (2013a), UNCTAD (2013a) and UNIDO (2012a).

The lower-right quadrant includes economies with high levels of trade openness but manufacturing structural change and upgrading below the average. Hong Kong SAR China belongs to this category between 1997 and 2007 (see Figure 5.2). Despite relocating light labour-intensive manufacturing industries to

Excessive specialization in low-tech manufacturing may represent a risk if countries are too exposed to the international market through trade

Figure 5.5
Manufacturing trade openness and structural change index, Europe



Source: UNIDO estimate based on UN (2013a), UNCTAD (2013a) and UNIDO (2012a).

China during the 1980s encouraged by rising labour and rent costs, Hong Kong SAR China still remains an economy with prominent printing, food and textile industries within the manufacturing sector, even though the services sector is now predominant in the overall economy.

The lower-left quadrant brings together low-income countries characterized by a low degree of trade openness, reflected in economic isolation, and low structural change. The countries in this group include Ethiopia, Malawi and the United Republic of Tanzania (see Figure 5.4). Their position in the lower-left quadrant also reflects their low capacity to exploit international business opportunities.

The upper-right quadrant includes Malaysia and Singapore, which are highly exposed to trade openness and have succeeded in upgrading their economies with a very competitive high-tech industry (see Figure 5.2).

No Latin American countries upgraded their industrial production despite the increasing trade openness over time (see Figure 5.3). Among the high-income countries, those in Southern Europe such as Italy and Spain downgraded theirs to below the average structural change index (see Figure 5.5). Countries in Eastern Europe are quite varied, with Poland and the Russian Federation having low trade openness and low structural change, and the Czech Republic and Hungary having high trade openness and high structural change (see Figure 5.5).

Over 1997–2007 both the average structural change index and trade openness index increased (from 0.48 to 0.61 and from 0.52 to 0.61, respectively), indicating that over 10 years the 44 countries became more successful in implementing structural change and on average more interconnected globally.

If the evidence on the relationship between structural change and trade openness is ambiguous, the data are clearer in showing that excessive specialization in low-tech manufacturing may represent a risk if countries are too exposed to the international market through trade. Concentration in a few categories of manufactured goods (or commodities) increases the volatility of export revenue and generates a higher risk of stop-start economic growth. This latter risk is reduced if countries have heavily changed their structure, as countries producing goods with a high

> **Structural change improves both the quality of goods and widens – or diversifies – the product mix**

technology content have less competition from global producers and are more likely to be resilient to shocks in manufacturing that could feed through to the rest of the economy.

Countries with the highest export concentration have the widest fluctuations in export revenue. They are often least developed countries with a high dependency on commodities (Table 5.2). Countries unable to diversify their economy towards greater technological complexity are more likely to see economic instability. With the "commodification" of low-tech manufactured goods, economies that do not upgrade industrial production are more exposed to market fluctuations than those relying on the production of high-tech goods (Kaplinsky 1993).

Structural change and diversification are strongly interconnected. Structural change improves both the quality of goods and widens – or diversifies – the product mix.

The potential for quality upgrading varies by category. Agricultural and natural resources tend to have lower potential for this than manufactures (Papageorgiou and Spatafora 2012). For low-income countries at early stages of development, expansion to manufacturing may be a necessary first step to secure the gains from quality improvement. Within manufacturing, structural change takes place as diversification from labour-intensive industries, such as textiles and wearing apparel, to industries with high skill, capital and technology intensity, such as advanced machinery, automobiles and chemicals (UNIDO 2012b).

Structural change of low-income countries towards high-tech sectors may help curb the negative effects of trade openness on employment and value added. This is because in a globalized world trade openness may lower manufacturing employment if developing countries suffer labour release (due to trade liberalization) that the natural resources sector can only partially absorb. And it may reduce value added if countries cannot diversify into high-tech non-mining manufacturing sectors.

We find that countries with the lowest openness to trade in manufactures and the highest structural change broadly correspond to the group of countries with the highest GDP per capita, such as Canada (see Figure 5.3) and the United Kingdom (see Figure 5.5). They are also the countries with the lowest GDP growth fluctuations over the period. Countries with high trade openness and low structural change are those with the highest GDP growth volatility (Table 5.3).

Among the group of countries with the highest trade openness, those with higher structural change show lower growth volatility. Countries with low trade openness in manufactures and low structural change have lower GDP growth volatility than countries with higher trade openness, but the difference is narrow. This is partly because the group of countries with a low openness to trade in manufactures and low structural change includes Kuwait, Malawi and Oman, which are exposed to fluctuations of primary commodity markets (oil for Kuwait and Oman, tobacco for Malawi).

Table 5.2
Export concentration and export revenue volatility, 2002 and 2008

Development status	Export concentration index 2002	Export concentration index 2008	Change from 2002 to 2008 (percent)	Relative deviation of export earnings (percent)
Advanced	0.07	0.06	–11.6	26.4
Developing	0.11	0.14	26.7	38.6
Least developed	0.31	0.54	71.2	52.6

Note: Relative deviation is the absolute value of the standard deviation–mean ratio.
Source: UNDP 2011.

“A more productive economy encourages additional demand for services and industrial products, which generates profitable investment opportunities and a growing demand for labour

Table 5.3
Coefficients of variation of GDP growth rates in different economy groups, 1997–2007

Group[a]	Coefficient of variation (standard deviation/average)[b]
Group 1: High structural change/low openness to trade in manufactures[c]	0.3
Group 2: Low structural change/low openness to trade in manufactures[d]	0.9
Group 3: High structural change/high openness to trade in manufactures[e]	1.0
Group 4: Low structural change/high openness to trade in manufactures[f]	1.2

a. Structural change and trade openness data for 2007 were used.
b. As a first step the aggregate group GDP as a sum of countries GDP in each group was calculated. Then annual growth rates for each group were calculated.
c. Canada, China, Denmark, Finland, France, Japan, the Republic of Korea, Mexico, Norway, Sweden, the United Kingdom and the United States.
d. Chile, Ecuador, Ethiopia, Greece, India, Italy, Kuwait, Malawi, Morocco, Oman, Poland, Portugal, Romania, the Russian Federation, Senegal, Spain, the United Republic of Tanzania, Turkey and Uruguay.
e. Austria, the Czech Republic, Hungary, Malaysia, Singapore, Slovakia and Slovenia.
f. Bulgaria, Costa Rica, Hong Kong SAR China, Latvia, the Former Yugoslav Republic of Macedonia and Mongolia.
Source: UNIDO estimate based on UN (2013a), UNCTAD (2013a) and UNIDO (2012a).

Thus two lessons emerge from the coefficients of variation for 1997–2007:

- Countries with the highest openness to trade in manufactures experience the highest fluctuations of GDP growth.
- Given a certain degree of openness to trade in manufactures (high or low), higher structural change helps stabilize economic performance.

Trade, structural change and employment creation

The impact of trade-based industrial structural change on employment is not straightforward. As discussed in the previous chapter, manufacturing stimulates structural change and employment through productivity growth, which is derived from specialization, learning and agglomeration economies, as well as from economies of scale. As labour and capital move into higher productivity activities, average productivity increases. A more productive economy encourages additional demand for services and industrial products, which generates profitable investment opportunities and a growing demand for labour (UNCTAD 2010a).

Two important mechanisms may, however, constrain employment generation (ILO 2012): labour-saving techniques and mechanization are increasingly becoming substitutes for human labour. Even in developing countries endowed with abundant labour relative to capital, technology transferred to them is often labour saving as it reflects the market conditions of technology-exporting advanced countries. Thus, the opportunity to absorb labour in manufacturing may be cut off prematurely (discussed in *Skill-biased technological change* in Chapter 4). Further, structural shifts have been based on export-led strategies and continuing global demand, often bolstered by a rise in debt in many developed nations, which is unsustainable in the long run.

To ensure that trade is positive for employment generation, government policies will need to ensure that:

- Output growth in the higher productivity sectors is strong enough to make up for the downward effect of productivity growth (UNCTAD 2010a).
- Diversification expands business activities of developing countries towards high-productivity sectors so that the scope and volume of output can be increased.
- Changes of productivity stimulate local economic activities through multiplier effects.

An increase of exports of developing countries may stimulate direct effects (additional labour demand to produce output), indirect effects (additional labour demand for intermediate inputs) and induced effects (additional production and labour deriving from the increase of household spending). Chen et al. (2012) report that for every $1,000 of Chinese total exports in 2007, domestic value added estimated at $591 and employment at 0.096 person-years (Table 5.4).

The role of global value chains

Global value chains and structural change

Chapter 4 showed that structural change is driven by the extent to which firms can segment the production process and locate production to minimize unit

Technological upgrading represents the best long-term strategy for protecting and promoting a country's participation in global value chains

Table 5.4
Effects of $1,000 of Chinese exports to the world, free on board, on total employment by sector, 2007 (person-years)

Manufacturing subsector	Employment multiplier
Food products	0.24
Textile and apparel	0.19
Sawmills and furniture	0.17
Papers and products	0.10
Chemicals	0.06
Non-metal mineral products	0.29
Metals smelting and pressing	0.13
Metals products	0.07
Common and special equipment	0.07
Transport equipment	0.07
Electric and electronic products	0.05
Other manufacturing products	0.12
Total for Chinese exports	0.10

Source: Chen et al. 2012.

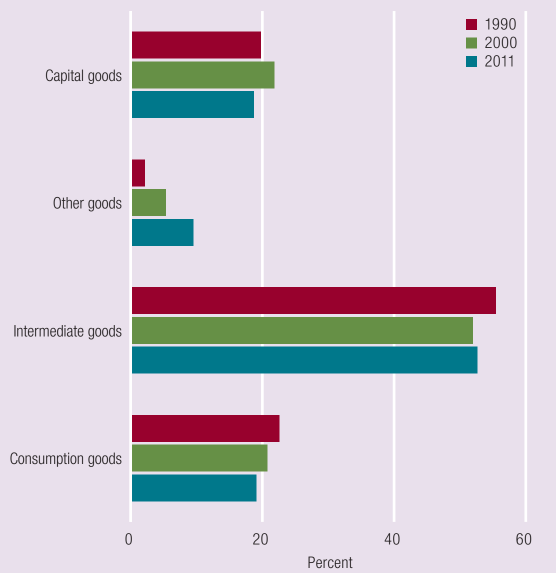
production costs. Thus product fragmentation has local and global dimensions – this subsection focuses on the global dimensions.

International trade has surged since the 1960s, far outpacing growth in GDP and becoming more fragmented since the 1980s. Domestic content accounts for only about half the total exports of the most important manufacturing country, China, and even less (18 percent) of its processed exports (Koopman, Wang and Wei 2008). China's exports in intermediate goods are growing faster than those of other Asian countries, and China is emerging not only as the centre of production but also as a leading processing hub in the region, being a prominent participant in global value chains (see Figure 2.7 in Chapter 2). Developing countries take advantage of GVCs because the increase in demand for intermediate goods and services creates opportunities for new firms and categories of workers to move into more complex and innovative activities (Sturgeon and Memedovic 2010). For this reason trade in intermediate goods is usually considered a good proxy for the size of GVCs. Global imports of intermediate goods are stable at more than 50 percent of the total (Figure 5.6).

Beyond traditional competitiveness drivers (production costs), a country's competitiveness can now be measured on its capacity to join, stay in and move up a GVC (Box 5.1). Technological upgrading – characterized by dynamic movement along the value chain towards production stages with higher growth potential that leads to structural change improvements – represents the best long-term strategy for protecting and promoting a country's participation in GVCs (Cattaneo et al. 2013). East Asian firms in the apparel market upgraded along the GVC with the shift from input assembly to original brand-name manufacturing, where firms design and sell their own branded products (Gereffi and Memedovic 2009).

But GVCs also pose challenges to firms in developing countries, the most important of which is that trade is unlikely to maintain its dynamism, as there are physical limits and transaction costs to product fragmentation. Elasticity of trade to income seems to have peaked in the 1990s (Table 5.5).

Figure 5.6
Share of intermediate goods in global imports, 1990, 2000 and 2011



Source: UNIDO estimate based on UN (2013a).

But global value chains also pose challenges to firms in developing countries, the most important of which is that trade is unlikely to maintain its dynamism

Box 5.1

Value chains development as an effective policy tool for promoting inclusive and sustainable growth: Malaysia's palm oil value chain

International best practice shows, that the identification of high-growth potential value chains and their promotion can be a fundamental driver for inclusive and sustainable growth.

In Malaysia the palm oil sector has notably contributed to the durable socioeconomic growth that over the last 3 decades, with the generation of long-term jobs and balanced revenue distribution, increased national value-added and export revenues.

The rapid expansion of oil palm in the 1960s was encouraged by Malaysia's government, which recognized its potential as a complementary crop to rubber.

"The oil palm is the world's most efficient oil-bearing crop in terms of land utilization and productivity. A hectare of cultivated oil palm land can supply about 10 and 5 times more oil than a soybean or rapeseed hectare, respectively. Whether further improvements occur in the agronomic performance of the palm or the nutritional property of palm oil, the crop's future depends on innovation through research and development" (May 2012).

The main palm product exported until the 1970s was crude palm oil. At that time taxation and incentive policies were introduced to encourage the export of refined palm products.

Malaysia currently accounts for 39 percent of world palm oil production and 44 percent of world exports. On average, the country produces 25 tonnes of palm oil a year (5–6 percent of the GDP) of which 84 percent is exported for more than $18 billion (60 percent of the total export earnings). Currently, more than 1.4 million workers are engaged in the palm oil sector, or 8 percent of the working population.

One of the biggest producers and exporters of palm oil and palm oil products, Malaysia has an important role in fulfilling the growing global need for oils and fats sustainably. With a head start of more than 100 years in the oil palm business, Malaysia has a competitive advantage and will continue to innovate with continuing support and facilitation of agronomic research, technology transfer and alliances with other centres of excellence to ensure the industry's sustainable development.

Malaysia – geographically small with scarce arable land for new oil palm plantations – continues to increase planter productivity and competitiveness through a nationwide replacement of unproductive palms with high-yielding hybrids. The exercise includes replanting on lands owned by independent smallholders who contribute to 14 percent of the area under oil palm in Malaysia.

Malaysia's example of supporting palm oil value chains demonstrates how identifying and developing value chains with high growth and employment potential can be an effective policy tool for ensuring inclusive and sustainable socioeconomic growth in the long run.

Source: Industrial Development Report 2013 Team.

Table 5.5

World trade to income elasticity, selected years, 1950–2009

	1950–1959	1960–1969	1970–1979	1980–1989	1990–1999	2000–2009
World trade to income elasticity	1.62	1.54	1.31	1.19	2.82	1.42

Source: Fontagné and Fouré 2013.

Other issues are that product differentiation on variety and quality matters less to non-high-income consumers than price. Consequently, the usual intensity of standards (public and private) in GVCs is going to be much less pronounced.[4] And given that emerging economies often have a comparative advantage in processing themselves, they will probably have a preference for importing relatively unprocessed products and may thus limit upgrading options for low-income countries that seemed to open up through the rise of GVCs in the past. Two case studies – one for cassava in Thailand and one for timber in Gabon – confirm that a market shift from the European Union to China has led to a decrease in the importance of standards and lower value addition in source countries (Kaplinsky and Farooki 2010).

Globalization may also cause global structural change because of re-balancing. China and the United

> **Technologically successful recipient economies built up capabilities to apply, adapt and modify foreign technologies, either in partnership with foreign firms or by copying from them**

States account for huge shares of global imbalances. There is widespread agreement that the current imbalances are unsustainable and that United States will reduce imports while China will increase consumer spending. As the import content and absolute value of Chinese consumption is lower than that of US households, this could affect exports and growth in low- and middle-income countries (UNCTAD 2010a; Mayer 2011).

For all these reasons implementing industrial policies to encourage firms to join, stay in and move up a GVC is not easy (see Chapter 7). The wide dispersion of productivity among businesses, the large number of unsustainable micro-enterprises and the stagnation of some larger firms suggest that the rapid growth of transition economies and East Asian countries in past decades will not be repeated in most developing countries (World Bank 2013a).

So, how do low-income countries take advantage of GVCs? Steps include encouraging the highest integration possible between the business systems of the low-income countries and the GVC; promoting traditional approaches (skill upgrading and vocational training, improving the business environment and aid for trade interventions for potential entrepreneurs in developing countries); and tackling "spoilers" – operators who are reluctant to change (WEF 2013). These operators include companies with high sunk costs or that depend on supply-chain barriers (like goods or services replaceable by alternative high-tech offerings). These constraints and lack of coordination could all hold back low- and middle-income countries from advancing along GVCs. That would be a huge loss: the 30 developing economies that successfully integrated in GVCs and showed the highest participation rates grew almost five times faster than the 30 bottom countries (UNCTAD 2013b).

Global value chains and technological change

The spread of global production networks based on a subdivision of the production process has had important implications for how technology is transferred and applied in importing developing countries. The technology transfer model of the 1960s and 1970s involved either FDI or transfer of foreign technology under licence. Technologically successful recipient economies built up capabilities to apply, adapt and modify foreign technologies, either in partnership with foreign firms or by copying from them. National support systems helped for R&D investment, training and various forms of subsidy, particularly in the most successful East Asian cases – the Republic of Korea, Singapore and Taiwan Province of China.

The newer form of technology transfer based on production networks has been termed technology "lending", with international firms providing their technology to produce parts needed for other elements of their global operations. In this interpretation industrialization has been made both "easier and faster" but at the same time "less meaningful" (Baldwin forthcoming). Before the 1980s, export success required a deep industrial base – a network of domestic suppliers and technological mastery. In the new era, firms in developing countries can link to international production networks and draw on the technological and marketing prowess of the lead firms in these chains.

One crucial effect of the new system is that much of the technology lent is specific to the lead firm and has tight intellectual property protection to prevent imitation. So once firms in developing countries are committed to GVCs, they risk finding it far harder than their predecessors in East Asia did to move through the various stages of own equipment manufacture. Their precursors worked with the lead firm from design, to manufacturing with their own designs, to finally breaking into world markets with their own brand. Many observers, such as Kaplinsky (2005), have commented on the risk that globalization is creating a distinction between "headquarter economies", where lead firms are based, where technology originates and where manufacturing profits are high, and "factory economies", where there is little technical innovation and where wages and profits are low.

In economies where this process of product fragmentation has played a major role, employment

“Trade is likely to have a positive impact on skilled labour but a negative impact on unskilled workers

growth in export manufacturing is likely to have contributed to rising inequality due to a relative rise in the demand for skilled labour (as discussed above). In developed economies the offshoring of lower productivity tasks raises the possibility of higher wages for the remaining jobs in manufacturing as the average productivity of those workers remaining in employment increases, again widening wage differentials with the rest of the economy.

Trade, particularly through the import of goods that embody new skill-intensive technologies, appears to have played an important role in increasing income inequality by raising the relative wage of skilled workers and increasing the premium attached to further education. Importantly, however, the relation between trade and inequality holds for trade between middle-income technology-importing countries and high-income countries, but not for trade between low-income countries and high-income countries nor for trade between low-income countries as a group.

Impact of trade in manufactures on employment quality

As seen at the start of this chapter, trade of manufactured goods may drive technological change and productivity. Economic theory postulates that productivity drives wages. So trade can improve employment quality through the productivity effect. Endogenous growth models providing theoretical foundations have largely focused on two types of technological change: R&D and learning-by-doing spillover effects (Grossman and Helpman 1991; Romer 1990; Box 5.2).

The literature has empirical evidence supporting the argument that trade improves skills and productivity through knowledge diffusion. Brazil started to liberalize trade in the 1990s, and exports and imports grew after 2000. Over the same period relative demand for skilled labour increased substantially. Technological transfer from richer countries upgraded the skills of Brazilian manufacturing firms (Araújo, Bogliacino and Vivarelli 2009).

Trade is likely to have a positive impact on skilled labour but a negative impact on unskilled workers. Evidence from six manufacturing sectors in Tunisia shows that unskilled workers are vulnerable to trade as they face increasing competition in the output market. Skilled labour is better positioned because the increase in market opportunities in skill-intensive markets derived from additional trade openness outweighs substitution possibilities for this category of worker (Mouheli and Ghazali 2012).

Rodrik (1997) identifies three main impacts of liberalization on the international labour market. First,

Box 5.2
Research and development and learning-by-doing spillover effects from trade

Coe and Helpman (1995) provide a theoretical and empirical background on the relationship between trade and spillovers. They estimate that foreign research and development has beneficial effects on domestic productivity, and that these are stronger the more open an economy is to foreign trade. Developing countries will be able to enjoy technology spillovers based on their capability to absorb technological change. Short geographical distance, short technological distance (expressed as a similar distribution of patenting among different technologies) and linguistic and trade-bloc relations all encourage technological transfer. The flow of knowledge is more likely to occur between leader innovators (Verdolini and Galeotti 2011).

The notion of learning by doing derives from the concept of the “learning curve”, which reflects the observation that with greater “experience” (cumulative production) there is a decline in the unit costs of new technologies (Arrow 1962). Trade also stimulates learning by doing, and most of the technical and managerial innovations made in high-income countries may be adopted by low-income countries (Young 1991). The positive externalities of cost discovery are also important, especially for entrepreneurs. If a project is successful, other entrepreneurs learn that they can make the product. In this way benefits to the first mover spread to the overall industry (Hausmann, Hwang and Rodrik 2006). This imitation process may help low-income countries transition to higher value-added sectors and increase their demand for skilled labour.

Source: Industrial Development Report 2013 Team.

“As with trade, FDI does not automatically generate growth and beneficial structural change

workers in the North have to accept lower labour standards and benefits, given poorer wages and conditions in competing countries (the race to the bottom). Second, greater openness leads to a more volatile labour market, which widens wage inequalities within groups and increases insecurity among workers. Third, given that workers are substitutable, the bargaining power of trade unions declines.

The effect of the race to the bottom is seen in the *Global Wage Report 2010–2011* (ILO 2011b). It shows a decrease of the manufacturing wage share over 1990–2007 – that is, before the global financial crisis, as wages rose less quickly than manufacturing value added (profits rose more quickly; Figure 5.7).

The race to the bottom would be unlikely ever to lead to positive structural change, except in those countries where low-productivity, low-wage jobs represent the only alternative to unemployment. But some low-income countries could take advantage of the race. In recent decades Asian countries have increased their share of world merchandise exports to more than 30 percent, attracting employment by offering a more competitive business environment such as through lower wages, while other countries (including those in South Asia and Sub-Saharan Africa) were unable to raise their merchandise export share, which remained below 5 percent (Figure 5.8). However, China's rising wages could help Sub-Saharan Africa increase its manufacturing jobs. Lin (2011) argues that China will free up 85 million labour-intensive manufacturing jobs, compared with Japan's 9.7 million in the 1960s and the Republic of Korea's 2.3 million in the 1980s, due to wage increases in the coming years. Africa, the continent with the lowest GDP per capita, has only around 10 million manufacturing jobs and could thus gain from changes in China's wages and competitiveness.

Foreign direct investment: a potentially key driver

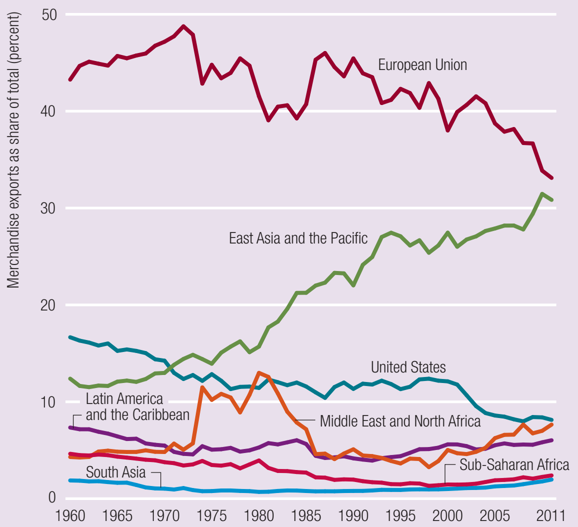
As with trade, FDI does not automatically generate growth and beneficial structural change. It affects the

Figure 5.7
Change in wage shares in manufacturing

Source: ILO 2011b.

FDI is often strongly related to export gains, and supports a positive correlation between the stock of FDI in the tradable sector and the export–GDP ratio

Figure 5.8
Merchandise exports as share of world total, selected regions, 1960–2011



Note: Merchandise exports comprise tangible goods but exclude services.
Source: UNIDO estimate based on World Bank (2013b).

structure of an economy generally and manufacturing particularly in various ways. Evidence shows that FDI is often strongly related to export gains, and supports a positive correlation between the stock of FDI in the tradable sector and the export–GDP ratio (Kinoshita 2011). Countries with a high FDI stock–GDP ratio are also those with the highest foreign value added in exports, GVC participation rate and contribution of value-added trade to GDP (UNCTAD 2013b).

These correlations translate into structural change if exports stimulated by FDI change the production composition and the technological intensity of production. The impact of economic diversification on long-run productivity crucially depends on the technology segment or the GVC stage receiving the investments (or both). Countries receiving FDI in high- and medium-tech sectors are more likely to boost productivity in the long run (for some Eastern European countries, see Damijan, Kostevc and Rojec 2013). Domestically oriented FDI may also help enhance structural change as it may fill expectations of demand increase, as in Viet Nam in the 1990s when domestic firms did not have the capacity to produce efficiently in the FDI-targeted sectors (Schaumburg-Müller 2002).

FDI may also affect structural change through other mechanisms:

- *By strengthening competition and weakening oligopoly/monopoly elements.* Increasing competition may stimulate structural change through a direct or indirect effect: directly, market restructuring makes firms more efficient since more efficient firms have more revenues to spend to upgrade business activities; indirectly, a competitive market helps to create a favourable business environment (Moose 2002).
- *By diffusing knowledge of new production processes.* Local firms may benefit through learning by watching, labour mobility, backward and forward linkages and relocation of R&D activities (Zhao and Zhang 2006). Additionally, FDI may be a means to transfer managerial know-how from foreign to local firms; vertical spillovers in the supply chain are more effective than horizontal spillovers; and managerial spillovers may spread intentionally (through demonstrations) or unintentionally (through relationships with business partners; Fu 2009).
- *By stimulating the entry of firms in other sectors (horizontal linkages).* They create business opportunities for local entrepreneurs (by creating demand for local products and services) or upstream/downstream activities (vertical linkages; Ayyagari and Kosová 2006).
- *By creating the right conditions to enhance structural change.* FDI may improve conditions in the financial market. With a direct channel, FDI helps correct capital-market failure; with an indirect channel, FDI may help strengthen stock market indicators (Soumaré and Tchana 2011).

Much evidence supports the positive relationship between FDI, growth and employment. IFC (2013) finds that over the last decade the rate of growth of FDI-related employment (28 percent) has outpaced growth of the global labour force (16 percent), indicating a growing importance of FDI in job creation.

> FDI is not a "silver bullet". While it is often linked to growth of capital and technology, spillovers to local economic development do not always spread to the whole economy

The *World Investment Report 2013* finds a strong and positive relationship between FDI and GDP growth (UNCTAD 2013b).

Despite this evidence FDI is not a "silver bullet". While it is often linked to growth of capital and technology, spillovers to local economic development do not always spread to the whole economy. For example, countries with rich natural resources but low quality of governance rarely show structural change (te Velde 2006), a point underlined in Table 5.6: Africa and least developed countries with the lowest GDP per capita have the biggest share of FDI in the primary sector (UNCTAD 2013b) – where backward and forward linkages are typically very weak.

Honing in on a single country, in Costa Rica over 1997–2005 foreign investment in offshoring activities contributed to the expansion of skilled, productive and well-paying jobs, reflecting business by Intel and other high-tech companies. But offshoring activities did not integrate well with the overall economy, particularly manufacturing – and such integration is key to maximizing FDI's beneficial impact on growth and employment (Ernst and Sánchez-Ancochea 2008).

Large, newly established and highly productive domestic firms seem more likely to benefit from FDI (Amendolagine et al. 2013). This means that FDI often provides most benefits to highly productive firms rather than to those needing to upgrade through technology, thus increasing inequality and offering little impact on structural change. So, for technology transfer to trickle down to domestic firms through FDI, governments need to promote local firms that can initially adopt and adapt technology from FDI, and support the development of domestic production linkages and networks, in which initial adopters play a conduit role in disseminating the foreign technology vertically and horizontally to related firms.

Notes

1. In this chapter we use trade liberalization, trade openness and export orientation almost as synonyms. Some analysts question whether East Asian countries really liberalized and increased trade openness as they adopted trade protectionist measures, and for this reason they prefer to call them export oriented. Trade openness is a broader concept than trade liberalization as it incorporates liberalization of FDI, remittances and the wider financial market. As the most common measure of trade openness (ratio of exports plus imports to GDP) and the scientific and policy debate do not always capture these nuances, we prefer to acknowledge this distinction but use these terms interchangeably.
2. For simplicity and for consistency with the rest of the report we call this index "structural change", even though it represents the orientation of the manufacturing production towards high-tech sectors (stock variable) rather than properly structural change (flow variable). The two variables are

Table 5.6
Greenfield projects by industry, 2012 (percent)

Region/development-level grouping	Primary	Manufacturing	Services
Africa	15.98	44.57	39.45
East and South-East Asia	0.25	47.84	51.92
South Asia	11.69	54.65	33.66
West Asia	1.11	42.08	56.80
Latin America and the Caribbean	8.06	47.32	44.62
Transition economies	6.49	45.19	48.32
Developed economies	4.05	38.26	57.69
Least developed countries	20.12	30.33	49.56

Source: UNIDO estimate based on UNCTAD (2013b).

strongly correlated as countries with the highest orientation towards high-tech sectors are those that implemented structural change more intensely over time.

3. For this regression we exclude Singapore as an outlier and excluded it from the dataset.
4. See *Private sustainability standards* in Chapter 9.

Chapter 6

Structural change and manufacturing employment in a resource-constrained world

Sustainable development rests on economic development, social advancement and environmental protection. The concept has been ensconced in policy for decades, but translating it into action remains a challenge, which for industry means producing goods and services that do not harm the natural environment but that improve living standards. The paradigm of continually increasing demand for finite resources to support economic growth, alongside worsening environmental degradation, must be shifted in the coming years.

The rate of this demand increase may well be set to rise too, with the rapid expansion of emerging markets and an estimated additional 3 billion middle-class consumers in the next 20 years (Kharas 2010). In recent years global material consumption has grown at around 3 percent a year, and so by 2050 could reach 140 billion tonnes of minerals, ores, fossil fuels and biomass a year, or about three times current levels (UNEP 2011a). In addition, this soaring demand takes place at a time when accessing and processing most of those resources has become more challenging and expensive (Dobbs et al. 2011). Wasteful production and consumption patterns – along with continuing soil degradation, deforestation and overfishing – will result in increasing water shortages and escalating prices for food, energy and other commodities (ILO 2012). And along with climate change, they are increasingly constraining production. Environmental change is likely to accelerate in the coming decades, no doubt affecting the underprivileged the most, as they depend the most on environmental capital and have the least means to adapt.

Resource efficiency thus has not been a major driver of structural change in the past – but must be so in the future. The paradigm of resource-intensive and highly polluting economic development is being questioned. Some scholars argue that green-sensitive ideas may well cause a slowdown in the rate of structural change and thus on employment. In this vein Dercon (2012) posits that environmental constraints may change the patterns of structural change with employment and distributional effects that will not lead to sustained economic growth. The argument holds from the perspective of internalization of environmental externalities.

But efforts to promote resource efficiency find themselves at the intersection of economic, employment and environmental policies. "Decoupling" natural resource use and environmental impacts from economic activity is a concrete means to reconcile the policy imperatives of economic growth, and thus employment and environmental protection. Indeed, increased resource productivity lifts competitiveness, especially as resources often represent a significant share of production costs, especially in developing countries. It also supports employment, and undoubtedly alleviates the burden on the environment.[1]

Green structural change – a move to green industry – will involve shifting to industries more technologically advanced and with higher labour and capital productivity, while improving resource productivity as a means of both boosting competitiveness and protecting the environment. Past abundance of relatively inexpensive natural resources, such as energy, water and materials, is coming to an end, and industries will need to restructure with demand for environmentally damaging goods falling and for environmentally preferable goods rising. Green structural change will be influenced by factors related to resource constraints and environmental protection, as well as other cost and environmental considerations. As manufacturing industries tend to be resource intensive, cost considerations will focus on increasing resource productivity. Environmental considerations will arise from consumers looking for environmentally friendly products or from governments aiming to reduce the environmental footprint of human activity.

"Reconciling the legitimate aspirations for a better life with environmental protection requires a paradigm shift that decouples economic activity from resource use and environmental impact

Reconciling the legitimate aspirations for a better life with environmental protection requires a paradigm shift that decouples economic activity from resource use and environmental impact. Opportunities for decoupling will arise for enterprises as they adapt to new prices and scarcities and as they get involved in new businesses that commercialize green goods and services, such as equipment for recycling or renewable energy, or specialized consulting services. Bettering resource efficiency will be the driver of green structural change underpinned by the uptake of new green technologies and a growing trade in environmental goods.

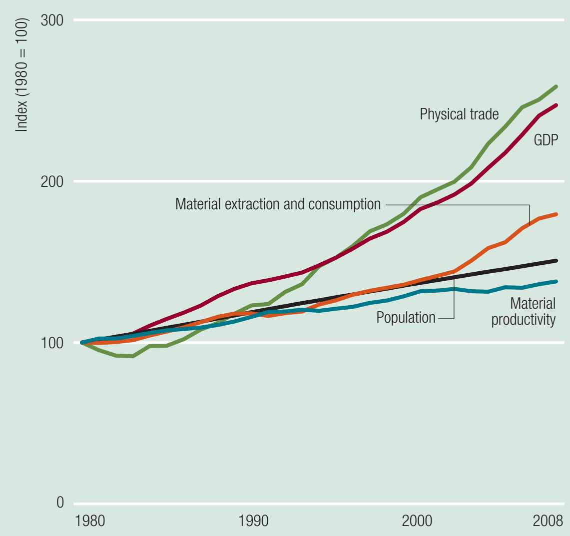
And green jobs will be created, arising from investments in the areas of renewable energy, industrial energy efficiency, waste management and recycling, environmental services and, most important, new green technologies and products as countries move up the productivity and technological ladder.

Industrial greening: an emerging driver

UNIDO refers to "green industry" as a pattern of industrial production and development that does not come at the expense of the health of natural systems and does not lead to adverse human health outcomes. It consists of an industrial system that does not require an ever-growing use of natural resources and pollution to fuel societal progress (Box 6.1).

Such a change is needed. In the recent past the abundance of relatively inexpensive natural resources, such as energy, water and materials, spurred economic development. The material throughput of the global economy and environmental pollution has followed similar trends (Figure 6.1). But there are strong indications that this era is coming to an end, given increasing competition for resources. Also, from an environmental perspective, "planetary boundaries" are being overstepped (Rockström et al. 2009).

Figure 6.1
Global trends in GDP, population and material use, 1980–2008



Source: Dittrich et al. (2012) based on SERI (2012).

Box 6.1
Green economy and green industry

A green economy results in "improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities" (UNEP 2010). Closely related, "green industry" is a concept to address global, interrelated challenges through a set of immediately actionable cross-cutting strategies that take advantage of market forces and emerging industries. It contributes to a model of development that considers resource constraints and the earth's carrying-capacity limits.

Developing and transition countries have huge potential for pursuing green industry further – they are already making heavy public and private investments to improve resource productivity and reduce environmental impact (in one of the worst manifestations, pollution) and securing the associated benefits of improved competiveness, employment and environmental conservation.

Green structural change reflects the growing importance of shifting towards sectors – and within them, activities – that efficiently use not only capital and labour but also natural resources to minimize environmental impact.

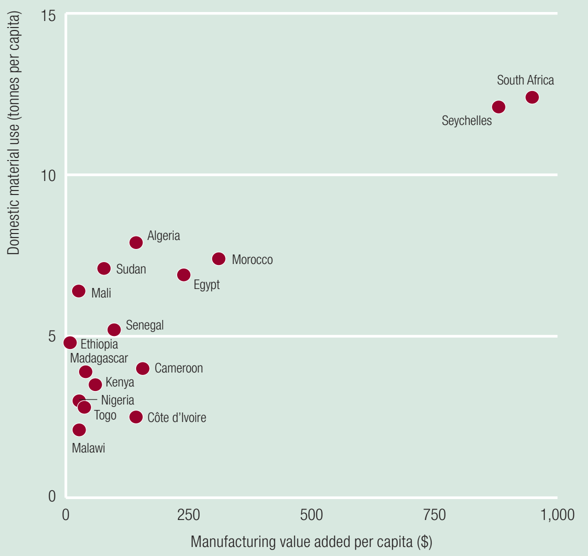
Source: Industrial Development Report 2013 Team.

Resource scarcity and environmental factors are constraining industrial production, leading to adjustments at the enterprise and sector levels to deal with resource-related risks and opportunities

This shift towards higher productivity and greener industries will entail economic restructuring. An overall increase in resource productivity and a decline in manufacturing's intensity of pollution – other things being equal – would be key characteristics of green structural change. But for now material use and socioeconomic development are intertwined, to some degree at least: countries with the highest per capita manufacturing value added are those with the highest domestic material use (Figure 6.2). Still, material consumption has been increasing globally over the past few decades more slowly than GDP in all major regions of the world – that is, productivity of material use is increasing (Dittrich et al. 2012).

Increased demand and investment in greener products and services, as well as the equipment and infrastructure to produce them, will expand certain industries and enterprises (ILO 2012). This will translate into higher labour demand and job creation (direct effect), mainly in green sectors (see *Green manufacturing jobs* below). In addition, due to inter-industry relations of the expanding industries, other parts of the economy that supply inputs to the expanding green sectors will also benefit, creating additional employment (indirect effect), including employment in non-green sectors such as cement for green buildings or steel and carbon fibre for the blades and towers of wind turbines. The income generated by this additional economic activity is redistributed by spending on additional consumption and investment across the economy, creating further employment (induced effects), in addition to the direct and indirect jobs.

Figure 6.2
Correlation between per capita manufacturing value added and domestic material use, 2008



Source: UNIDO estimate based on UNCTAD (2012b).

Factors at play

The empirical evidence is becoming more persuasive that resource scarcity and environmental factors are constraining industrial production, leading to adjustments at the enterprise and sector levels to deal with resource-related risks and opportunities (Dobbs et al. 2011). Job opportunities, especially those of the underprivileged, may decline if economic growth is constrained by physical or economic shortages (EU 2012).

The response – green structural change – is thus influenced by factors related to resource constraints and environmental protection, as well as to other external factors, classified as cost and environmental.

Cost considerations may well trigger a shift from resource- and pollution-intensive sectors, but independently from considerations related to resource conservation and environmental protection. As manufacturing industries tend to be resource intensive, greater resource productivity is a key factor in competitiveness in its own right. For their part, environmental concerns will stimulate increased resource productivity in industrial activities and reduce their environmental impact. They can trigger a self-induced structural shift towards greener manufacturing, to respond to increasing customer demand for resource-efficient products, for example. Or they can be prompted by targeted policy and regulatory interventions, such as phasing out subsidies for fossil fuels or banning incandescent light bulbs.

For sustainable industrial development, industrial structure has to change towards a direction that decouples economic activity from resource use and environmental impact

Straddling the two sides are cases when the environmental burden has an internalized cost. Decreasing the cost of managing waste is best achieved by avoiding waste in the first place. Also, non-compliance with environmental regulations – when enforced – can have financial and operational consequences, including sanctions.

Adapting manufacturing capacity to this evolving context translates into two elements: reorienting existing industries towards greener resources, processes, practices and products; and creating green industries (UNIDO 2011c).

The first element entails improving production efficiency, by using resources more efficiently and optimizing the productive use of natural resources; minimizing environmental impact by reducing the generation of waste and emissions and promoting the environmentally sound management of residual wastes; and minimizing health risks by managing chemicals safely.

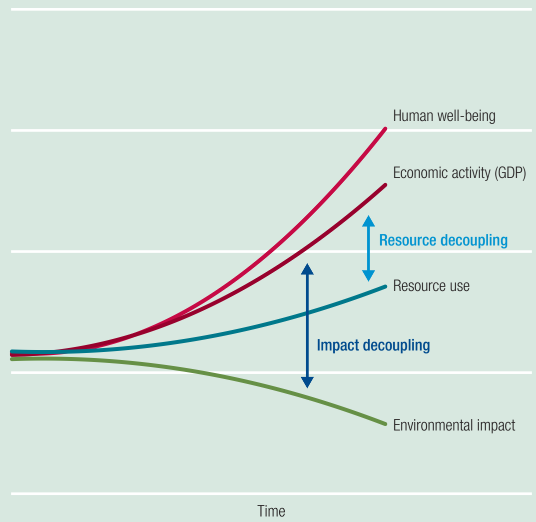
The second reflects environmental technologies and services originating from the transition to a green economy, including companies that develop, manufacture and install clean technologies for industrial, transport, buildings and automotive sectors. They also cover service industries, including material-recovery companies, recycling companies and waste-management, -treatment and -transport companies. Other examples are engineering companies specializing in wastewater treatment, air pollution control and the manufacture of waste treatment equipment, as well as companies providing monitoring, measurement and analytical services.

Decoupling

For sustainable industrial development, industrial structure has to change towards a direction that *decouples* economic activity from resource use and environmental impact (Figure 6.3).

Decoupling may be viewed as relative, where production rises but the increase in resource use and environmental impact does not rise as quickly – and as absolute, where production can increase while

Figure 6.3
Decoupling economic activity from resource use and environmental impact



Source: UNEP 2011a.

resource use and environmental impact fall. The world economy has already achieved a relative decoupling, extracting around 40 percent more economic value from each tonne of raw material than three decades ago. Still, these gains have been swamped by economic growth of 150 percent over the same period (Hinterberger et al. 2013).

Even though an abundant literature stresses that environmental protection bears a cost, a parallel literature has emerged showing that green measures can provide economic and social benefits, including von Weizsäcker et al. (2009), who argue that gains in resource productivity in several economic sectors can lead to an 80 percent reduction of environmental impacts per unit of economic output. Similarly Dobbs et al. (2011) observe that up to 30 percent of the resource demand in 2030 could be addressed by resource-productivity opportunities – and thus avoided in absolute terms.

Since the 1990s an academic discussion has emerged around the hypothesis of the "Environmental Kuznets Curve" (EKC).[2] In this, the environmental impact first increases until reaching a given level of

> **Aspirations for better socioeconomic conditions can be reconciled with the finite nature of natural resources and the need to protect the environment**

economic activity, before gradually decreasing by itself as economies mature (Azar, Holmberg and Karlsson 2002). The hypothesis is based on four assumptions (Stamm et al. 2009).

First, there is a tendency for the values to shift from welfare based on quantitative satisfaction towards higher preferences for environmental quality. Better educated and informed agents tend to be more likely to take the environmental externalities into account before consuming, thus providing an incentive for manufacturers to adapt production patterns accordingly (Inglehart 1977). Second, as an economy develops, the composition of value addition changes, changing the pattern of resource use and environmental impact (Pasinetti 1983). Third, institutions in higher income countries are more inclined to internalize environmental externalities and provide adequate incentives. Fourth, more advanced and sophisticated businesses tend to apply technological innovations in production. Whether introduced to spur productivity or based on environmental concerns, these innovations often raise resource productivity and lower the intensity of environmental impact.

A vast body of work has tested this EKC hypothesis. Some studies have corroborated the existence of an EKC-like relationship with local pollutants, such as sulphur dioxide and nitrogen dioxide (Stern 2004), though the empirical evidence demonstrating the prevalence of EKC for other environmental indicators and at a broader scale is "scant, fleeting and fragile" (Carson 2010).

But even assuming that an EKC exists, passively waiting for the hypothetical turning point is no option, as it could coincide with a global level of pollution beyond the abortive capacity of the biosphere (Stamm et al. 2009). Also, the link between income and environmental impact at country level is blurred, due to the huge increase in international trade. Indeed, consumption might be delinked from production in a given country (Panayotou 2000).

The key thus lies in decoupling natural resource use and environmental impacts from economic activity. In such a way, aspirations for better socioeconomic conditions can be reconciled with the finite nature of natural resources and the need to protect the environment. This huge shift will require drastic structural changes, affecting employment positively (through opportunities for green jobs) as well as less benignly.

The opportunities will stem from two areas of adjustment. First, existing enterprises will need to adapt to the new circumstances, whether caused by more expensive raw materials or by policy incentives and disincentives, and so will require new skill sets and experience. Second, greener manufacturing will create a range of opportunities for businesses that commercialize green goods and services such as equipment for recycling or renewable energy, or specialized consulting services.

Some subsectors will undoubtedly see job losses, though the number should be manageable and small relative to shifts produced by other factors such as globalization or movement between enterprises (ILO 2012). Firms in more resource- or energy-intensive activities will no doubt lose competitiveness as well, but this is all the more reason for them to be looking forward. The same argument holds at the macroeconomic level. Countries improving competitiveness through measures to achieve greater resource efficiency will be well positioned in a resource-constrained global economy: Figure 6.4 suggests that countries with lower energy intensive industry tend to add more value – and vice versa.

Countries that focus on moving towards cleaner and more sustainable industries have numerous field-proven instruments. At their core, strategy-planning, goal-setting and benchmarking have proved useful in identifying potential improvements. Benchmarking, which can raise awareness of resource productivity (or its lack), provides a tangible way to determine the resource or energy efficiency of a system, whether a process, company or nation. It compares actual energy and resource use against best available practice.

Despite the seemingly clear case for resource efficiency – environmentally or economically – major

> **Resource efficiency is the ratio between resources required and desired output. So resource productivity can be defined as the efficiency with which energy or materials are used to produce a given output**

Figure 6.4
Manufacturing value added per capita and industrial energy intensity at the country level, 2010

Source: UNIDO estimate based on IEA (2013), UNIDO (2012a) and World Bank (2013b).

barriers remain to pushing through concrete measures. Central is access to financing. Many enterprises in developing countries, particularly small and medium-size ones, struggle to finance gains in resource productivity and environmental performance. These investments are crucial to any government strategy aimed at promoting industrial development, especially as small and medium-size enterprises often form the backbone of developing economies.

Resource efficiency as a driver of manufacturing structural change

Resource efficiency is the ratio between resources required and desired output. So resource productivity can be defined as the efficiency with which energy or materials are used to produce a given output. Increasing resource efficiency is appealing from a number of viewpoints: economic, given that resources often loom large in many developing countries' manufacturing output costs; and environmental, as fewer inputs should mean less pollution and less contamination from wastage.

One school of thought draws attention to the potential negative impacts of restrictions on resource use and pollution on firms' competitiveness, arguably jeopardizing jobs. Morgenstern, Pizer and Shih (2002) analysed job dynamics in four heavily polluting industries in the United States (pulp and paper mills, plastic manufacturers, petroleum refiners, and iron and steel mills) and found that increased environmental spending generally did not cause a significant drop in employment. If anything, the change tended to be positive.

There is ample empirical evidence demonstrating the positive influence of more efficient resource use on economic performance. For a sample of ISO 14001 certified companies in South-East Asia, Rao and Holt (2005) modelled the link between green supply-chain management practices and increased competitiveness on the one hand and improved economic performance on the other. They found a positive correlation between those dimensions. Similarly, Ilinitch and Schaltegger (1995) demonstrated that positive environmental performance

Steep gains in resource efficiency require dedicated actions

could be associated with neutral or positive economic performance, in contrast to the often asserted negative effects.

Steep gains in resource efficiency require dedicated actions. Indeed, even in world regions characterized by limited economic growth and advanced innovation systems, signs of effective decoupling are feeble, perhaps due to the "rebound effect" (Sorrell and Dimitropoulos 2008). This refers to the behavioural or other systemic responses to the introduction of new technologies that increase the efficiency of resource use, thus potentially offsetting the benefits of the measures taken.

What some argue for is thus a qualitative leap in resource productivity, particularly in economies with high growth and weaker innovation. Huber (2000) looks to transformational, as opposed to incremental, changes in industrial structures, which would require a shift from the predominant policy focus on improvement of labour and capital productivity towards resource productivity (see also Hinterberger et al. 2013).

By the mid-1990s thought leaders had already developed such a vision of drastic change. The "Factor 4" strategy outlined a world with double the wealth using half the natural resources in the coming decades (von Weizsäcker, Lovins and Lovins 1997). Based on this, and examining innovation in industry, the subsequent Factor Five described how to roll out measures leading to 80 percent improvements in resource and energy productivity, with a massive boost in wealth for billions of people (von Weizsäcker et al. 2009).

Uptake of green technology

Technology will be essential in decoupling economic growth from the burdens on the environment. Ocampo (2011) stresses that the green transition entails a technological revolution, with fundamental impacts on production structures and consumption patterns. Yet technological change rarely takes place in a vacuum, and often requires incentives. Success stories of widespread penetration of new energy technologies are the product of forward-thinking, ambitious government policies.

Bursts of innovation are associated with cyclical economic development (Freeman and Perez 1988). From this perspective, Rifkin (2011) argues that we are entering an area of innovations related to sustainability, paving the way towards the "next great economic era" (Figure 6.5).

A logarithmic mean Divisia index technique is applied to investigate the green technological uptake using carbon dioxide emissions reduction as a proxy of environmental impact. Using the I = PAT model, where the human impact on the environment is assumed to be a function of the population, economic activity (affluence) and technology, it is possible to calculate to what extent the variation of manufacturing carbon dioxide emissions depends on the variation of emission intensity, energy productivity, value added per capita and population:

$$E_{i,t} = Pop_{i,t} * \frac{MVA_{i,t}}{Pop_{i,t}} * \frac{Ener_{i,t}}{MVA_{i,t}} * \frac{E_{i,t}}{Ener_{i,t}} \quad ,$$

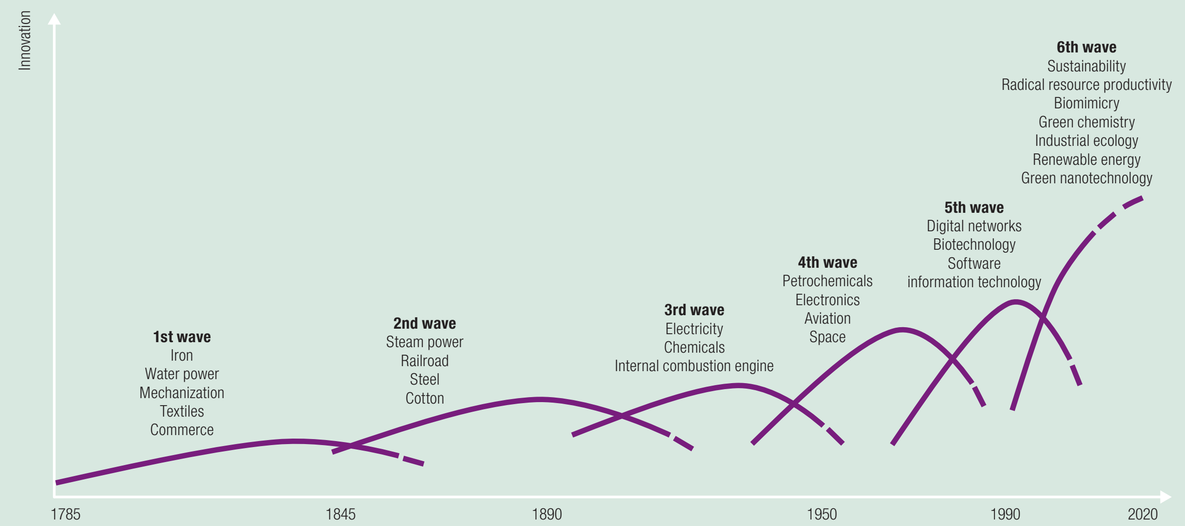
where E represents manufacturing carbon dioxide emissions, MVA is manufacturing value added, Pop is total population and $Ener$ is manufacturing energy.

The calculation was applied to 45 countries with data on all these variables over 2001–2010, and Figure 6.6 shows the outcome of the decomposition of manufacturing carbon dioxide emissions. Global manufacturing carbon dioxide emissions rose 40 percent. The decomposition indicates that at the global level all components – population, value added per capita, energy intensity and emissions intensity – contributed positively to that increase. By contrast, considering high-income countries separately, where manufacturing emissions fell 11 percent, all determinants contributed to the decrease with the notable exception of population, which is inversely correlated.

In Brazil, the Russian Federation, India, China and South Africa (BRICS) where manufacturing emissions rose 109 percent, the emission intensity rose only slightly while energy intensity declined a

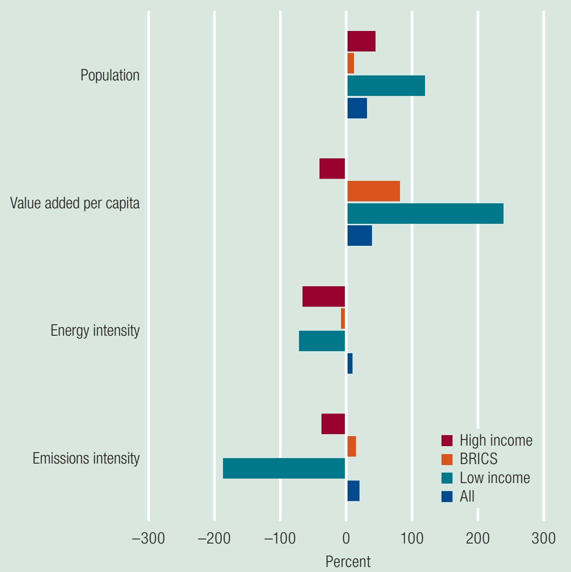
The increase in manufacturing value added per capita explains most of the increase in emissions, reflecting the shift in materials production to developing countries, particularly to the BRICS

Figure 6.5
Waves of innovation



Source: Adapted from Hargroves and Smith (2005).

Figure 6.6
Decomposition of manufacturing carbon dioxide emissions, 2001–2010



BRICS is Brazil, the Russian Federation, India, China and South Africa.
Source: UNIDO estimate based on IEA (2013), UNIDO (2012a) and World Bank (2013b).

little. Interestingly, the increase in manufacturing value added per capita explains most of the increase in emissions, reflecting the shift in materials production to developing countries, particularly to the BRICS (Banerjee et al. 2012). As far as low-income countries are concerned, where carbon dioxide manufacturing emissions climbed 16 percent, the decomposition indicates that much of that increase is due to increased manufacturing activity and a rising population. The emission intensity of manufacturing energy fell sharply, a trend that can be interpreted as a sign of gains in manufacturing processes and greater use of green technology.

Low-income countries account for a small share of global emissions, though the likely growth of their economic activity will no doubt add to emissions, offset to a degree (on the current pattern) by the uptake of green technology. Applying the "best available technologies" as industries develop represents a unique opportunity for low-income countries. Large investments, particularly in heavy machinery, have an impact over several decades, as switches of existing plant are few and refurbishing costly. So cleaner technologies offer promising prospects to boost industry's competitiveness in these countries.

For green structure change, knowledge and innovation – including technologies – represent key

> **Governments in all countries will need to carry out policies to continue strengthening green technological change by encouraging profitable opportunities as industries go green**

assets. Schumpeter identified innovation as the critical dimension of economic change (Pol and Carroll 2006). Recent changes in intellectual property rights are due to the increase of cross-border exchanges in terms of goods and services, but also to structural changes in economies, with knowledge becoming an important tradable asset (Curtis 2012).

With intellectual property rights associated with private sector investment, strengthening such regimes would imply greater opportunities for firms to compound their position (Lesser 1998). But some studies indicate that developing countries with low human capital might not benefit from strengthening intellectual property rights (Bravo-Ortega and Lederman 2010). Indeed, such action could have a negative effect on domestic innovation, particularly where it is mostly based on imitation or adaptive in nature (Schneider 2005).

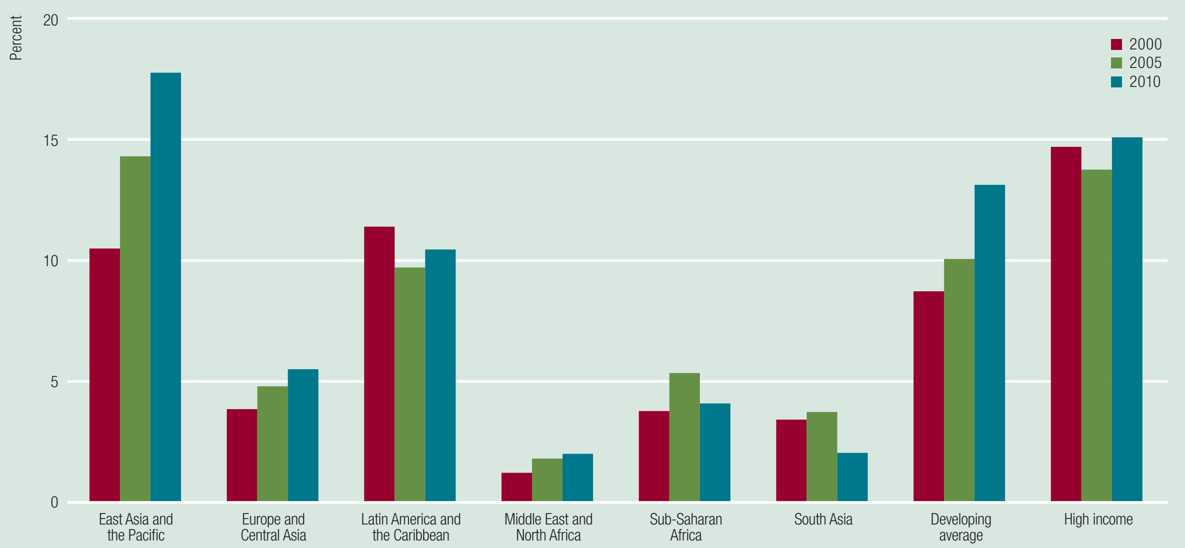
In the next few decades governments in all countries will need to carry out policies to continue strengthening green technological change by encouraging profitable opportunities as industries go green (UNIDO 2011b).

Trade and green structural change

All major world regions already export environmental goods (Figure 6.7), demonstrating the ready market for such products. As an illustration, about 9 percent of the retail price of high-efficiency refrigerators in Spain can be considered a price premium, representing a third of the cost of saved energy over the appliance's life (Galarraga, Heres and Gonzalez-Eguino 2011). An expanded environmental market could generate international spillovers by reducing production costs for low-income countries exporting to high-income economies (Cantore 2009).

Under the global regime for mitigating climate change, industrialized countries are bound to targets for reducing greenhouse gas emissions, theoretically enabling developing countries to grow in two ways (Gerlagh and Kuik 2007): a reduction of fossil fuel demand in high-income countries cuts the global price of energy, raising demand for energy and thus growth in developing countries; or environmental policies in high-income countries encourage industries to relocate to developing countries, where constraints are looser.

Figure 6.7
Exports of green and "close-to-green" goods and services as a share of GDP, 2000, 2005 and 2010



Source: Adapted from Dutz and Sharma (2012) based on data from the Organisation for Economic Co-operation and Development's list of environmental six-digit Harmonized System categories and UN (2013a).

Structural change towards a service-focused society, as in industrialized countries, does not necessarily imply a global reduction of resource use

Reduced emissions in high-income countries would thus be partly offset by increased emissions in developing countries, a variant of "carbon leakage". This occurs when one country increases its carbon dioxide emissions because a second country with a strict climate policy has reduced its emissions, though the literature shows little evidence of the size of the long-term leakage effects.

The prospect of carbon leakage gave rise to proposals for border taxes based on the embodied carbon content of goods imported from developing countries. But such schemes are rarely effective and are hard to set up. Some scholars find that the border tax adjustments have little impact on reducing carbon leakage and protecting economic competitiveness (Antimiani et al. 2011; McKibbin and Wilcoxen 2009). Cosbey (2008) further raises issues of compliance with international trade agreements, as well as other legal and institutional issues. Also, border tax does not hold the comparison with consumption taxation, which, besides being simpler to implement, implies a more efficient allocation of resources across the life cycle and thus an arguably more equitable proposition from the perspective of developing countries.

Structural change towards a service-focused society, as in industrialized countries, does not necessarily imply a global reduction of resource use, because resource- and pollution-intensive industries in developing countries are producing goods for wealthier countries (Stamm et al. 2009). For this reason data based on domestic production provide a highly skewed picture as they disregard embodied resources and emissions in imported goods and services, especially in a world where manufacturing production is shifting to industrializing and developing countries.

Consumption-based accounting helps reorient the picture: covering international trade and transport, it encapsulates all emissions related to global consumption (Peters 2008). Consumption-based inventories draw on total global emissions for the economic consumption of a country, rather than the economic activity of the producing country. This has obvious implications for the political economy of environmental protection, as current regimes in the realm of climate change are based on production-based environmental impact.

Green manufacturing jobs

An approach rather than a definition

Green jobs have no single and universally accepted definition, although typical characteristics are that they reduce consumption of energy and raw materials; limit greenhouse gas emissions; minimize waste and pollution; protect and restore ecosystems; and enable enterprises and communities to adapt to climate change (ILO 2013).

The quality of employment often features, and the literature frequently incorporates, social considerations such as "decent work" (Renner, Sweeney and Kubit 2008, for example). Such considerations involve opportunities for work that is productive and delivers a fair income, security in the workplace and social protection for families, better prospects for personal development and social integration, freedom for people to express their concerns and organize and participate in the decisions that affect their lives, and equality of opportunity and treatment for all women and men (ILO 2013).

Some commentators distinguish between green jobs and environment-related employment. Varma (2010) argues that to be called green, environment-related jobs must meet acceptable standards on wages, gender and working conditions, and suggests that green jobs account for only about a quarter of all environment-related jobs.[3] But as Pollin (2009) has noted, an absence of a clear-cut definition should not stand in the way of actions to promote green jobs.

Estimates of current jobs

As industries that provide environmental goods and services continue to expand – reflecting a combination of growing green demand, increasingly stringent laws

> **Skilled jobs in energy and environmental services, the smart application of information and communications technologies, repair and maintenance, and substitute and recycled materials will be in greater demand**

and agreements and a growing focus on resource efficiency, productivity and competitiveness – so too does demand for cleaner technologies, less risk to the environment and better resource management (including recycling and resource recovery; UNIDO 2011b).

But pinning down job numbers is a challenge, not least for the methodological and definitional reasons suggested above (see, for example, Bowen 2012). Statistics rarely capture self-employment or the informal economy, especially in developing countries where reliable and comprehensive data are scarce.

Still, the literature abounds with estimates for green jobs, and usually suggests that numbers are increasing steadily (for example, Renner, Sweeney and Kubit 2008). It may also claim that tens of millions of green jobs have been created worldwide, with a growth surge over the past few years, notably in renewable energy and ecosystem services, such as forestry (ILO 2012).

Many sector-specific studies estimate numbers. Rutovitz and Atherton (2009) estimate 9 million jobs were created in energy globally in 2010, with about 20 percent of jobs created by renewable energy and energy-efficient generation. Renner, Sweeney and Kubit (2008) "conservatively" put jobs in renewable and supplier industries at 2.3 million worldwide.

India alone may be able to create some 900,000 jobs by 2020 (from 2007) in biomass gasification. Of these, 300,000 might be among manufacturers of gasifier stoves (including masons and metal fabricators) and 600,000 in biomass production, supply chain operations and after-sales services. Another 10,000 people might find employment in advanced biomass cooking technologies (Holdren 2007).

UNEP (2011b) estimates that waste recycling employs 12 million people in just three countries – Brazil, China and the United States. Sorting and processing recyclables alone sustain 10 times more jobs than land filling or incineration based on weight. Basic manufacturing industries such as steel, aluminium, cement and paper are starting to stimulate green jobs through scrap use, greater energy efficiency and reliance on alternative energy sources (Renner, Sweeney and Kubit 2008).

Potential for green jobs

Energy is the emblematic example of sectoral "greening". Renewable energy (excluding large hydropower) represented almost half the new generation capacity added globally in 2011, up from a minuscule share just a few years earlier. Global investments in renewable power and fuels rose by 17 percent to $257 billion in 2011 – for comparison, investment in fossil-fuel generating capacity was $302 billion – with about a third of that in developing countries (REN21 2012; UNEP and BNEF 2012).

Evaluations of the impact of green technology on employment are rare. One that used model simulation and scenario analysis estimated the impact of a "green investment" scenario on industry. Assuming that 3 percent of total additional green investment was allocated to improving the efficiency of industrial energy, it estimated that 109 million jobs would be created by 2050, or 15 percent more than in the business-as-usual baseline scenario (UNEP 2011b).

Waste collection seems to offer promising returns on investment. In the same simulation the green investment scenario then allocated 0.16 percent of global GDP to three areas of waste management, prioritizing investment in the first two, waste recycling and composting of agricultural and forestry organic waste (including energy recovery), to support material recovery and agricultural activities; the remaining investment was in waste collection.

About $33 billion a year was allocated to waste recycling and composting over the period, based on a global average estimated cost of recycling of $100 per tonne of waste. Waste collection alone generated almost 10 percent of the additional jobs worldwide expected by 2050 in this scenario over the baseline, reflecting current low rates of collection and recycling in low-income countries.

Skilled jobs in energy and environmental services, the smart application of information and

"The impact of green structural changes on total employment is probably quite small

Table 6.1
Debate on issues of green jobs

Proposition/hypothesis	Supporters	Detractors
Investments in green jobs will boost productive employment	By raising overall employment, green investments provide new opportunities to previously unemployed and to underemployed workers, thus raising productivity of both groups	Green job estimates commonly include clerical, bureaucratic and administrative positions that do not produce goods and services for consumption
Green jobs promote employment growth	Investments in, say, energy efficiency or renewable energy create more jobs than in conventional energy	By promoting more jobs instead of more productivity, green jobs actually encourage low-paying jobs in less desirable conditions
Green job forecasts are reliable	It is difficult to go beyond the science limits	Estimates are based on disputed methodology and questionable assumptions

Source: UNIDO, based on Morriss et al. (2009a,b) and Pollin (2009).

communications technologies, repair and maintenance, and substitute and recycled materials will be in greater demand (ILO 2012).

Evidence is mixed on the employment effects across economies as a whole, with most research suggesting that the impact of green structural changes on total employment is probably quite small (OECD 2011). Moreover, an increase in renewable energy prices may raise overall energy prices throughout the economy, offsetting some of the gains. Production and employment in other sectors of the economy can also be held down when the energy sector absorbs more workers and greater investment in physical capacity.

How much policy support to give?

From a policy perspective, the prospects for green jobs are far more interesting than current headcount figures. The literature on the outlook and on the level of state support that associated policies should receive reflects the debate on this topic, which is closely linked to questions on the degree of state intervention in a market economy (Table 6.1).

Studies relying on general equilibrium models tend to be less optimistic about the overall impact of renewable energy expansion on employment. Concretely, some studies disregard the potential effects of the investments elsewhere in the economy, possibly in another sector.

Resolving these issues is not merely academic, but key for policy in that they form the foundation (sometimes motivation) for interventions: the debate is almost reduced to the trade-offs between policy objectives in environmental protection, job creation and economic growth. These goals converge in some cases, but not always. But the aspirations for further socioeconomic development and environmental concerns can be reconciled through adjustments that help in decoupling – put simply, dissociating the "environmental bads" from the "economic goods" (OECD 2002). Globally, the political will to support greener industries and associated employment stems from rising concerns over resource dependency and security (Dittrich et al. 2012).

Notes

1. As an example, secondary scrap-based steel production requires up to 7 percent less energy than primary production, and employs around 200,000 people worldwide (Renner, Sweeney and Kubit 2008). Energy-efficiency measures also have high yield potential (UNIDO 2011b). Other related measures, such as resource substitution, eco-innovation and industrial symbiosis, all offer prospects for improving resource productivity cost-effectively, primarily in developing countries (Dobbs et al. 2011).

2. The term makes an analogy to the work by Simon Kuznets who postulated that income inequality first rises as economic activity increases, then plateaus and finally decreases. This relationship would thus form an inverted U shape, implying that a certain level of economic activity needs to be reached before income inequality can decouple.
3. This is because green jobs relate to occupations and skills with an identifiable environmental focus, but environment-related jobs include employment in industries (or projects) whose products are deemed of environmental benefit.

Section 3 Policy imperatives

One important message from the previous section was that the effect of drivers on employment is not straightforward and not always unambiguous. Ensuring that it is beneficial often depends on having the right combination of government policies in place.

The third section of the report thus turns to examine the role of industrial policy in promoting structural change and employment generation. In its first chapter it begins by looking at the policy efforts needed at the national level to achieve this change. After discussing the different roles and instruments governments have in targeting drivers of structural change, it underlines the importance of understanding the specific conditions of countries attempting to transform themselves and of using tailor-made policies. While policy content attuned to concrete realities is a necessity, another strong message is that getting the policy-making process right is crucial, as is consensual implementation: proper coordination among stakeholders; engaged political leadership; public–private dialogue; management capability; and flexibility in execution are just a few of the key dimensions that make industrial policies work.

The second chapter then highlights human capital for manufacturing structural change. It is one of the policy areas where, arguably, more consensus could be achieved among views of what a government's role should be in promoting industrialization, and so deserves special attention in this report.

The final chapter of the section addresses whether current international arrangements provide the necessary policy space for countries to be able to engage in structural change and, through it, generate employment. It analyses international collaboration as expressed in bilateral investment treaties in attracting foreign direct investment, the role of private sustainability standards in avoiding the "race to the bottom", and the role of international knowledge exchange for best practices in learning. It ends with a glance at what the post-2015 development agenda might entail for manufacturing structural change and employment generation.

Chapter 7

Industrial policy

Industrial policy should seek to promote structural change: from agriculture to labour-intensive or resource-based manufacturing at an early stage of industrialization; through upgrading and diversification in manufacturing at a later stage; and through technological innovation at an advanced stage.

The state can promote policy either as a regulator, financier, producer or consumer, using policy instruments that target key drivers of structural change: education and skills, capital and technology, and material inputs. In this targeting the state should oversee close coordination with other policies such as those on competition, trade and foreign direct investment (FDI), as well as the exchange rate, as they can undermine the objectives of industrial policy if they are misaligned.

Carefully chosen and implemented interventions can promote industrial growth and employment, as confirmed by solid evidence from the results of impact evaluations for high-income countries published in 2010 and 2012. (Subsidies for competitive sectors may be one promising approach.) But while international experience with policy instruments can provide interesting lessons, developing countries are unlikely to succeed with simple emulation, because a strategic approach to industrial policy-making has to be tailored to their own circumstances.

Evidence-based and realistic industrial policy implemented in a consensual way is key for policy effectiveness, irrespective of the concrete instruments used. This would require measures to:

- *Use – do not fight – the political system.* A fact of political life is that no policy will be underwritten unless those in power agree to it.
- *Strengthen political leadership.* This will set a national transformation agenda that aims, in low-income countries, to create and nurture productive activities or, in middle-income countries, to advance technologically.
- *Encourage public–private dialogue.* This will help to both design interventions that draw on expert knowledge in the private sector and ensure that all key stakeholders support decisions.
- *Boost industrial policy management capabilities.* These capabilities have to be strengthened considerably among key actors in developing countries in a pragmatic and concentrated way, ideally through learning by doing.

Finally, developing countries should initiate their own national industrial policy experimentation and learning processes, including monitoring and evaluation, to identify high-impact solutions.

Promoting structural change through industrial policy

Industrial policy is a widely used term but difficult to define. Warwick (2013, p. 15) suggests "any type of intervention or government policy that attempts to improve the business environment or to alter the structure of economic activity towards sectors, technologies or tasks that are expected to offer better prospects for economic growth or societal welfare than would occur in the absence of such intervention, i.e. in the market equilibrium".[1]

The main objective of industrial policy is to "anticipate structural change, facilitating it by removing obstacles and correcting for market failures" (Syrquin 2007). Hausmann and Rodrik (2003, 2006) identify three main types of market failure that are particularly relevant for new activities to emerge (thus changing the industrial structure), where identification and correction provide a rationale for industrial policy: coordination externalities, as specific new industries or activities require simultaneous, large investments to become profitable; information externalities, as discovery of new activities requires an investment whose returns cannot be fully appropriated by the investor; and labour training externalities, as firms regard labour mobility as a disincentive to invest in on-the-job training, thus reducing technological spillovers.

> **Influencing and planning strategically a country's position in an international setting has gained importance as an industrial policy objective**

Financial market failures sometimes provide a major justification for industrial policy through the creation of special financial instruments for small and medium-size enterprises (SMEs), or special financing institutions like development banks to finance, say, new products, firms entering new markets or new technologies.

Finally, the role of influencing and planning strategically a country's position in an international setting has gained importance as an industrial policy objective during an age when value chains get more fragmented and there are more options for countries and regions to plug themselves into international and regional production networks.

But industrial policies have not been free of controversy, even though they have been extensively used in the developed and developing worlds. In the decades after World War II advanced countries successfully implemented industrial policies – usually the tricky part – as, for example, France through indicative planning, Finland through technology policy and Ireland through the targeting of high-tech foreign investment (Weiss 2011). In the developing world East Asia from the 1960s provides good examples of success: starting with Japan and continuing with the Republic of Korea, Singapore and Taiwan Province of China, governments took extensive measures to promote industry, depending on the country's development stage. These different stages are reviewed below.

Early stage: from agriculture to low-technology manufacturing

At the initial stage of industrialization agriculture is still the largest sector for employment, though it tends to be the least productive (Herrendorf, Rogerson and Valentinyi 2013). This lower productivity than in the more advanced sectors leaves a great potential untapped, suggesting that manufacturing can still play a major role as an engine of growth through the reallocation of resources (see Chapter 1).

To promote structural change by moving from agriculture to manufacturing, low-income countries need to align agricultural and industrial policies. They need agricultural development strategies with a strong emphasis on increasing agricultural productivity, which will translate into cheaper agricultural products and release a typically unskilled and cheap labour force. And to absorb the released labour and to benefit from cheaper agricultural inputs, industrial policy should seek to create or support labour-intensive and resource-based manufacturing with low entry barriers, which are likely to favour industrial SMEs important for broadening the industrial base. Support for SME development should thus be an integral part of industrial policy at this early stage.

Climbing the ladder: towards more technologically advanced industries

In countries that have reached the middle-income range or are on track to do so, such as Brazil, China, Malaysia and Thailand, the contribution of agriculture to GDP and employment has declined, due to a greater share of industry, particularly manufacturing. Although low-tech manufacturing subsectors still play an important but decreasing role, some medium- and high-tech industries increase their employment (see Chapter 3). While the latter sectors tend to create fewer jobs than low-tech manufacturing, they provide more high-skilled jobs with positive spillover effects on the economy.

The above observations suggest that industrial policy should focus on two issues. First, because unemployment is likely to remain a critical issue in most middle-income countries, industrial policy should aim to improve efficiency and productivity in labour-intensive and low-tech sectors to increase competitiveness. Yet as per capita income grows, competing on cost with low-income countries will become increasingly difficult, bringing forth a second issue: middle-income countries will need to diversify and upgrade their economic structure towards more technologically advanced sectors.

Government intervention is needed to favour a shift towards higher value, higher tech or skill-intensive industries and to build the required productive and technological capabilities, with a sharper focus on the quality rather than quantity of jobs.[2]

> **Direct subsidies are important for national governments to promote industry in areas such as production, investment, research and development, exports and training**

Keeping technological leadership: innovation

Although reindustrialization is now on the agenda of many high-income countries, they cannot compete in low-cost, mature segments of industry. So they should pursue differentiation (by raising quality) and innovation (by launching new products and services) – a strategy that may be prescient given their relative abundance of highly educated labour. In particular, although global manufacturing production is shifting gradually from high-income to lower income countries, innovation remains dominated by countries in the Organisation for Economic Co-operation and Development (OECD; Pilat et al. 2006).

The differentiation and innovation strategy requires countries to shift resources into promising new areas so as to expand the global technological frontier. The shift towards new technological trajectories, which are desirable from an industrial–dynamic or social ("green technology") perspective, will require an industrial policy that removes obstacles. It has therefore to be aligned with competition and innovation policies to reduce entry barriers, and instruments have to be designed to favour innovative new entrants and counter incumbents' industrial advantages, as well as their lobbying power.

Manufacturing-related services, too, should be a key element in high-income countries. Although these countries typically show waning reliance on manufacturing as a source of growth and increasing dependence on services, links between industrial and service activities have become important because of the greater share of service activities necessary for or complementary to manufacturing production (see Chapter 3).

Industrial policy instruments – four main categories

According to Peres and Primi (2009), the state can promote industrial development in four main ways: as a regulator establishing tariffs, fiscal incentives or subsidies; as a financier influencing the credit market and allocating public and private financial resources to industrial projects; as a producer participating directly in economic activity through, for example, state-owned enterprises (SOEs); and as a consumer guaranteeing a market for strategic industries through public procurement programmes.

This subsection discusses the main policy instruments for these roles, and notes that successful industrial policy is not only about picking winners but also about letting losers go (Günther and Alcorta 2011). Beneficiaries should be aware that government support is time limited (through "sunset clauses") and based on performance incentives.

The state as regulator

Fiscal incentives are government transfers of public resources to firms, activities, whole industries or regions, free or at below-market rates, made through direct subsidies (cash or in kind) or indirect subsidies (tax incentives).

Direct subsidies are important for national governments to promote industry in areas such as production, investment, research and development (R&D), exports and training. It is important to distinguish between generic subsidies from sectorial ones. The former may encourage investment but not structural change. The areas requiring support depend on a country's characteristics. Advanced countries consider R&D subsidies to be legitimate industrial policy for promoting high-tech industries, but they generally oppose export subsidies – also prohibited by the World Trade Organization (WTO) – which target a particular activity in which emerging market countries are typically strong (Naudé 2010). But during the 2008 global financial crisis France, Germany and the United States resorted to direct subsidies to bail out manufacturing firms, particularly in the automotive industry.

Indirect subsidies (tax incentives) present no general model for promoting manufacturing. While many commentators attribute part of the Asian growth story to tax incentives, some recommend governments to limit their use (James 2009). In fact, tax systems in many countries have been subject to comprehensive reforms, curtailing the use of incentives for investment. The United Nations, World Bank, OECD and International Monetary Fund all recognize the importance for developing countries to

> **Recognizing the importance of manufacturing SMEs in the economy, many countries have developed subsidized loan schemes to support their development**

find "the right balance between an attractive tax regime for domestic and foreign investment, by using tax incentives, for example, and securing the necessary revenues for public spending" (IMF et al. 2011, p. 10).

The fact is that the tax incentives offered by individual countries now more than ever affect the choice of enterprises with regard to where to set up a business (James 2009). Countries can no longer design their tax systems in isolation but have to consider those of other countries thanks to the global mobility of capital and labour, but they risk engaging in harmful tax competition. Such countries are also concerned that once the tax holiday expires, manufacturing enterprises, often very mobile, will move their operations to another country that lures them with incentives.

The state as financier

A well-functioning financial market is crucial to boost industrial development through the provision of competitive lending for working capital, leasing of capital goods, consultancy services, and loans for fixed assets including investment projects and real-estate development. Access to reasonably priced credit is a key constraint for SMEs particularly, even for those with projects having positive private and social returns, as they usually lack collateral or credit history.

Recognizing the importance of manufacturing SMEs in the economy, many countries have developed subsidized loan schemes to support their development. Under the execution of the Small and Medium Industry Development Organization, the Turkish government has targeted manufacturing enterprises through the SME Credit Support Mechanism, which offers interest rate support for bank loans.

Governments can also offer guarantee schemes to increase lender confidence in making investments in SMEs, by supporting either debt or equity finance, to ensure more credit or better credit terms for targeted sectors or groups. The Egyptian Credit Guarantee Company, established by the government as a joint-stock company, had a guarantee coverage of only 50 percent with a low risk-sharing rate, but the guarantee has nevertheless proved "attractive to banks in Egypt because the guarantee fund is actually deposited in participating banks" (Levitsky 1997, p. 7).

Launched in 2000, the Small Business Guarantee Fund (FOGAPE) in Chile guarantees a share of loans made by banks to SMEs, small exporters and small business associations, with a maximum of 50–80 percent according to credit type. No doubt partly due to FOGAPE, the share of SMEs with access to credit is far higher (estimated in 2007 at 93 percent at least) than in many other countries (Agosin, Larraín and Grau 2010).

National development banks hold a special place as industrial policy tools (Box 7.1). They are typically

Box 7.1
The Brazilian Development Bank

Founded in 1952, the Brazilian Development Bank (BNDES) is wholly owned by the federal government. Its mission is "to foster sustainable and competitive development in the Brazilian economy, generating employment while reducing social and regional inequalities" (BNDES n.d.). BNDES, the largest creditor in South America, is a main source of long-term financing to Brazilian enterprises, with annual disbursements climbing sharply from $11.7 billion in 2003 to $82.3 billion in 2011 (Colby 2012).

The government uses BNDES as a key instrument in implementing industrial, infrastructure and foreign trade policies. Manufacturing industry is central to the agenda of BNDES and received around 40 percent of the Bank's total disbursements in 1995–2012 (Banco Central do Brasil n.d.).

BNDES supports manufacturing firms through the following measures: finance for investment projects to establish and upgrade plants, modernize processes and spur technological upgrading and innovation; funding for production, sales, acquisition or leasing of new machinery and equipment; support for production and export of goods and services marketed abroad; and facilitation of changes in firm ownership and project risk sharing (Ottaviano and de Sousa 2007).

Source: UNCTAD 2012a.

> **As a consumer, a national government can be the single largest buyer in several markets for goods and services in a country**

"set up to foster economic development, often taking into account objectives of social development and regional integration, mainly by providing long-term financing to, or facilitating the financing of, projects generating positive externalities" (UNDESA 2006b, pp. 10–11). Most of these banks focus on sectors that governments consider strategically important for the long-term development of the domestic economy, and act as catalysts for expanding targeted sectors and as facilitators of structural change.

In the longer run countries could aim at correcting credit market failures by strengthening institutions to reduce asymmetric information costs through credit bureaus, improve legal and judicial enforcement institutions and influence informal institutions by promoting a "repayment culture" (Meléndez and Perry 2010). The provision of credit rating systems is particularly important, and this type of information service should be introduced by governments if not developed by the private sector.

The state as producer

In pursuing development objectives the state has historically played a key role in industrial development through SOEs. State ownership can be justified when there are natural monopolies unsuitable for private enterprises, for social or developmental goals, to achieve investment returns for supporting budgetary objectives, and for national economic security (Mattlin 2009). They can also act as incubators for technical skills and managerial talent, as in China (Rodrik 2010).

Although there are good arguments to privatize enterprises, the state can succeed as an entrepreneur. A well-known example is the Republic of Korea's steel firm, POSCO, which began production in 1973, at a time where the country's biggest export items were fish, cheap apparel, wigs and plywood. It became the most efficient producer in the global steel industry in 10 years (Chang 2006). Likewise, Embraer, the state-owned Brazilian aircraft company, has established itself as a key player in the aerospace industry. European countries had used state subsidies and SOEs to expand at an unprecedented rate for more than three decades after World War II, but shifted towards privatization, deregulation and competition at the end of the 1970s (Ulltveit-Moe 2008).

The state as consumer

As a consumer, a national government can be the single largest buyer in several markets for goods and services in a country. It can use this purchasing power to stimulate economic activity and innovation, protect national industry against foreign competition, improve competitiveness of some industrial sectors or remedy regional disparities (Watermeyer 2000). For example, to develop or improve the competitiveness of selected sectors, public procurement was used after World War II in East Asia (Kattel and Lember 2010). Countries there started by identifying the products as well as the technological capabilities and know-how needed to produce them. Procurement contracts were then awarded to domestic firms with the government setting deadlines and quality standards to ensure continuing improvement and productivity in these targeted products.

States use several approaches (Yülek and Taylor 2012). A government can "buy domestic" to support selected industrial sectors, as illustrated by the Buy America Act in the United States, which gives preference to domestic products in federal government procurements. Similarly, local content rules – requiring a share of the procured product to be produced by domestic firms – can support domestic industry in two ways: first, by providing a market to domestic business (even when the procurement contract is awarded to a foreign firm) as well as employment and income to the country; second, by helping domestic businesses acquire know-how, transfer technology and lower unit costs through learning-curve effects.

Countertrade agreements are another approach, and build reciprocity into a transaction by requiring a foreign seller to purchase specified products from domestic firms. One example is an offset arrangement where a government requires a foreign firm to transfer economic benefits (beyond cash) to the domestic

> **Training and education call for industrial policy instruments that provide explicit incentives for human capital investments by firms and households, beyond the government's required investments in education**

economy as a condition for awarding a procurement contract. These benefits may include technology transfer, managerial services, investment, credit transfer, licensed production or co-production, with a view to improving domestic productive capabilities.

Public procurement usually needs strong government capabilities, and often generates controversy among foreign companies, which may request application of the WTO principle of equal treatment (Yülek and Taylor 2012).

Targeting key drivers of structural change

Industrial policy instruments can be used to target key drivers of structural change (see Chapter 4): education and skills, technology and innovation, and material inputs.

Education and skills

Education and skills[3] are essential to build productive capacities for national industrial development, yet would be underprovided in a pure market-driven environment as employers have too few incentives to provide funds for training and education because of labour mobility (the employee may move to another firm). Likewise, there is typically insufficient private spending on education as individuals base their investment decisions on private returns, not social returns. Further, employees would have few chances to self-finance the acquisition of human capital because it is extremely hard to "mortgage" future expected returns (a financial market failure).

So, training and education call for industrial policy instruments that provide explicit incentives for human capital investments by firms and households, beyond the government's required investments in education. These instruments include scholarships or long-term loans for undergraduate and graduate university studies (at home and abroad); vocational or engineering scholarships to carry out in-house training of prospective workers by firms; wage subsidies as an incentive for firms to hire and train more employees; demand-driven courses to train workers in the technical standards in certain industries; and business training for owners and managers of SMEs in issues like management, finance, accounting and investment analysis. Although countries have introduced policy measures to support such skills, the national training fund is increasingly popular (see Box 8.3 in Chapter 8).

Technology and innovation

Technology and innovation are crucial for strengthening industrial competitiveness. Yet limited appropriability, lack of competitive finance, and coordination failures, among other factors, make them prone to market failures and induce underinvestment relative to the socially optimal level (Martin and Scott 2000). Government intervention to promote adopting technology and innovation to upgrade domestic private sector capabilities is required. Countries have very different capabilities in this area, often dictating different policies, but most policy instruments finance and provide public inputs or information (Melo 2001) and include grants (typically non-reimbursable), subsidized loans and fiscal incentives (see above).

Innovation requires strong links between universities and research institutions and enterprises. To create those links, technological platforms can be established to provide forums where firms in a particular sector (or region) can identify technological obstacles and define the actions to remove them, partnering with research institutions. Similarly, technological centres or institutions can be set up to offer consulting to firms in various areas, such as product or process R&D; metrology, normalization, and certification services; and technology choice and adaptation (Box 7.2).

In public procurement schemes for innovation, a government agency places orders to purchase a product that does not yet exist or needs to be customized but that could probably be developed within a reasonable time through additional R&D, in this way lifting the producers' innovative capacity. The Internet and global positioning technology are two examples of government innovation-oriented procurement from the United States (Kattel and Lember 2010),

> **As a reliable supply system of low-cost and high-quality material inputs is crucial for local industrial production, countries lacking it sometimes use policy instruments to reduce the costs of inputs**

Box 7.2
Fundación Chile

A private, non-profit organization created in 1976 by the government of Chile and ITT Corporation, Fundación Chile focuses its main research on adapting and applying technologies in commercial operation elsewhere to the Chilean environment, though it sometimes conducts original research. Its best-known success is salmon cultivation, developed in Norway and Scotland.

Fundación Chile turns an idea abroad into a domestic business opportunity by first identifying a profitable product, technology or service that has still to enter the national economy. Then it attempts to acquire the rights through licensing (if needed) so as to adapt it to the national environment through research and development. Finally it commercializes it.

Other successes include berry cultivation, and exports of vacuum-packed and boxed frozen pork and beef, now worth about $500 million annually. Yet it has also had a few projects that did not meet expectations, such as the cultivation of southern hake, farmed turbot and abalone.

Source: Agosin, Larraín and Grau 2010.

and the X2000 high-speed train, the AXE telephone switch and energy-efficient lighting and refrigerators are examples from Sweden (Edquist and Zabala-Iturriagagoitia 2012).

Material inputs

As a reliable supply system of low-cost and high-quality material inputs is crucial for local industrial production, countries lacking it sometimes use policy instruments to reduce the costs of inputs. A "linkage creation" policy seeks to identify the main requirements for inputs and raw materials from large firms, and match this demand with local suppliers, often SMEs. More important, the policy should promote the development of local suppliers through technical assistance. Likewise, trade liberalization can reduce costs of imported inputs, benefiting local manufacturers, particularly those targeting export markets, through productivity and competitiveness gains (Amiti and Konings 2007; Topalova and Khandelwal 2011). For their part, tariff incentives allow firms to partially or totally recover some taxes or duties on imported inputs, while temporary admission schemes give to importing firms partial or total exemption from duties on input materials used in production.

In the current global context of increased resource scarcity and availability, industrial policy instruments must support green structural change (see Chapter 6), involving three categories of policy instruments to alter firms' behaviour.[4]

Market-based instruments. Instruments such as taxes, subsidies and tradable permits consider the costs of pollution and environmental degradation in the pricing of goods and services. For example, material input taxes seek to encourage a more efficient use of resources and to promote more material-efficient production technologies; they are applied to each (physical) unit of virgin extraction. They are already levied on a few resources (usually minerals) in some countries, including Bulgaria, Canada, Denmark and France. Tradable resource-use permits can be rights to emit pollutants (including greenhouse gas emissions) or rights to access natural resources (such as water) that are allocated to firms, which may trade them. The aim is to encourage firms to use existing opportunities to reduce resource use and particularly to develop innovative resource-saving technologies, to profit from unused permits.

Financial incentives or subsidies can also be used for resource-saving research and technological innovation, but subsidies that encourage overuse of natural resources should be removed. All subsidies should be time bound, well targeted and performance monitored.

Regulatory and voluntary instruments. Norms and standards that set binding limits can be defined by public authorities to achieve goals like reducing emissions and waste or increasing resource or energy efficiency. Bans are more stringent, and

> **“If industrial policy targets sectors rather than particular firms, it can be quite compatible – in fact complementary – to competition policy**

typically imposed on toxic materials. The Stockholm Convention focuses, for instance, on eliminating or reducing the release of 12 persistent organic pollutants. Beyond regulatory measures, voluntary agreements or negotiated environmental agreements can also be used to address, say, pollution and energy efficiency targets as well as reporting requirements.

Information-based instruments. Governments can use various measures to increase awareness by providing information on resource efficiencies and sustainable industrial production. Information-based approaches include using environmental data, indicators and eco-labelling or certification. Designed and implemented well, they can strengthen the effectiveness of other policy instruments such as environmental taxes. Finally, data and indicators should facilitate benchmarking as a way to determine the resource or energy efficiency of a system.

Aligning industrial and other policies

The targeting of key drivers requires close coordination with other policies – notably on competition, trade and FDI, and exchange rates – that play an important complementary role to industrial policy.[5] Failure to exploit these synergies may counteract policy objectives.

Competition policy

Competition policy includes competition legislation, which aims to prevent agreements between firms restricting competition (cartels), abuse of market power by dominant firms, and mergers or acquisitions that may create a dominant player and weaken competition. It may also include competition advocacy, which aims to promote (if needed, set up) a culture of competition.

Competition and industrial policies are often viewed as mutually conflicting. This is because competition policy typically aims to foster rivalry between firms in an industry for greater efficiency and economic welfare, while industrial policy frequently gives a market advantage over competitors (including producers of substitute products) to favoured domestic sectors or industries.

Two areas of possible conflict stand out (Brooks 2007). The first relates to new entry. There is a conflict zone between a high degree of competition (“contestability”) in markets and the willingness of firms to commit large investments into developing new products and new types of technologies or branching out into new areas of international specialization. Thus where innovation is crucial, protection of intellectual property rights is needed through patents, copyrights and trademarks, as temporary monopoly rents provide incentives to invest in creating or improving products, services or processes.

The second area concerns competition between domestic and foreign firms, as entry of the foreign firms usually increases competition in the short term and may threaten domestic ones. Governments may be tempted to use industrial policy to impede foreign entry, but they should also consider the possible positive effects of FDI on the endowments and productivity of factors of production, as well as spillover effects. The mode of foreign entry also matters, as mergers and acquisitions may result in abuse of market power by a dominant player, violating competition policy.

Aghion et al. (2012) argue that if industrial policy targets sectors rather than particular firms, it can be quite compatible – in fact complementary – to competition policy (see also Possas and Borges 2009). In order words, competition policy can be used to foster competition within sectors or industries that were picked by industrial policy, as in the Republic of Korea where intense competition between chaebol was ensured in the domestic market, or in Japan where oligopolistic rivalry rather than single national champions was promoted (Brooks 2007). Competitive pressures within an industry can also be maintained if instruments use sunset clauses (Rodrik 2004).

Finally, industrial policy seeks to favour technologies or tasks expected to offer better prospects for economic growth or societal welfare. Given its greater emphasis on the long-term development path, industrial policy can be given precedence over

> Climbing up the ladder in the seemingly hierarchical structure of international production and trade relationships has become a prime target of trade and industrial policies

competition policy. But competition policy provides a framework or contributes to "proper governance" of industrial policies. A strong and independent competition authority with clear and transparent rules for decision-making can be an important complementary agency for forward-looking industrial policy measures, as in the European Union (EU), where competition policy is at the EU level and so somewhat removed from capture by national lobbying efforts of incumbent firms.

Trade and foreign direct investment policy

Trade policy no doubt played an important role in countries' catch up by imposing direct import restrictions (tariffs, quotas and non-tariff barriers), offering preferable treatment to domestic producers on the domestic market (public procurement policies) and providing export support (export credits, and support to access foreign markets and export-processing zones; Chang 2003). Today, although some trade and FDI policies have been restricted through bilateral or multilateral trade policy agreements, governments still have some space to use trade-related instruments for industrial policy.

Developments over recent decades have been two-sided. There has been a strong increase in international integration, with a rising number of countries with liberalized trade regimes, leading to greater openness of their economies. But there has also been greater pressure on countries to move towards a more liberalized trade policy regime, but this can lead to specialization in products in which a country has a comparative advantage at the moment of liberalization. For many developing countries this may translate into producing and exporting only low value-added products, such as agricultural commodities, or only low value-added manufactures, such as textiles and electronic components, characterized by low wages. So analysis and policy concerns have shifted toward a dynamic perception of the place that a country's producers occupy in international production structures (at the industry level) or international value chains (at the task or fragment level within industries).

Climbing up the ladder in this seemingly hierarchical structure of international production and trade relationships has become a prime target of trade and industrial policies. Such hierarchies have been operationalized in empirical research through rankings by capital-, skill-, technology- or R&D-intensities, leading to a focus on supporting a country's move across ladders of such hierarchies. The role of foreign producers as sources of technology spillovers and as support for access to foreign markets has been recognized. As a result, great attention has been paid to incentivizing the channels through which such spillovers to domestic producers would occur, such as through linkage programmes. Policies that try to encourage more use of domestic inputs by foreign firms may also play an important role in upgrading domestic industry and promoting structural change.

In addition to specialization, trade liberalization can also lead to deindustrialization, with rapid growth of manufactured imports, closure of some local industries and stagnation or low growth in industrial jobs (see, for example, Reinert 2006).

The upshot is that trade policy instruments previously used by successful countries like China and the Republic of Korea to restrict imports are being replaced by:

- Non-tariff barriers, in a combination of import licensing, unjustified sanitary and phyto-sanitary conditions, a complex regulatory environment, red tape or lengthy customs procedures.
- Export-promoting instruments that support exporters in areas such as access to competitive and diversified finance, market access, R&D and training.

As trade policy is a key component of any industrial policy, the current policy space (such as under WTO rules) may need to be fully assessed and taken advantage of, or recovered if needed to promote structural change, particularly in developing countries (see Chapter 9).

Exchange rate policy

Movement of the real exchange rate (the nominal exchange rate adjusted by relative prices or unit costs

Well-designed industrial policies are a mechanism to promote employment generation, spur growth and improve welfare in developing and developed countries alike

between the domestic economy and its main trading partners) heavily influences industrial development. An appreciating real exchange rate makes a country's manufactured products less price competitive, which affects competition on the domestic market relative to imports and competition of the country's exports on foreign markets.[6]

An argument for policies targeting the tradable sector (through real exchange rate undervaluation, for instance) is that tradable activities (particularly manufacturing) are inherently scalable, in that economies can expand output without running into diminishing returns, unlike non-tradable activities (Rodrik 2008a). Moreover, the scope for productivity growth and learning is higher in tradable than non-tradable activities.

In trying to influence real exchange rate movements, authorities have to deal with the difference between the economy being in a fixed exchange rate regime (or even a currency union) and in a flexible exchange rate regime counterpart to its main trading partners. Closely monitoring the real exchange rate and keeping it undervalued to support the tradable sector, primarily manufacturing – including manipulation of the nominal exchange rate – have featured in almost all successful catch-up countries (Gala 2008; Rodrik 1986, 2008a). These measures are also crucial to prevent the current account deficit from becoming unsustainable, which would jeopardize industrial policy (McCombie and Thirlwall 2004).

Getting industrial policy to work – more than emulation required

Several recent design-based studies provide compelling empirical evidence that carefully chosen and implemented industrial policy can promote industrial growth and employment. For instance, there is now robust evidence that subsidies to manufacturing firms can increase employment at comparably very low "cost per job" (Criscuolo et al. 2012). Well-allocated firm-level subsidies can also boost total factor productivity (Aghion et al. 2012), and there is convincing evidence that tariffs that account for the varying skill levels among industries can boost economic growth (Nunn and Trefler 2010). These studies – discussed in more detail below – emphasize clean-research designs and use either randomized control trials or natural experiments to identify causal effects, helping make the industrial policy debate more objective.

Many scholars are now more optimistic that well-designed industrial policies are a mechanism to promote employment generation, spur growth and improve welfare in developing and developed countries alike. Consequently, many of them demand to move the debate from whether industrial policies should be considered at all, to how these policies should be designed and implemented (for instance, Aghion et al. 2012; Rodrik 2008a).

This subsection summarizes the lessons from selected impact evaluations of industrial policy interventions. It stresses that reproducing policy instruments in different countries needs to be handled cautiously, and that evaluations are crucial for experimentation and learning.

Handle with care

The majority of industrial policy instruments in the past were deliberately designed to achieve a set of policy objectives. But in most cases prospective justifications were not backed up by retrospective evaluations of the results' impact on objectives. This paucity of impact evaluations is a key constraint for a comprehensive and comparative appraisal of their future potential, their applicability in certain countries or sectors and their effectiveness for achieving growth and employment objectives.

In addition, most available analyses must be interpreted with great caution. First, many were not performed thoroughly enough, so an assessment of their internal validity suggests that causal relationships between policy instruments and observable impacts are hard to establish.[7] Second, the findings on the achievements or failures that can be distilled from international experiences cannot that easily be generalized because of country heterogeneity, so careful case-by-case assessment is needed.

Governments have many ways to subsidize firms, activities, whole industries or regions

In a nutshell no comparison of industrial policy instruments will find a "silver bullet". Still, it is evident that the more comparable the two countries under review are in their stage of development, country-specific factors, evident challenges and so on, the more likely it is that comparable results can be achieved.

With these caveats the rest of this subsection presents the most convincing evidence of the potential success that carefully chosen and well-implemented instruments can bring about. It looks into the effects of a number of regularly applied industrial policy instruments: first, subsidies and subsidized loans and fiscal incentives, then, trade policy instruments.

Subsidies, subsidized loans and fiscal incentives

Governments have many ways to subsidize firms, activities, whole industries or regions. Here, we refer to subsidies as any government action that allocates public resources – cash, financial assets and tangibles – for free or at below market prices. Many past cases involved SOEs and provided production inputs at below market prices, or government owned-banks that provided credit on preferential terms. Another way is reduced tax liabilities through tax exemptions, deductions or credits.

In each case one might assume that the crucial point is to identify and subsidize those productive activities where public resources would have the highest impact on employment and growth. But many policy instruments in high-income countries are explicitly based on an equity rationale and do not focus on efficiency. These include place-based economic development policies that target public resources at disadvantaged geographical areas rather than selected firms or disadvantaged groups of people. The most credible impact evaluations are for these place-based policies, and some design-based studies from high-income countries provide evidence that such policies have the potential to promote employment and growth.

For example, Criscuolo et al. (2012) examine the most important business support scheme in the United Kingdom: Regional Selective Assistance, which has provided subsidies to firms (mainly in manufacturing) in deprived areas over the last 40 years. By firm size the authors find that the subsidy programme had strong, positive effects for smaller firms, but an essentially zero impact on larger firms.[8] Spatially, the authors find that the programme raised employment mainly by reducing unemployment and did not result in equal and offsetting falls in employment in non-participating firms. The programme increased employment (and investment) in deprived areas, where the authors estimate the cost per job at about $6,300. They find no effects on total factor productivity.

Kline and Moretti (2012) evaluate the long-run impact of the most ambitious US place-based economic development policy: the Tennessee Valley Authority programme launched in the 1930s, which aimed to improve regional economic activity mainly by investing in large-scale infrastructure programmes. The authors find that the policy has increased employment in manufacturing, where positive effects are still present over 70 years after launch. In agriculture positive employment effects were only temporary, and starting in the 1960s gains were completely reversed. As wages in manufacturing were far higher than those in agriculture, the shift raised aggregate income in the Tennessee Valley Authority region for an extended period.

In contrast, Becker, Egger and von Ehrlich (2010), who evaluated the impact of the Objective 1 scheme of the EU's Structural Funds, do not find statistically significant positive effects on employment rates in eligible areas, but they do report positive GDP per capita growth effects. In a follow-up study they show that the impact of the policy varies greatly by a region's absorptive capacity – that is, the higher a region's human capital endowment, the more it benefits (Becker, Egger and von Ehrlich forthcoming).

It remains unclear to what degree these findings for high-income countries can be generalized to developing countries, especially as policy-makers in developing countries may not target deprived areas but focus on efficiency. One could seek to identify market imperfections, which impede manufacturing activities in areas where economic development is already

"When subsidies are allocated to competitive sectors, the net impact of subsidies on total factor productivity becomes positive and significant

above the national average that could be overcome with public resources. Equivalently, the conclusions of Criscuolo et al. (2012) – to focus on smaller firms – might not be applicable in low-income countries, because in such settings only larger firms may have enough absorptive capacity to benefit from such programmes. In middle-income countries the situation might again be different.

Design-based studies for low-income countries are unavailable, but Aghion et al. (2012), looking at China, provide a convincing argument that firm-level subsidies targeting production activities to a particular sector have the highest potential to spur growth if within-sector competition is high, and when the policy preserves this competition.

The crucial role of industrial policy is to induce companies to stay in high-growth sectors. The notion that targeting these sectors is more efficient when competition is more intense within a sector and when the policy manages to preserve competition is supported by the authors' empirical analysis (Aghion et al. 2012). Based on a panel dataset of large Chinese firms for 1998–2007, the authors show that when subsidies are allocated to competitive sectors (or in such a way as to preserve competition), the net impact of subsidies on total factor productivity becomes positive and significant. This suggests that subsidies to competitive sectors may be a promising approach.

What can trade policy instruments contribute?

The likely impact of trade policy instruments on growth and employment is not as clear cut as the proponents of trade liberalization and openness usually suggest. First, tailored packages of complementary industrial policy instruments comprising different areas and accounting for the specific circumstances of each country seem necessary to benefit from trade liberalization (see above). Second, trade protection can be a promising complement for strategically chosen, relatively skill-intensive sectors.

On the mechanics themselves, trade policies comprise all government actions that favour domestic (rather than foreign) manufacturing and that promote exports of the domestic industry. Favouring domestic manufacturing is achieved by trade protection – imposing some sort of cost on the import of foreign goods, typically distinguished between tariffs and non-tariff barriers to trade (such as import quotas or import licences). And promoting exports of the domestic industry can be achieved by any intervention that subsidizes export activity.

Export subsidies have three theoretical advantages over trade protection (Harrison and Rodríguez-Clare 2010):

- Subsidized exporting firms are subject to the discipline of the international market, which should force them to become more productive.
- Subsidies to exporting firms implicitly help firms with a certain level of productivity.
- The domestic market may be too small to reap the full benefits of externalities.

It is hard to find rigorous evidence on the impact of any specific trade policy, and only a single design-based study on the impact of a specific trade policy could be identified. But a vast empirical literature exists that tries to answer the underlying question of how trade protection (in contrast to trade liberalization) affects economic growth and employment. Many studies show a strong correlation between increasing trade shares and country performance, while the more recent literature has started investigating the mechanisms for gains from trade. For at least two reasons, though, these investigations cannot say much about the actual impact of trade policies on growth and employment:

- The most commonly used measures of openness to trade are not measures of policy instruments themselves, but rather trade volumes (exports or imports). Given that trade volumes are also affected by many other factors such as geography or exchange rate movements, the results could be misleading (Rodriguez and Rodrik 2001). Notably, the far fewer studies that use trade policies themselves as an explanatory variable tend to find insignificant or weak relationships (Harrison and Rodríguez-Clare 2010).

> **Any industrial policy will only work if it is in line with, or at least does not go against, the incentives of the political system**

- Irrespective of the measure for openness, it is extremely hard to establish causality. Is it openness to trade that causes economic growth? Or do growing economies simply become more open? And if that is not enough, many policies that liberalize trade are introduced as parts of a broader package of policy changes, making it even harder to tease out their impacts.

Thus, empirical evidence on trade policy instruments does not allow for a conclusion that policies promoting openness will spur growth and that trade protection will hamper growth. And many studies suggest that openness is not a sufficient condition for growth, but that gains from trade are contingent on industrial policies. Accordingly, trade policy instruments should be investigated in a more detailed way in the future, particularly because effects are very likely to be heterogeneous across industries.

One design-based study on the impact of tariffs follows this approach and does at least partially provide support for protectionist trade policy instruments. Nunn and Trefler (2010) point out that the conflicting results in the previous literature may be because it is conceptually wrong to look at the impact of a country's average tariff. Based on a comprehensive empirical analysis using cross-country industry-level panel data, they conclude that tariffs can be effective in raising growth if the industries chosen for protection are skill intensive. This result is in line with the infant industry argument that predicts a productivity-enhancing effect of tariff protection in the skill-intensive early stages of industrial development.

Making the industrial policy process more effective

This chapter showed earlier that low- and middle-income developing countries require a strategic approach to industrial policy-making, tailored to specific country circumstances. A one-size-fits-all approach to economic policy has not succeeded in the last decades and is unlikely to bring about structural changes in the future. Country heterogeneity demands a flexible approach to policy design. So the industrial policy process can look very different in one country than in another, and industrial policy should not follow a universal blueprint approach. Effective industrial policy has to consider country characteristics and deliberately target the prevalent constraints that are the key obstacles to a sustained industrial growth path.

Using – not fighting – the political system

An important source of variation in the success and failure of industrial policy is "political equilibrium" (Robinson 2009; Evans 1995; Haggard 1990; Wade 1990). This encapsulates the idea that the political system determines the objectives and functioning of the institutions implementing the industrial policy. This system, which reflects the preferences of the politically powerful, determines through its institutions the incentives of the key economic actors, influences the allocation of all public resources and decides on the distribution of income (Acemoglu, Johnson and Robinson 2005). Given such an institutional setting any industrial policy will only work if it is in line with, or at least does not go against, the incentives of the political system.

Whether the politically powerful always benefit from industrial promotion is not known. But to the extent that structural change causes a redistribution of income (or political power), as succinctly put by Robinson (2009, p. 27): "[I]t is not sufficient to just propose good economic policies, one must propose a way in which they will be endogenously chosen by those with the political power to do so".

Strengthening political leadership

Despite the increased attention on industrialization in many developing countries, budgets for industrial support initiatives, from national treasuries or donors, are seldom more than negligible, bound up in the fact that ministries of industry are usually weak players in cabinet. This was not always the case.

Lall (2004a), arguing persuasively that the priority given to industrial policy in East Asia was crucial in turning industry into the growth driver, shows that the importance of industrial policy was partly reflected in the power vested in the ministries

“Governments should join forces with their industrial private sector to design interventions based on their combined expert knowledge and to ensure that decisions are supported by key stakeholders

responsible for the sector. In Singapore, for instance, “the management of industrial policy and FDI targeting has been centralized in the powerful Economic Development Board (EDB). . . . EDB was endowed with the authority to coordinate all activities relating to industrial competitiveness and FDI, and given the resources to hire qualified and well-paid professional staff, [which is an essential prerequisite] to manage discretionary policy efficiently and honestly” (Lall 2004a, p. 18). Similarly, the Republic of Korea held “monthly meetings between top government officials (chaired by the President himself) and leading exporters” (Lall 2004a, p. 20).

In middle-income countries today, industrial development rarely receives such backing. Even the better supported agencies, like the Department of Trade and Industry in South Africa, are less involved in structural change than its peers in East Asia were.

In low-income countries some initiatives at the presidential level are emerging,[9] but most plans are underfunded and donors still largely disregard this priority, often arguing that industrial development is for the private sector and that governments should focus on infrastructure or training programmes.

These views seem misguided. Political leadership at the top is crucial for raising the profile of industrial policies and for ensuring the required coordination, oversight and monitoring (Rodrik 2004). Inter-ministerial competition for resources and policy incoherence can only be prevented by strategic leadership at the highest levels. It is also essential for high-ranking government officials to be responsible for industrial policy so they can be held accountable if these policies fail. In the 1970s the president of the Republic of Korea himself took the lead role in championing the country’s industrial policies and strategies. Such ownership is imperative. And beyond that, dialogue with the private sector can create further incentives for the political class to act.

Encouraging public–private dialogue

Governments should join forces with their industrial private sector to design interventions based on their combined expert knowledge and to ensure that decisions are supported by key stakeholders.

Such dialogue between government and private sectors – defined as any interaction between the state and the private sector relating to the design of public policies – is a key policy process in countries that have achieved economic growth through structural change (Altenburg 2010; UNIDO and UNCTAD 2011). In developing countries with low public sector capacity, private sector input can make a real contribution to successful policies (Altenburg 2010). Even so, rent seeking is an inherent risk in public–private dialogue and governance mechanisms are needed to avoid a policy outcome narrowly focused on the interests of certain groups (te Velde and Leftwich 2010).

For that reason a participatory and consensual decision-making mechanism is one of the key determinants of an effective industrial policy process. It is easy to agree that a new industrial policy cannot be a top-down planning process and needs to be based on such dialogue, but in practical terms at the very least a clear structure to ensure close private sector involvement is needed.

Easier said than done, however. Fruitful dialogue requires private sector organizations that allow companies to articulate their needs and give input to the policy process, yet in low-income countries producers in chambers of commerce and industry may be overshadowed by trading companies. As retailers and wholesalers can have fairly different policy concerns from manufacturers (on tariffs, import quotas and so forth), governments should consider strengthening manufacturers’ representation in national chambers.

The unorganized private sector may even need to strengthen the manufacturers’ (or subsector’s) association, or possibly create it. Most support programmes for private sector associations focus on increasing membership or enhancing technical services to constituents, but frequently disregard their capacity to lobby for member firms’ interests. Thus a more consensual and effective industrial policy process often requires targeted institutional-strengthening measures for policy management capabilities of these associations.

> "Umbrella organizations can help ensure broad participation of different private sector segments without overburdening the dialogue

Another point is how to institutionalize mechanisms for public–private dialogue so as to make them sustainable. They can exist either temporarily, such as the informal "growth alliances" of public and private representatives in different industries in Egypt (Abdel-Latif and Schmitz 2010), or be sustained over longer periods, such as the National Economic Development and Labour Council in South Africa.

Developing country governments may want to consult a range of successful cases of effective participatory approaches in other countries to decide on the most appropriate institutional set-up, which could include a centralized government agency for public–private dialogue, a focal point for private sector engagement or regular forums.

While the aim of this dialogue is to secure broad political commitment, success can be held back by a suboptimal trade-off between the broadest possible participation and flexible decision-making. Umbrella organizations can help ensure broad participation of different private sector segments without overburdening the dialogue, but the internal governance structures must be made representative of industry as a whole. This point is particularly relevant for SMEs, which need to join forces to make their voices heard (Pinaud 2007). Whether and how much trade unions and civil society bodies should be represented depends on the scope of deliberations.

A country's industrial policy is usually formed at the national level, but dialogue should ideally take place at various levels of government – from national through regional to local – to capitalize on companies' and entrepreneurs' local knowledge. This approach would require private associations organized at different levels as well as corresponding institutional structures for the dialogue. This risks overburdening the process, particularly in the early phase, but some degree of inclusion of local actors is prerequisite for serious buy-in, and it can be achieved without far-reaching institutional rearrangements, as with the help of subnational industrial policy forums, which allow firms to air their concerns.

Boosting industrial policy management capabilities

Beyond making the above political and other adjustments, countries need to have a certain technocratic capacity to realize the vision of, say, the president or prime minister, for industrial policy to succeed. Many developing countries lack this capacity, which has to be built pragmatically.

Capacity gaps inhibiting industrial policy

Altenburg (2011, p. 3), who coined the term "industrial policy management capabilities", highlights that "the key problem of industrial policy in poor developing countries is that, while the need to correct market failures is much greater than it is in highly developed societies, the ability of the public sector to tackle such failures is also much more limited".

So the question runs: What are these capacities and how can they be built? Effective industrial policy-making requires adequate capacities for each step of the policy cycle (Box 7.3). Strong analytical capacities are needed to thoroughly diagnose industrial performance, constraints and potential. Decision-making capacities are needed for the smart design of strategic directions, and the industrial policy toolbox needs to be understood to propose adequate policy interventions. Implementation requires strong management as well as technical and sectoral competencies. And forward-looking monitoring and evaluation requires not only adequate financial resources but also technical expertise.

Altenburg (2011) argues that most low- and lower middle-income countries perform very weakly in four key dimensions: defining priorities and building a broad consensus; establishing clear rules for market-based competition transparently and efficiently; delivering services effectively; and avoiding political capture.

The causes of the capability challenge are from home and abroad. Domestically, weak education and training systems fail to provide enough well-prepared bureaucrats, and neo-patrimonial political systems go right down most technocratic structures

> **Strong analytical capacities are needed to thoroughly diagnose industrial performance, constraints and potential**

Box 7.3
The policy cycle

The phases of the industrial policy process can be characterized as a cycle that starts with the diagnosis and design of the policy, and then implementation, followed by monitoring and evaluation – which closes one cycle and starts the next.

The initial phase entails thoroughly evaluating the country's industrial capacity, its structure and its competitive performance – an industrial diagnosis. It should also cover endowment structures, country and population size, and so on.

The design, building on this diagnosis, prioritizes the key objectives of the envisaged growth path and proposes measures to accomplish them. The policy may have different objectives but should identify and acknowledge trade-offs. Achieving industrial growth the fastest will no doubt require different choices from securing employment creation or equitable regional development. In addition, industrial policies have to identify and prioritize immediate and future potential and solutions.

A short-term component that aims at easy gains or "low-hanging fruit" – as through upgrading a sector or increasing value addition to a traditional commodity – is highly important for a realistic process, though any pragmatic short-term focus must still show the pathway for full-fledged structural change. Thus, a longer term component for new productive capabilities must be the ultimate goal (UNIDO and UNCTAD 2011). The idea of "defying" comparative advantage to create the foundations for future gains is at the core of this leapfrogging approach (Lin and Chang 2009).

Industrial policy interventions for structural change have to be ambitious by definition, though they can only be effective if they are realistic not only over time and scope, but also on the current capabilities of firms and the labour force and on financial resources for implementation. Governments of low-income countries have to take strategic bets into consideration, deliberating on the right ambitions.

Once the policy is designed and agreed among stakeholders, policy instruments have to be chosen (see *Industrial policy instruments – four main categories,* above). The implementation process of these instruments varies considerably, posing very different challenges among developing countries.

A key feature of the cycle is the feedback loop from implementation to diagnosis, based on monitoring and evaluation. This identifies success and failure to be fed into the next cycle, enabling adaptation and better performance (UNIDO and UNCTAD 2011).

Source: Industrial Development Report 2013 Team.

and sometimes discourage even the most motivated and well-educated staff involved in industrial policy. Internationally, some donors have reduced policy space or even undermined industrial policy measures in the last few decades in various ways, including by facilitating poverty reduction strategy papers that were biased towards social sectors; imposing economic policies that do not align with industrial policy objectives; enforcing deregulation that has weakened technocratic structures; replacing senior national decision-makers with international advisors; reducing the competitiveness of productive sectors through large aid inflows; actively attracting the most capable and entrepreneurial workforce into aid institutions; allowing donor fragmentation and non-alignment with national strategies; and replacing existing institutional structures and mandates with new implementation units (Altenburg 2011; Olukoshi 2004).

One cannot argue that industrial policy initiatives would have succeeded in low-income countries without donor involvement, but some egregious examples of the above issues stand out:

- The set-up by an international organization of a project for competitiveness and private sector development in Mozambique, which exceeded the total budget of the national Ministry of Industry and Trade, was designed with little national involvement, appropriated senior personnel from the ministry and essentially operated as a parallel agency (Krause and Kaufmann 2012).
- The simultaneous activities of 10 different donor agencies on value chain development in Ethiopia in the 2000s, which all used differing methodologies and cooperated seldom cooperated with each other (Altenburg 2011).
- The regular posting of long-term senior international experts into ministries of industry in

> **The pragmatic idea is to concentrate the available resources on executing highest priority tasks, and to incrementally build additional skills when they are really needed**

Sub-Saharan Africa, who largely replaced the national design of industrial strategies and policies without much interaction with local actors.

This capability challenge is more severe in the industrial policy arena than others because the more centralized government agencies usually also succeed in securing the best talent. Particularly in many Sub-Saharan countries, ministries of finance, planning commissions, development banks and other key players in cabinet are best placed to secure government resources.

Building management capabilities, ideally through learning by doing

During the Washington Consensus period, the World Bank (1997) stated that industrial policy was very difficult and required particularly high policy skills compared with other policy areas. Suggesting that the state's role should be aligned with its capabilities, it felt that low-income countries should not engage in this area but rather build their institutional capabilities beforehand. Lall (2004b), too, made the point that the strategic choice for an industrial policy in a country should ideally be based on an understanding of government capabilities – suggesting that simpler policies are the preferable option in less sophisticated administrations. But he also highlighted that capabilities can be built over time.

Criticizing the approach of policy-capability matching more fundamentally, Ohno (2009) makes the point that institutions and capabilities of technocrats in low-income countries cannot be enhanced in a general way, as this is neither politically appealing nor administratively implementable. Instead, capabilities should be strengthened in a more concentrated way, through dynamic capacity development. Citing the East Asian experiences, he suggests that the policy capabilities in developing countries can best be enhanced through hands-on efforts towards concrete goals. The pragmatic idea is to concentrate the available resources on executing highest priority tasks, and to incrementally build additional skills when they are really needed so as to solve emerging problems when they arise.

This debate cannot easily be settled without recourse to country cases, but it is clear that, as any economic or social decision with future impact, industrial policy-making is subject to fundamental uncertainty. This means that even the most capable administration will be unable to anticipate either the future development of its country, the dynamics of a certain sector or the competitive behaviour of competing countries. Equally, even the most sophistically designed policy intervention based on thorough analysis and implemented efficiently will not necessarily lead to success. Industrial policy may certainly be more risky in low-capability contexts, but may fail anywhere.

Industrial policy should thus be seen as experimentation – essentially learning by doing (see next subsection). Accordingly, the question of whether industrial policy is possible or not with the given capabilities should be replaced with: "How can the experimentation and policy-learning process be structured to fit the country context?" This process should not be held back because of concerns about failure, but interventions should rather be scaled up slowly from low-risk, low-complexity interventions to more ambitious initiatives. To quote Altenburg (2011, p. 36) again: "[T]here is a special need for policies that are cheap [and] simple in their implementation, and cannot easily be captured by influential interest groups".

Flexible policy design: experimenting, learning and evaluating

> Gone is the confidence that we have the correct recipe, or that privatization, stabilization and liberalization can be implemented in similar ways in different parts of the world. Reform discussions focus on the need to get away from "one-size-fits-all" strategies and on context-specific solutions. The emphasis is on the need for humility, for policy diversity, for selective and modest reforms and for experimentation. . . . Policy design . . . relies less on "best practices" and more on a combination of experimentation and monitoring (Rodrik 2008b).

> **Industrial policy-makers in developing countries would be well advised to gradually shift their attention from investigating and imitating international best practices to identifying and reproducing national success stories**

This chapter has made the point that industrial policy-makers who need to choose suitable industrial policy instruments cannot simply follow deterministic planning. While there is plenty to learn from theory and practice, and from benchmarking across countries, it is just not possible to generalize findings from one situation to another. Rather than simply emulating industrial policies that have worked elsewhere, countries have to go through their own learning process. This process necessarily involves experimentation, and trial and error. Abhijit Banerjee, one of the leading proponents of this school of thought, emphasizes that "what is probably the best argument for the experimental approach [is that] it spurs innovation by making it easy to see what works" (Banerjee 2007, p. 122).

For this approach to work, however, industrial policy experimentation has to be combined with rigorous impact evaluation of each implemented instrument to generate the evidence on which industrial policy measures work (and which do not) in a given context. Probably the most important role of industrial policy monitoring and evaluation in developing countries is to provide feedback for making the next cycle more innovative and effective.

Industrial policy-makers in developing countries would be well advised to gradually shift their attention from investigating and imitating international best practices to identifying and reproducing national success stories. In principle this leads us to the recommendation that every industrial policy intervention should be evaluated retrospectively. Especially in contexts with serious budget limitations and thus prioritization, it is essential to know whether the policy intervention was effective and whether the resulting benefits outweighed the associated public costs. But while this approach is finding more support among academics and in the donor community, policy practitioners encounter at least two political challenges:

- Evaluations, particularly the more sophisticated ones that include design-based studies, do not come free, thus reducing the available budgets for implementing policy. So small interventions especially do not readily lend themselves to comprehensive monitoring and evaluation approaches.
- Evaluations can reveal inherent flaws, limitations and even adverse consequences of industrial policy interventions. In almost all cases this implies a serious political cost. So full-fledged evaluations are frequently perceived as a threat, particularly larger interventions that usually coincide with ambitious political rhetoric and wide-ranging public interest.

Both these concerns could possibly be resolved though, at least partially, with a more nuanced and pragmatic approach to industrial policy experimentation and evaluation. While full-fledged design-based studies and experimental designs are not always feasible, their distinctive logic should at least be incorporated in the industrial policy decision-making, even if a final evaluation cannot. The point is that there are possibilities to design policy instruments as if they were experiments, without actually executing them as such. Policy interventions should come with a clearly formulated and realistic intervention logic or theory of change. At the very least, this approach would entail:

- A clear definition of a target system that makes concrete the objectives (including trade-offs among different objectives) that the policy instrument is aiming to have an impact on in the longer term (increased employment or economic growth, for example).
- Realistic "target corridors" for judging success or failure with regard to each objective ideally based on real-world benchmarks (such as minimum and maximum expected increase in employment, based on prior achievements in the country or elsewhere).
- An explicit impact model with a comprehensive depiction of the short- and medium-term changes in industrial sectors (at the firm and sector levels) that are needed to reach these long-term targets (such as required investments of manufacturing firms and structural changes in the production activities of firms).
- A detailed description of the steps required for reaching each of these goals (impact paths),

> **This process does at least ensure that interventions are discussed and designed reflexively and that stakeholders are well aware of the actions and achievements expected of them**

including a critical examination of whether it is realistic to expect to reach the goal with the time and resources available.

- An account of possible unintended impacts and side-effects of the policy instrument (risk factors), based, say, on consultations of experts and affected stakeholders before the intervention is carried out.
- An honest description of the assumed counterfactual, for instance: "What would the employment rate have been if the government had not subsidized manufacturing wages?"
- The selection of concrete impact indicators, which can be used to measure change both "on the way" (intermediate indicators) and with regard to the end objective (final indicators).

This process does not guarantee retrospective scientific evidence on the causal effect of the policy instrument, which is unquestionably an evaluation's main objective for the academic and donor communities. But it does at least ensure that interventions are discussed and designed reflexively and that stakeholders are well aware of the actions and achievements expected of them.

If this process is combined with less sophisticated and less costly (non-experimental) monitoring and evaluation designs, such as reflexive comparisons and qualitative research, industrial policy interventions are likely to be much more evidence based, consensual and transparent – and (it is hoped) more effective, without overburdening the technical and budgetary capacities of developing countries.

Notes

1. Pack and Saggi (2006) offer a similar but narrower definition.
2. In some cases capabilities can be transferable or complementary between sectors. For example, China was able to develop a wind power industry and become competitive in only few years (Lema, Berger and Schmitz 2012).
3. This issue is discussed in detail in Chapter 8.
4. Based on UNIDO (2011c). See also Jäger (2008) and Rayment et al. (2009).
5. For example, labour and skills can be considered part of education and employment policy, capital and technology part of innovation policy, and material inputs part of environmental policy.
6. Formally, the real exchange rate = $P_d/(\varepsilon^*P_f)$, where P_d is the domestic price level, P_f the foreign price level and ε the nominal exchange rate. This ratio tells us how much goods and services can be purchased abroad (after conversion into a foreign currency) compared with the domestic market with a given amount of local currency.
7. In the ideal case, to obtain an unbiased estimate of a true causal effect of a policy measure, it is essential to execute a thorough design-based study that considers confounding factors, including a control group, and that avoids selection biases as well as under- and overestimation of results. A detailed technical description of impact evaluation methodologies goes well beyond the scope of this chapter, but Gertler et al. (2011) provide a comprehensive overview from a practitioner's perspective. Impact evaluations can be costly and time consuming, and thus hard to combine with an industrial policy process that often puts more emphasis on short-term objectives and quick wins than on systemic transformation.
8. The heterogeneity of results with respect to firm size is quite intuitive, as larger firms are less likely to be financially constrained.
9. The most recent Five-Year-Development-Plan of the United Republic of Tanzania and the Growth and Transformation Programme in Ethiopia, to name two.

Chapter 8

Education and training policies for creating jobs in manufacturing

Employment creation is at the core of industrial strategies geared to sustainable development. There seems to be consensus that to maximize the benefits of industrialization, labour markets have to generate more and better jobs, which in turn increase real incomes and take people out of poverty.

The formation of specialized technical skills plays a major role in the quantity and quality of employment generation, and the accelerating pace of technological change is making these skills more important. And as the skills required for modern manufacturing have changed, so too have the institutional structures providing them. In the past, employability was correlated with improvements in basic education. Today's more competitive world puts greater emphasis on specialized high-level training, not only through formal training systems but mainly from the close interaction between the industrial private sector and the education apparatus.

Technological change and increased pressures to compete have put a premium on top skills in science, engineering, mathematics, computing and information technology. The most advanced countries in Asia, for example, give incentives to students to enrol in scientific subjects at university and offer early access to vocational training.

General considerations for skill policies

Most governments agree that human capital is a crucial driver for economic growth. Yet many, particularly in the developing world, have failed to act on this belief, partly because of their inability to push through the right policies and partly because of the private sector's unwillingness to get involved in creating skills. Some guiding principles based on good practice can help policy-makers understand the elements that go into successful skill policies.

Understanding the complexity of industrial skill needs

A simplified matrix (see Table 4.4 in Chapter 4) can help policy-makers identify broad skill profiles, demand, and education and training methods, but they need to make thorough assessments of skill gaps to identify industry's specific needs.

Matching short-term needs and long-term goals

Policy-makers have to create or strengthen skills for industry today while anticipating demand for tomorrow, especially in countries that want to transform their economies. They may need to consider three types of intervention: "early reactive" to tackle immediate skill shortages; "continuing" to tackle the skill demand for upgrading within existing industries; and "future-oriented" to supply the skills for long-term structural change (Fernandez-Stark, Bamber and Gereffi 2012). Early reactive can be addressed quickly through on-the-job training, but future-oriented may call for long-term changes to education. Still, policies have to be realistic, and changes should be gradual and sequential to forestall possibly huge misuse of resources on a system that does not meet industry's demands.

The formal education system needs to adjust over time. Other forms of training by private and public suppliers should fill in the gaps, and firms have to adopt a "skill culture" through innovation and learning. This will not happen automatically, hence the need for policy intervention.

Specialized technical skills need to be built on strong education foundations set during primary and secondary school, primarily comprising the fundamental academic skills of numeracy and literacy, as well as behavioural (or soft) skills acquired at an early age through personal interactions and problem solving.

Matching supply and demand

As discussed in Chapter 4 (see *Mismatch between skill demand and supply*), successful skill policies have to bridge the gaps of over-supply in some areas

> **The education system will need to develop the capacity to anticipate upcoming demand – and work towards providing the upcoming areas of expertise**

of knowledge and of offering too many diplomas in non-required fields. Reconciling the "what is needed" with the "what can be provided and how" is possibly the most important challenge in designing skill policies, yet the interplay between supply and demand is complex. The supply side essentially reacts to signals from the demand side, but the timing of demand and the lack of innovation strategies may hamper the speed and nature of the response by education and training organizations. Without having a complex planning system, the education system will need to develop the capacity to anticipate upcoming demand – and work towards providing the upcoming areas of expertise despite facing major uncertainty as to whether these actually will be the needed fields, if it is going to provide the required workforce for structural change and economic growth.

Aligning skill policies with the broader socioeconomic agenda

Skill policies have to be aligned with the economic and social development needs of society, which requires strong coordination between stakeholders engaged in policy-making – public and private. Policy-makers have to be aware that the skill policies may differ greatly depending on a country's industrialization starting point and goal – the challenges for a resource-rich unindustrialized country differ greatly from those for a country trying to escape the middle-income trap.

Many developing countries suffer from coordination failures when designing skill policies, for two main reasons. First, the government agency developing the economic agenda is not necessarily the one responsible for executing it. The lack of inter-ministerial coordination often results in the design of industrial policies that are unrealistic for the country's human resources. Second, the private sector in developing countries, even if organized, is minimally involved in policy-making, which again leads to misconceptions of industry's skill needs. Thus skill policies become supply driven.

Policy recommendations for skills

As countries differ in many ways, so does the choice of skill policies. There is no one-fits-all policy mix that works for all countries. Policies that worked in Asia many years ago, for example, may not work in Africa today. The knowledge structure of a country is determined by multiple factors, including formal schooling, in-firm learning and the knowledge acquired and influenced by social networks such as families and communities (Nübler 2013b). The sociocultural and historical context plays a fundamental role that can lead to failure of policies that have worked elsewhere, so policy-makers should be cautious when designing skill policies. Still, they may wish to consider a few broad thrusts and some other countries' approaches.

Support development of soft transferable skills for manufacturing

In Viet Nam manufacturing employers are not just looking for technical skills but also for cognitive, social and behavioural skills. Teamwork and problem-solving skills are considered key for blue-collar workers, while critical thinking comes out as the most desired skill for white-collar workers (Bodewig 2012). Mastering English is a top priority in Thai manufacturing (World Bank 2010). These are just two examples of how important soft skills have become in South-East Asian manufacturing.

Indeed, with the growing pace of technological change in manufacturing, and the shift from routine manual to more non-routine analytical and interactive activities, companies now put a premium on a workforce better prepared to learn and absorb new tasks. Problem-solving attitudes as well as interpersonal skills such as communication and teamwork have become crucial for on-the-job learning, to the extent that some firms have now prioritized these over other technical education when hiring staff due to the transferability of skills across sectors (EC 2011; Fernandez-Stark, Bamber and Gereffi 2012; Murnane and Levy 1996).

While specialized technical skills remain key for structural change and technological upgrading in manufacturing, soft transferable skills have become

> **The emphasis should be on critical thinking, problem solving and the encouragement of teamwork and creativity**

a crucial asset for employability, both in and outside manufacturing.[1] Many of these soft skills have to be developed at an early age, signifying the importance of supporting policies that establish the learning foundations of the future workforce. More and better schooling will be crucial for manufacturing, and developing soft transferable skills will enhance employment prospects later on. The non-technical nature of these skills also calls for changes in the teaching approach. Traditional "follow the model" methods that emphasized static learning, memorization and imitation are no longer viable for developing interpersonal skills. The emphasis should be on critical thinking, problem solving and the encouragement of teamwork and creativity. The combination of these skills and specialized technical skills acquired later will provide the best possible skill mix for employment in highly advanced manufacturing.

Complement formal education with technical and vocational education and training

Over the last few decades there has been a strong emphasis on technical and vocational education and training (TVET) to meet the demand for industrial skills. No substitute for formal education – instead, TVET builds on it to deliver specialized technical training. Although TVET covers the whole gamut of manufacturing skills, the shift from simple assembly and processing to technology-intensive industries calls for a skilled workforce capable of operating state-of-the-art technologies. Tertiary enrolment in technical subjects, including engineering and mathematics, has normally been taken as a useful indicator for the availability of skilled labour for highly advanced industry.

But university education has often proved to be insufficient supplying the skills needed by industry both because of the rigidity of university curricula in times where the demand for skills in industry is constantly changing and because of a lack of private sector participation in developing those curricula. There seems to be a consensus that TVET is usually more adaptable to industrial needs as the private sector is often engaged in its design and even execution.[2]

TVET does not work automatically. In many instances the suppliers of TVET were unable to keep up with the skill needs of industry due to sudden changes in demand. If the private sector does not provide the information continually, it is very unlikely that TVET suppliers can anticipate changes in demand and so adjust the training curriculum. Governments at times assume incorrectly to have more and better information than private parties on programmes. Finally, TVET can also fail due to enrolment shortages as families in developing countries may not be aware of the longer terms benefits of a technical education (Almeida, Behrman and Robalino 2012).

For TVET to be mainstreamed within the education system in developing countries – and in many developed ones – TVET programmes have to overcome three main challenges:

- They still do not enjoy a good reputation among the general public, which sees TVET as an alternative for those who do not perform well at school, rather than as a mechanism that enhances future employability through the acquisition of industrial skills.
- A variety of public and private bodies offer them, frequently leading to many uncoordinated efforts and myriad certifications that can confuse prospective students and employers. Most countries lack a single body responsible for setting standards for TVET programmes, not only for their design but also for execution and monitoring.
- Programmes rarely have tracking systems to confirm whether participants have found jobs in related fields, giving the institutions little feedback on their courses' relevance and suitability for graduates.

Engage the private sector in designing technical and vocational education and training

The involvement of the private sector in TVET is crucial for its success because its involvement is the most efficient way to link skills to the labour market (DFID 2011). The private sector is not only important by

> **On-the-job enterprise training is possibly one of the most important sources of skill development in manufacturing**

providing relevant information on skill needs but also by taking an active role in shaping the training programmes to make sure they match skill demands more closely (Box 8.1).

Where the private sector is less strong, there is still the possibility to develop successful TVET programmes by involving relevant stakeholders. For instance, in India the Skills Development Initiative, which aims to provide 1 million workers with employable skills over five years with an additional million workers each year after that, is a public–private partnership.

Encourage on-the-job training

On-the-job enterprise training is possibly one of the most important sources of skill development in manufacturing. Training in enterprises, usually provided to employees after formal education and vocational training, is a very effective and economical way to develop the workforce's industrial skills. The reason is that manufacturing firms bear the cost of training only to the extent that they expect to reap some benefits. Such training can take different forms. At the lower end of the spectrum formal training is rare and only occurs through informal exchanges with colleagues. In highly advanced sectors training is formalized, becoming an integral part of the worker's job.[3]

Apprenticeship schemes have become increasingly popular as an efficient public–private partnership to bring industrial skills to the shop floor (Box 8.2). They are not only responsible for developing skills that are very specific to individual firms and sectors, but are thought to be a key reasons for low youth unemployment – as in Austria, Germany and Switzerland, which have successful dual-training systems.

In all countries considering this system the private sector needs to have a key role in designing the training, to ensure that the skills required are being learned (AU 2007). Economies relying on a large agricultural sector and with a large informal sector may not find the dual system suitable, however, as it needs a strong private sector and a high level of institutional coordination among the parties.

Make financing for training efficient and equitable

Lack of financing is the main constraint to supplying high-quality TVET. Governments cannot be expected

Box 8.1
Involving the private sector in Singapore

Singapore's vocational and technical education (VTE) is frequently cited as among the most effective in having achieved a transformation from an unskilled workforce to a highly skilled one, in 20 years (Lai and Yap 2004; Lall 2001).

VTE seems to differentiate itself from those in neighbouring economies in one aspect – a private sector role in the coordinating body (Lai and Yap 2004). Although in the Republic of Korea, Malaysia and Taiwan Province of China the government is either the principal or only body making decisions on vocational education, the government of Singapore has ensured that the private sector has a key role in shaping VTE, and representatives of industry and labour organizations form a significant part of the coordinating body. This representation allows for a direct and continual flow of information on changes in the demand for skills in industry, and teaching curricula can thus be adapted quickly.

Additionally, the system offers traineeship programmes with key industries such as aircraft maintenance and ship manufacturing. Agreements have been signed with industry for technology and knowledge transfer between education centres and industry, to ensure that teachers remain up to date with industry developments (Law 2007).

The government-funded Institute of Technical Education – Singapore's pride in VTE – has become a world-class institution, known for its quality, values and relevance internationally. Over the years it has changed from comprising various vocational institutes to three "educational colleges". With strong industry partnership, 70 percent of the curriculum consisting of practical work and a wide range of programmes and courses for students, the Institute strongly emphasizes the suitability of its graduates for future employment (Law 2007).

Source: Industrial Development Report 2013 Team.

A unified nationwide certification scheme, ideally under one body, avoids duplication and informs sectors about the qualifications held by individuals

Box 8.2
Apprenticeship schemes

Apprenticeship schemes combine classroom vocational training with practical work experience in the firm. The strong link with the private sector enables the curriculum to adapt rapidly to changing demands in industry. The government offers the classroom courses, and the firm pays a reduced salary to the participant. After the contract between the participant and the employer for this work experience expires, the employer can hire the participant (or choose not to).

Young people in the scheme have a smoother and faster transition from education to their first job, which may be very important in ensuring that they are not discouraged at the start of their career, especially as participants are more likely to be those with lower educational attainment at an earlier stage (Biavaschi et al. 2012).

The best-known example of a dual-training system is in Germany. It is complex, having developed over many years. Adequate organizational capacity is required, as is participation and collaboration of trade unions, the government (including for regulatory frameworks), employers and others. Particularly for employers, such in-house training can be costly, making it crucial for the advantages of such a scheme to be well communicated.

Source: Industrial Development Report 2013 Team.

to meet the whole burden when private returns surpass social returns. Yet firms, even aware of the benefits of training, may be unable to bear the associated costs and risks. This is particularly true for smaller firms in developing countries.

Governments have to make financing efficient and equitable, and the best way to do this is by partnering with the private sector. Indirect financing – the state co-finances training schemes but the private sector takes responsibility for delivering services – has proved successful. The policy is based on the expected efficiency and equity gains economy-wide, especially for manufacturing firms that require a pool of highly skilled professionals. Two approaches have become increasingly popular for such co-financing (Box 8.3).

Develop nationwide certification for manufacturing skills

A large number of uncoordinated efforts to build industrial skills results in duplicity, waste of resources and confusion among employers and prospective students. A unified nationwide certification scheme, ideally under one body, avoids duplication and informs sectors about the qualifications held by individuals. For these people such a certificate signals to potential employers the types of skills they have, which can be particularly advantageous for youth who do not have experience or personal contacts, and thus face difficulties in presenting themselves to potential employers. For a firm it is a form of quality assurance and allows them to measure and compare skills among applicants (World Bank 2010). Certification also facilitates labour mobility and creates competition within the labour market.

Support skill development through inter-firm linkages

It is important to look beyond traditional forms of providing training and education. With globalization, the dynamics of manufacturing have changed dramatically. As production becomes more fragmented and the need to increase efficiency to remain competitive internationally grows, firms have found new ways to position themselves.

International trade has changed production networks (see Chapter 5), including skill creation, manufacturing clusters (Box 8.4) and huge scope for knowledge spillovers. Some governments have reacted by encouraging growth through training centres, research and development (R&D) institutes and science parks. These routes allow for knowledge to flow much faster, especially across borders.

Governments need to do more to facilitate such knowledge exchange. (The national and regional authorities were key in developing training and R&D centres in the clusters in Box 8.4.) Being part of a global production network can allow a firm and its employees to develop the skills for manufacturing employment. Often, lead firms in more economically

> **To develop the higher education system to better suit industry's needs for higher skills, a variety of similar policies need to be put in place, like those proposed for general education and TVET systems**

Box 8.3
Targeted voucher programmes and levy schemes

Targeted voucher programmes

Targeted voucher programmes have traditionally been used to make education more equitable by targeting underserved groups like women and youth. Vouchers for low-income students can be given for them to get the education of their choice. The same principle applies to out-of-school training, similar to vocational training delivered by the private sector. This can lead to more efficiency as vocational training schools depend on revenue from students' fees.

Levy schemes

A national training fund is typically used to finance employee training inside or outside the enterprise. Financing is usually secured through payroll-training levies. Such funds are becoming an increasingly common engine for financing in-firm training and for many countries – often in Latin America and Africa – they constitute the embryo of their emerging educational systems for lifelong learning (Johanson 2009; Unni 2011).

The scattered evidence suggests that these schemes have helped increase training. In Malaysia employer-participants of the Human Resource Development Fund levy were more likely than non-participants to have trained their employees (Tan and Gill 1998). In Singapore, through the Skills Development Fund, the amount of training by employers increased (Kuruvilla and Chua 1999; Tzannatos and Johnes 1997; Dar, Canagarajah and Murphy 2003). "A common feature of schemes, in which training has increased, has been the fact that an effective system is in place for administering the levy" (Dar, Canagarajah and Murphy 2003, p. 7).

One of the main criticisms is that the scheme is far from equitable as larger firms tend to benefit more than smaller ones. Smaller firms thus see this scheme more as a tax burden, and larger companies more as a subsidy, partly because higher educated workers are more likely than those with less education to receive training (OECD 1999).

In developing countries levy schemes are particularly difficult to implement well because they rely on effective tax collection. "The high rates of non-compliance are related to the low administrative capacity of governments and ineffective levy-collection mechanisms that cannot target smaller employers" (Dar, Canagarajah and Murphy 2003, p. 7). Also, procedures for receiving the training grant can be burdensome – a deadweight for smaller firms.

Source: Industrial Development Report 2013 Team.

Box 8.4
Clustering

Clusters, often built for firms within a manufacturing subsector, have started to benefit from their geographical proximity to undergo collective training activities. This is particularly true in Europe, where clusters such as the advanced textiles manufacturing cluster in Flanders (Belgium), the Brainport high-tech cluster (the Netherlands) or the medical technologies cluster in Baden-Wurttemberg (Germany) are exchanging knowledge and expertise through education and training institutions. As firms collaborate within these clusters, workers are conscious of the different working environments and conditions among the firms, exerting pressure on employers to ensure that employees are satisfied.

Source: CEDEFOP 2012.

advanced countries either train or provide guidelines on how production should take place (Humphrey and Schmitz 2001). This knowledge is useful for the current job and can be transferred later.

Support private sector–university collaboration

When skills need to be developed to suit manufacturing's highly sophisticated activities, such as R&D and innovation, universities may be crucial in producing graduates with the right skills, especially in developing countries (World Bank 2010). But as with basic education, and even TVET in many countries, there tends to be little collaboration with the private sector in higher education. Teaching methods are typically academic in style, denying students the opportunity to learn practical skills for manufacturing jobs.

So, to develop the higher education system to better suit industry's needs for higher skills, a variety of similar policies need to be put in place, like those proposed for general education and TVET systems.

Ensure a focus on youth

Young people are the group most vulnerable to unemployment, especially during a recession. A focus on

> **It is important to develop structured and recognized education and training accessible for the informal sector**

jobs for them is important for three main reasons: joblessness at that stage is a strong predictor of unemployment later; it means a loss in the experience component of human capital formation; and it may discourage some of them, causing them to drop out of the labour market.

So supporting youth is very important, whether the political focus is on industrial competitiveness through skills or on social policies (Box 8.5). The majority of education and training for manufacturing employment and the policies suggested in this chapter are by nature more directed towards youth, particularly TVET and apprenticeship.

But these policies may not always be enough to cater to all needs. In developing countries particularly – where general educational attainment tends to be lower and students are more likely to have fewer years of education – second-chance initiatives can be particularly beneficial, especially for those on low incomes and in the informal sector.

Do not forget the informal economy

Access to formal or recognized TVET is hard for people working in the informal sector or in a micro- or small enterprise. Training is usually informal, on the job and with no recognized certification. In Morocco 80 percent of those in the informal sector, whether employers or employees, had no other skills than those developed on the job. In Ethiopia virtually nobody in the informal sector had any kind of formal training (Walther 2011).

But a significant share of those employed in manufacturing work in the informal sector or within small firms (many of which operate in the informal economy). Additionally, in many countries the informal sector is the main entry point for youth for any kind of employment, even those who have completed higher education. In Central Africa 60 percent of those who have undertaken a bachelor's or master's course started their career in the informal sector (Walther 2011).

So it is important to develop structured and recognized education and training accessible for the informal sector to develop the sector, increase its productivity and strengthen the link between the informal and formal economies, making it easier for workers to move from the former to the latter. For such training to be effective, it should focus on addressing the skill

Box 8.5
Youth unemployment in Tunisia

In Tunisia the rate of unemployment has reached an average of 46 percent among qualified youth. After the Revolution employment creation with a special focus on youth in the lagging regions has become the first development priority for the new Tunisian government.

As part of a project funded by the Spanish government and the Millennium Development Goal Fund, UNIDO in partnership with four other United Nations agencies,[1] implemented a joint programme to support the Tunisian government in its efforts to create jobs and prevent migration. UNIDO intervention focused on a three-fold approach that aimed at reinforcing local support structures (public, private and civil society organizations), assisting young entrepreneurs to create and develop their enterprises in selected value chains (such as the handicraft and carpet value chain) and finally enhancing youth participation and information sharing through a web-based platform.

Here are some results:

- 31 support structures trained in enterprise creation and development as well as in "counselling" young people.
- 200 youth trained in enterprise creation and development, of which 16 youth in the carpet industry.
- 3,000 youth trained and actively engaged on the Digital Entrepreneurship Platform.[2]
- More than 100 enterprises created by youth.
- 900 productive jobs created.
- Three studies on "Investment opportunities in the selected regions", "Handicraft and carpet value-chain in Gafsa" and "Access to finance for youth".
- Two exhibitions of Gafsa carpets in Tunis and Amsterdam.

Notes

1. The Food and Agriculture Organization, International Organization for Migration, International Labour Organization and United Nations Development Programme.
2. See www.dep.tn.

Source: Industrial Development Report 2013 Team.

> **For such training to be effective, it should focus on addressing the skill needs of the informal sector in particular, in addition to enabling access**

needs of the informal sector in particular, in addition to enabling access. But as the informal sector has a larger share of young people, women and less-skilled workers, and stretches across all sectors of the economy, a flexible approach is required to offer different schemes to match the sector's heterogeneity (Gibson 2013).[4] Training must also be recognized nationally, with participants receiving certification.

Notes

1. Australia, Canada and the European Commission have identified key competences to be developed for the workforce to prepare better for a changing and increasingly demanding labour market (Mayer 1992; Brunello and Schlotter 2011; EC 2009).
2. A review of the data and different studies by the European Centre for the Development of Vocational Training suggests that TVET has a stronger positive effect on firms in manufacturing than in other sectors (CEDEFOP 2011). Studying the effects of vocational education in Ghana, Jones (2001) finds that, besides TVET increasing manufacturing productivity, employees who have undergone vocational education have higher productivity than graduates with only secondary education, even if the former had fewer years of formal education.
3. The likelihood of firms engaging in formal in-house training depends on three main factors: size – larger firms are more likely to invest in training (Almeida and Aterido 2011); ownership and orientation – foreign and export-oriented firms are more likely to train; and education attainment of the workforce and management and training capabilities of employers – capable workforce and management are more aware of the benefits of training.
4. Although the informal sector has largely been ignored in the past, some developing countries are addressing this omission. For example, the Kenyan government has established a Ministry of Technical Training and Applied Technology, with responsibility for the sector (Gibson 2007).

Chapter 9

International cooperation

Manufacturing industry worldwide is facing challenges, most fundamentally generating large numbers of jobs while taking into account the impact of climate change, which requires a major transformation and restructuring of industrial activity (see Chapter 6). Yet many developing countries and economies in transition lack the necessary human, financial and technical resources to make this shift – a shortfall that international cooperation can help address.

After discussing the impact on developing countries of a national policy space that has been curtailed by international agreements on trade, this chapter looks at international cooperation mediated through institutions like the United Nations Conference on Trade and Development (UNCTAD), UNIDO and the International Labour Organization (ILO), particularly in three areas: liberating economic resources for investment in manufacturing, facilitating cross-border adoption of labour standards and generating learning effects on industrial restructuring.

International cooperation in the first of these areas contributes to economic development by providing and protecting investments, often through bilateral investment treaties (BITs). These treaties have fast become a fixture in regulating international trade, and because they have a measured, positive impact on foreign direct investment (FDI), they have proved useful for regulating cross-border investments. Further, BITs and other investment regulations may also improve conditions for manufacturing-related employment generation, which international organizations can encourage. In the second area cooperation can help harmonize, strengthen and enforce labour standards globally, particularly in the fairly new area of private sustainability standards. It can also assist in generating and sharing knowledge – the third area – where emerging platforms and forums that aim to promote industrial development can serve as vehicles, as well as the traditional multilateral bodies.

This chapter also stresses the need to ensure that an economic dimension appears on the development agenda after 2015, unlike the original Millennium Development Goals (MDGs). As the world considers how to move beyond the MDGs, the opportunity arises to build a framework with goals anchored in all of the three dimensions of sustainable development – economic, social and environmental.

The trade-off between national policy autonomy and trade liberalization

To address global environmental and economic challenges, manufacturing industry needs to be transformed and restructured into sustainable industry. But to guide and as necessary stimulate this transformation, national regulators need policy autonomy, a position that may be at odds with international cooperation through trade agreements.

Such agreements seek to reduce barriers to trade and enhance trade through legally binding rules. Yet trade liberalization is not itself the ultimate goal. Even the first paragraph of the preamble to the Marrakesh Agreement Establishing the World Trade Organization (WTO) refers to trade in accord with the objective of sustainable development and the protection and preservation of the environment.[1] International cooperation, especially through trade and investment agreements, aims to lead to regulatory convergence, which requires countries to relinquish some of their policy autonomy (Trebilcock and Howse 1998), thus removing certain policy options from a regulator's arsenal.

The reduction of policy autonomy can manifest itself in two ways. First, it may no longer be possible to use a certain policy instrument, such as subsidies. Second, a national regulator may have to refrain from introducing new (or applying current) legislation to protect non-trade policy objectives such as health or the environment.

A clear example of the former is the WTO Agreement on Subsidies and Countervailing Measures

> **International cooperation can contribute to manufacturing employment by legally protecting foreign investors**

– a powerful and frequently used policy instrument – which prohibits governments to use subsidies under certain conditions (Coppens 2009, 2013). Similarly, many export restrictions are only allowed when they follow the relevant rules in the General Agreement on Tariffs and Trade (Karapinar 2011).

The debate on the balance between policy autonomy and trade liberalization is especially heated in cases of the latter type where measures not directly related to trade are assessed for their compliance with trade rules, and these cases give rise to some of the most contentious decisions by the dispute settlement organs of the WTO.

But it would be unfair to qualify WTO dispute settlement as in itself hostile to industrial policies, particularly those related to sustainable industrialization. Considering that the WTO has identified more than 100 trade-restrictive measures, which include some measures with industrial environment in mind, enacted by Group of Twenty countries in only seven months, the disputes before the WTO are merely the tip of the iceberg (EC 2013; WTO 2013). Still, the issue of policy autonomy remains crucial for the legitimacy of trade agreements.

Bilateral investment treaties – protecting and promoting foreign direct investment

International cooperation can contribute to manufacturing employment by legally protecting foreign investors.[2] As the *World Investment Report 2011* puts it: "Investment promotion policy can be an important means to build productive capacity in developing countries" (UNCTAD 2011, p. 105).

FDI influences employment in manufacturing in several ways: by increasing the number of jobs through direct investment in production facilities; by lifting productivity through knowledge spillovers (World Bank 2013a) and by raising the quality of jobs, especially through higher wages and better working conditions (Mosley 2011). But as shown in Chapter 5 and touched on again in Box 9.1, FDI is not a one-way bet.

FDI represents a commitment of capital: such investment transfers financial, technological and informational resources from owners in one country to new subsidiaries, plants, offices or owners in a second – host – country. Investing directly in a host country allows firms to circumvent complications associated with servicing foreign markets and

Box 9.1
A few warning lights for foreign direct investment

Foreign direct investment (FDI) is not the unmitigated boon for accelerated economic development that some claim it to be. First, it can crowd out domestic investment – that is, investment from foreign sources discourages domestic investment by host-country nationals (Caves 1996). As de Backer and Sleuwaegen (2003, p. 71) put it: foreign firms paying higher wages "skim the domestic labour market and decrease the labour supply for domestic companies, at least in the short term".

Second and relatedly, newer analyses are finding weaker, negative links between innovation and FDI inflows. This is a significant step backwards for FDI's proponents, as a principal rationale for liberalizing access to FDI is for the domestic market to gain from technological spillovers. Jin, Garcia and Salomon (2013), studying the Spanish manufacturing sector over 1990–2002, find that as inward FDI flows increase, and despite rises in total factor productivity and labour productivity, innovation decreases, measured by the numbers of patent applications and of new products launched on the market. States may then be faced with a decision: support productivity increases by encouraging FDI or favour innovation by limiting FDI.

Thus the economic gains promised by FDI are less clear cut than some supporters argue: crowding out and stifled innovation create hurdles for domestic employment generation by eliminating the organic processes of firm creation and growth. Yet these issues are largely observed in the short term: over longer periods, crowding-out effects diminish and a measurable uptick appears in domestic entrepreneurship through learning, networking and linkage effects between domestic and foreign firms (de Backer and Sleuwaegen 2003).

Source: Industrial Development Report 2013 Team.

> **Bilateral investment treaties aim to protect the sources of FDI and so stimulate investment and create jobs**

fragmented production processes (Helpman, Melitz and Yeaple 2003). When FDI roots a firm in a foreign market through a subsidiary or similar entity, firms tap local labour and supply markets to bolster output.

But foreign direct investors run risks, including expropriation and unfair treatment, as FDI host states maintain the legal right to decide how to treat incoming foreign investment – a right upheld by the UN Charter in 1974 – meaning that FDI-importing states have full discretion over the conditions, tax rates, property rights, dispute-settlement procedures and treatment afforded to international investors.

Rules established in BITs allay these concerns by requiring states to compensate for expropriation and allowing repatriation of assets. To avert discrimination against foreign investment, BITs also extend national treatment, most-favoured nation treatment and the like to investments defined as FDI in the BIT. BITs thus aim to protect the sources of FDI and so stimulate investment and create jobs. They mitigate risks and credibly demonstrate the host country's commitment to assuring the legal and domestic conditions to house FDI safely. Governments accede to these stringent conditions because the prospects of FDI entice, promising technology transfers and domestic job creation (Elkins, Guzman and Simmons 2006). They are willing to subject themselves to multilaterally supported dispute-settlement mechanisms.

The number of BITs has surged in the last couple of decades as the main tool for states looking to facilitate FDI, from a mere 447 in 1990 to more than 2,000 unique, bilateral agreements in 2000 and more than 3,000 in 2011 (UNCTAD 2011). Recognizing this increasingly dense web, discussions arose within the Organisation for Economic Co-operation and Development (OECD) to harmonize FDI policies in the mid-1990s. The result was a draft agreement called the Multilateral Agreement on Investment, which attempted to institutionalize FDI promotion and protection policies within the OECD and to provide internal dispute resolution mechanisms (OECD 1998). But incompatibility among states' preferences for the contents of BITs stifled progress towards multilateral cooperation in 1998, and OECD states subsequently returned to strictly bilateral approaches to regulating FDI.

Generally positive impacts of bilateral investment treaties

The question remains whether BITs positively – if at all – affect FDI flows. Several authors approach this issue, employing political, economic and legal perspectives. Neumeyer and Spess (2005), for example, analyse the effect of BITs on FDI flows to developing countries. They find a positive relationship between BITs and FDI, indicating that an agreement – all other factors held constant – increases FDI flows to a BIT signatory. Importantly, FDI inflows are not isolated to just the BIT signatory partners, so this result includes FDI inflows from countries without BITs.

More recent findings also tend to find a similarly positive relationship, though these results are contingent on political factors. In fact, most of the more recent studies, such Büthe and Milner (2009), depart from traditional trade and legal analyses of BITs to concentrate on political conditions and their role in shaping BITs and FDI. Along this seam, Tobin and Rose-Ackerman (2011) report that political conditions are the most important factors for attracting FDI, but also that a BIT serves as a guarantee to improve political stability of domestic institutions. In this way BITs are capable of attracting FDI when signed between developed (FDI-exporting) and developing (FDI-importing) states. Still, they find that legal institutions and mechanisms provided for in BITs complement, but do not supplant, sound, functioning domestic institutions in the developing country partner.

Mixed results indicate that other factors influence FDI inflows, but as Büthe and Milner (2009) note, BITs are now standard means for states to bilaterally coordinate FDI policies. In this way investors increasingly identify BITs as a prerequisite when scouting for new countries for outward FDI (Büthe and Milner 2009). Most notable, though, are BITs' impacts on regulatory governance and market liberalization. The terms they embody dismantle investment barriers

> **International bodies have an opportunity to bolster states' benefits from bilateral investment treaties by buttressing coordination efforts**

by legally binding signatories to non-discriminatory behaviour towards foreign investors and unparalleled permission for FDI entry. A by-product of relegating dispute-settlement processes to international bodies, BITs strengthen the regulatory quality of their policies on investment.

Allee and Peinhardt (2011) offer more conclusive evidence of BITs' impact on FDI. They find that signing a BIT increases FDI inflows to signatory states, but this result is conditional, too. An economy's FDI picks up if the state is neither accused nor found guilty of violating the agreement's terms. States taken to the International Centre for Settlement of Investment Disputes (ICSID) see a significant decrease in FDI inflows no matter the number of BITs they have signed. Allee and Peinhardt (2011) also note that states must be able to support BIT clauses institutionally to enjoy the benefits (employment and otherwise) of greater FDI.

Persuading developing countries of the benefits of bilateral investment treaties

Despite the sharp rise in numbers of BITs signed in the last two decades, many countries (mainly developing) have failed to be among the parties. International bodies have an opportunity to bolster states' benefits from them in four ways, by buttressing coordination efforts.

First, investment-related international cooperation can be multilateral or bilateral. Multilateral agreements are far better for efficiency and economic benefit, but are much harder to conclude and none is likely in the near future. Here is where international organizations can initially help: they can serve as a vehicle or forum for aggregating interests. As seen, multilateral efforts in the OECD in the later 1990s failed due to irreconcilable differences on investment protection. Since then the number of parties in BITs, and thus with "unique preferences" on protection, has risen, complicating prospects for a multilateral agreement.

International organizations can instead support bilateral and regional efforts by extending their databases on investment agreements and ensuring transparent reporting of agreements signed, cases disputed and the firms and locations of FDI. Such data are valuable for states considering new negotiations or firms seeking new investment locations. This will aid developing countries especially, as knowledge on standard conditions for national treatment and disputes can help them negotiate better. Moreover, understanding the public nature of such data encourages states to comply more rigidly with the agreements they have signed, which in turn increases the credibility of their commitments (Büthe and Milner 2009).

Second, international organizations can provide consultative services to states interested in pursuing BITs or other investment agreements. Negotiations often begin with a template that states keep on file and alter according to the partners targeted for a particular agreement. But developing states often lack the administrative capacity to fully develop such a template or, worse still, lack the administrative capacity to negotiate with states holding greater bargaining power. To this end, international organizations can lend expertise to developing states to institute a well-rounded BIT template or to train administrative staff responsible for negotiations on strategies and typical agreement clauses. UNCTAD and UNIDO seem particularly fit for such a task, as its in-house expertise on BITs is substantial. For example, UNIDO's Investment Promotion Programme has been providing advice and capacity building for 30 years to investment promotion officers in the developing world, helping start international industrial partnerships through FDI in developing countries and establish investment and technology promotion units and agencies in developed and developing countries.

Third, international organizations can disseminate knowledge on investment agreements. Although violations of BITs' terms trigger marked reputational damage that hurts FDI inflows, developing states largely consider BITs ceremonial agreements with little or non-strictly binding terms (Allee and Peinhardt 2011). Here ICSID can disseminate information to states less keen on litigation (usually developing countries) on how to use ICSID to settle disputes, by creating a lending system for states burdened by dispute-settlement

International organizations should also ensure that their capacity building has a focus on technical expertise in bilateral investment treaties

costs and by advising states negotiating BITs on the implications of clauses related to dispute settlement.

Fourth, academic studies indicate BITs' positive influence on FDI flows, noting that signing and fulfilling the terms of a BIT increase FDI flows to partner countries (Haftel 2010), but only if the states show institutional quality (Büthe and Milner 2009), especially in the judiciary (Tobin and Rose-Ackerman 2010). So international organizations with expertise in establishing domestic institutions, ensuring their quality and monitoring their functioning can intervene to improve institutional quality where most pertinent to BITs. Tapping the data and resources of bodies like the European Commission, ICSID, OECD, UNCTAD, UNIDO and World Bank can translate vast quantities of information into capacity building for domestic institutions. International organizations should also ensure that their capacity building has a focus on technical expertise in BITs.

Private sustainability standards

Another area for international cooperation is in international labour standards, particularly for manufacturing. They have a long history, often tied to the ILO, which urges their global adoption. Thus over many decades a body of international rules has developed on labour standards including wages, worker safety and collective bargaining. Beyond the ILO's norms and procedures to enforce them, trade unions, nongovernment organizations and social movements have put enforcement high on the political agenda, and often criticize national and international governmental agencies for not enforcing them properly (de Bakker et al. 2013; Keck and Sikkink 1998), as well as many leading firms and brand owners. Social activists' discovery that reputation was a firm's tangible asset that they could easily harm spurred a proliferation of social protests, such as the Clean Clothes Campaign, directed at apparel and textile firms (Bartley 2003).

These criticisms prompted firms in the early 1990s to respond with new forms of private governance, which aimed to assure international standards along the whole value chain (Abbott and Snidal 2009; Mattli and Woods 2009). First, many firms established codes of conduct and initiatives on corporate social responsibility (CSR; Box 9.2). In 2003 the World Bank estimated that firms had more than 1,000 codes of conduct, many in manufacturing

Box 9.2
Corporate social responsibility and industrial restructuring

In a world attuned to voluntary regulation, corporate social responsibility (CSR) has emerged as a promising tool to incorporate environmental and social concerns in industrial restructuring. But large multinationals dominate the CSR movement, a concern for the United Nations and its specialized agencies, which aim to bring small and medium-size enterprises (SMEs) into the movement. Multinationals often invest heavily in CSR policies and campaigns, putting pressure on smaller companies that supply them or struggle to make their own way in the international market. Already grappling with requirements to meet strict standards on food safety and quality, many SMEs lack the expertise or finance to build sustainable business and employment practices. Without help to create socially responsible and sustainable practices, they risk being left behind as big market players look to suppliers who can meet these criteria.

Working with large private companies, international organizations such as the International Labour Organization and UNIDO are adapting their technical assistance programmes to include the CSR needs of SMEs in their projects (ILO 2013; UNIDO 2013b). They receive support in better management techniques, productivity and safer, sustainable production and labour practices, which should create a win-win situation for both suppliers and buyers as large companies can demonstrate their commitment to social inclusion and to society by bringing smaller suppliers further into the value chain.

From the point of view of SMEs, if companies achieve lower absenteeism, fewer accidents and better working conditions, along with lower energy consumption and waste, then competitiveness as well as social and environmental responsibility can go together. In practice these projects show that the business case for CSR for smaller companies is no different from that of large corporations – better productivity, morale and competitiveness.

Source: Industrial Development Report 2013 Team.

> **Pioneering labelling and certification schemes involved firms, non-governmental organizations, trade unions, governments and international organizations to create new forms of international regulation**

subsectors such as textiles, footwear and wood processing, and many more have come about since. But many codes have been attacked for being too weak and serving as mere "window dressing" (Wells 2007), encouraging yet new forms of private governance that brought together actors and stakeholders.

Besides those from multilateral organizations, many private initiatives emerged such as the Fair Labor Association and Social Accountability 8000. These pioneering labelling and certification schemes involved firms, non-governmental organizations, trade unions, governments and international organizations to create new forms of international regulation (Abbott and Snidal 2009).

Labour standards also spilled over into many other initiatives aimed at promoting such "private sustainability standards" through certification and eco-labelling (Abbott and Snidal 2009; Marx 2011).[3] Transnational certification initiatives aim to implement labour standards in global production processes and communicate to consumers across national and regional markets that certified products have been made according to these standards.

This proliferation of labels and certification systems was driven by several interrelated factors, including the commitment of multinational firms to CSR (O'Rourke 2012) and that of governments to support private sustainability standards through public procurement legislation.

Many such standards now cover multiple sectors, with many variations, but common characteristics are an organization that defines social and ecological standards – and procedures to check that products or processes conform to these standards. When they conform, a certificate is awarded (sometimes used for advertising and promotion), and here differences emerge in stringency of standards (Fransen 2012; O'Rourke 2003) and the certification procedure (Gereffi, Garcia-Johnson and Sasser 2001).

Impact on labour conditions

Private sustainability standards were initially welcomed as "one of the most innovative and startling institutional designs of the past 50 years" (Cashore, Auld and Newsom 2004) and were regarded as key instruments in ratcheting up labour standards internationally (Sabel, Fung and O'Rourke 2000). But doubts have emerged more recently over their potential to improve labour conditions in developing countries.

Some reservations stem from journalistic exposés of certified factories that breach the standards, most dramatically recent fires in garment factories in Bangladesh and Pakistan, which killed many hundreds of workers. Others come from the lack of credible empirical data that these systems are effective.

Effectiveness in this context is often measured along two dimensions: problem solving and process (Marx, Bécault and Wouters 2012; Tikina and Innes 2008). The former is the degree to which the problem that prompted the certification initiative is solved (often compliance with ILO conventions and standards); the latter evaluates the adoption rate of certification initiatives by firms (the number of certified firms).

On problem solving there is some evidence that private sustainability standards improve working conditions. For the Forest Stewardship Council, de Azevedo and de Freitas (2003) analyse the impact of certification on working conditions of workers in the Amazon basin in Brazil and find that in certified forests the logging camps and safety of forest operations are significantly better than in non-certified forests. But some "on the ground" reports or testimonies call into question the thoroughness of audited factories' compliance with labour conditions, questioning their impact (Esbenshade 2004; Locke 2013; O'Rourke 2000).

For process effectiveness, annual reports of the leading initiatives on private sustainability standards show that the number of certified factories is limited, pointing to a very low overall adoption rate given that many retailers work with several thousands of contractors, each with several subcontractors. In addition, most certification is in only a few countries such as Bangladesh, China, India, Pakistan and Viet Nam.[4]

“Multilateral organizations are becoming key knowledge managers and coordinators, bringing together actors to share their information and learn from others

Private sustainability standards and international cooperation

Thus how these mechanisms are playing out in the real world is largely unknown. No sound, overall quantitative studies – to our knowledge – exist that estimate the effects of these mechanisms on labour conditions or employment. The scattered available studies give some evidence on certain aspects but no consolidated picture (Locke 2013; Reich 2008; Vogel 2008). Here lies an important role for multilateral organizations, especially a new international body, the United Nations Forum on Sustainability Standards (Box 9.3).

Generating and sharing knowledge

Multilateral organizations are becoming key knowledge managers and coordinators, bringing together actors to share their information and learn from others. International cooperation on knowledge sharing is expected to enhance mutual learning and peer review, identify good practices and their conditions for transferability and develop joint policy initiatives or identify areas where joint initiatives can reinforce states' current policies (Tholoniat 2010).

The key focus in sharing knowledge is on managing and coordinating knowledge (Abbott and Snidal 2010). Several authors propose a comprehensive approach to knowledge management with a strong emphasis on a networked approach to learning and improved network management (Rayner, Buck and Katila 2011). The former is necessary because improved knowledge management does not necessarily lead to learning. A key issue is bridging knowledge generation and use, which can be achieved through networked learning platforms defined "as an integrated set of services that provide information, tools and resources to support policy learning" (Rayner, Buck and Katila 2011, p. 141).

These knowledge platforms aim to promote structural change and green growth strategies, including UNIDO's Green Industry Platform. This is a voluntary multi-stakeholder partnership designed to provide a framework for participants, individually or in groups, to take specific and measurable action to advance environmentally sustainable approaches and employment in industry (GIP 2013).

Sustainable manufacturing and employment post-2015

As the world considers how to move beyond the MDGs after 2015, the opportunity arises to build a framework with goals anchored in the three dimensions of sustainable development – economic, social and environmental. The eight MDGs were intended to unify pursuit of these three dimensions, but an economic dimension was missing and a target on employment was only added in 2008 (UN System Task Team 2012). Generating new employment remains a

Box 9.3
United Nations Forum on Sustainability Standards

The United Nations Forum on Sustainability Standards (UNFSS) is a new platform to generate knowledge and information on private sustainability standards with a particular focus on their potential contribution to development. It is a joint initiative of the Food and Agriculture Organization, UNIDO, International Trade Centre, United Nations Environment Programme and United Nations Conference on Trade and Development. UNFSS can make a contribution in several areas.

First, it could pool data and research on the effectiveness of these systems and their potential employment impact. In doing so, it might consider expanding the systems' focus (not only agri-foods) to the sectors in manufacturing where private standards are important, such as textiles, apparel, leather, wood products, paper, chemicals and furniture.

UNFSS could also consider developing a watchdog function for private sustainability standards. Some authors have argued that these systems differ in several aspects directly related to their effectiveness and potential employment, in numbers and quality (O'Rourke 2003; Sabel, Fung and O'Rourke 2001; van Waarden 2011). Most important, these systems differ in how they enforce standards.

Source: Industrial Development Report 2013 Team.

> The post-2015 agenda offers a new opportunity for states to recouple considerations for sustainable manufacturing and employment with the focus on human development

pivotal global social concern, however: the first indicative findings from the United Nations–led consultations on the post-2015 development agenda, through which more than 200,000 people from across the world contributed their views on the ideal development priorities after the expiry of the MDGs, show that job creation will remain a major social challenge, encompassing almost all economies well beyond 2015 (UNDG 2013). The post-2015 agenda thus offers a new opportunity for states to recouple considerations for sustainable manufacturing and employment with the focus on human development that dominated the original MDG programme, by recommitting to the economic dimensions of development.

Four challenges stand out: concerns about the nature of the relationship among growth, equality and development; perceptions by some parties of historical over-emphasis on economic globalization and the market or on the role of public policy in economic activity; uncertainty about the environmental and resource impacts of expanding the productive activities of developing countries; and fear of obscuring the clarity and simplicity of the outcome-oriented MDGs. All need to be squarely addressed in the post-2015 process (UN 2013c).

The first steps in this direction are evident in the United Nations High Level Panel of Eminent Persons on the Post-2015 Development Agenda, which combines global development and sustainability with provisions and goals for industry and trade.[5] Reflecting on the accomplishments achieved and the hurdles encountered under the MDG programme, the Panel outlined five transformative shifts. One transformation specifically links "sustained, long term, inclusive growth" to overcoming the challenges of unemployment, resource security and adaptation to climate change and calls for the transformation of economies for jobs and inclusive growth (UN 2013b). Targeted efforts to meet these goals hold the potential to provide 47 million more workers with good jobs and livelihoods and to equip 200 million more young people with the skills they need to get good work (UN 2013b). Following the Panel's report, the General Assembly reaffirmed the essential contribution of industrial development and employment to achieving internationally agreed development goals and called for "giving appropriate consideration to the issue of industrial development in the elaboration of the development agenda beyond 2015" (UN 2013c, p. 3).

The findings of the Panel and the implications from other post-2015 processes such as the Open Working Group on Sustained and Inclusive Economic Growth, Infrastructure and Industrialization indicate that clear action from international organizations can aid in addressing these concerns as well as building the capabilities and labour forces that will allow countries to resolve these global development challenges.

Fully bringing sustained, inclusive and sustainable economic growth, manufacturing and employment into the post-2015 development framework means paying careful attention to the globalization of production, trade, technology and finance that has made manufacturing more international and made it harder for developing countries to compete internationally. A strategy based on developing the productive resources, entrepreneurial capabilities and production linkages that together determine the capacity of a country to produce goods and services and enable it to grow and develop could set the stage for a new development partnership (UNCTAD 2010b). Along these lines, Japan has proposed a post-2015 Pact for Global Wellbeing, prioritizing growth that is green, inclusive, shared and knowledge based (Berg and Melamed 2012).

These visions of a future where economic growth and manufacturing employment are more stable, inclusive, sustainable and equitable arguably contrast with the more "quick-win" approach of the MDG era. It remains to be seen to what extent the General Assembly will adequately resolve these issues when it ultimately decides on the post-2015 development agenda during its 69th session opening in September 2014.

Notes

1. The first paragraph of the preamble states: "Recognizing that their relations in the field of trade and economic endeavour should be

conducted with a view to raising standards of living, ensuring full employment and a large and steadily growing volume of real income and effective demand, and expanding the production of and trade in goods and services, while allowing for the optimal use of the world's resources in accordance with the objective of sustainable development, seeking both to protect and preserve the environment and to enhance the means for doing so in a manner consistent with their respective needs and concerns at different levels of economic development " (WTO n.d.).

2. This chapter does not focus on the many different forms of official development assistance (grants and loans) in which international organizations are involved.
3. In the literature one can find many different references to a similar phenomenon: private standards, labels, certificates, sustainability standards and so on. We refer to "private sustainability standards" as this is the term used in the new United Nations Forum on Sustainability Standards.
4. For data on certified facilities (including breakdown by country) of two leading certification initiatives, Fair Labor Association and Social Accountability International, see FLA (2012) and SAAS (2013).
5. In July 2012 Secretary-General Ban Ki-moon assembled a 27-member High Level Panel to advise on the global development framework beyond 2015. The aim of the Panel was to draw up a report on the post-2015 development goals after consultations with civil society, the private sector, academia and research institutions from all regions in the world. The aim of the report: to set out a new development framework.

Part B

Trends in manufacturing valued added and in manufactured exports

Chapter 10

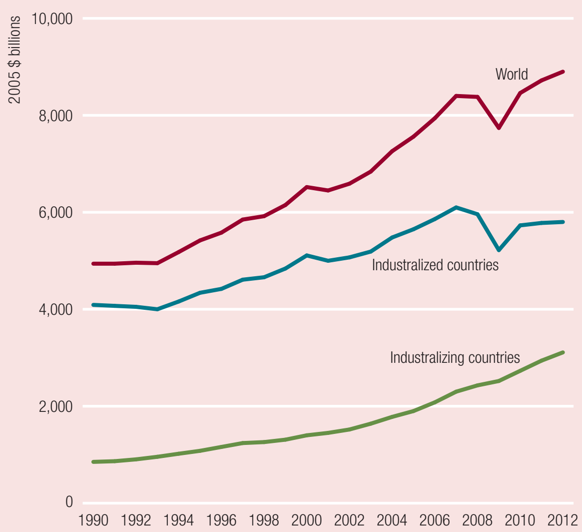
Trends in manufacturing value added

Since the start of this century industrializing economies have accounted for a growing share of the world's manufacturing value added (MVA). This trend is as much the result of a gradual shift of production from industrialized to industrializing countries to benefit from cheaper labour, largely improved infrastructure and lower social costs, as it is a reflection of the growth of industrializing countries' domestic markets for industrial goods due to higher incomes and a fast-rising middle class.

The world's MVA reached an all-time high of $8,900 billion in 2012 (16.7 percent of global GDP), recovering fully from the sharp contraction of 2008–2009 caused by the global economic and financial crisis (Figure 10.1).[1] MVA's share in GDP in industrialized countries fell from 16.4 percent in 1990 to 15.0 percent in 2012, while it rose from 16.5 percent to 21.3 percent in industrializing countries.[2]

In manufacturing, globalization of production and the accompanying trade liberalization seem to benefit industrializing countries, bringing in more financial resources, supporting economic growth and generating employment for a growing population, if at the risk of increasing their vulnerability to external shocks. Conversely, some industrialized countries are facing the tougher task of having to adapt to the new world economic scenario with stagnating growth, budgetary constraints, unemployment and social unrest.

Figure 10.1
Manufacturing value added by development group, 1990–2012



Source: UNIDO estimate based on UNIDO (2013c).

Manufacturing in industrializing countries

Between 1992 and 2012 global MVA nearly doubled, from $4,960 billion to $8,900 billion, averaging 3 percent annual growth. While MVA expanded by a mere 1.8 percent a year in industrialized countries, below their 2.1 percent annual GDP growth rate for the period, it rose more than three-fold in industrializing countries, at an annual rate of 6.4 percent, faster than their 5.0 percent a year GDP growth rate (Table 10.1). The outcome was a near-doubling in the share in world MVA held by industrializing countries, from 18 percent in 1992 to 35 percent in 2012 (Figure 10.2) and a corresponding retreat of industrialized countries from the world's manufacturing scene, underscoring the structural changes taking place in both groups.

These long-term trends conceal a clear change of pattern around the turn of the century, coinciding with the accession of China to the World Trade Organization and the increased trade liberalization and globalization of production that ensued. Over 1992–2002 the annual growth of world MVA averaged 2.9 percent, whereas over 2002–2012 it averaged 3.1 percent. Accompanying this seemingly minor difference was a remarkable acceleration in MVA growth in industrializing countries, from an average annual 5.3 percent over 1992–2002 to 7.4 percent over 2002–2012. This surge was more than enough to offset the deceleration in MVA growth in industrialized economies, which fell from an average annual 2.3 percent to 1.4 percent over the same periods.

"Between 1992 and 2012 global MVA nearly doubled, from $4,960 billion to $8,900 billion, averaging 3 percent annual growth

Table 10.1

Manufacturing value added in industrializing countries, by industrialization level, region and income group, 1992, 2002 and 2012

	Manufacturing value added (constant 2005 $ billion)			Share of manufacturing value added (percent)		
	1992	2002	2012	1992	2002	2012
World	4,960	6,590	8,900	100	100	100
Industrialized economies	4,050	5,070	5,800	82	77	65
Industrializing economies	904	1,520	3,110	18	23	35
By industrialization level						
Emerging industrial economies	778	1,340	2,820	86	88	91
Other industrializing economies	111	157	240	12	10	8
Least developed countries	14	22	44	2	1	1
By region						
East Asia and the Pacific	267	684	1,810	30	45	58
Excluding China	87	149	253	10	10	8
Europe	92	106	186	10	7	6
Excluding Poland	74	68	97	8	4	3
Latin America and the Caribbean	320	391	517	35	26	17
Excluding Mexico	214	246	340	24	16	11
Middle East and North Africa	96	134	221	11	9	7
Excluding Turkey	49	71	107	5	5	3
South and Central Asia	81	143	294	9	9	9
Excluding India	32	49	89	4	3	3
Sub-Saharan Africa	48	62	84	5	4	3
Excluding South Africa	20	25	37	2	2	1
By income group						
High income industrializing	175	273	495	19	18	16
Upper middle income industrializing	57	91	163	6	6	5
Lower middle income industrializing	657	1,140	2,410	73	75	78
Low income industrializing	15	21	41	2	1	1

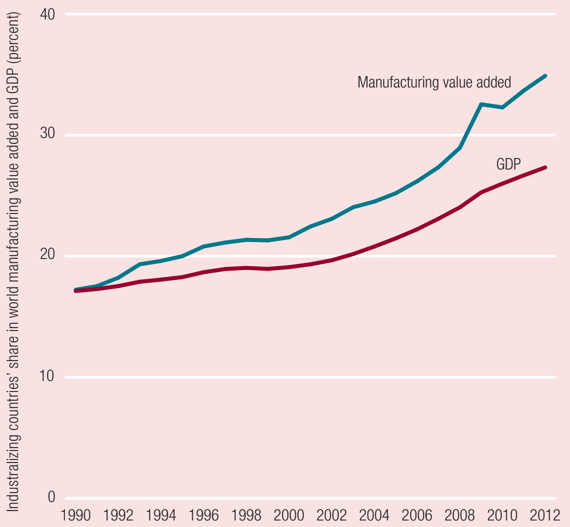
Source: UNIDO estimate based on UNIDO (2013c).

China sustained extremely high but stable MVA growth throughout both periods, with annual rates averaging 11.5 percent over 1992–2002 and 11.3 percent over 2002–2012, respectively, in itself an extraordinary performance but not an explanation for the change of pattern. Instead, it is other industrializing countries such as India (6.9 percent over 1992–2002; 8.2 percent over 2002–2012), Turkey (3.0 percent; 6.0 percent), Poland (8.0 percent; 8.9 percent), Argentina (–1.3 percent; 7.4 percent), Belarus (2.0 percent; 10.1 percent), Peru (3.9 percent; 6.5 percent) and Bangladesh (6.7 percent; 7.8 percent) that have seen a sharp acceleration of MVA growth since 2002 and are thus responsible for the increased dynamism. Given that it was in the second period when the economic and financial crisis set on, the emerging pattern gains in significance.

Despite the gain in world MVA share, manufacturing performance among industrializing countries and regions varies widely. China increased its share in global MVA nearly five-fold over 1992–2012, reaching 17.5 percent, and confirmed its role as the second-largest manufacturer behind the United States. India

> **"Manufacturing in industrializing countries is geographically highly concentrated, with the five leading economies accounting for 70.9 percent of total production in 2012**

Figure 10.2
Industrializing countries' share in world manufacturing value added and GDP, 1990–2012



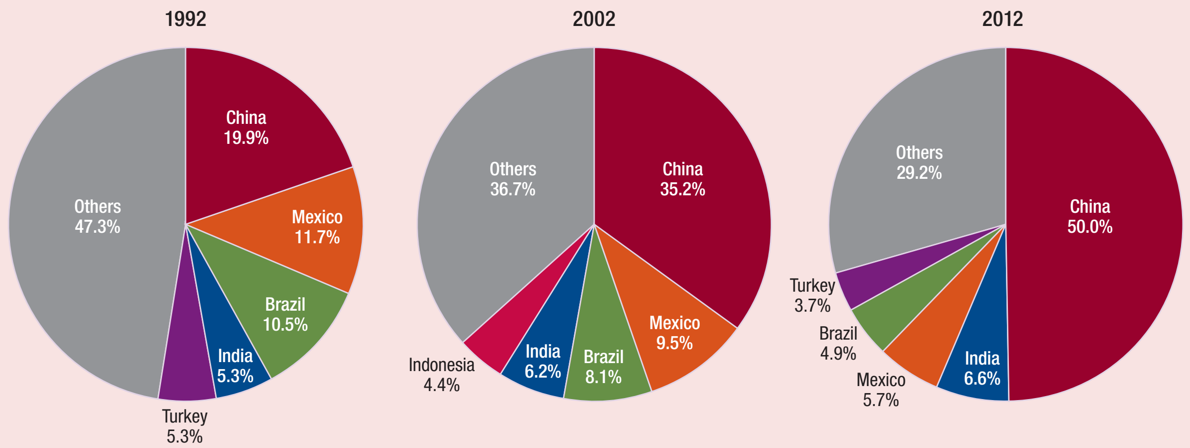
Source: UNIDO estimate based on UNIDO (2013c).

also had an impressive performance (though from a much lower base), with its share in global MVA growing four-fold in the same period and attaining 2.3 percent in 2012.

East Asia and the Pacific ($1,810 billion) accounted for 58 percent of industrializing country MVA in 2012, almost doubling its weight in 20 years and drawing largely on China's performance. South and Central Asia ($294 billion), the second-most dynamic region, managed to keep its industrializing country MVA share at 9 percent. By contrast, over 1992–2012 the industrializing country MVA share of Latin America and the Caribbean ($517 billion) fell by half from 35 percent to 17 percent, as years of economic restructuring under extreme liberalization and financial tightness drove economic activity away from manufacturing and into commodities and services. A similar phenomenon is observed in Europe ($186 billion in 2012), where the industrializing country MVA share tumbled from 10 percent in 1992 to 6 percent in 2012 as most of its countries struggled with the demands of restructuring following the adoption of a market economy. The Middle East and North Africa ($219 billion) and Sub-Saharan Africa ($84 billion) performed better but still lost some of their share in industrializing country MVA over the past 20 years.

Manufacturing in industrializing countries is geographically highly concentrated, with the five leading economies accounting for 70.9 percent of total production in 2012, up from 52.7 percent in 1992 (Figure 10.3). The high and sustained MVA growth in China over this period (11.4 percent on average) is behind its emergence as the factory of the world: in

Figure 10.3
Share of largest industrializing economies in manufacturing value added for all industrializing countries, 1992, 2002 and 2012



Source: UNIDO estimate based on UNIDO (2013c).

“The share of resource-based products in global manufacturing fell from 31.5 percent in 2002 to 26.8 percent in 2011, while the share of medium- and high-tech products rose from 43.2 percent to 47.8 percent

2012, 50 percent of industrializing-country manufactured goods was produced in China. Of all other large industrializing economy manufacturers, only India (7.4 percent average annual MVA growth) kept pace with China's expansion. It gained MVA share to become the second-leading manufacturer among industrializing economies, superseding Mexico and Brazil, which saw their MVA shares fall more than half from 11.7 percent and 10.5 percent in 1992 to 5.7 percent and 4.9 percent in 2012. Turkey's steady MVA growth (4.5 percent on average a year over 1992–2012) enabled it to preserve its position as the fifth-largest manufacturer among industrializing economies.

Manufacturing value added by technological category

Manufacturing is continually shifting to products with higher technological complexity. The share of resource-based products in global manufacturing fell from 31.5 percent in 2002 to 26.8 percent in 2011, while the share of medium- and high-tech products rose from 43.2 percent to 47.8 percent (Table 10.2).

Table 10.2
Technology composition of manufacturing value added, by industrialization level, region and income group, selected years, 2002–2011 (percent)

	2002			2005			2008			2011		
	RB	LT	MHT	RB	LT	MHT	RB	LT	MHT	RB	LT	MHT
World	31.51	25.32	43.17	29.60	25.29	45.12	27.81	25.15	47.04	26.75	25.42	47.83
Industrialized economies	29.42	24.84	45.74	27.49	24.35	48.16	25.59	23.58	50.83	24.52	22.44	53.04
Industrializing economies	39.66	27.18	33.15	35.97	28.12	35.91	32.86	28.73	38.42	30.29	30.17	39.53
By industrialization level												
Emerging industrial economies	37.82	27.57	34.61	34.47	28.35	37.18	31.49	28.87	39.63	29.10	30.45	40.45
Other industrializing economies	52.78	25.04	22.18	49.26	26.93	23.81	47.34	28.26	24.40	47.01	27.08	25.91
Least developed countries	67.58	11.64	20.78	67.35	11.70	20.95	71.29	10.93	17.78	72.95	10.55	16.50
By region												
East Asia and the Pacific	36.58	23.85	39.58	32.40	26.59	41.02	29.68	28.42	41.90	27.28	31.10	41.62
Excluding China	47.97	19.80	32.23	43.70	19.65	36.65	42.12	17.32	40.57	42.90	17.22	39.88
Europe	45.46	32.91	21.64	42.91	32.49	24.60	40.20	32.12	27.68	38.42	31.44	30.14
Excluding Poland	46.78	32.87	20.35	44.99	33.10	21.91	44.79	31.55	23.66	45.24	30.36	24.40
Latin America and the Caribbean	41.40	27.01	31.59	40.52	27.35	32.12	40.06	26.82	33.13	40.62	25.27	34.11
Excluding Mexico	42.79	32.62	24.59	41.28	32.39	26.33	40.57	31.53	27.90	41.58	29.53	28.89
Middle East and North Africa	47.00	27.72	25.28	41.79	28.97	29.24	39.57	29.26	31.18	40.30	27.06	32.65
Excluding Turkey	44.55	28.92	26.53	41.84	29.78	28.38	39.95	30.69	29.36	41.52	27.97	30.51
South and Central Asia	31.12	37.30	31.58	29.32	35.20	35.48	25.27	32.99	41.74	24.57	32.75	42.69
Excluding India	44.44	31.25	24.32	41.91	30.60	27.49	41.03	30.99	27.98	39.70	30.87	29.44
Sub-Saharan Africa	50.80	23.54	25.66	50.39	23.61	26.00	48.86	24.60	26.55	49.00	24.88	26.11
Excluding South Africa	72.48	17.87	9.66	68.42	21.74	9.83	66.40	24.09	9.51	66.17	25.53	8.29
By income group												
High income industrializing	43.35	28.84	27.81	39.76	28.33	31.91	35.32	26.91	37.77	35.20	26.19	38.61
Upper middle income industrializing	43.17	30.36	26.47	40.82	29.80	29.38	38.02	29.79	32.19	35.81	29.78	34.41
Lower middle income industrializing	38.09	26.59	35.32	34.50	28.07	37.43	31.79	29.13	39.08	29.07	30.88	40.05
Low income industrializing	66.82	12.74	20.44	65.75	13.05	21.20	69.04	13.22	17.73	71.84	12.45	15.71

RB is resource-based; LT is low-tech; MHT =is medium- and high-tech.
Note: Value added at constant 2005 $.
Source: UNIDO estimate based on UNIDO (2013c).

> **The rate at which industrializing countries have modified their industrial structure and, especially, shifted from resource-based manufacturing over 2002–2011 is particularly noteworthy**

Industrialized and industrializing countries exhibited similar trends, with their share of resource-based products declining and that of medium- and high-tech products rising over 2002–2011. Low-tech manufacturing maintained its MVA share of around 25 percent over 2002–2011 worldwide but there was a substantial relocation of production from industrialized to industrializing countries, mainly to China, in search of lower labour costs and closer access to rapidly growing markets.

The rate at which industrializing countries have modified their industrial structure and, especially, shifted from resource-based manufacturing over 2002–2011 is particularly noteworthy. Their share of these products fell from 39.7 percent to 30.3 percent over the period and matched in 2012 the weight of resource-based manufacturing in industrialized countries in 2002. Equally noteworthy is the persistent concentration of medium- and high-tech manufacturing in industrialized countries. The recent economic crisis hit resource-based and low-tech manufacturing in these countries hard, but the production of technologically complex goods seems to have persisted. By 2011 the share of these products in the industrialized countries' MVA had risen to 53 percent.

Regionally, South and Central Asia has experienced a substantial reduction in the share of both resource-based (to 24.6 percent in 2012) and low-tech products (to 32.8 percent), and an increase in the share of medium- and high-tech products (from 31.6 percent to 42.7 percent), largely relying on the transformation of the manufacturing base in India with more technologically advanced products. East Asia and the Pacific already had a fairly high share of medium- and high-tech products in 2002, which increased to 41.6 percent in 2011 as other economies in the region joined China in producing technologically complex goods for global value chains and production networks. The relocation of low-tech production from industrialized countries, mainly but not exclusively to China, accounts for the expansion of the MVA share of these products in the region from 23.9 percent in 2002 to 31.1 percent in 2011.

Europe and the Middle East and North Africa exhibit a similar pattern of shedding resource-based manufacturing (the respective shares fell to 38.4 percent and 40.3 percent in 2011) and embracing medium- and high-tech production (the respective shares rose to 30.1 percent and 32.7 percent in 2011), but they still have a long way to go to reach average industrializing-country shares for both categories. Latin America and the Caribbean and Sub-Saharan Africa have shown the least change in their manufacturing base in terms of technological complexity of products over 2002–2011: as in 2002, in 2011 they were heavily concentrated in producing resource-based goods (with shares of 40.6 percent and 49.0 percent, respectively), and marginally increased their medium- and high-tech manufacturing (to 34.1 percent and 26.1 percent, respectively).

Manufacturing value added by industry sector

In 2011 the dominant manufacturing sectors worldwide were food and beverages (11.6 percent), chemicals and chemical products (11.2 percent), machinery and equipment (8.9 percent), basic metals (8.6 percent) and radio, television and communication equipment (8.3 percent; Table 10.3). The last two had made significant gains over 2002–2011 thanks to the higher demand for basic metals derived from the acceleration of MVA growth in industrializing countries and the global surge in demand for electronic devices. Fifteen manufacturing sectors registered a decrease in their MVA share worldwide over 2002–2011, from a combined 70.4 percent to 62.0 percent, including mainly traditional manufacturing sectors such as food and beverages, textiles, wood products, and paper and printing, but also coke and refined petroleum products, chemicals, rubber, non-metallic products, fabricated metal products, furniture and even motor vehicles. The only seven sectors that increased their MVA share, from a combined 29.4 percent to 38.0 percent, were largely advanced manufacturing such as machinery and equipment; office, accounting and computing machinery; electrical machinery; radio, television and

"In 2011 industrializing countries accounted for more than two-thirds (70 percent or more) of world production of low-tech products in labour-intensive sectors

Table 10.3
Share of manufacturing value added within development group, by industry sector, selected years, 2002–2011 (percent)

International Standard Industrial Classification description	Industrializing countries				Industrialized countries				World			
	2002	2005	2008	2011	2002	2005	2008	2011	2002	2005	2008	2011
Food and beverages	16.1	14.7	13.4	12.1	11.6	11.3	11.1	11.2	12.5	12.2	11.8	11.6
Tobacco products	3.5	3.0	2.7	2.5	1.0	0.9	0.8	0.7	1.5	1.4	1.3	1.4
Textiles	5.7	5.2	4.7	4.4	2.2	1.8	1.4	1.2	2.9	2.6	2.4	2.4
Wearing apparel and fur	3.7	3.4	3.1	3.0	1.4	1.0	0.9	0.8	1.8	1.6	1.6	1.6
Leather, leather products and footwear	1.8	1.4	1.3	1.3	0.6	0.4	0.3	0.3	0.8	0.7	0.6	0.7
Wood products (excluding furniture)	1.6	1.4	1.1	1.1	2.0	2.0	1.6	1.5	1.9	1.8	1.5	1.3
Paper and paper products	3.2	2.9	2.8	2.7	3.0	2.8	2.6	2.5	3.0	2.9	2.7	2.6
Printing and publishing	2.0	1.8	1.5	1.2	4.5	4.2	3.9	3.7	4.0	3.6	3.2	2.7
Coke, refined petroleum products and nuclear fuel	6.0	5.2	4.5	3.7	3.4	3.5	3.3	3.2	3.9	3.9	3.7	3.4
Chemicals and chemical products	11.2	11.3	10.9	10.4	11.9	12.0	11.5	11.8	11.7	11.8	11.3	11.2
Rubber and plastics products	3.6	3.5	3.2	3.0	4.7	4.6	4.4	4.3	4.5	4.3	4.0	3.8
Non-metallic mineral products	5.4	5.3	5.0	4.5	3.9	3.8	3.6	3.3	4.2	4.2	4.0	3.8
Basic metals	8.2	10.1	12.1	15.1	5.0	5.0	4.8	4.5	5.7	6.2	7.0	8.6
Fabricated metal products	4.0	4.0	3.9	3.8	7.8	7.5	7.5	7.2	7.0	6.6	6.4	5.9
Machinery and equipment, not elsewhere classified	5.2	5.9	6.6	7.2	9.2	9.7	10.0	9.9	8.3	8.7	9.0	8.9
Office, accounting and computing machinery	1.2	1.6	1.9	2.2	1.4	1.4	1.8	1.8	1.3	1.5	1.8	2.0
Electrical machinery and apparatus	2.9	3.4	4.2	4.3	3.7	3.8	4.0	4.0	3.6	3.7	4.0	4.1
Radio, television and communication equipment	3.9	4.6	5.7	6.1	4.9	6.2	8.3	9.8	4.7	5.8	7.5	8.3
Medical, precision and optical instruments	0.8	0.9	1.1	1.2	3.7	3.9	4.2	4.6	3.1	3.1	3.2	3.3
Motor vehicles, trailers and semi-trailers	6.3	6.5	6.2	6.0	8.1	8.3	7.7	7.7	7.7	7.8	7.2	7.1
Other transport equipment	1.7	1.7	1.8	2.0	3.0	3.0	3.3	3.5	2.7	2.7	2.9	2.9
Furniture; manufacturing, not elsewhere classified	2.1	2.2	2.2	2.1	3.2	3.0	2.9	2.8	3.0	2.8	2.7	2.5
Total	100	100	100	100	100	100	100	100	100	100	100	100

Note: Value added at constant 2005 $.
Source: UNIDO estimate based on UNIDO (2013a).

communication equipment; medical, precision and optical instruments; and other transport equipment, which confirms the shift towards production with higher technological complexity worldwide.

In industrializing countries the leading sectors in 2011 were basic metals (15.1 percent), food and beverages (12.1 percent) and chemicals and chemical products (10.4 percent). The near doubling of the share of basic metals in a short time (from 8.2 percent in 2002) is an indicator of the impact that the pull effect of accelerated manufacturing in industrializing countries is having on resource-producing countries. Machinery and equipment (7.2 percent) and radio, television and communication equipment (6.1 percent) also showed large gains in MVA share.

In 2002 industrialized countries were generally the largest producers (52 percent or more) in all manufacturing sectors (Table 10.4). The substantial industrialization efforts and expansion of markets in industrializing countries since 2002, coupled with the repercussions of the recent crisis on industrialized countries, have produced a significant shift in the distribution of manufacturing activities worldwide, and in 2011 industrializing countries accounted for more than two-thirds (70 percent or more) of world production of low-tech products in labour-intensive sectors such as

“ Industrializing countries easily doubled or even trebled their world share in many manufacturing sectors

Table 10.4
Share of manufacturing value added in industry sectors, by development group, selected years, 2002–2011 (percent)

International Standard Industrial Classification description	Industrializing countries				Industrialized countries			
	2002	2005	2008	2011	2002	2005	2008	2011
Food and beverages	26.3	30.0	34.6	40.5	73.7	70.0	65.4	59.5
Tobacco products	47.3	51.5	60.4	70.3	52.7	48.5	39.6	29.7
Textiles	40.2	49.1	59.8	70.3	59.8	50.9	40.2	29.7
Wearing apparel and fur	40.9	52.6	60.5	71.0	59.1	47.4	39.5	29.0
Leather, leather products and footwear	45.6	52.8	62.6	74.2	54.4	47.2	37.4	25.8
Wood products (excluding furniture)	17.0	18.9	23.6	31.1	83.0	81.1	76.4	68.9
Paper and paper products	21.5	25.4	31.9	40.2	78.5	74.6	68.1	59.8
Printing and publishing	10.2	12.3	14.4	17.4	89.8	87.7	85.6	82.6
Coke, refined petroleum products and nuclear fuel	31.3	33.0	37.4	42.7	68.7	67.0	62.6	57.3
Chemicals and chemical products	19.5	23.8	29.3	35.7	80.5	76.2	70.7	64.3
Rubber and plastics products	16.5	20.0	24.1	30.3	83.5	80.0	75.9	69.7
Non-metallic mineral products	26.2	31.6	38.2	45.8	73.8	68.4	61.8	54.2
Basic metals	29.6	40.3	52.6	68.0	70.4	59.7	47.4	32.0
Fabricated metal products	11.6	14.9	18.6	25.2	88.4	85.1	81.4	74.8
Machinery and equipment, not elsewhere classified	12.7	16.9	22.4	31.6	87.3	83.1	77.6	68.4
Office, accounting and computing machinery	18.4	26.4	31.2	43.9	81.6	73.6	68.8	56.1
Electrical machinery and apparatus	16.7	22.9	31.9	40.1	83.3	77.1	68.1	59.9
Radio, television and communication equipment	17.2	19.9	23.2	28.2	82.8	80.1	76.8	71.8
Medical, precision and optical instruments	5.2	7.4	10.2	14.5	94.8	92.6	89.8	85.5
Motor vehicles, trailers and semi-trailers	16.6	20.6	26.0	32.9	83.4	79.4	74.0	67.1
Other transport equipment	12.9	15.6	19.6	26.5	87.1	84.4	80.4	73.5
Furniture; manufacturing, not elsewhere classified	14.5	19.7	24.7	31.9	85.5	80.3	75.3	68.1

Note: Value added at constant 2005 $.
Source: UNIDO estimate based on UNIDO (2013a).

tobacco, textiles, wearing apparel and leather. Across the board over 2002–2011, industrializing countries easily doubled or even trebled their world share in many manufacturing sectors, either by relocating existing production from industrialized countries or starting new production. But industrialized countries still maintain a considerable lead (more than 70 percent of world production) in technologically complex, high value-added activities such as radio, television and communication equipment; medical, precision and optical instruments; and other transport equipment.

The five fastest growing sectors over 2007–2011 were basic metals; radio, television and communication equipment; office, accounting and computing machinery; electrical machinery and apparatus; and other transport equipment (Table 10.5). In 2011 China had become the clear global leader in four out of the five sectors, and second only to the United States in other transport equipment. The top three – China, the United States and Japan or the United Kingdom – in each sector concentrated between 51.3 percent and 70.4 percent of world manufacturing. Among industrializing countries India had become the largest manufacturer in four out of the five fastest growing sectors, with Mexico leading the production of office, accounting and computing machinery.

China was the first- or second-largest manufacturer in the world in 20 out of 22 industrial sectors in

Industrialized countries still maintain a considerable lead (more than 70 percent of world production) in technologically complex, high value-added activities

Table 10.5
Leading producers in the five fastest growing industry sectors, 2005 and 2011

Five fastest growing manufacturing value added sectors over 2007–2011

World's leading economies (percent share in world manufacturing value added)				Leading industrializing economies[a] (percent share in industrializing countries' manufacturing value added)			
2005		2011		2005		2011	
Basic metals (ISIC 27) (average annual growth rate, 10.1 percent)							
China	20.9	China	55.3	India	18.7	India	26.6
Japan	14.1	Japan	8.3	Brazil	13.1	Brazil	12.3
United States	13.3	United States	4.6	Chile	9.4	Mexico	7.7
Germany	5.8	Germany	3.9	Mexico	9.1	Chile	6.3
Russian Federation	4.6	India	3.4	Turkey	6.3	Turkey	6.2
Radio, television and communication equipment (ISIC 32) (average annual growth rate, 10.0 percent)							
Japan	20.5	China	21.8	Thailand	33.4	India	30
United States	20.2	United States	16.8	Indonesia	14.6	Indonesia	26.4
China	13.6	Japan	15.5	Philippines	11.7	Thailand	14.9
Korea, Rep. of	9.9	Korea, Rep. of	12.8	Brazil	11.6	Philippines	7.5
Taiwan Province of China	8	Taiwan Province of China	11.3	India	7.5	Brazil	4.5
Office, accounting and computing machinery (ISIC 30) (average annual growth rate, 8.8 percent)							
United States	27	China	38.8	Mexico	31.9	Mexico	29.2
China	19.9	United States	23.7	Philippines	19.5	Philippines	17.3
Japan	14.5	Japan	7.9	India	13.5	Brazil	13.1
Taiwan Province of China	6.1	Germany	7	Brazil	11.4	Thailand	12.6
Germany	4.6	Taiwan Province of China	3.6	Thailand	8.7	India	10
Electrical machinery and apparatus (ISIC 31) (average annual growth rate, 5.9 percent)							
United States	18.8	China	28.6	India	14.8	India	31.2
Germany	14.5	Japan	13.9	Mexico	12.4	Mexico	10.5
Japan	14.4	Germany	12.6	Brazil	10.2	Brazil	7.4
China	11.6	United States	11.1	Turkey	7.8	Saudi Arabia	6.8
Italy	4.6	India	3.6	Saudi Arabia	7.6	Turkey	6.8
Other transport equipment (ISIC 35) (average annual growth rate, 5.5 percent)							
United States	34.9	United States	28.2	India	18.5	India	24.6
United Kingdom	8	China	16.1	Indonesia	16.4	Brazil	15.4
Germany	7.1	United Kingdom	7	Brazil	13	Indonesia	10.2
China	6.2	Germany	6.9	Thailand	6.3	Turkey	7.1
Japan	5.9	France	5.9	Turkey	6	Romania	5.4

a. Excluding China.
ISIC is International Standard Industrial Classification.
Note: Value added at constant 2005 $.
Source: UNIDO estimate based on UNIDO (2013a).

> **Among industrializing countries China has become the uncontested leader in all 22 industrial sectors, accounting for more than 50 percent of industrializing countries' total manufacturing value added in 18 of them**

2011. Other industrializing countries among top-five leaders in global manufacturing included Argentina, Brazil, India, Indonesia, Mexico and Turkey.

Among industrializing countries China has become the uncontested leader in all 22 industrial sectors, accounting for more than 50 percent of industrializing countries' total MVA in 18 of them. When China is excluded, India leads in four out of the five fastest growing sectors and is among the top three in 13 industrial sectors, the same as Brazil. Mexico leads in one of the five fastest growing sectors and is among the top three producers in nine industrial sectors, closely followed by Indonesia, Poland and Turkey.

Manufacturing value added by region

Global MVA grew at an average 3.1 percent a year over 2002–2012, reaching $8,900 billion (Table 10.6). The impact of the 2008–2009 crisis on MVA was very different for industrialized and industrializing countries: whereas industrialized countries registered an average decline of 1.0 percent annually over 2007–2012 and have yet to recover to pre-crisis production levels, industrializing countries did not experience a contraction and, except for a slowdown to 4.1 percent growth in 2009, each year after they expanded their MVA faster than the 5.3 percent average growth of 1992–2002. The relatively high MVA growth in industrializing countries over 2007–2012, 6.2 percent a year on average, goes hand in hand with their good overall economic performance, as their GDP expanded by 5.1 percent annually over the same period.

But the manufacturing performance of individual countries and regions was not even, reflecting their different articulation into the world economy. Although all regions showed growth, the ratio was 6:1 between the fastest and slowest growing regions.

East Asia and the Pacific scored the highest growth, 9.1 percent annually over 2007–2012, mainly driven by manufacturing in China (9.9 percent growth). A powerful stimulus programme put together by Chinese authorities in 2008 and 2009 – boosting domestic consumption and investment through tax cuts, increasing government spending in infrastructure development, increasing affordable housing and loosening bank lending – succeeded in compensating for the fall in external demand that came with the global recession and in sustaining high growth in manufacturing until 2012. Only two small economies outperformed Chinese manufacturing over 2007–2012: Myanmar (14.2 percent) and Timor-Leste (11.2 percent).

Most of the region's countries profited from the dynamism of China, from widespread participation in regional production networks and from the adoption of stimulus packages of their own, scoring significant industrial growth throughout the period (Viet Nam, 7.5 percent; Lao People's Democratic Republic, 7.5 percent; Cambodia, 7.2 percent; Indonesia, 4.9 percent). Only Samoa (–6.4 percent) and Brunei Darussalam (–0.4 percent) recorded yearly contractions in their MVA.

South and Central Asia registered the second-highest growth in manufacturing over 2007–2012, at an average annual rate of 5.6 percent, and it was the only other region whose manufacturing production kept growing in 2009 despite the global recession. It benefited from proximity to China and production networks in East Asia, and from the dynamism of Indian manufacturing, which in turn was fuelled by strong domestic demand and a shift towards more technologically complex products. Since 2009 India has become the second-largest manufacturer among industrializing countries and ranks ninth in the world. There were no great outliers in industrial performance in the region, the countries with the fastest growing manufacturing sectors over 2007–2012 being Bhutan (7.5 percent), Afghanistan (7.4 percent), Bangladesh (7.1 percent), India (6.7 percent), Sri Lanka (6.6 percent) and Tajikistan (5.8 percent). Only the Maldives (–3.0 percent) and the Islamic Republic of Iran (–0.1 percent) showed negative results.

In the Middle East and North Africa MVA grew by 3.5 percent over 2007–2012. The industrial performance was mixed, with the bulk of countries showing moderate growth averaging 3–5 percent a year

“The relatively high manufacturing value added growth in industrializing countries over 2007–2012, 6.2 percent a year on average, goes hand in hand with their good overall economic performance

Table 10.6
Manufacturing value added by industrialization level, region and income group, 2007–2012

	Manufacturing value added (constant 2005 $ billions)						Average growth rate (percent)	
	2007	2008	2009	2010	2011	2012	2003–2007	2007–2012
World	8,400	8,380	7,740	8,460	8,720	8,900	4.98	1.18
Industrialized economies	6,100	5,960	5,220	5,730	5,780	5,800	3.79	–1.02
Industrializing economies	2,300	2,430	2,520	2,730	2,940	3,110	8.60	6.23
By industrialization level								
Emerging industrial economies	2,060	2,180	2,270	2,460	2,660	2,820	8.91	6.55
Other industrializing economies	209	217	216	228	235	240	5.91	2.84
Least developed countries	32	34	36	39	41	44	7.47	6.52
By region								
East Asia and the Pacific	1,170	1,270	1,400	1,520	1,670	1,810	11.32	9.08
Excluding China	201	210	207	226	236	253	6.24	4.64
Europe	161	168	163	174	182	186	8.60	3.00
Excluding Poland	96	98	92	94	96	97	6.99	0.26
Latin America and the Caribbean	481	489	453	492	511	517	4.24	1.43
Excluding Mexico	315	324	304	328	340	340	5.09	1.52
Middle East and North Africa	186	190	185	200	212	221	6.76	3.51
Excluding Turkey	91	95	97	100	102	107	5.12	3.36
South and Central Asia	224	231	247	264	282	294	9.38	5.61
Excluding India	76	76	77	81	86	89	8.85	3.26
Sub-Saharan Africa	76	78	74	78	81	84	4.08	2.04
Excluding South Africa	30	31	32	34	35	37	3.94	4.49
By income group								
High income industrializing	387	403	416	444	471	495	7.26	5.04
Upper middle income industrializing	133	142	143	150	158	163	7.84	4.12
Lower middle income industrializing	1,750	1,850	1,930	2,100	2,270	2,410	8.99	6.64
Low income industrializing	30	32	33	36	38	41	7.43	6.54

Source: UNIDO estimate based on UNIDO (2013c).

thanks to strong domestic demand, though most of the growth took place only after 2009. The top performing countries were Iraq (8.6 percent) and Oman (6.0 percent), the former gradually reconstructing after years of war. Cyprus (–2.1 percent), Azerbaijan (–2.0 percent), Lebanon (–1.2 percent) and Algeria (–0.7 percent) were unable to recover to pre-crisis levels of manufacturing output.

Industrializing countries in Europe showed combined annualized MVA growth of 3 percent over 2007–2012, which would seem to indicate a remarkable recovery after the slump in 2009. There was considerable growth in Belarus (7.6 percent) and Poland (6.6 percent), pumped by fairly strong internal demand and a good export performance, in turn made possible by an upgrading of the domestic production structure and a shift towards more high-tech products (EU 2012). Whereas Albania (2.5 percent) and Romania (1.4 percent) at least managed to recover the ground lost during the 2008–2009 recession, manufacturing in all other industrializing countries, mainly in Eastern Europe or the Balkans, stagnated or regressed drastically, emulating the general trend in the region's industrialized countries.

> **Most Sub-Saharan countries exhibited robust manufacturing value added growth, with Ethiopia (8.6 percent), Equatorial Guinea (8.4 percent), Tanzania (8.2 percent), Uganda (8.2 percent) and Nigeria (7.9 percent) showing the highest rates**

Most Sub-Saharan countries exhibited robust MVA growth, with Ethiopia (8.6 percent), Equatorial Guinea (8.4 percent), Tanzania (8.2 percent), Uganda (8.2 percent) and Nigeria (7.9 percent) showing the highest rates. Only a few countries, including Zimbabwe, The Gambia and the Central African Republic, saw a decline in their manufacturing output over 2007–2012. The rather modest performance of South Africa (0.3 percent), the region's largest producer, accounted for the low overall growth. Amid rising domestic costs and low demand in its main export markets, South Africa has yet to find a way to harness the potential benefits of manufacturing, which accounts for only 13 percent of jobs and 15 percent of GDP, figures much lower than in other emerging countries.

Latin America and the Caribbean's MVA expanded the least, by 1.4 percent, which explains how the region's share in industrializing countries' MVA fell from 21 percent in 2007 to 16.6 percent in 2012. Many countries in the region have the United States as the major destination of their manufactured exports and were hit hard by the crisis as they faced a sharp fall in demand for their products. The highest MVA growth over 2007–2012 was in Peru (5.7 percent), Ecuador (4.8 percent) and Argentina (4.5 percent), as these countries benefited from strong domestic demand. Other Latin American countries had more modest results; most Caribbean countries saw a contraction of their manufacturing output.

The industrial performance of the least developed countries over 2007–2012 was strong. Not only did they score the highest average annual growth as a group (6.7 percent; see Table 10.6) but many least developed countries (Myanmar, Timor-Leste, Lao People's Democratic Republic, Cambodia, Bhutan, Afghanistan, Bangladesh, Ethiopia, Tanzania and Uganda) topped their regions' MVA growth. Some of these countries seem to be integrating with international production networks in their regions and catching up after years of isolation and domestic instability. Others are benefiting from preferential access to industrialized countries. And all seem to be benefiting from the growth of the Chinese market.

Notes

1. Data for 2011 and 2012 are obtained using "nowcasting" (see Boudt, Todorov and Upadhyaya 2009).
2. See Annex 8 for a list of industrialized and industrializing countries and a classification of countries by region.

Chapter 11
Trends in manufactured exports

A feature of the current organization of manufacturing is the increased use of international production networks to carry out different stages of the production process across borders, made possible by large scales of production, advances in technology (especially micro-electronics) and affordable transport costs.

From simple products such as garments and shoes to complex products such as aircraft and automobiles, manufactured parts and components are likely to be produced by numerous suppliers in different countries, shipped around several times before finally being incorporated into the end product. One extreme example is the Airbus, which relies on a network of some 1,500 suppliers in 30 countries.

The result of this production sharing has been a larger increase in trade than the corresponding increase in manufacturing value added (MVA). World exports grew 6.4 percent annually between 2006 and 2011 to reach $16.7 trillion in 2011, more than 80 percent of it manufactured products (Table 11.1). In the same period world output expanded on average by just 1.5 percent a year, as many countries were hit hard by the economic crisis in 2008–2009.

Industrialized economies have the bulk of the world's manufactured exports, but industrializing countries have been increasing their world share since the 1990s.[1]

Global trends

In 2011 world manufactured exports peaked at $13,469 billion, growing faster than manufacturing value added and GDP over 2007–2011 (see Table 11.1). They recovered fully from the contraction that followed the crisis, due mainly to the expansion in exports from large industrializing countries such as China and India. Exports of primary products grew nearly twice as fast over the same period, often fuelled by higher prices and strong demand from fast-growing countries.

Manufactured exports from industrialized countries grew just 3.7 percent annually over 2007–2011, reaching $9,483 billion in 2011, as they struggled to recover from the dip in economic activity brought about by the crisis (Table 11.2; see also Table 11.4). Manufactured exports from industrializing countries grew 10.5 percent annually over the same period, to a peak of $3,985 billion in 2011.

The higher dynamism of industrializing economies is also reflected in the increase in their share in world manufactured exports, from 13.9 percent in 1997 to 29.6 percent in 2011 (Figure 11.1). It was the emerging economies that accounted for most of this increase, their world share more than doubling from 12.3 percent in 1997 to 27.1 percent in 2011. Given current trends and growth in network trade, it is expected that more manufacturing activities will be

Table 11.1
World exports by product category, 2006–2011

Category	Exports ($ billions)						Average growth rate, 2003–2007 (percent)	Average growth rate, 2007–2011 (percent)
	2006	2007	2008	2009	2010	2011		
Manufactured	9,452	10,862	12,121	9,517	11,558	13,469	15.8	5.5
Primary	1,881	2,025	2,711	1,880	2,342	2,929	23.6	9.7
Other	149	168	217	214	250	326	19.9	18.0
World trade	11,482	13,054	15,049	11,611	14,150	16,724	17.0	6.4

Source: UNIDO estimate based on UN (2013a).

> **In 2011 world manufactured exports peaked at $13,469 billion, growing faster than manufacturing value added and GDP over 2007–2011**

Table 11.2
World manufactured exports by region and income group, selected years, 1997–2011 ($ billions)

	1997	2002	2007	2011
World	4,473	5,254	10,861	13,469
Industrialized economies	3,850	4,301	8,189	9,483
Industrializing economies	623	952	2,672	3,985
By industrialization level				
Emerging industrial economies	548	833	2,417	3,646
Other industrializing economies	69	110	232	321
Least developed countries	6	10	24	18[a]
By region				
East Asia and the Pacific	269	446	1,454	2,232
Excluding China	106	143	287	407
Europe	60	92	292	402
Excluding Poland	39	56	170	237
Latin America and the Caribbean	182	239	459	639
Excluding Mexico	89	99	250	370
Middle East and North Africa	42	77	224	274
Excluding Turkey	19	45	127	154
South and Central Asia	44	65	171	327
Excluding India	16	23	46	75
Sub-Saharan Africa	25	33	73	112
Excluding South Africa	10	16	31	54
By income group				
High income industrializing	120	175	399	629
Upper middle income industrializing	39	72	217	289
Lower middle income industrializing	457	696	2,032	3,052
Low income industrializing	7	10	25	15

a. About half the least developed countries have yet to report 2011 data.
Source: UNIDO estimate based on UN (2013a).

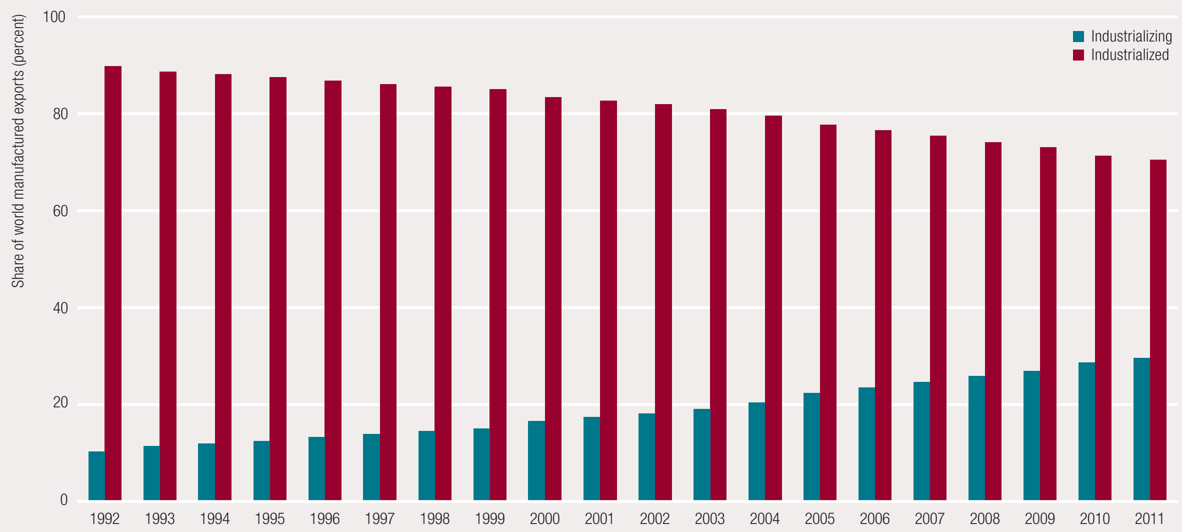
located to industrializing countries so as to benefit from lower production costs.

Together, the combined manufactured exports of the largest country in each industrializing region – China, India, Mexico, Poland, South Africa and Turkey – accounted for 67.5 percent of the total for industrializing countries in 2011, up from 59.9 percent in 2002 and 55.1 percent in 1997, confirming the higher dynamism of the larger countries and a worrying widening gap with the smaller economies.

Around 60 percent of world manufactured exports consist of medium- and high-tech products, such as pharmaceuticals, plastics, office machinery, telecommunications equipment, electrical machinery and appliances, road vehicles and other industrial machinery and parts (Figure 11.2).[2] After a peak of 26 percent in 2000, the share of high-tech products in world manufactured exports receded to 21 percent in 2011. A half-hearted investment climate in high-income countries could be a factor behind this weak result. While the world shares of exports of medium- and low-tech products have been gradually declining throughout 2000–2011, it was resource-based products that expanded their share substantially over this period, from 17 percent to 23 percent. Worldwide, the rapid growth of manufacturing

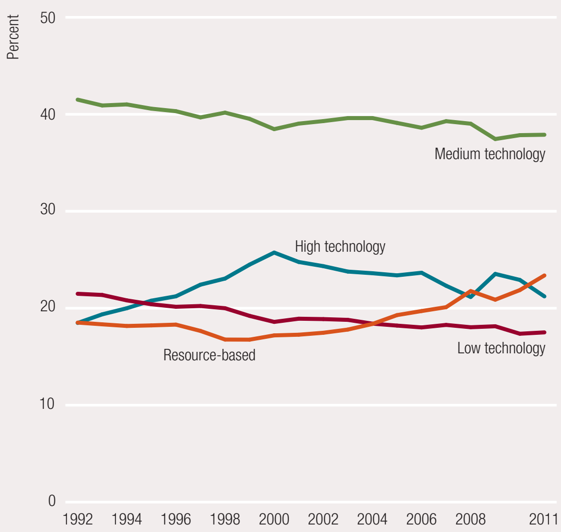
Together, the combined manufactured exports of the largest country in each industrializing region – China, India, Mexico, Poland, South Africa and Turkey – accounted for 67.5 percent of the total for industrializing countries in 2011

Figure 11.1
World manufactured exports by development group, 1992–2011



Source: UNIDO estimate based on UN (2013a).

Figure 11.2
Technology composition of manufactured exports, 1992–2011



Source: UNIDO estimate based on UN (2013a).

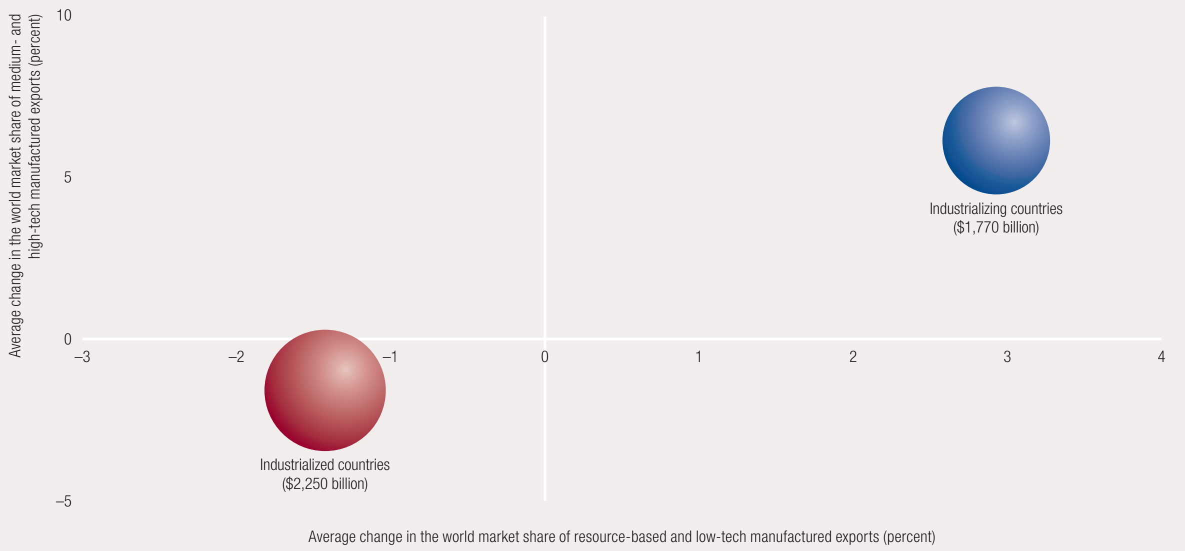
activities in industrializing countries has translated into a growing need for materials, while the higher incomes and rising urban middle class in many of these countries pushed up demand for processed food.

Advances in automation, coupled with tight quality control by production networks' leading firms and the upgrading of workforce skills, have made possible a large-scale relocation of manufacturing of medium- and high-tech products to industrializing countries, altering the technological complexity of their exports greatly.[3] Over 2006–2011 industrializing countries expanded their share in world exports of medium- and high-tech products by 6.2 percent annually while their share in world exports of resource-based and low-tech products grew at the slower rate of 2.9 percent a year. In the same period industrialized countries saw their corresponding shares in world manufactured exports decline by 1.6 percent and 1.4 percent a year (Figure 11.3).

Of the 20 most dynamic manufactured export products (products with the highest average annual growth rates) over 2007–2011, 11 were resource-based products (Table 11.3).[4] Resource-endowed industrializing countries such as Argentina, Brazil, Indonesia, Saudi Arabia, South Africa and Ukraine profited from the fast growth that was fuelled by high demand from the construction, metal working and food processing industries in China and India. At the other end of the spectrum, seven of the fastest growing manufactured

> **"China's exports of manufactured goods grew on average by 22.1 percent a year over 2002–2011, twice as fast as the world's rate of 11.0 percent**

Figure 11.3
Average change in world market share by technological level, 2006–2011



Note: Bubble size indicates the change in the value of manufactured exports (in parentheses).
Source: UNIDO estimate based on UN (2013a).

exports were medium- and high-tech products in industrialized countries as well as in China (and other Asian industrializing countries such as India, Thailand and Viet Nam). One of the major markets for these medium- and high-tech products, besides the traditional high-income Organisation for Economic Co-operation and Development countries, is China itself: in 2011 it received 63 percent of all optical instrument exports.

Exports of the top four products (iron ores, vegetable fat and oils, fertilizers and office machines) grew more than 20 percent a year on average. By total export value, one resource-based product, petroleum oils (not crude oil), headed the list in 2011 with $893 billion, followed by one medium-tech item, ships, boats and floating structures ($182 billion), and one high-tech product, medicinal and pharmaceutical products other than medicaments ($153 billion).

Industrializing countries' role in world manufactured exports

All industrializing regions have increased their share in world manufacturing exports since 1997, but not all countries and regions have fared equally well. The surge in industrializing countries' exports of manufactures since the turn of the century is largely attributable to China's emergence as a large manufacturer and exporter of many of these products. Its exports of manufactured goods grew on average by 22.1 percent a year over 2002–2011, twice as fast as the world's rate of 11.0 percent. Having become the world's largest exporter of manufactures in 2008, China improved its lead further, achieving exports of $1,825 billion and a world market share of 16.6 percent in 2011.

In line with its position as leading manufacturing region among industrializing countries, East Asia and the Pacific accounted for the largest export share in 2011: 56.0 percent of industrializing countries' manufactured exports came from the region, up from 44.1 percent in 2000 (Figure 11.4). A considerable proportion of these exports respond to intra-regional trade, in turn driven by specialization and increased component trade within global production networks. But despite the resulting stronger economic integration among the region's countries, their dependence on the global economy remains very high, making them

“Of China’s top 10 export products in 2012, 6 were high-tech manufactures, totalling $446.7 billion and representing 22.8 percent of the country’s exports

Table 11.3
Twenty most dynamic manufactured exports, 2007–2011

Ranking	Code	Technology category	Product	Average annual growth rate, 2007–2011 (percent)	Value, 2011 ($ billions)
1	281	Resource-based	Iron ore and concentrates	35.6	148.4
2	422	Resource-based	Fixed vegetable fat and oils, other	26.5	49.0
3	562	Medium-tech	Fertilizer, except Group 272	23.5	69.5
4	751	High-tech	Office machines	22.8	51.0
5	335	Resource-based	Residual petroleum products	17.7	50.4
6	897	Low-tech	Gold, silverware and jewellery, not elsewhere classified	17.1	106.8
7	793	Medium-tech	Ships, boats and floating structures	16.4	182.4
8	541	High-tech	Medicinal and pharmaceutical products, other than medicaments of Group 542	15.7	153.1
9	232	Resource-based	Synthetic rubber and so on	15.6	28.4
10	831	Low-tech	Travel goods, suitcases, bags and so on	14.5	52.9
11	334	Resource-based	Petroleum oils, not crude	14.1	893.1
12	421	Resource-based	Fixed vegetable fat and oils, soft	13.8	37.8
13	342	Resource-based	Liquefied propane and butane	13.4	51.2
14	61	Resource-based	Sugars, molasses and honey	13.4	42.2
15	718	High-tech	Other power generating machinery	13.2	24.3
16	625	Resource-based	Rubber tyres, tubes and so on	12.9	91.5
17	871	High-tech	Optical instruments, not elsewhere classified	12.4	102.8
18	522	Resource-based	Inorganic chemical elements	12.1	57.0
19	512	Medium-tech	Alcohols, phenols and derivatives	12.0	56.9
20	282	Resource-based	Ferrous waste and scrap	12.0	54.4

Source: UNIDO estimate based on UN (2013a).

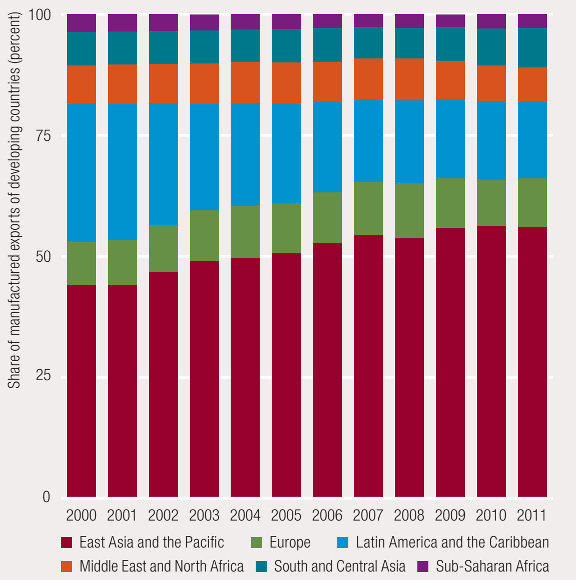
particularly vulnerable to the international business cycle (Athukorala 2011; Gangnes and van Asche 2010).

Initially, China was concentrated in manufacturing low-tech, labour-intensive assembly products, mainly as an outsourcing option for East Asian producers exporting to the world market in the 1980s and 1990s. Following its accession to the World Trade Organization in 2001, China moved massively into the production and export of more complex, medium- and high-tech manufactures with such success that in 2011 it accounted for 81.7 percent of the region’s exports (Figure 11.5). Of China’s top 10 export products in 2012, 6 were high-tech manufactures, totalling $446.7 billion and representing 22.8 percent of the country’s exports. They included computer, telecommunications and office equipment; diodes and transistors; and optical instruments. Three other were medium-tech engineering products (UN 2013a). The main destinations for these technologically complex manufactures were the United States, industrialized economies in Asia (Hong Kong SAR China, Japan, Republic of Korea and Singapore), the European Union (EU) and India.

The second-largest exporter of manufactured products, Latin America and the Caribbean, could not keep up with the fast expansion of trade in Asia and saw its share in industrializing countries’ manufactured exports drop from 28.8 percent in 2000 to 16.0 percent in 2011. Mexico and Brazil were the major actors, accounting for 68.2 percent of the region’s manufactured exports in 2011, but showed two patterns of integration with international markets.

A textbook example of a resource-rich industrializing country, Brazil concentrated its top 10 exports in 2012 in five primary products and four resource-based manufactures

Figure 11.4
Share of manufactured exports of developing countries by region, 2000–2011



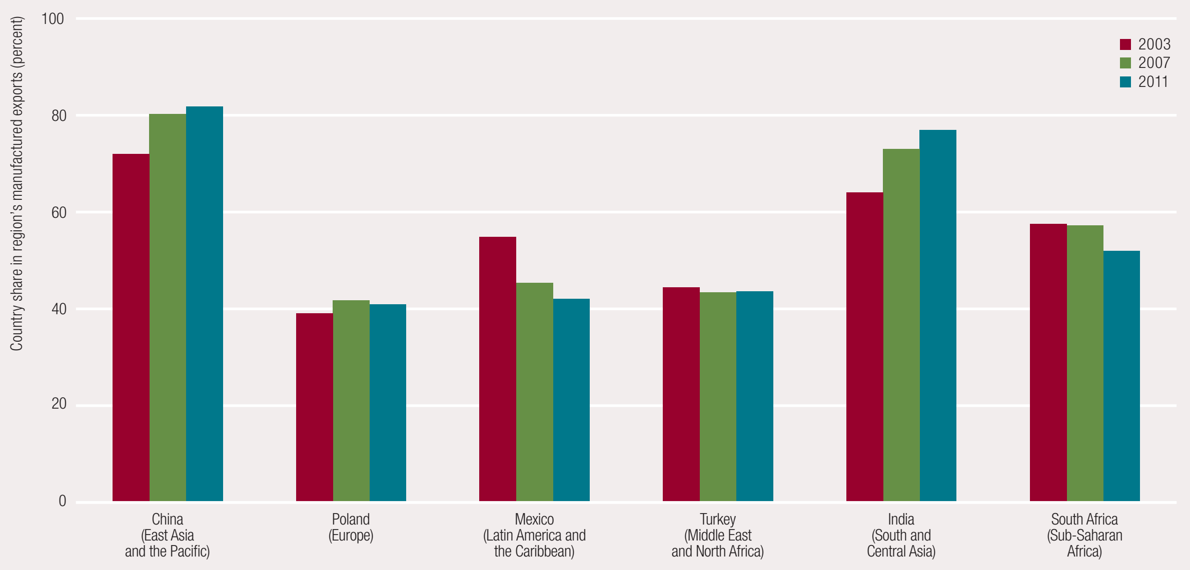
Source: UNIDO estimate based on UN (2013a).

Mexico, the larger exporter of the two, is heavily exposed to the North American market (80.7 percent of total exports in 2012), and its exports were severely hit by the contraction in 2008–2009. Of Mexico's top 10 export products in 2012, two were high-tech manufactures (telecommunications and computer equipment), representing 9.6 percent of total exports, and five were medium-tech products (passenger and goods vehicles and their parts, TV receivers, and electrical distribution equipment), representing 24.2 percent.

By contrast, Brazil had only one high-tech product (aircraft, 0.2 percent of total exports) and no medium-tech products among its top 10 exports in 2012. A textbook example of a resource-rich industrializing country, Brazil concentrated its top 10 exports in 2012 in five primary products (23.4 percent of total exports) and four resource-based manufactures (iron ore, heavy petroleum oil, sugar, and pulp, representing 22.0 percent). Its major export destinations (China, the United States, Argentina, the EU and Japan) accounted for only 48.0 percent of total exports. Different export patterns gave different results too: over 2003–2011 Mexico's exports of manufactures grew 7.5 percent a year while Brazil's expanded 16.3 percent a year.

Led by Poland, the largest economy in the region, Europe has maintained its share in industrializing countries' exports at around 10 percent throughout

Figure 11.5
Largest country share in regional manufactured exports, 2003, 2007 and 2011



Source: UNIDO estimate based on UN (2013a).

“In 2011, 48.7 percent ($6,472 billion) of total manufactured exports was from one industrialized country to another

2000–2011. While keeping their traditional export markets, mostly in Eastern Europe, some countries have shown benefits of joining the EU and succeeded in securing new markets for their exports of manufactures. Over the last few years the downside of this approach has been sluggish export and output growth as Industrialized Europe struggled with the repercussions of the global economic and euro crises.

Poland accounted for 41.0 percent of the region's exports of manufactures in 2011, and although its main export market is the EU (55.6 percent of total exports), it has a fairly diversified export base concentrated in medium-tech products. Its top 10 exports in 2012 represented only 24.2 percent of the export total and included five medium-tech manufactures (passenger and goods vehicles and their parts, TV receivers, seats, combustion engines, and ships and floating structures), representing 14.3 percent of total exports, and one high-tech product (computer equipment), representing 1.7 percent.

Industrializing country shares of manufactured exports for the Middle East and North Africa and South and Central Asia remained below 10 percent in 2012, despite fast export growth of 15.1 percent and 19.7 percent a year, respectively. India accounted for 77 percent of South and Central Asia's manufactured exports in 2012 and their growth over 2002–2011 – 22.0 percent a year – was impressive, nearly matching the expansion in China. Of India's top 10 exports in 2012, three were medium- or high-tech manufactures (motor vehicles, medicines and communications equipment), representing 5.7 percent of total exports; low-tech jewellery exports accounted for 6.3 percent; and three resource-based products (non-crude petroleum oils, diamonds and iron ores) made up 26.8 percent.

Turkey, the main exporter of manufactures in the Middle East and North Africa with a 43.8 percent share, also exhibited a diversified structure among its top 10 exports: medium-tech products (motor vehicles and their parts, and insulated cables) accounted for 10.0 percent of total exports, low-tech exports (garments and jewellery) came to 8.8 percent and resource-based exports and gold represented 11.2 percent.

Manufactured exports from Sub-Saharan Africa also grew quickly, at a 14.5 percent annual average over 2002–2011, but this was not enough to prevent a decline in the region's share from 3.5 percent to 2.8 percent of industrializing countries' manufactured exports over the period. Besides primary products the region was concentrated mainly in the export of resource-based and medium-tech manufactures, primarily motor vehicles and their parts, basic chemicals, and basic iron and steel produced in South Africa.

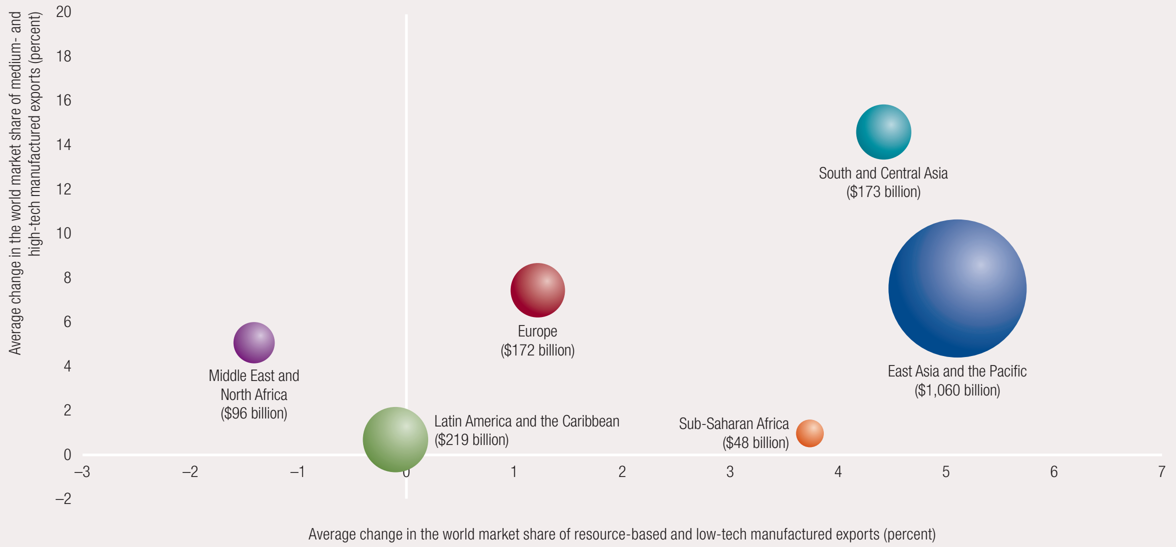
To appraise better a region's export performance in terms of strength and technological complexity, the evolution of world market shares by technological level is examined (Figure 11.6). Over 2006–2011 East Asia and the Pacific, South and Central Asia and Europe increased their world market shares of resource-based and low-tech products; their shares of medium- and high-tech products increased nearly twice as fast. Latin America and the Caribbean's share of resourced-based and low-tech products stagnated and its share of medium- and high-tech products grew marginally. The Middle East and North Africa lost world market share in resource-based and low-tech manufactured exports but made considerable gains in that of medium- and high-tech products. Sub-Saharan Africa's world market share of resource-based and low-tech products grew much faster than its share of medium- and high-tech products.

Industrializing countries' manufactured export markets

The largest share of world manufactured exports is mainly accounted for by trade between industrialized countries. In 2011, 48.7 percent ($6,472 billion) of total manufactured exports was from one industrialized country to another. By contrast, exports of manufactures among industrializing countries represented a minor fraction of the total, 9.1 percent ($1,208 billion). But although both trade flows increased over 2006–2011, manufactured exports among industrializing countries did so at nearly 20 percent a year (Figure 11.7). Expansion of global production networks incorporating new locations and involving

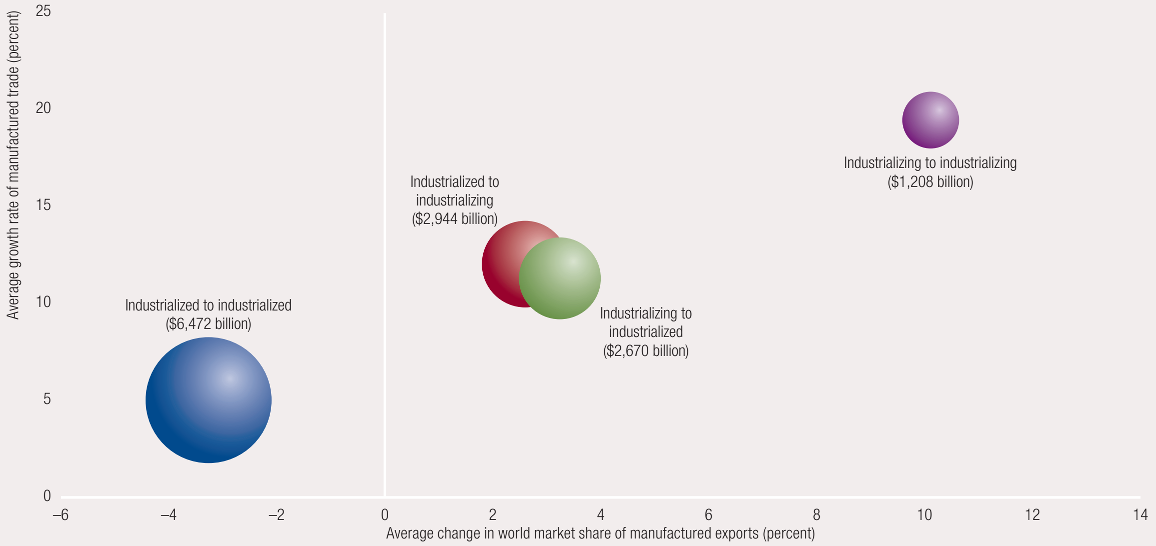
Manufactured trade flows between the groups of industrialized and industrializing countries accounted together for 42.1 percent of total world exports of manufactures over 2006–2011

Figure 11.6
Change in regional world market share by region and technological level of manufactured exports, 2006–2011



Note: Bubble size indicates the change in the value of manufactured exports (in parentheses).
Source: UNIDO estimate based on UN (2013a).

Figure 11.7
Trade patterns between industrialized and industrializing countries, 2006–2011



Note: Bubble size indicates the value of manufactures exports in 2011 (in parentheses).
Source: UNIDO estimate based on UN (2013a).

increasingly more complex goods, fast liberalization of intraregional trade in certain areas and development of closer commercial ties among industrializing countries, combined with a rising demand for consumer and capital goods in these countries, explain the rapid export growth.

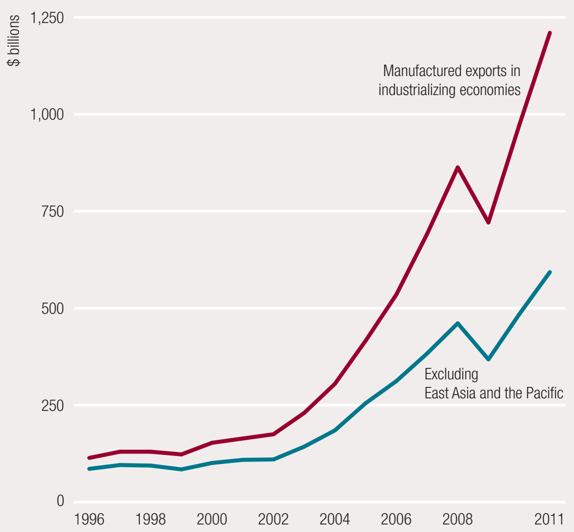
> **By 2011 trade in manufactured exports had fully recovered, setting a new record of $13,469 billion, 11 percent higher than the 2008 peak**

Manufactured trade flows between the groups of industrialized and industrializing countries accounted together for 42.1 percent of total world exports of manufactures and grew at comparable rates of around 11–12 percent over 2006–2011. But despite expanding their export share faster, industrializing countries showed a trade deficit with industrialized countries ($274 billion) in 2011.

With the largest and best intertwined production networks having developed in East Asia and the Pacific, it is this region driving the expansion in manufactured export trade between industrializing countries (Figure 11.8). Parts and components (for electronic equipment and for garments or vehicles) are produced in different countries in the region according to the level of technological complexity involved, with final assembly usually taking place in China, enabling participation in the network – and in international trade – by countries with varying levels of competency and experience in international markets (Athukorala 2011).

In all industrializing country regions, industrialized countries remain the top manufactured-export partners, but their share had been declining in favour of exports to industrializing countries even before the 2008–2009 crisis (Figure 11.9). The growing processed trade (import of foreign parts and components for assembly and subsequent export as final goods) in industrializing countries, particularly in East Asia and the Pacific, reinforces this trend. In addition, traditional commercial ties and more familiarity with the demand, tastes and standards of countries in the same region help explain that they, as a group, are the second destination of manufactured exports in all regions but South and Central Asia, where trade with East Asia and the Pacific is more important.

Figure 11.8
Manufactured exports between industrializing countries, 1996–2011



Source: UNIDO estimate based on UN (2013a).

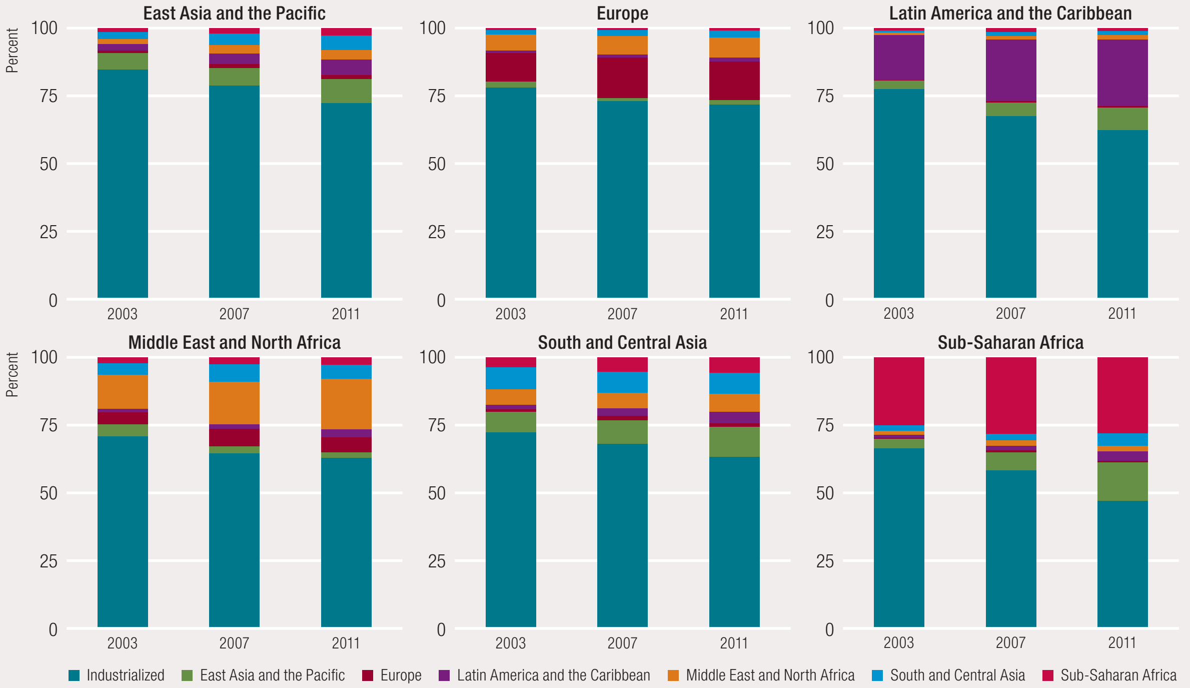
The recovery of global manufactured exports

World manufactured exports had grown 15.6 percent annually over 2003–2007, reaching more than $12,120 billion in 2008, with the growth rate in industrializing economies (23.2 percent) far greater than that in industrialized economies (13.6 percent; Table 11.4). After that, recession set in the United States, the EU and Japan, affecting most industrializing countries through reduced demand for their exports and lower migrant remittances, investment flows, tourism income and even development aid. The severe contraction in manufactured exports worldwide (–21.5 percent) in 2009 hit all industrializing countries, albeit with varying force. The most stricken regions were the Middle East and North Africa (–26.3 percent) and Europe (–25.9 percent), as these regions are important trading partners of the EU, but also Sub-Saharan Africa (–23.6 percent) and Latin America and the Caribbean (–22.3 percent).

By 2011 trade in manufactured exports had fully recovered, setting a new record of $13,469 billion, 11 percent higher than the 2008 peak. Despite their smaller share in manufacturing output and exports compared with industrialized economies, it is industrializing economies that are behind the recent revival in trade. Of the $1,349 billion additional exports in 2011 (relative to 2008), industrializing economies accounted for $846 billion (62.7 percent), equivalent

> **Of the $1,349 billion additional exports in 2011, industrializing economies accounted for $846 billion, while industrialized economies only registered $503 billion**

Figure 11.9
Manufactured exports markets by region, 2003, 2007 and 2011



Source: UNIDO estimate based on UN (2013a).

to a growth rate of 8.3 percent a year, while industrialized economies only registered $503 billion more manufactured exports (37.3 percent), or a growth rate of 1.8 percent a year over 2008–2011. This is as much a reflection of overall economic performance – because industrialized countries are still struggling to put their economies back on their feet while most of the industrializing world was already up and running in 2010 – as it is a sign of the intensification of network trade and the incorporation of more industrializing countries into existing production networks (Hanson 2012).

Manufactured export performance of each region was broadly in line with the performance of their respective major countries (Figure 11.10). East Asia and the Pacific and South and Central Asia – led by China and India – recorded new highs in 2010 and consolidated their lead in 2011. Sub-Saharan Africa also exceeded its prior performance in 2010, but the main economy in the region, South Africa, took longer to recover. Industrializing Europe and Latin America and the Caribbean needed two years to regain their grip on manufactured exports, as did Poland and Mexico. Only the Middle East and North Africa stood in 2011 at the same level of exports as before the crisis.

Manufactured export growth in South and Central Asia (averaging 18.4 percent a year over 2008–2011) was helped by a surge in exports from India, especially from the newly established special economic zones (SEZs; spurred by the SEZ Act 2005). Although 19 SEZs existed previously, new rules were put in place and 154 new SEZs became operational after 2006. Exports of Indian SEZs boomed from a meagre $2.5 billion in (fiscal year) 2003/04 to about $60 billion in 2011/12 (SEZ India 2013). India contributed with $96 billion of additional manufactured exports in 2011 (from 2008); this was similar to the $102 billion contribution of all of Latin America and the Caribbean but coming from a manufacturing

"Manufactured export growth in South and Central Asia (averaging 18.4 percent a year over 2008–2011) was helped by a surge in exports from India

Table 11.4
World manufactured exports by industrialization level, region and income group, 2006–2011

	Manufactured exports ($ billions)						Average growth rate (percent)	
	2006	2007	2008	2009	2010	2011	2003–2007	2007–2011
World	9,447	10,861	12,120	9,516	11,558	13,469	15.6	5.5
Industrialized economies	7,232	8,189	8,980	6,954	8,242	9,483	13.6	3.7
Industrializing economies	2,215	2,672	3,139	2,562	3,316	3,985	23.2	10.5
By industrialization level								
Emerging industrial economies	1,989	2,417	2,853	2,334	3,002	3,646	24.0	10.8
Other industrializing economies	206	232	270	214	297	321	16.7	8.5
Least developed countries	20	24	16	14	17	18	17.9	–6.9
By region								
East Asia and the Pacific	1,169	1,454	1,688	1,431	1,868	2,232	26.4	11.3
Excluding China	248	287	318	275	349	407	15.8	9.1
Europe	230	292	355	263	314	402	24.8	8.3
Excluding Poland	136	170	204	143	176	237	23.4	8.7
Latin America and the Caribbean	420	459	537	417	536	639	15.7	8.6
Excluding Mexico	219	250	308	232	297	370	21.3	10.3
Middle East and North Africa	178	224	274	202	247	274	23.5	5.2
Excluding Turkey	101	127	155	114	147	154	24.0	4.9
South and Central Asia	154	171	197	181	254	327	21.2	17.6
Excluding India	49	46	41	32	66	75	12.7	13.0
Sub-Saharan Africa	64	73	89	68	97	112	16.7	11.3
Excluding South Africa	29	31	38	32	48	54	16.9	14.9
By income group								
High income industrializing	339	399	478	408	518	629	18.7	12.1
Upper middle income industrializing	178	217	257	195	240	289	24.2	7.4
Lower middle income industrializing	1,677	2,032	2,389	1,947	2,541	3,052	24.1	10.7
Low income industrializing	21	25	15	12	17	15	20.6	–12.0

a. About half the least developed countries have yet to report 2011 data.
Source: UNIDO estimate based on UN 2013a.

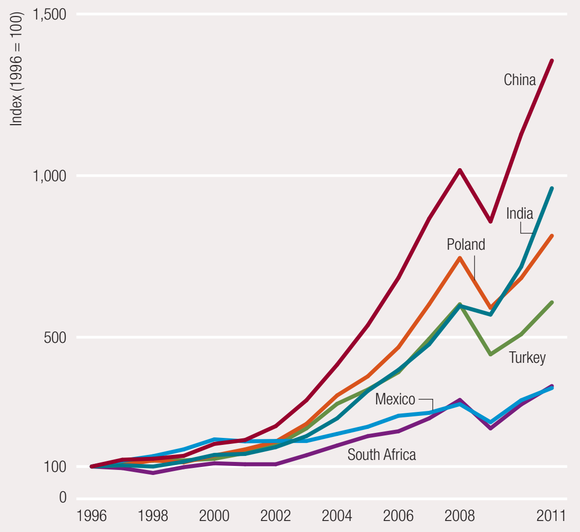
sector that was only 40 percent the size. The expansion of manufactured exports from the other countries in the region was also fast, as they too, like India, intensified their ties with countries in the growing East Asia and the Pacific region, and experienced reductions in their exports shares to the EU and the United States.

The upturn in East Asia and the Pacific was largely led by China, which accounted for $455 billion of the new manufactured exports in 2011 (from 2008). Although China's main export markets were still in the mire, it seems that increased competitiveness and lower prices may have helped in securing new exports and even influenced decisions to relocate production from more expensive sites in industrialized countries. Other emerging economies in the region specialize in key final products and in different stages of component manufacturing, supplying China or industrialized economies in the region with inputs for further incorporation into final products.

The pace of recovery of manufactured exports in Sub-Saharan Africa (8.0 percent annual growth over 2008–2011), Latin America and the Caribbean (6.0 percent), and Europe (4.2 percent) was more

“ The least developed countries fared fairly well after the crisis, with manufactured exports in 2011 reaching $18 billion, up from $16 billion in 2008

Figure 11.10
Growth of manufactured exports in selected industrializing countries, 1996–2011



Source: UNIDO estimate based on UN (2013a).

moderate. The first two regions have a strong presence of resource-based manufactures, whose prices have been on the rise due to strong demand growth in large industrializing countries. The growth in manufactured exports in Industrializing Europe was instead helped by the accession of Bulgaria and Romania to the EU in 2007. Middle East and North African countries do not enjoy tariff-free access to the EU and have been unable to surpass their manufactured exports peak of 2008.

The least developed countries fared fairly well after the crisis, with manufactured exports in 2011 reaching $18 billion, up from $16 billion in 2008. Their specialization in low-tech, affordable consumer products gave them a competitive edge in the context of restrained spending in their traditional export markets, the EU and the United States. Bangladesh, the largest economy in the group, obtains more than 75 percent of its export earnings from the export of knitted and woven garments and saw its exports of these products increase steadily after the crisis. Other least developed countries, such as Cambodia, the Lao People’s Democratic Republic and Myanmar, are slowly being incorporated into their regional production networks to capitalize on their factor advantages, while other countries have benefited from high prices for their resource-based manufactures.

Despite progress, the least developed countries remain fragile, as most of them concentrate on a few products that are prone to market volatility, some of them are torn by war or political instability, and generally they have weak infrastructure to support manufacturing exports.

Notes

1. See Annex 8 for a list of industrialized and industrializing countries and a classification of countries by region.
2. Manufactured trade can be classified by technological complexity as natural resource–based, low-technology and medium- and high-technology (see Annex 4 for details).
3. Highly skilled manufacturing-related services, such as design and marketing, as well as complex manufacturing activities, are still largely performed in industrialized countries.
4. Geometric means are used to compute the average growth rates.

Annexes

Annex 1

Correlations between growth of per capita value added and labour productivity

Table A1.1
Growth of per capita value added and labour productivity

	Coefficient	t-value	p-value
Food and beverages	0.7614	6.26	0.0000
Textiles	0.4418	3.85	0.0000
Wearing apparel	0.3857	2.57	0.0130
Chemicals	0.8573	7.55	0.0000
Basic metals	1.4851	9.66	0.0000
Fabricated metals	0.8563	4.93	0.0000
Electrical machinery and apparatus	1.0727	5.90	0.0000
Motor vehicles	1.0775	6.37	0.0000

Note: Independent variable: change in labour productivity a year. Dependent variable: change in value added per capita a year. GDP range: $3,000–$6,000.
Source: UNIDO estimate based on UNIDO (2012a).

Annex 2

Labour intensity

To determine the level of labour intensity, employment per value added was estimated for 18 manufacturing industries at two income levels of $5,000 and $20,000 GDP per capita, as the labour intensity changes along income level. If an industry's labour intensity is higher than the median of 18 manufacturing industries at both income levels, it is considered labour intensive; if an industry's labour intensity is lower than the median at both income levels, it is considered relatively capital intensive.

Labour-intensive industries (ordered from the industry of the highest labour intensity):

- Wearing apparel.
- Textiles.
- Wood products.
- Fabricated metals.
- Food and beverages.

Capital-intensive industries (ordered from the industry of the highest capital intensity):

- Coke and refined petroleum.
- Tobacco.
- Chemicals.
- Printing and publishing.
- Electrical machinery and apparatus.

Annex 3

Indicators of industrial performance by economy

Table A3.1
Indicators of industrial performance by economy, 2006 and 2011

Economy	Manufacturing value added per capita (2005 $)		Share of manufacturing value added in GDP (percent)		Share of world manufacturing value added (percent)		Share of medium- and high-technology activities (percent)	
	2006	2011	2006	2011	2006	2011	2006	2011
Albania	419	542	15.05	15.77	0.02	0.02	20.21	14.36
Algeria	176	159	5.65	4.79	0.07	0.07	11.28	11.28
Argentina	1,097	1,396	21.53	20.60	0.54	0.65	25.84	25.84
Armenia	232	247	12.85	12.38	0.01	0.01	7.62	5.81
Australia	3,744	3,685	9.81	9.33	0.98	0.96	23.01	23.01
Austria	7,046	7,360	18.44	18.43	0.73	0.71	42.05	41.74
Azerbaijan	108	104	5.26	3.41	0.01	0.01	9.56	6.34
Bangladesh	74	101	16.48	17.58	0.13	0.17	20.20	20.20
Barbados	655	566	5.71	5.23	0.00	0.00	38.11	38.11
Belgium	5,652	5,360	15.28	14.16	0.75	0.66	44.81	42.28
Belize	397	418	9.76	10.36	0.00	0.00	18.46	18.46
Bolivia, Plurinational State of	129	147	11.99	11.82	0.02	0.02	5.05	5.05
Botswana	195	230	3.45	3.75	0.00	0.01	21.59	21.59
Brazil	737	779	15.11	13.60	1.74	1.76	33.27	34.97
Bulgaria	560	675	13.99	14.98	0.05	0.06	24.20	25.57
Cambodia	97	127	18.88	19.51	0.02	0.02	0.26	0.26
Cameroon	158	158	16.61	15.82	0.04	0.04	11.01	11.01
Canada	4,764	3,867	13.33	10.77	1.96	1.52	37.34	37.35
Cape Verde	120	150	5.36	5.31	0.00	0.00	30.60	27.10
Central African Republic	25	19	7.19	5.38	0.00	0.00	9.25	9.25
Chile	1,111	1,069	14.79	12.57	0.23	0.21	1.32	18.92
China	631	1,063	32.62	34.15	10.44	16.42	41.29	40.70
Colombia	505	545	14.13	13.20	0.28	0.29	20.71	20.71
Congo	72	86	4.07	4.40	0.00	0.00	13.14	2.42
Costa Rica	991	972	20.00	17.67	0.05	0.05	19.73	16.58
Côte d'Ivoire	159	152	17.71	17.63	0.04	0.04	14.99	14.99
Croatia	1,555	1,347	14.65	12.63	0.09	0.07	31.77	31.77
Cyprus	1,234	1,096	7.31	6.35	0.02	0.01	4.83	12.32
Czech Republic	3,287	3,812	24.22	26.58	0.42	0.46	44.36	44.62
Denmark	5,941	5,528	12.14	11.85	0.41	0.35	42.71	30.51
Ecuador	259	307	9.12	9.50	0.04	0.05	8.97	8.04
Egypt	200	241	15.81	16.17	0.19	0.23	22.30	22.30
El Salvador	614	633	20.99	21.20	0.05	0.05	19.13	19.13
Eritrea	13	11	5.66	5.32	0.00	0.00	14.32	7.05
Estonia	1,685	1,592	14.79	14.27	0.03	0.02	18.07	25.66

A3

Manufactured exports per capita (US$)		Share of manufactured exports in total exports (percent)		Share of world manufactured exports (percent)		Share of medium- and high-technology activities in manufactured exports (percent)	
2006	2011	2006	2011	2006	2011	2006	2011
53	446	70.31	73.62	0.00	0.01	16.27	16.67
267	512	16.32	25.07	0.10	0.15	1.28	0.53
686	1,059	57.53	51.38	0.30	0.35	34.19	46.33
2,613	5,687	43.95	47.71	0.61	1.03	29.39	17.47
14,023	17,497	86.47	86.84	1.30	1.18	60.73	59.93
252	280	34.45	9.83	0.02	0.02	11.90	13.88
77	84	93.71	91.74	0.12	0.12	2.93	4.34
232	230	83.28	63.66	0.01	0.01	25.70	21.60
743	825	81.88	84.65	0.00	0.00	37.14	41.90
30,903	38,777	87.66	87.25	3.64	3.34	55.46	53.12
164	321	36.16	35.54	0.02	0.03	10.86	2.00
2,259	2,787	95.28	96.24	0.05	0.05	2.24	5.78
527	846	71.88	64.96	1.11	1.33	46.32	35.54
403	361	43.10	33.63	0.00	0.00	0.61	0.45
1,471	2,639	74.89	69.76	0.13	0.16	27.77	35.93
210	335	79.57	71.46	0.03	0.04	2.44	7.06
55	49	27.46	45.68	0.01	0.01	2.88	28.66
7,554	7,359	67.95	59.97	2.77	2.02	57.89	54.48
20	86	47.06	62.27	0.00	0.00	0.75	1.10
20	7	75.46	30.39	0.00	0.00	0.27	13.24
1,807	2,202	50.12	46.71	0.33	0.30	12.67	12.56
701	1,355	95.09	96.17	10.36	14.60	57.94	58.96
270	337	48.40	28.08	0.13	0.13	39.00	31.98
54	597	13.60	34.91	0.00	0.02	6.30	83.42
1,193	1,595	72.08	73.77	0.06	0.06	69.14	58.77
213	159	47.89	29.04	0.04	0.03	31.10	19.22
2,063	2,738	88.15	90.07	0.10	0.10	44.56	47.80
363	553	66.93	70.67	0.00	0.00	53.14	55.08
8,572	14,364	92.44	93.17	0.99	1.21	66.09	67.88
12,528	14,805	74.46	73.15	0.77	0.66	54.07	52.24
203	317	21.72	20.78	0.03	0.04	24.91	19.06
91	239	50.07	62.37	0.08	0.16	13.51	28.05
556	701	90.54	82.26	0.04	0.03	19.26	15.38
1	4	7.24	12.06	0.00	0.00	2.68	12.86
0	0	34.57	34.57	0.00	0.00	14.67	14.67

(continued)

A3

Table A3.1 *(continued)*
Indicators of industrial performance by economy, 2006 and 2011

	Manufacturing value added per capita (2005 $)		Share of manufacturing value added in GDP (percent)		Share of world manufacturing value added (percent)		Share of medium- and high-technology activities (percent)	
Economy	2006	2011	2006	2011	2006	2011	2006	2011
Ethiopia	8	11	4.39	4.24	0.01	0.01	6.86	9.41
Fiji	471	462	12.72	13.01	0.00	0.00	6.81	5.54
Finland	8,514	8,097	21.95	20.52	0.56	0.50	42.95	45.36
France	4,131	3,918	11.58	11.01	3.19	2.84	44.59	45.41
Gabon	251	267	4.01	3.86	0.00	0.00	5.39	5.39
Gambia, The	28	23	6.57	4.70	0.00	0.00	3.90	3.90
Georgia	213	282	13.52	13.83	0.01	0.01	20.23	21.39
Germany	7,405	7,106	21.31	19.23	7.69	6.70	57.00	56.76
Ghana	44	45	8.48	6.70	0.01	0.01	0.80	0.80
Greece	1,784	1,618	7.90	8.14	0.25	0.21	16.64	17.17
Guatemala	405	395	18.41	17.21	0.07	0.07	22.93	16.25
Haiti	45	40	10.00	8.83	0.01	0.00	5.26	5.26
Honduras	275	271	18.68	17.59	0.02	0.02	7.16	7.16
Hong Kong SAR China	558	575	2.01	1.81	0.05	0.05	33.08	32.58
Hungary	2,230	2,357	19.58	21.14	0.28	0.27	53.41	53.47
Iceland	4,895	4,884	8.64	9.36	0.02	0.02	14.18	14.18
India	116	158	14.78	14.89	1.70	2.25	36.14	37.27
Indonesia	356	420	27.17	25.30	1.03	1.17	31.09	37.81
Iran, Islamic Rep. of	314	326	10.90	10.37	0.28	0.28	41.82	40.70
Iraq	20	25	1.69	1.93	0.01	0.01	24.68	24.68
Ireland	10,141	11,536	20.02	25.44	0.54	0.60	59.24	64.07
Israel	2,932	3,203	14.00	14.11	0.25	0.28	57.78	55.61
Italy	5,164	4,223	16.82	14.66	3.84	2.94	36.91	39.33
Jamaica	312	284	7.22	6.92	0.01	0.01	18.77	18.77
Japan	8,006	7,374	21.80	20.53	12.74	10.70	53.36	53.70
Jordan	415	449	16.77	16.26	0.03	0.03	21.31	24.91
Kazakhstan	485	565	11.74	11.03	0.09	0.11	6.50	6.84
Kenya	57	61	10.53	10.35	0.03	0.03	9.29	4.08
Korea, Rep. of	4,770	6,046	25.37	27.74	2.84	3.36	54.65	53.41
Kuwait	2,581	2,323	7.14	6.72	0.08	0.08	20.56	18.09
Kyrgyzstan	53	68	10.70	11.41	0.00	0.00	2.67	4.36
Latvia	828	771	10.55	10.58	0.02	0.02	14.59	20.77
Lebanon	531	510	9.89	7.13	0.03	0.02	10.83	19.95
Lithuania	1,576	1,694	19.13	19.34	0.07	0.06	18.54	18.46
Luxembourg	6,268	4,333	7.39	5.33	0.04	0.03	15.06	4.97
Macao SAR China	796	506	2.91	1.08	0.00	0.00	3.55	3.55
Macedonia, Former Yugoslav Rep. of	444	410	14.44	11.61	0.01	0.01	14.09	14.60
Madagascar	36	37	12.46	13.36	0.01	0.01	3.28	3.28

Manufactured exports per capita (US$)		Share of manufactured exports in total exports (percent)		Share of world manufactured exports (percent)		Share of medium- and high-technology activities in manufactured exports (percent)	
2006	2011	2006	2011	2006	2011	2006	2011
6,586	11,775	88.17	87.08	0.10	0.13	42.38	44.59
411	438	72.93	67.52	0.00	0.00	5.01	9.20
13,548	13,191	92.32	90.15	0.80	0.57	55.59	46.44
6,951	8,025	89.07	87.11	4.80	4.05	65.57	64.34
643	661	14.93	18.23	0.01	0.01	10.65	10.09
1	2	16.33	35.81	0.00	0.00	64.06	5.69
172	297	81.61	75.67	0.01	0.01	42.74	49.27
12,279	15,901	90.33	88.14	11.39	10.45	71.94	72.04
43	265	26.11	35.89	0.01	0.05	2.86	5.93
1,422	2,184	76.18	78.45	0.18	0.20	34.75	26.05
139	464	56.86	67.33	0.02	0.05	29.03	18.96
6	6	82.97	82.97	0.00	0.00	3.80	3.80
132	143	49.17	40.40	0.01	0.01	39.72	27.79
2,397	1,041	71.94	44.01	0.18	0.06	36.89	44.78
6,526	9,812	88.69	87.92	0.74	0.78	77.97	75.62
4,151	4,573	36.18	27.70	0.01	0.01	43.37	42.88
90	202	85.95	83.34	1.17	2.01	23.18	27.67
277	466	63.20	55.50	0.72	0.90	30.54	28.92
132	344	14.78	19.69	0.11	0.21	25.15	31.69
24	4	2.34	0.27	0.01	0.00	80.00	5.23
23,635	26,348	91.84	93.89	1.12	0.95	56.41	53.35
5,798	8,652	83.71	96.51	0.44	0.52	41.84	53.44
6,529	7,826	92.47	90.92	4.34	3.81	53.98	53.69
687	513	94.82	91.85	0.02	0.01	3.12	1.71
4,753	5,968	92.94	91.70	6.76	6.04	82.24	78.89
593	790	79.56	74.28	0.04	0.04	27.74	46.40
536	1,251	21.47	23.01	0.09	0.16	31.13	34.55
50	62	52.53	48.85	0.02	0.02	18.04	24.93
6,669	11,100	96.86	96.74	3.54	4.30	75.16	71.85
7,825	7,783	33.40	40.93	0.21	0.23	7.86	13.45
66	88	47.74	25.94	0.00	0.00	19.75	17.93
2,220	4,314	86.41	80.71	0.06	0.08	27.58	35.07
393	651	70.49	64.99	0.02	0.02	35.36	35.80
3,743	7,377	89.97	86.92	0.14	0.20	37.54	37.58
26,257	26,432	86.27	83.99	0.14	0.11	39.78	37.64
3,547	239	97.35	43.47	0.02	0.00	1.65	7.06
1,049	1,951	89.29	90.40	0.02	0.03	22.27	40.18
28	44	55.91	67.70	0.01	0.01	2.89	8.17

(continued)

Table A3.1 *(continued)*
Indicators of industrial performance by economy, 2006 and 2011

Economy	Manufacturing value added per capita (2005 $)		Share of manufacturing value added in GDP (percent)		Share of world manufacturing value added (percent)		Share of medium- and high-technology activities (percent)	
	2006	2011	2006	2011	2006	2011	2006	2011
Malawi	23	27	10.27	10.20	0.00	0.00	11.16	12.51
Malaysia	1,639	1,673	29.84	26.73	0.55	0.55	48.95	41.76
Malta	2,022	1,817	13.59	11.19	0.01	0.01	41.95	44.92
Mauritius	895	982	17.37	15.75	0.01	0.01	2.27	2.98
Mexico	1,511	1,482	18.33	17.75	2.05	1.95	39.54	38.45
Moldova, Rep. of	103	95	12.18	9.08	0.00	0.00	7.73	5.55
Mongolia	63	86	5.96	5.97	0.00	0.00	5.76	5.30
Morocco	293	316	14.04	12.89	0.11	0.12	21.67	21.61
Mozambique	45	48	13.60	11.71	0.01	0.01	10.74	10.74
Nepal	23	22	7.51	6.41	0.01	0.01	9.13	1.89
Netherlands	5,116	5,094	12.69	12.26	1.05	0.97	39.73	40.07
New Zealand	3,673	3,486	13.30	12.52	0.19	0.18	12.65	13.86
Niger	16	15	5.89	5.43	0.00	0.00	24.77	24.77
Nigeria	24	32	2.89	3.08	0.04	0.06	33.44	33.44
Norway	5,805	5,633	8.77	8.67	0.34	0.32	30.17	24.09
Oman	1,110	1,362	8.48	8.90	0.03	0.04	13.10	16.75
Pakistan	129	142	17.90	18.04	0.26	0.29	24.57	24.57
Palestinian Territories	141	162	11.69	11.11	0.01	0.01	7.13	7.59
Panama	338	367	6.64	5.11	0.01	0.02	6.13	6.13
Paraguay	177	175	13.65	11.33	0.01	0.01	12.87	12.87
Peru	457	596	14.90	14.61	0.16	0.20	13.52	14.49
Philippines	296	322	23.79	22.40	0.32	0.35	45.31	45.31
Poland	1,509	2,251	17.84	21.59	0.72	0.99	32.51	35.35
Portugal	2,288	2,062	12.48	11.42	0.30	0.25	18.02	22.36
Qatar	4,275	4,122	8.19	7.30	0.05	0.09	17.44	17.44
Romania	1,045	1,206	21.19	22.54	0.29	0.30	23.05	33.88
Russian Federation	890	909	15.45	13.71	1.61	1.49	21.88	23.14
Rwanda	22	24	7.30	6.62	0.00	0.00	6.66	6.66
Saudi Arabia	1,266	1,405	9.64	10.17	0.40	0.45	41.12	41.12
Senegal	101	102	12.62	12.26	0.01	0.01	18.31	17.66
Serbia	391	359	14.71	12.50	0.05	0.04	20.76	20.05
Singapore	8,027	8,966	26.35	26.24	0.45	0.53	77.80	73.41
Slovakia	2,194	2,336	22.93	20.55	0.15	0.15	39.83	43.32
Slovenia	3,852	3,644	20.45	18.88	0.10	0.09	42.66	45.52
South Africa	897	897	16.62	15.19	0.55	0.52	23.47	21.24
Spain	3,705	2,975	13.87	11.66	2.05	1.59	30.31	34.28
Sri Lanka	251	324	19.13	18.97	0.06	0.08	17.49	12.11
St. Lucia	269	327	4.82	6.59	0.00	0.00	7.83	7.83

Manufactured exports per capita (US$)		Share of manufactured exports in total exports (percent)		Share of world manufactured exports (percent)		Share of medium- and high-technology activities in manufactured exports (percent)	
2006	2011	2006	2011	2006	2011	2006	2011
10	33	20.46	35.58	0.00	0.00	18.97	14.80
5,109	6,385	84.54	81.18	1.53	1.47	70.81	59.11
6,392	11,970	92.26	94.78	0.03	0.04	79.23	42.59
1,607	1,401	87.25	96.49	0.02	0.01	22.11	3.87
1,864	2,338	80.43	76.78	2.26	2.15	76.64	77.83
371	452	62.13	62.93	0.01	0.01	2.47	1.91
142	201	73.92	58.53	0.01	0.01	14.08	13.60
330	521	80.75	77.70	0.11	0.13	28.77	40.10
13	35	11.94	23.41	0.00	0.01	29.77	26.67
22	24	87.02	79.62	0.01	0.01	9.18	19.60
18,475	27,405	75.52	86.08	3.40	3.65	58.14	52.39
2,526	3,699	49.89	45.02	0.12	0.13	25.68	20.91
20	47	56.21	78.23	0.00	0.01	22.61	4.83
28	121	6.85	15.60	0.05	0.16	15.82	8.87
6,471	8,433	24.72	26.06	0.34	0.33	45.95	45.34
754	2,328	9.59	16.07	0.02	0.05	33.94	49.55
93	115	89.29	80.67	0.17	0.16	7.67	10.94
67	105	92.10	92.29	0.00	0.00	13.02	9.49
63	3,928	20.58	96.37	0.00	0.11	12.40	60.28
89	184	28.86	15.57	0.01	0.01	15.29	12.53
412	782	48.33	50.35	0.13	0.18	3.66	5.03
506	350	93.00	69.19	0.50	0.27	78.66	65.27
2,480	4,295	86.37	87.44	1.06	1.32	55.74	56.16
3,568	5,055	87.06	91.70	0.42	0.43	44.36	40.13
5,211	11,552	15.16	19.16	0.06	0.17	35.43	21.46
1,400	2,628	93.99	89.86	0.34	0.45	38.62	54.36
753	1,265	35.83	34.95	1.21	1.45	25.99	22.18
4	20	34.48	58.35	0.00	0.00	6.97	5.06
1,702	2,476	20.35	19.41	0.47	0.56	24.66	36.89
34	136	56.41	68.08	0.00	0.01	20.90	12.84
533	931	81.52	77.92	0.06	0.07	25.96	33.78
30,163	32,241	92.88	89.76	1.50	1.52	72.45	68.99
7,009	13,389	91.16	93.35	0.43	0.59	60.76	64.78
9,444	12,784	90.33	89.76	0.21	0.21	60.34	61.37
722	1,156	66.34	62.75	0.39	0.47	47.77	43.56
4,184	5,351	86.04	83.37	2.07	1.99	60.26	54.99
253	344	75.18	72.29	0.06	0.06	8.82	9.43
197	247	63.18	61.64	0.00	0.00	28.87	30.00

(continued)

Table A3.1 *(continued)*

Indicators of industrial performance by economy, 2006 and 2011

Economy	Manufacturing value added per capita (2005 $)		Share of manufacturing value added in GDP (percent)		Share of world manufacturing value added (percent)		Share of medium- and high-technology activities (percent)	
	2006	2011	2006	2011	2006	2011	2006	2011
Suriname	579	598	15.69	13.88	0.00	0.00	11.64	11.64
Swaziland	720	727	30.15	29.88	0.01	0.01	0.01	0.01
Sweden	7,598	7,419	17.87	16.97	0.87	0.80	52.87	46.96
Switzerland	9,687	10,110	18.74	18.56	0.91	0.89	34.91	34.91
Syrian Arab Rep.	41	52	2.59	2.96	0.01	0.01	21.52	21.52
Taiwan Province of China	4,402	4,885	26.46	25.77	1.27	1.30	61.88	61.88
Tajikistan	80	100	26.88	20.47	0.01	0.01	3.28	2.40
Tanzania, United Rep. of	31	40	8.08	8.71	0.02	0.02	1.18	1.18
Thailand	963	1,108	34.96	36.66	0.82	0.88	46.16	46.16
Tonga	196	200	7.70	7.86	0.00	0.00	17.31	17.31
Trinidad and Tobago	756	883	5.48	6.37	0.01	0.01	39.38	39.38
Tunisia	521	611	15.30	16.38	0.07	0.07	9.32	9.32
Turkey	1,309	1,503	17.51	18.07	1.14	1.27	29.81	30.04
Uganda	24	29	6.79	6.93	0.01	0.01	11.07	11.07
Ukraine	349	380	17.57	18.07	0.20	0.20	22.70	20.78
United Kingdom	4,518	3,882	11.69	10.32	3.44	2.78	42.33	41.99
United States	5,901	5,714	13.70	13.50	22.25	20.52	48.25	51.52
Uruguay	812	966	14.95	13.42	0.03	0.04	10.67	13.40
Venezuela, Bol. Rep. of	868	784	14.73	12.68	0.30	0.26	34.28	34.28
Viet Nam	146	209	21.43	23.57	0.15	0.21	20.26	20.26
Yemen	59	62	7.27	8.30	0.02	0.02	3.89	3.89
Zambia	69	79	10.66	10.21	0.01	0.01	21.08	21.08

Source: UNIDO 2013c.

Manufactured exports per capita (US$)		Share of manufactured exports in total exports (percent)		Share of world manufactured exports (percent)		Share of medium- and high-technology activities in manufactured exports (percent)	
2006	2011	2006	2011	2006	2011	2006	2011
156	626	6.99	13.83	0.00	0.00	22.13	19.37
1,174	890	94.72	92.86	0.01	0.01	20.80	28.96
14,551	17,620	89.76	89.01	1.49	1.33	60.87	57.76
18,403	27,800	92.95	91.18	1.55	1.71	67.97	70.57
255	244	44.12	43.87	0.05	0.05	29.13	22.69
9,449	11,941	96.49	95.41	2.43	2.22	71.99	71.08
16	16	13.82	13.82	0.00	0.00	66.30	66.30
11	43	25.97	42.30	0.00	0.02	11.30	16.67
1,677	2,696	86.41	81.90	1.27	1.50	62.36	58.53
8	18	8.49	13.13	0.00	0.00	35.19	18.91
5,662	5,510	53.31	73.95	0.08	0.07	20.95	17.70
1,002	1,381	85.80	81.96	0.11	0.12	32.33	45.80
1,115	1,623	90.06	88.60	0.87	0.96	42.70	41.19
10	32	30.51	51.06	0.00	0.01	37.72	32.16
727	1,286	88.31	84.95	0.38	0.46	40.31	42.16
6,138	6,015	83.61	79.25	4.18	3.00	69.30	62.14
2,669	3,150	86.04	75.93	8.99	7.89	72.23	62.18
533	974	44.86	41.59	0.02	0.03	19.28	26.35
140	1,018	6.18	32.81	0.04	0.24	53.17	4.32
265	764	55.92	70.01	0.25	0.54	23.04	33.65
28	24	9.13	8.97	0.01	0.00	2.98	11.63
77	118	23.89	17.63	0.01	0.01	14.40	29.57

Annex 4

Technological classification of international trade data

Table A4.1
Technology classification of exports, SITC Revision 3

Type of export	SITC sections
Resource-based	016, 017, 023, 024, 035, 037, 046, 047, 048, 056, 058, 059, 061, 062, 073, 098, 111, 112, 122, 232, 247, 248, 251, 264, 265, 281, 282, 283, 284, 285, 286, 287, 288, 289, 322, 334, 335, 342, 344, 345, 411, 421, 422, 431, 511, 514, 515, 516, 522, 523, 524, 531, 532, 551, 592, 621, 625, 629, 633, 634, 635, 641, 661, 662, 663, 664, 667, 689
Low technology	611, 612, 613, 642, 651, 652, 654, 655, 656, 657, 658, 659, 665, 666, 673, 674, 675, 676, 677, 679, 691, 692, 693, 694, 695, 696, 697, 699, 821, 831, 841, 842, 843, 844, 845, 846, 848, 851, 893, 894, 895, 897, 898, 899
Medium technology	266, 267, 512, 513, 533, 553, 554, 562, 571, 572, 573, 574, 575, 579, 581, 582, 583, 591, 593, 597, 598, 653, 671, 672, 678, 711, 712,713 ,714, 721, 722, 723, 724, 725, 726, 727, 728, 731, 733, 735, 737, 741, 742, 743, 744, 745, 746, 747, 748, 749, 761, 762, 763, 772, 773, 775, 778, 781, 782, 783, 784, 785, 786, 791, 793, 811, 812, 813, 872, 873, 882, 884, 885
High technology	525, 541, 542, 716, 718, 751, 752, 759, 764, 771, 774, 776, 792, 871, 874, 881, 891

Source: UNIDO 2011b.

Table A4.2
Technology classification of exports, SITC Revision 1

Type of export	SITC sections
Resource-based	012, 013, 023, 024, 032, 046, 047, 048, 053, 055, 061, 062, 073, 099, 111, 112, 122, 231, 242, 243, 251, 264, 265, 267, 281, 282, 283, 284, 286, 321, 332, 411, 421, 422, 431, 512, 513, 514, 521, 531, 551, 532, 621, 629, 631, 632, 633, 641, 551, 661, 662
Low technology	611, 612, 613, 642, 651, 652, 654, 655, 656, 657, 665, 666, 673, 674, 675, 676, 677, 679, 691, 692, 693, 694, 695, 696, 697, 698, 821, 831, 841, 842, 851, 891, 893, 894, 895, 897, 899
Medium technology	266, 533, 553, 554, 561, 571, 581, 599, 653, 671, 672, 678, 712, 715, 717, 718, 719, 723, 725, 731, 732, 733, 812, 862, 863, 864, 735, 951
High technology	515, 541, 711, 714, 722, 724, 726, 729, 734, 861

Source: UNIDO elaboration based on UN (2013a).

Annex 5

Technological classification of manufacturing value added data

To compute the share of medium- and high-technology activities in manufacturing value added, the Organisation for Economic Co-operation and Development technology classification (OECD 2005) was used (Table A5.1).

For Niger and Zimbabwe, the classification in Table A5.2 was used because data were available only in ISIC Revision 2.

For this classification, medium- and high-technology activities were combined. The sector shares of value added were then calculated in relation to the total for manufacturing subsectors.

Table A5.1
Technology classification of manufacturing value added, ISIC Revision 3

Type of activity	ISIC division, major group or group
Low technology	15, 16, 17, 18, 19, 20, 21, 22, 36, 37
Medium-low technology manufacturing	23, 25, 26, 27, 28, 351
Medium- and high-technology manufacturing	24, 29, 30, 31, 32, 33, 34, 35 (excluding 351)

Source: UNIDO elaboration based on the Organisation for Economic Co-operation and Development technology classification (OECD 2005).

Table A5.2
Technology classification of manufacturing value added, ISIC Revision 2

Type of activity	ISIC division, major group or group
Type of activity	ISIC division, major group or group
Resource-based	31, 331, 341, 353, 354, 355, 362, 369
Low technology	32, 332, 361, 381, 390
Medium and high technology	342, 351, 352, 356, 37, 38 (excluding 381), 3522, 3852, 3832, 3845, 3849, 385

Source: UNIDO 2011b.

Annex 6

Indicators of manufacturing value added and exports by industrialization level, region and income group

Table A6.1

Manufacturing value added per capita, 2007–2011 (constant 2005 $)

Group	2007	2008	2009	2010	2011
World	1,275	1,258	1,148	1,240	1,264
Industrialized economies	5,142	4,985	4,344	4,735	4,754
Industrializing economies	425	443	455	487	517
By industrialization level					
Emerging industrial economies	578	605	625	673	720
Other developing economies	186	190	186	193	196
Least developed economies	44	46	48	50	52
By region					
East Asia and the Pacific	624	672	735	796	866
Excluding China	364	376	366	395	409
Europe	977	1,026	996	1,062	1,118
Excluding Poland	757	776	730	750	770
Latin America and the Caribbean	852	856	784	841	864
Excluding Mexico	692	703	653	697	715
Middle East and North Africa	521	523	500	532	554
Excluding Turkey	315	325	324	329	329
South and Central Asia	133	135	142	150	158
Excluding India	147	147	146	152	158
Sub-Saharan Africa	100	101	93	96	97
Excluding South Africa	42	43	43	45	45
By income group					
High income industrializing	165	169	172	181	190
Upper middle income industrializing	1,549	1,636	1,625	1,691	1,768
Lower middle income industrializing	776	816	844	914	980
Low income industrializing	41	43	44	46	48

Source: UNIDO 2013c.

Table A6.2
Share of manufacturing value added in GDP, 2007–2011 (percent)

Group	2007	2008	2009	2010	2011
World	17	17	16	17	17
Industrialized economies	16	16	14	15	15
Industrializing economies	20	20	20	21	21
By industrialization level					
Emerging industrial economies	22	22	22	23	23
Other developing economies	12	12	11	12	12
Least developed economies	11	11	11	11	11
By region					
East Asia and the Pacific	32	32	33	32	33
Excluding China	27	27	26	27	27
Europe	16	16	16	17	17
Excluding Poland	14	14	14	14	15
Latin America and the Caribbean	16	16	15	15	15
Excluding Mexico	15	15	14	14	14
Middle East and North Africa	13	12	12	12	13
Excluding Turkey	10	10	9	9	10
South and Central Asia	14	14	14	14	14
Excluding India	14	13	13	13	13
Sub-Saharan Africa	11	10	10	10	10
Excluding South Africa	7	7	7	7	7
By income group					
High income industrializing	16	16	16	16	16
Upper middle income industrializing	12	13	13	13	13
Lower middle income industrializing	23	23	23	23	24
Low income industrializing	12	12	12	12	12

Source: UNIDO 2013c.

Table A6.3
Share of manufacturing value added in world manufacturing value added, 2007–2011 (percent)

Group	2007	2008	2009	2010	2011
World	100	100	100	100	100
Industrialized economies	73	71	67	68	66
Industrializing economies	27	29	33	32	34
By industrialization level					
Emerging industrial economies	24	26	29	29	31
Other developing economies	2	3	3	3	3
Least developed economies	0	0	0	0	0
By region					
East Asia and the Pacific	14	15	18	18	19
Excluding China	2	3	3	3	3
Europe	2	2	2	2	2
Excluding Poland	1	1	1	1	1
Latin America and the Caribbean	6	6	6	6	6
Excluding Mexico	4	4	4	4	4
Middle East and North Africa	2	2	2	2	2
Excluding Turkey	1	1	1	1	1
South and Central Asia	3	3	3	3	3
Excluding India	1	1	1	1	1
Sub-Saharan Africa	1	1	1	1	1
Excluding South Africa	0	0	0	0	0
By income group					
High income industrializing	5	5	5	5	5
Upper middle income industrializing	2	2	2	2	2
Lower middle income industrializing	21	22	25	25	26
Low income industrializing	0	0	0	0	0

Source: UNIDO 2013c.

Table A6.4
Share of medium- and high-technology activities in manufacturing value added, 2007–2011 (percent)

Group	2007	2008	2009	2010	2011
World	47	47	47	48	48
Industrialized economies	50	51	51	52	53
Industrializing economies	38	38	38	40	40
By industrialization level					
Emerging industrial economies	39	40	40	41	40
Other developing economies	24	24	25	25	26
Least developed economies	19	18	18	19	16
By region					
East Asia and the Pacific	42	42	42	43	42
Excluding China	40	41	39	41	40
Europe	26	28	28	29	30
Excluding Poland	23	24	23	24	24
Latin America and the Caribbean	33	33	32	33	34
Excluding Mexico	27	28	27	29	29
Middle East and North Africa	30	31	31	31	33
Excluding Turkey	28	29	29	30	31
South and Central Asia	40	42	43	44	43
Excluding India	27	28	29	29	29
Sub-Saharan Africa	26	27	24	25	26
Excluding South Africa	10	10	9	8	8
By income group					
High income industrializing	36	38	38	39	39
Upper middle income industrializing	31	32	33	34	34
Lower middle income industrializing	39	39	39	40	40
Low income industrializing	19	18	17	18	16

Source: UNIDO 2013a.

Table A6.5
Manufactured exports per capita, 2007–2011 (constant 2005 $)

Group	2007	2008	2009	2010	2011
World	1,649	1,818	1,411	1,695	1,953
Industrialized economies	6,901	7,517	5,784	6,814	7,798
Industrializing economies	495	574	462	591	702
By industrialization level					
Emerging industrial economies	679	794	644	820	988
Other developing economies	206	237	184	252	268
Least developed economies	34	22	18	23	23
By region					
East Asia and the Pacific	776	895	753	976	1,159
Excluding China	519	569	487	611	703
Europe	1,771	2,162	1,605	1,923	2,465
Excluding Poland	1,345	1,623	1,143	1,408	1,904
Latin America and the Caribbean	811	939	722	917	1,080
Excluding Mexico	549	667	498	631	777
Middle East and North Africa	627	753	546	656	715
Excluding Turkey	441	531	383	484	499
South and Central Asia	101	115	104	144	183
Excluding India	90	79	60	124	139
Sub-Saharan Africa	96	115	86	119	135
Excluding South Africa	44	52	43	63	69
By income group					
High income industrializing	171	201	169	212	253
Upper middle income industrializing	2,516	2,960	2,216	2,706	3,230
Lower middle income industrializing	903	1,054	853	1,104	1,318
Low income industrializing	35	20	16	23	19

Source: UN 2013a.

Table A6.6
Share of manufactured exports in total exports, 2007–2011 (percent)

Group	2007	2008	2009	2010	2011
World	83	81	82	82	81
Industrialized economies	87	85	86	85	85
Industrializing economies	74	71	74	74	72
By industrialization level					
Emerging industrial economies	80	77	79	79	77
Other developing economies	45	39	43	46	43
Least developed economies	53	40	40	35	37
By region					
East Asia and the Pacific	91	91	91	91	90
Excluding China	77	74	74	73	71
Europe	88	87	86	86	86
Excluding Poland	88	86	84	85	85
Latin America and the Caribbean	68	62	62	63	61
Excluding Mexico	61	54	52	53	52
Middle East and North Africa	39	34	39	41	38
Excluding Turkey	27	23	27	30	27
South and Central Asia	74	70	75	66	62
Excluding India	52	40	45	39	31
Sub-Saharan Africa	39	38	39	42	37
Excluding South Africa	25	23	27	30	26
By income group					
High income industrializing	63	60	62	66	64
Upper middle income industrializing	49	45	51	49	45
Lower middle income industrializing	82	78	81	80	79
Low income industrializing	62	47	45	41	43

Source: UN 2013a.

Table A6.7
Share in world manufactured exports, 2007–2011 (percent)

Group	2007	2008	2009	2010	2011
World	100	100	100	100	100
Industrialized economies	75	74	73	71	70
Industrializing economies	25	26	27	29	30
By industrialization level					
Emerging industrial economies	22	24	25	26	27
Other developing economies	2	2	2	3	2
Least developed economies	0	0	0	0	0
By region					
East Asia and the Pacific	13	14	15	16	17
Excluding China	3	3	3	3	3
Europe	3	3	3	3	3
Excluding Poland	2	2	2	2	2
Latin America and the Caribbean	4	4	4	5	5
Excluding Mexico	2	3	2	3	3
Middle East and North Africa	2	2	2	2	2
Excluding Turkey	1	1	1	1	1
South and Central Asia	2	2	2	2	2
Excluding India	0	0	0	1	1
Sub-Saharan Africa	1	1	1	1	1
Excluding South Africa	0	0	0	0	0
By income group					
High income industrializing	4	4	4	4	5
Upper middle income industrializing	2	2	2	2	2
Lower middle income industrializing	19	20	20	22	23
Low income industrializing	0	0	0	0	0

Source: UN 2013a.

Table A6.8
Share of medium- and high-technology activities in manufactured exports, 2007–2011 (percent)

Group	2007	2008	2009	2010	2011
World	62	60	61	61	59
Industrialized economies	65	64	65	64	63
Industrializing economies	50	50	51	51	50
By industrialization level					
Emerging industrial economies	53	53	53	54	52
Other developing economies	31	30	31	27	27
Least developed economies	8	15	18	15	17
By region					
East Asia and the Pacific	57	57	58	58	57
Excluding China	52	50	49	48	46
Europe	46	48	50	50	48
Excluding Poland	39	41	42	43	42
Latin America and the Caribbean	54	52	51	51	50
Excluding Mexico	34	34	30	29	30
Middle East and North Africa	34	34	36	37	37
Excluding Turkey	27	27	31	33	35
South and Central Asia	22	26	27	27	27
Excluding India	15	21	19	22	25
Sub-Saharan Africa	36	40	36	32	28
Excluding South Africa	19	25	25	17	12
By income group					
High income industrializing	32	34	33	31	30
Upper middle income industrializing	47	47	51	50	49
Lower middle income industrializing	55	54	55	56	55
Low income industrializing	11	16	18	15	15

Source: UN 2013a.

Annex 7

Summary of world trade, by industrialization level, region and income group

Table A7.1
Total exports, all commodities, 2007–2011 ($ billions)

Group	2007	2008	2009	2010	2011
World	13,053	15,038	11,601	14,150	16,724
Industrialized economies	9,463	10,596	8,124	9,657	11,190
Industrializing economies	3,591	4,442	3,477	4,493	5,534
By industrialization level					
Emerging industrial economies	3,030	3,707	2,948	3,798	4,741
Other developing economies	515	695	495	646	744
Least developed economies	45	40	34	49	49
By region					
East Asia and the Pacific	1,590	1,859	1,570	2,052	2,470
Excluding China	372	429	369	477	573
Europe	330	406	304	363	466
Excluding Poland	192	237	171	207	279
Latin America and the Caribbean	675	861	672	856	1,055
Excluding Mexico	414	570	444	558	708
Middle East and North Africa	577	801	518	603	712
Excluding Turkey	471	672	417	492	579
South and Central Asia	232	281	240	386	530
Excluding India	87	102	72	171	243
Sub-Saharan Africa	187	235	173	233	301
Excluding South Africa	123	162	120	162	207
By income group					
High income industrializing	633	797	654	784	981
Upper middle income industrializing	446	567	382	485	640
Lower middle income industrializing	2,472	3,046	2,414	3,182	3,878
Low income industrializing	40	32	28	42	35

Source: UN 2013a.

Table A7.2
Primary exports, 2007–2011 ($ billions)

Group	2007	2008	2009	2010	2011
World	2,024	2,701	1,872	2,342	2,929
Industrialized economies	1,138	1,443	1,014	1,230	1,468
Industrializing economies	886	1,258	859	1,112	1,461
By industrialization level					
Emerging industrial economies	595	826	579	759	1,041
Other developing economies	274	412	264	328	395
Least developed economies	18	19	16	25	25
By region					
East Asia and the Pacific	128	159	124	167	218
Excluding China	81	105	84	114	153
Europe	35	46	38	45	59
Excluding Poland	21	30	24	27	36
Latin America and the Caribbean	205	309	235	294	383
Excluding Mexico	153	252	198	243	312
Middle East and North Africa	351	523	308	350	432
Excluding Turkey	342	513	300	339	420
South and Central Asia	59	81	57	130	200
Excluding India	42	60	36	102	165
Sub-Saharan Africa	108	139	97	125	169
Excluding South Africa	87	117	81	102	141
By income group					
High income industrializing	228	313	236	254	335
Upper middle income industrializing	227	307	185	243	348
Lower middle income industrializing	419	626	427	598	766
Low income industrializing	11	12	10	17	12

Source: UN 2013a.

Table A7.3

Resource-based manufactured exports, 2007–2011 ($ billions)

Group	2007	2008	2009	2010	2011
World	2,184	2,638	1,986	2,527	3,149
Industrialized economies	1,608	1,924	1,428	1,759	2,180
Industrializing economies	576	715	558	769	969
By industrialization level					
Emerging industrial economies	477	595	473	628	822
Other developing economies	93	112	79	132	139
Least developed economies	7	8	6	9	8
By region					
East Asia and the Pacific	167	203	168	227	288
Excluding China	72	87	75	102	126
Europe	75	90	66	83	117
Excluding Poland	51	63	45	57	84
Latin America and the Caribbean	147	187	150	200	246
Excluding Mexico	129	165	132	177	219
Middle East and North Africa	86	109	73	92	103
Excluding Turkey	72	87	57	75	81
South and Central Asia	66	84	67	115	146
Excluding India	9	12	9	30	30
Sub-Saharan Africa	35	41	33	52	69
Excluding South Africa	21	21	18	30	42
By income group					
High income industrializing	143	174	140	205	261
Upper middle income industrializing	72	87	59	78	98
Lower middle income industrializing	354	447	354	478	604
Low income industrializing	6	6	5	8	6

Source: UN 2013a.

Table A7.4
Low-technology manufactured exports, 2007–2011 ($ billions)

Group	2007	2008	2009	2010	2011
World	1,985	2,186	1,726	2,007	2,358
Industrialized economies	1,239	1,348	1,040	1,168	1,339
Industrializing economies	747	839	686	840	1,019
By industrialization level					
Emerging industrial economies	665	756	613	748	917
Other developing economies	66	76	68	85	95
Least developed economies	16	6	5	6	7
By region					
East Asia and the Pacific	458	529	436	554	681
Excluding China	66	72	66	81	93
Europe	83	94	65	75	94
Excluding Poland	51	57	39	45	54
Latin America and the Caribbean	66	70	54	61	72
Excluding Mexico	36	39	30	33	42
Middle East and North Africa	61	71	57	64	68
Excluding Turkey	21	24	21	24	21
South and Central Asia	68	62	64	72	93
Excluding India	30	18	18	21	27
Sub-Saharan Africa	11	12	10	14	11
Excluding South Africa	6	6	6	9	6
By income group					
High income industrializing	126	143	131	153	180
Upper middle income industrializing	42	48	36	42	51
Lower middle income industrializing	562	641	513	638	781
Low income industrializing	16	6	5	7	7

Source: UN 2013a.

Table A7.5
Medium-technology manufactured exports, 2007–2011 ($ billions)

Group	2007	2008	2009	2010	2011
World	4,267	4,730	3,564	4,374	5,103
Industrialized economies	3,446	3,738	2,783	3,345	3,868
Industrializing economies	821	992	781	1,029	1,235
By industrialization level					
Emerging industrial economies	787	945	744	977	1,182
Other developing economies	33	45	36	50	51
Least developed economies	2	2	2	2	2
By region					
East Asia and the Pacific	393	475	395	530	641
Excluding China	75	87	75	99	117
Europe	117	148	109	129	162
Excluding Poland	57	72	48	63	81
Latin America and the Caribbean	192	215	158	209	245
Excluding Mexico	69	84	54	69	87
Middle East and North Africa	70	85	66	83	95
Excluding Turkey	30	39	30	42	48
South and Central Asia	27	37	32	50	64
Excluding India	6	6	3	12	15
Sub-Saharan Africa	23	32	22	28	29
Excluding South Africa	3	9	6	6	6
By income group					
High income industrializing	78	107	85	110	128
Upper middle income industrializing	90	106	84	102	122
Lower middle income industrializing	651	778	610	815	984
Low income industrializing	2	2	2	2	2

Source: UN 2013a.

Table A7.6
High-technology manufactured exports, 2007–2011 ($ billions)

Group	2007	2008	2009	2010	2011
World	2,424	2,565	2,240	2,649	2,858
Industrialized economies	1,897	1,971	1,703	1,970	2,096
Industrializing economies	528	594	537	679	762
By industrialization level					
Emerging industrial economies	488	556	505	649	724
Other developing economies	39	37	31	30	38
Least developed economies	0	0	0	0	1
By region					
East Asia and the Pacific	437	481	432	557	623
Excluding China	72	72	63	69	72
Europe	16	24	22	27	29
Excluding Poland	9	12	12	15	18
Latin America and the Caribbean	54	64	56	66	75
Excluding Mexico	18	21	15	18	24
Middle East and North Africa	7	7	7	9	8
Excluding Turkey	6	6	3	6	6
South and Central Asia	10	15	17	18	24
Excluding India	3	3	3	3	3
Sub-Saharan Africa	3	3	3	3	3
Excluding South Africa	0	0	0	0	0
By income group					
High income industrializing	51	54	51	50	60
Upper middle income industrializing	12	16	15	18	19
Lower middle income industrializing	464	523	470	610	683
Low income industrializing	1	1	1	0	1

Source: UN 2013a.

Annex 8

Country and economy groups

Table A8.1
Countries and economies by region

Industrialized economies				
East Asia and the Pacific				
Australia	Hong Kong SAR China	Macao SAR China	New Zealand	
French Polynesia	Japan	Malaysia	Singapore	
Guam	Korea, Rep. of	New Caledonia	Taiwan Province of China	
Europe				
Austria	France	Italy	Netherlands	Slovenia
Belgium	Germany	Liechtenstein	Norway	Spain
Czech Republic	Hungary	Lithuania	Portugal	Sweden
Denmark	Iceland	Luxembourg	Russian Federation	Switzerland
Estonia	Ireland	Malta	Slovakia	United Kingdom
Finland				
Latin America and the Caribbean				
Aruba	British Virgin Islands	French Guiana	Puerto Rico	US Virgin Islands
Middle East and North Africa				
Bahrain	Israel	Kuwait	Qatar	United Arab Emirates
North America				
Bermuda	Canada	Greenland	United States	
Industrializing economies				
East Asia and the Pacific				
Brunei Darussalam	Indonesia	Micronesia, Federated States of	Philippines	Tonga
Cambodia	Kiribati	Mongolia	Samoa	Tuvalu
China	Korea, Dem. People's Rep. of	Myanmar	Solomon Islands	Vanuatu
Cook Islands	Lao People's Dem. Rep.	Palau	Thailand	Viet Nam
Fiji	Marshall Islands	Papua New Guinea	Timor-Leste	
Europe				
Albania	Bulgaria	Latvia	Montenegro	Serbia
Belarus	Croatia	Macedonia, Former Yugoslav Rep. of	Poland	Ukraine
Bosnia and Herzegovina	Greece	Moldova, Rep. of	Romania	

Table A8.1 *(continued)*
Countries and economies by region

Industrializing economies (continued)				
Latin America and the Caribbean				
Anguilla	Chile	Grenada	Mexico	St. Vincent and the Grenadines
Antigua and Barbuda	Colombia	Guadeloupe	Montserrat	Suriname
Argentina	Costa Rica	Guatemala	Nicaragua	Trinidad and Tobago
Bahamas	Cuba	Guyana	Panama	Uruguay
Barbados	Dominica	Haiti	Paraguay	Venezuela, Bol. Rep. of
Belize	Dominican Republic	Honduras	Peru	
Bolivia, Plurinational State of	Ecuador	Jamaica	St. Kitts and Nevis	
Brazil	El Salvador	Martinique	St. Lucia	
Middle East and North Africa				
Algeria	Egypt	Lebanon	Palestinian Territories	Syrian Arab Rep.
Armenia	Georgia	Libya	Saudi Arabia	Tunisia
Azerbaijan	Iraq	Morocco	South Sudan	Turkey
Cyprus	Jordan	Oman	Sudan	Yemen
South and Central Asia				
Afghanistan	India	Kyrgyzstan	Pakistan	Turkmenistan
Bangladesh	Iran, Islamic Rep. of	Maldives	Sri Lanka	Uzbekistan
Bhutan	Kazakhstan	Nepal	Tajikistan	
Sub-Saharan Africa				
Angola	Congo, Dem. Rep. of	Guinea	Mozambique	Somalia
Benin	Congo	Guinea-Bissau	Namibia	South Africa
Botswana	Côte d'Ivoire	Kenya	Niger	Swaziland
Burkina Faso	Djibouti	Lesotho	Nigeria	Tanzania, United Rep. of
Burundi	Equatorial Guinea	Liberia	Rwanda	Togo
Cameroon	Eritrea	Madagascar	Réunion	Uganda
Cape Verde	Ethiopia	Malawi	São Tomé and Príncipe	Zambia
Central African Rep.	Gabon	Mali	Senegal	Zimbabwe
Chad	Gambia, The	Mauritania	Seychelles	
Comoros	Ghana	Mauritius	Sierra Leone	

Source: UNIDO elaboration based on UN Statistics Classification.

Table A8.2
Countries and economies by industrialization level

Industrialized economies				
Aruba	Estonia	Ireland	Malta	Slovenia
Australia	Finland	Israel	Netherlands	Spain
Austria	France	Italy	New Caledonia	Sweden
Bahrain	French Guiana	Japan	New Zealand	Switzerland
Belgium	French Polynesia	Korea, Rep. of	Norway	Taiwan Province of China
Bermuda	Germany	Kuwait	Portugal	United Arab Emirates
British Virgin Islands	Greenland	Liechtenstein	Puerto Rico	United Kingdom
Canada	Guam	Lithuania	Qatar	United States
Curaçao	Hong Kong SAR China	Luxembourg	Russian Federation	US Virgin Islands
Czech Republic	Hungary	Macao SAR China	Singapore	
Denmark	Iceland	Malaysia	Slovakia	

Industrializing economies				
Emerging industrial economies				
Argentina	Colombia	Kazakhstan	Romania	Turkey
Belarus	Costa Rica	Latvia	Saudi Arabia	Ukraine
Brazil	Croatia	Macedonia, Former Yugoslav Rep. of	Serbia	Uruguay
Brunei Darussalam	Cyprus	Mauritius	South Africa	Venezuela, Bol. Rep. of
Bulgaria	Greece	Mexico	Suriname	
Chile	India	Oman	Thailand	
China	Indonesia	Poland	Tunisia	
Other developing economies				
Albania	Cook Islands	Guyana	Mongolia	Seychelles
Algeria	Côte d'Ivoire	Honduras	Montenegro	Sri Lanka
Angola	Cuba	Iran, Islamic Rep. of	Montserrat	St. Kitts and Nevis
Anguilla	Dominica	Iraq	Morocco	St. Lucia
Antigua and Barbuda	Dominican Republic	Jamaica	Namibia	St. Vincent and the Grenadines
Armenia	Ecuador	Jordan	Nicaragua	Swaziland
Azerbaijan	Egypt	Kenya	Nigeria	Syrian Arab Rep.
Bahamas	El Salvador	Korea, Dem. Rep. of	Pakistan	Tajikistan
Barbados	Equatorial Guinea	Kyrgyzstan	Palau	Tonga
Belize	Fiji	Lebanon	Palestinian Territories	Trinidad and Tobago
Bolivia, Plurinational State of	Gabon	Libya	Panama	Turkmenistan
Bosnia and Herzegovina	Georgia	Maldives	Papua New Guinea	Uzbekistan
Botswana	Ghana	Marshall Islands	Paraguay	Viet Nam
Cameroon	Grenada	Martinique	Peru	Zimbabwe
Cape Verde	Guadeloupe	Micronesia, Federated States of	Philippines	
Congo	Guatemala	Moldova, Rep. of	Réunion	

Table A8.2 (continued)
Countries and economies by industrialization level

Industrializing economies (continued)				
Least developed economies				
Afghanistan	Congo, Dem. Rep. of	Lesotho	Rwanda	Timor-Leste
Bangladesh	Djibouti	Liberia	Samoa	Togo
Benin	Eritrea	Madagascar	São Tomé and Príncipe	Tuvalu
Bhutan	Ethiopia	Malawi	Senegal	Uganda
Burkina Faso	Gambia, The	Mali	Sierra Leone	Vanuatu
Burundi	Guinea	Mauritania	Solomon Islands	Yemen
Cambodia	Guinea-Bissau	Mozambique	Somalia	Zambia
Central African Rep.	Haiti	Myanmar	South Sudan	
Chad	Kiribati	Nepal	Sudan	
Comoros	Lao People's Dem. Rep.	Niger	Tanzania, United Rep. of	

Source: UNIDO 2013d.

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Table A8.3
Countries and economies by income (gross national income per capita)

High income ($12,476 or more)				
Andorra	Curaçao	Guam	Macao SAR China	Singapore
Anguilla	Cyprus	Hong Kong SAR China	Malta	Slovakia
Aruba	Czech Republic	Hungary	Netherlands	Slovenia
Australia	Denmark	Iceland	New Caledonia	Spain
Austria	Equatorial Guinea	Ireland	New Zealand	Sweden
Bahamas	Estonia	Israel	Norway	Switzerland
Bahrain	Finland	Italy	Oman	Taiwan Province of China
Barbados	France	Japan	Poland	Trinidad and Tobago
Belgium	French Polynesia	Korea, Rep. of	Portugal	United Arab Emirates
Bermuda	Germany	Kuwait	Puerto Rico	United Kingdom
Brunei Darussalam	Greece	Liechtenstein	Qatar	United States
Canada	Greenland	Luxembourg	Saudi Arabia	US Virgin Islands
Croatia				

Upper middle income ($12,475–$4,036)				
Algeria	Chile	Iraq	Mauritius	South Africa
American Samoa	China	Jamaica	Mexico	St. Lucia
Angola	Colombia	Jordan	Montenegro	St. Vincent and the Grenadines
Antigua and Barbuda	Costa Rica	Kazakhstan	Namibia	Suriname
Argentina	Cuba	Latvia	Palau	Thailand
Azerbaijan	Dominica	Lebanon	Panama	Tunisia
Belarus	Dominican Rep.	Libya	Peru	Turkey
Bosnia and Herzegovina	Ecuador	Lithuania	Romania	Turkmenistan
Botswana	Gabon	Macedonia, Former Yugoslav Rep. of	Russian Federation	Uruguay
Brazil	Grenada	Malaysia	Serbia	Venezuela, Bol. Rep. of
Bulgaria	Iran, Islamic Rep. of	Maldives	Seychelles	

Table A8.3 (continued)
Countries and economies by income (gross national income per capita)

Lower middle income ($4,035–$1,026)				
Albania	El Salvador	Lao People's Dem. Rep.	Papua New Guinea	Syrian Arab Rep.
Armenia	Fiji	Lesotho	Paraguay	Timor-Leste
Belize	Georgia	Marshall Islands	Philippines	Tonga
Bhutan	Ghana	Micronesia, Federated States of	Samoa	Tuvalu
Bolivia, Plurinational State of	Guatemala	Moldova, Rep. of	São Tomé and Príncipe	Ukraine
Cameroon	Guyana	Mongolia	Senegal	Uzbekistan
Cape Verde	Honduras	Morocco	Solomon Islands	Vanuatu
Congo	India	Nicaragua	South Sudan	Viet Nam
Côte d'Ivoire	Indonesia	Nigeria	Sri Lanka	Yemen
Djibouti	Iraq	Pakistan	Sudan	Zambia
Egypt	Kiribati	Palestine	Swaziland	

Low income ($1,025 or less)				
Afghanistan	Comoros	Haiti	Mali	Sierra Leone
Bangladesh	Congo, Dem. Rep. of	Kenya	Mauritania	Somalia
Benin	Eritrea	Korea, Dem. Rep. of	Mozambique	Tajikistan
Burkina Faso	Ethiopia	Kyrgyzstan	Myanmar	Tanzania, United Rep. of
Burundi	Gambia	Liberia	Nepal	Togo
Cambodia	Guinea	Madagascar	Niger	Uganda
Central African Rep.	Guinea-Bissau	Malawi	Rwanda	Zimbabwe
Chad				

Source: World Bank 2012.

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COUNTRY AND ECONOMY GROUPS

Table A8.4
Countries and economies by income (constant 2005 PPP$)

High income ($15,000 or more)				
Antigua and Barbuda	Chile	Iceland	Malta	Singapore
Argentina	Cyprus	Ireland	Mauritius	Slovakia
Australia	Czech Rep.	Israel	Netherlands	Slovenia
Austria	Denmark	Italy	New Zealand	Spain
Bahamas	Equatorial Guinea	Japan	Norway	Sweden
Bahrain	Estonia	Kazakhstan	Oman	Switzerland
Barbados	Finland	Korea, Rep. of	Palau	Taiwan
Belarus	France	Kuwait	Portugal	Trinidad and Tobago
Belgium	Germany	Libya	Puerto Rico	United Arab Emirates
Bermuda	Greece	Luxembourg	Qatar	United Kingdom
Brunei	Hong Kong SAR China	Macao SAR China	Saudi Arabia	United States
Canada	Hungary	Malaysia	Seychelles	
Upper middle income ($6,500–$15,000)				
Armenia	Costa Rica	Latvia	Romania	Tunisia
Azerbaijan	Croatia	Lebanon	Russian Federation	Turkey
Belize	Cuba	Lithuania	Serbia	Turkmenistan
Botswana	Dominican Rep.	Macedonia, Former Yugoslav Rep. of	South Africa	Ukraine
Brazil	Gabon	Marshall Islands	St. Kitts and Nevis	Uruguay
Bulgaria	Georgia	Mexico	St. Lucia	Venezuela, Bol. Rep. of
Cape Verde	Grenada	Montenegro	Suriname	
China	Iran, Islamic Rep. of	Panama	Swaziland	
Colombia	Jamaica	Poland	Thailand	
Low and lower middle income ($6,500 or less)				
Afghanistan	Côte d'Ivoire	Indonesia	Mozambique	Sri Lanka
Albania	Djibouti	Iraq	Namibia	St. Vincent and Grenadines
Algeria	Dominica	Jordan	Nepal	Sudan
Angola	Ecuador	Kenya	Nicaragua	Syria
Bangladesh	Egypt	Kiribati	Niger	Tajikistan
Benin	El Salvador	Kyrgyzstan	Nigeria	Tanzania, United Rep. of
Bhutan	Eritrea	Lao People's Dem. Rep.	Pakistan	Timor-Leste
Bolivia	Ethiopia	Lesotho	Papua New Guinea	Togo
Bosnia and Herzegovina	Fiji	Liberia	Paraguay	Tonga
Burkina Faso	Gambia, The	Madagascar	Peru	Uganda
Burundi	Ghana	Malawi	Philippines	Uzbekistan
Cambodia	Guatemala	Maldives	Rwanda	Vanuatu
Cameroon	Guinea	Mali	Samoa	Viet Nam
Central African Rep.	Guinea-Bissau	Mauritania	São Tomé and Príncipe	Yemen
Chad	Guyana	Micronesia, Federated States of	Senegal	Zambia
Comoros	Haiti	Moldova, Rep. of	Sierra Leone	Zimbabwe
Congo, Dem. Rep. of	Honduras	Mongolia	Solomon Islands	
Congo	India	Morocco	Somalia	

Source: CIC 2009.

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