UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

Structural Change for Inclusive and Sustainable Industrial Development

INCLUSIVE AND SUSTAINABLE INDUSTRIAL DEVELOPMENT

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Foreword

This report highlights the importance of the manufacturing sector in economic development and, with a focus on structural change, discusses how industrial development can be harnessed for faster growth, greater inclusiveness and sustainability. The concept of industrial structure is often elusive as income level, country-specific conditions, technological change and policies all play a role in structural change. Insights into the ebb and flow of different sectors and industries within the manufacturing sector along a country's development path are crucial, as they give rise to new opportunities and challenges for the country in question.

The manufacturing sector has always been a key driver of economic growth for developing countries. At an early stage of development, manufacturing development can open a window for countries to pursue strong and inclusive growth. The competitive wage levels of low-income countries give them a distinct advantage in developing labour-intensive industries, which can generate a large number of formal jobs for both women and men. Successful development of labour-intensive industries sets the foundation for industrialization, as increased exports, revenues and consumption boost investments in education, infrastructure, and research and development. This can foster the development of higher valued and more technologically sophisticated industries. Such structural change ensures sustained and rapid industrial development, even after the loss of labour-cost advantage.

UNIDO's research shows that the types of industries that emerge in the middle-income stage are likely to be more emissions- and material use-intensive and thus often increase the pressure on the environment, unless proper mitigation measures are introduced. The successful shift of the industrial structure from labour-intensive to capital-intensive industries increases productivity and generates higher wage jobs, which could help sustain industrial growth and lead to the creation of shared prosperity. Entering a high-income stage of development often slows down the growth of manufacturing relative to services, with the exception of technology-intensive industries. While the growth of manufacturing moderates, manufacturing activities gradually shift away from resource-intensive industries to high valued-added activities, and to a manufacturing sector that is less emissions-intensive.

Our research also provides a theoretical foundation and empirical support for the general pattern of industrial structural change and its contribution to economic development. Moreover, this report identifies the obstacles and challenges that can stall structural change, deviate the change from the general pattern or intensify the trade-off between growth and environmental protection. For example, unless countries build a production base and a conducive business environment, even at the early stage of development, countries could experience deindustrialization. Without continuous upgrading of production capabilities, countries will not move from labour-intensive to more technologically sophisticated industries and may thus fall into the middle-income trap.

UNIDO has conducted research on structural change since its establishment and has accumulated extensive knowledge on the policy implications for sustained growth, technological development, employment generation and environmental impact. This report combines UNIDO's own research as well as contributions from leading experts on the most recent developments in the field of structural change for inclusive and sustainable industrial development.

LI Yong
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Director General

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Technical Notes and Abbreviations

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

Appendices A and B provide tables and indicators complementary to the chapters of the report.

This report classifies countries according to four primary groupings: *industrialized economies, emerging industrial economies, other developing economies and least developed countries*. The three latter groupings are together referred to as *developing and emerging industrial economies*. See Appendix C for a complete list of countries and economies by region, industrialization level and income level, as well as detailed information on the classifications of sectors used throughout the report.

In-text values in non-$ currencies are generally followed by a $-approximation, which in all cases is based on the average exchange rate for the relevant year.

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

GDP	Gross domestic product
ICT	Information and communication technology
ISIC	International standard industrial classification
ISID	Inclusive and sustainable industrial development
LDC	Least developed countries
MVA	Manufacturing value added
NIC	Newly industrialized countries
OECD	Organisation for Economic Co-operation and Development
PPP	Purchasing power parity
R&D	Research and development
SDG	Sustainable Development Goals
UN	United Nations
UNIDO	United Nations Industrial Development Organization

Executive Summary

Structural change is a central feature of economic development and as economies evolve, the manufacturing industry plays a key role. However, development is increasingly not only about raising income because the form growth takes also matters. Issues of inclusion (with as many as possible benefiting from the proceeds of growth) and sustainability (with growth minimizing the environmental impact) have become crucial. This report explores the role of the manufacturing industry in the twenty-first century in this context. Manufacturing offers the possibility of both job and income creation, but also poses challenges in terms of the effects this process has on natural resources and climate change. Recent history demonstrates that experience with industrialization has been very uneven, both in terms of the spread of benefits between countries and their distribution within countries. The report highlights successful and unsuccessful experiences and considers their policy implications. The challenges discussed here are of central importance for most countries, especially for developing countries wishing to expand their industrial base and embark on a path of sustainable industrialization.

Manufacturing matters for the growth of developing countries

There is ample empirical evidence to show that the manufacturing sector plays an important role in growth, particularly when countries are at a relatively low-income level. Manufacturing offers the possibility of higher levels of productivity, more rapid productivity growth and greater technical change than agriculture, or below a certain income, many parts of services. In addition, it can create jobs that offer higher wages due to this higher level of productivity. Hence, there is usually an association between the growth of an economy and the size and growth of its manufacturing sector. This relationship is typically stronger in low- and lower-middle-income economies than in middle- and high-income economies, since the productivity and employment effects of manufacturing relative to other sectors are expected to be higher at lower income levels. In addition, there is some evidence that this relationship may have weakened post-1990 in the more globalized world economy, where positive growth effects from manufacturing only operate in economies with relatively high levels of human capital. In policy terms this means that governments of developing countries need to consider ways to encourage and support manufacturing activities and prevent a shift of resources from manufacturing to activities such as traditional agriculture or informal services, which offer less economic returns and have less potential for growth.

No unique path to development but understanding general patterns may inform policy

Cross-country analyses of the patterns of manufacturing development reveal both empirical regularities in these patterns and significant variations in country experiences due to country-specific factors. As per capita incomes rise, the share of the manufacturing sector in gross domestic product (GDP) typically follows an inverted U-shaped path peaking at a threshold level of income and declining as income rises further. This relationship has changed over time and the maximum share of manufacturing in GDP in today's economies is at much lower levels of income per capita compared to the point at which the now industrialized countries

reach their peak level of manufacturing activity. Once the peak has been reached, the share of manufacturing tends to gradually decrease and the share of the services sector rises. There is no predetermined or unique path to development, and individual countries have specific features that influence the extent to which they may deviate from the general or average pattern. Nonetheless, establishing this general pattern can inform policy since it indicates how far the structure of an economy is from the 'expected' structure, given its income level, size and other characteristics.

In terms of trends over the period 1970-2013 in different regions, a significant relocation of manufacturing value added has been observed from wealthier countries (the United States and Western Europe) to Asia, in particular China. The share of manufacturing in GDP (at constant prices) over this period dropped in Western Europe, Latin America and sub-Saharan Africa, and has been constant in the United States (at 13 percent). On the other hand, its share in Asia (excluding China) has increased from 16 percent to 20 percent while in China it has risen four-fold from 9 percent to 36 percent. Within the developing country group, the share of manufacturing in total economic activity rose from around 15 percent to over 20 percent over this period. In 2014, China contributed over 18 percent of world manufacturing value added, and was the second largest manufacturing producer behind the United States.

Patterns can also be established for change within manufacturing as the sector expands at different levels of income. Industries within manufacturing can be classified as 'early', 'middle' or 'late' depending on the level of income (at constant prices) at which an industry's share in GDP reaches its peak. Early industries are mostly those that are relatively labour-intensive and/or domestic-oriented (typically food and beverages, tobacco, textiles, wearing apparel, wood products, publishing, furniture, and non-metallic minerals). Middle industries include those that process natural resources (typically coke and refined petroleum, paper, basic metals and fabricated metals). Late industries tend to be more knowledge- and capital-intensive (typically rubber and plastics, motor vehicles, chemicals, machinery and equipment, electrical machinery and apparatus and precision instruments). There are country differences from this general pattern, and at low income levels in particular, there can be considerable variation between countries as evidenced by differing experiences in the development of textiles and wearing apparel. Once the manufacturing sector has accumulated experience and incomes have risen, the differences in performance between countries at the same income level decrease. However, as countries approach the end of the upper-middle-income stage (at around $15,000 GDP per capita in terms of PPP in 2005 constant prices), they again exhibit bigger differences in performance, as they face the challenge of competing in more sophisticated and technology-intensive goods.

Overall, the aggregate share of world manufacturing employment in total world employment (including both developed and developing countries) has barely changed since 1970. Rather, a major reallocation of the share of manufacturing in total employment has occurred, rising from below 10 percent to around 14 percent in the developing country group, whilst it has fallen significantly in developed countries.

Although there are sufficient regularities in the data to identify a 'normal' development pattern and path of structural change as income grows, countries may deviate from this path because of their specific characteristics. Small countries (defined here by a population size below 12.5 million) tend to develop labour-intensive industries earlier than large countries, although they

decline fairly rapidly once these industries reach their peak levels of output relative to other industries. At high income levels, the growth of industries between small and large countries tends to vary far more, as small countries must specialize more than larger ones. Due to agglomeration effects, high levels of population density tend to be associated with relatively high levels of manufacturing. On the other hand, countries with large levels of natural resources have lower than expected levels of manufacturing for their income level. Similarly, countries with high labour costs and poor governance have lower levels of manufacturing than expected. Whilst there may be a few developing countries that have significant potential in high productivity activities, such as tourism services or mineral processing, a need for most countries will eventually arise to develop some form of manufacturing. The policy challenge is to ensure that given the country's size and natural resource endowment, its actual level of manufacturing activity is not significantly below what might be expected. This requires ensuring that adequate support for manufacturing and key aspects of the investment climate, like high quality infrastructure, training activities and a stable macro-economic environment, are in place.

Manufacturing can be inclusive where it leads to strong job creation…

Inclusive industrial development implies that all parts of society benefit from industrial progress, whereby industrialization helps reduce absolute poverty and inequality and provides well-paid jobs for both women and men. The key issue in policy terms is to ensure that manufacturing activities grow sufficiently more rapidly to create jobs both directly and indirectly through linkage effects. Currently, industry provides around 24 percent of global employment and manufacturing contributes around 15 percent. The globalization of production processes and consumption have accelerated the specialization of manufacturing tasks, and contributed to inequalities in the labour market in terms of differences in wages and employment opportunities between skilled and unskilled labour and between men and women. Whilst manufacturing alone cannot resolve all problems of inclusion, there is an approximate negative correlation between the share of manufacturing in a country's GDP and the levels of both poverty and inequality. Globally, both poverty rates and the numbers in poverty have fallen substantially post-1990, but the numbers in poverty (by the World Bank $1.9/day line) actually rose from 2005 to 2013 in sub-Saharan Africa, where the manufacturing sector remains small and job creation in this sector has been weak.

At an early stage of development, the subsectors food and beverages, chemicals, non-metallic minerals, textiles and wearing apparel are most likely to generate the most significant employment opportunities. As incomes and wages rise, it will be necessary to move beyond these early stage industries and to establish competitive production in more capital-intensive and technologically sophisticated industries. Manufacturing is an important source of employment for women, typically offering higher wages and better benefits than other sectors. Whilst globalization and the development of lengthy supply chains has created opportunities for female employment in export manufacturing, there is an ongoing debate as to how far recent trends in technological change and reorganization within firms generate a process of 'defeminization' and employment biases against women. The share of female employees in manufacturing has dropped from 50 percent in 1991 to 38 percent in 2014, and women's share in industrial employment relative to men's fell in all regions (apart from West Asia) between 1991 and 2013.

Technological change inevitably affects and transforms employment opportunities. Recent trends towards using robots, principally in automotive production, computers and electronics, have triggered a debate on their long-term employment effects. Currently, the use of industrial robots globally remains limited, and the expectation is that their labour-displacing effect will be limited to the short term. In the longer run, however, they are likely to bias job creation towards higher skill jobs. A partial counter to this may come from the increased link between service and manufacturing activities with jobs created in service-based activities that support manufacturing.

Given the imperative to create jobs in order to meet inclusion objectives, the challenge is to ensure adequate growth of manufacturing production. There is evidence that the employment response to manufacturing expansion has been weakening due to technological change. Nonetheless, for countries at low- and lower-middle-income levels, low wage costs continue to provide an opportunity to develop competitive production in a range of activities which, if successful, can create a significant number of jobs. The difference from earlier periods is that internationally competitive production now requires a constant upgrading of products and increased production capability and skills, so that low labour costs alone will rarely be a sufficient base for successful industrialisation. This means that countries must continually seek to upgrade production even within 'early' or labour-intensive industries.

...and it must do more to support sustainability

Addressing the environmental impact of industrialization is a crucial component of a policy directed at sustainable industrialization. Structural change within manufacturing has implications for the level of environmental impact, which in this report is measured by two indicators, namely CO2 emissions and material use by industry (calculated as the sum of ores, biomasses and construction materials). Input-output data is used to calculate both the direct and indirect environmental effects in terms of emission and material use from manufacturing expansion over the period 1995-2013, both in the aggregate and by subsector.

An increase in CO2 emission and material use was registered in the manufacturing sectors across all country groups, largely driven by the effects of increased volumes of production. This occurred despite the positive trend in the reduction in environmental intensity (environmental impact per unit of output) of production across all country groups, except for low-income economies. There is a clear declining trend in CO2 intensity for high- and upper-middle-income countries from 1995 onwards, as well as for material use for these country groups and lower-middle-income countries, although both trends reversed for upper-middle-income countries after the 2009 global recession. This reduced intensity is particularly noticeable in high-income economies and explains their relatively low increase in total emissions over the period.

Increased production in upper- and lower-middle-income economies has led to an upsurge in CO2 and material use, although more progress has been made in the reduction in emission intensity of material use than of CO2 emission. In upper-middle-income economies, the slowdown in growth following the 2009 recession has been associated with a decline in environmental efficiency as the intensity of material use increased. Low-income economies have not benefitted from technological improvements that have resulted in intensity reductions

elsewhere, indicating the limitations of current transfer mechanisms of environmental technology.

Although overall compositional changes are much less important than scale or intensity effects in explaining the increase in CO2 emissions or material use, interesting differences are found by subsector. For example, for the transport equipment industry, unlike others, improvements in the intensity of CO2 emissions are only found in high-income economies. On the other hand, an improvement in the intensity of CO2 emissions for food and beverages and textiles and leather is found in all country groups, except for low-income economies, where these activities are of relatively greater significance. Improvements in the intensity of CO2 in these subsectors for high-income countries have been strong enough to offset the effects of scale, so that the level of CO2 emissions has fallen in absolute terms.

Overall experience demonstrates that there is still a long way to go if manufacturing is to help achieve global climate change targets. Whilst there has been some progress in terms of the environmental impact of a unit of manufacturing production, the expansion of output has added to global emissions. Efforts to reduce environmental intensity further still must be accelerated and the relevant technology defused as widely as possible. The diversity in country experiences found shows that technological change that reduces the environmental intensity of production and which is effectively transmitted between countries will be the key to ensuring that long-term sustainability goals are met. Low-income countries in particular remain well behind other groupings in the application of less environmentally-intensive production techniques. The diversity of experiences between manufacturing subsectors highlights the potential role of sector-targeted environmental policies to encourage decarbonization and more efficient waste management and recycling.

Macro-economic conditions are important for successful industrialization

A small sample of 'successful industrializer' economies, defined by their growth of manufacturing value added relative to other developing countries, is identified with a view to establishing their shared characteristics and the policy implications of their experiences. A key common denominator is stability in both macro-economic and political terms. The analysis covers two periods before and after 1990, with the post-1990 period reflecting the emergence of a more globalized world economy. The sample for the first period is composed of the East Asian economies Malaysia, the Republic of Korea and Thailand, plus Turkey and Oman, and for the second period by the large emerging economies of China, India and Bangladesh as well as the production hub economies involved in global and regional value chains–Cambodia, People's Democratic Republic of Lao, Myanmar and Viet Nam. The countries examined have common features, as well as many differences in terms of size, resource endowments, institutions and economic policy. All had undergone a major shift in economic policy prior to their period of rapid manufacturing expansion, all experienced a major increase in manufacturing exports and a rise in the manufacturing share in GDP. All apart from Oman (and part of Turkey) are geographically part of Asia.

An analysis to explain the probability of inclusion in the group of successful industrializers confirms the importance of both factor endowments and geography, which countries cannot

influence, along with country-specific conditions like income level and population structure, as well as policies. Successful industrializers are usually those countries with a lower level of income per capita with the possibility of catching up, and those with a low age dependency ratio, as a young population offers the possibility of an expanding low-cost labour force. Resource-rich and landlocked countries are less likely to be successful, although the performance of land-locked People's Democratic Republic of Lao demonstrates that exceptions do exist.

Results are not predetermined by natural resource endowments and geography, however, as policy and macro-economic conditions also matter. Our analysis confirms the importance of investment—both in terms of physical and human capital—although its significance can vary between countries and over time. Successful industrializers are generally characterized by higher access to credit, lower interest rates and a competitive real exchange rate. The role of capital account controls is found to have varied over time with openness of the capital account contributing to successful industrialization pre-1990, but not in the post-1990 period. Political stability in terms of absence of regime change also appears to promote industrialization.

There are considerable differences between countries confirming that there is no unique model of industrial policy or of public intervention to promote industrialization, not even within the group of East Asian countries, with differences between policy in cases such as the Republic of Korea in the 1970s and 1980s or China and Viet Nam more recently. No one-size-fits-all solution exists for successful industrialization and specific policies have to reflect country specificities in terms of size, endowments, economic specialization, level of development and institutional framework. Nonetheless, the macro-economic conditions leading to high levels of investment, a competitive exchange rate, access to low cost credit and a competitive exchange rate, appear to be a key common factor that governments must aim for.

Deindustrialization can mean developing countries grow more slowly

Deindustrialization measured in terms of a fall in the share of manufacturing in total employment has become a key policy issue in both member countries of the Organisation for Economic Co-operation and Development (OECD) and developing economies. In the former, in particular, the decline in the rates of employment in manufacturing post-1970 has been quite rapid and a similar problem ensued in some middle-income countries, particularly in Latin America, from the 1990s. Deindustrialization can be positive if it means that resources are being transferred from industry to dynamic high productivity activities, like modern services. It is negative if the transfer is to low productivity, low wage activities, whether informal services or traditional agriculture. Current evidence suggests it is the negative aspect that has dominated in many countries, and where this is the case, measures are needed to reverse the trend towards deindustrialization.

Empirical analysis identifies an inverted U-shaped relationship with the share of manufacturing employment first rising and then falling with income per capita. However, this relationship has not been stable over time with a clear tendency for the estimated relationship between manufacturing employment share and income per capita to fall over time. Hence, the discussion of 'premature deindustrialization' in the sense that the share of employment in manufacturing in many of today's middle- and lower-middle-income economies has declined at levels of real

income per capita at which it was still rising in earlier periods in today's developed economies. Where economies are major primary exporters or have a large tradable service sector (for example, in finance or tourism), so that they do not need an export surplus in the trade in manufactured goods, their deindustrialization pattern as incomes rise is more pronounced, but also potentially less serious.

Latin America's experience is highly relevant in this context since in 1970, despite their significant endowments of natural resources, these economies had levels of industrialization that were higher than expected due to the pursuit of import substitution policies. Economic reforms in relation to trade opening, financial liberalization and privatization combined with a period of rising commodity prices saw the countries of the region witness very substantial relative shifts in employment out of manufacturing. As in Latin America, much of the transfer of workers was into low productivity service jobs, the overall growth of productivity strongly decelerated, giving rise to the 'premature deindustrialization' debate. Brazil is an extreme case in point of this pattern with a decrease in the average annual growth rate of manufacturing of 9.4 percent between 1965 and 1980, to a mere 1.2 percent between 1980 and 2016, and a fall in annual productivity growth from 6.5 percent from 1965 to 1980, to a negative rate of 0.5 percent from 1980 to 2016.

Output can be a combination of the growth of productivity and employment. Since 1980, it has only been the emerging economies of Asia (including the large economies of India and China, the early industrializers the Republic of Korea, Singapore and the Taiwan Province of China, as well as the newly industrialized economies [NICs], Thailand, Malaysia and Viet Nam), which have successfully combined rapid rates of productivity growth in manufacturing with employment growth. In the OECD countries, output increases have been attributable to productivity growth, whilst in Latin America, productivity has been very sluggish and output growth has been largely driven by employment. This divergence has had a major impact on the share of global manufacturing taken by emerging Asia. Relative to the rest of the developing world, the share of these countries increased from one-quarter of that of the rest of the developing world in the 1970s to roughly three times that amount by 2015, a trend principally driven by the relative decline of manufacturing in Latin America. The key lesson from the relatively diverse country group of emerging Asia is that any successful process of industrialization requires high levels of investment in activities with a long-term potential for productivity growth, effective management of openness to foreign trade and technology and a competitive exchange rate. In lower- and middle-income economies outside the group of emerging Asia, the transfer of workers out of manufacturing and into lower productivity jobs is a serious policy issue and ways to support manufacturing need to be considered.

There is a need for industrial policy

There are different ways to support industry, and the precise choice of instruments matters less than the way in which they are applied. Current thinking highlights the need to focus on the key constraints to new investments. These constraints are to be identified by a dialogue between government (through the agency that implements industrial policy) and the productive sector (private or public enterprises). Instruments are to be used flexibly so that where one is ineffective, it should be replaced by another or terminated. Support for a given instrument should be linked to performance and the achievement of targets, and be of a temporary nature.

In practice, governments are 'doomed to choose' in the sense that as resources are limited priorities for support need to be set if interventions are to be effective.

Manufacturing offers the potential for higher wages and stable employment. The links between employment growth and output growth have weakened in recent decades in part because of the skills bias inherent in new technologies created in higher income economies. Overall, the expectation is that innovation increases employment since even if innovation in processes results in labour-shedding, innovation in products creates new markets and expands output. Whilst the spread of industrial robots may create a labour-displacing effect in the long run, this has not as yet emerged as a major problem in middle- and lower-income economies.

Interventions to support sustainable green growth will be increasingly important in the future to offset the negative effects of a growing rate of production on the environment. Governments can play a key role in getting prices to incorporate the negative consequences of resource use on the environment and in funding research and development (R&D) in environmentally supportive technology and its dissemination, so that increasingly, environmental considerations will need to be an important aspect of industrial policy.

CHAPTER 1

MANUFACTURING AND ECONOMIC DEVELOPMENT: AN INTRODUCTION

Manufacturing for economic growth

Economic growth is a necessary condition for a country's economic development. The question is what type of economic structure does a country need to achieve this? Circumstances will vary from country to country, but all historical and contemporary evidence suggests that rapid economic growth over long periods is associated with the structural transformation of countries from being primarily land-based to becoming producers of manufactured goods. In Europe and North America in the 19th century, living standards rose rapidly with industrialization, and the fastest growing countries in the world today are the newly industrializing countries in Asia.

The essential feature of manufacturing is its potential to generate high levels of labour productivity and therefore high per capita income because industrial production is subject to increasing returns—both static and dynamic—and also has higher backward and forward linkages than other sectors of the economy. A few countries, such as Australia, New Zealand and Canada, became rich based on agriculture; other countries have become rich based on oil, but they are the exception rather than the rule. Some services have high productivity, but these only tend to emerge at relatively high income levels and cannot provide the basis for sustained economic development in low- and middle-income economies.

Manufacturing has been described as an 'engine of growth' because of the beneficial effects it can have on the rest of the economy. Box 1.1 provides a summary of the key points of this argument.

The key arguments in relation to manufacturing as an engine of growth were put forward by Nicholas Kaldor (1966, 1967) over 50 year ago. He argued that it is not possible to understand the differences in the level of development between countries and why growth rates differ between countries without distinguishing between increasing returns activities, on the one hand, and diminishing returns activities, on the other. Developed and fast-growing countries tend to specialize in increasing returns activities while less developed slow growing countries tend to specialize in diminishing returns activities. Industry (and some services) are characterized by increasing returns, whereas land-based activities are subject to diminishing returns (because land is a fixed factor of production). Manufacturing is therefore the 'engine of growth'. Kaldor's views have subsequently been referred to as 'Kaldor's growth laws', which can be empirically tested and have been tested extensively (see Appendix A for a summary of said laws).[1]

Box 1.1
Manufacturing as the engine of growth

The theoretical and empirical argument that manufacturing is the engine of growth can be summarised as follows:

1. There is an empirical correlation between the degree of industrialisation and per capita income in developing countries.
2. Productivity is higher in the manufacturing sector than in the agricultural sector. The transfer of resources from agriculture to manufacturing provides a 'structural change bonus'. A dynamic version of the structural change bonus is that manufacturing has higher rates of productivity growth than other sectors.
3. At relatively low income levels the transfer of resources from manufacturing to services provides a 'structural change burden' as it will lower the average productivity of an economy.
4. Compared to agriculture, the manufacturing sector offers special opportunities for capital accumulation. Capital accumulation can be more easily realized in spatially concentrated manufacturing than in spatially dispersed agriculture. Thus, an increasing share of manufacturing in national income will contribute to aggregate growth.
5. The manufacturing sector offers special opportunities for economies of scale, which are less available in agriculture and services.
6. The manufacturing sector offers opportunities for technological change both embodied in new physical investment and through the creation and transfer of knowledge.
7. Linkage and spill-over effects are stronger in manufacturing than in other sectors. Linkage effects refer to the backward and forward linkages between producers within and outside manufacturing which can create positive externalities. Spill-over effects refer to knowledge flows between sectors.
8. As per capita income rises, the share of total expenditure on agricultural items declines and the share of expenditure on goods increases. This applies both domestically and internationally so countries specializing in agricultural and primary production will not profit from expanding world markets for manufactured goods.

Source: Smirzai (2012).

Kaldor's growth laws refer to a closed economy, but it is also possible to highlight the role of manufactured goods in countries' export success. Manufactured goods tend to have a higher income elasticity of demand in world trade than agricultural goods and services, and all manufactured goods are potentially tradeable. Therefore, the faster manufacturing output grows, the faster the potential growth of exports and the greater the capacity to import without running into balance of payment difficulties. Thus, a strong relationship is expected between manufacturing growth, export growth and the growth of GDP.

Inclusive and sustainable industrial development

The United Nations acknowledges the importance of industry by including the development of the industrial sector as a priority in its list of new SDGs. Specifically, SDG9 refers to: *Industry, Innovation and Infrastructure. Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation.* It could be argued that the successful implementation of SDG9 rests primarily on the full use of the expansion of the manufacturing sector to accelerate productivity growth and actively support the creation of linkages between the

most dynamic subsectors of manufacturing and the rest of the economy. However, export-led industrialization is much more difficult to achieve, as countries must meet certain conditions in a very competitive and fast-changing world economy. UNCTAD (2016) notes that "[t]o induce industrialization and productivity enhancing structural change it is not enough to expand export of manufactures; it also necessitates the development of deep and robust domestic production, learning and income linkages" (Ibid. p. 97).

The recommendation for developing countries is to not turn away from manufacturing and abandon the path of economic development through industrialization, but to strengthen their manufacturing sector. In particular, at the macroeconomic level, it is essential for the exporting sector to generate positive linkages with the rest of the economy. Only then are the necessary conditions met for inclusive manufacturing development. The Lima Declaration, adopted by UNIDO's Member States in December 2013, set the foundation for a new vision of inclusive and sustainable development (ISID). Inclusive in this context means that industrial development must include all countries and all peoples, as well as the private sector, civil society organizations, multinational development institutions and all parts of the UN system, and offer equal opportunities and an equitable distribution of the benefits of industrialization to all stakeholders.[2]

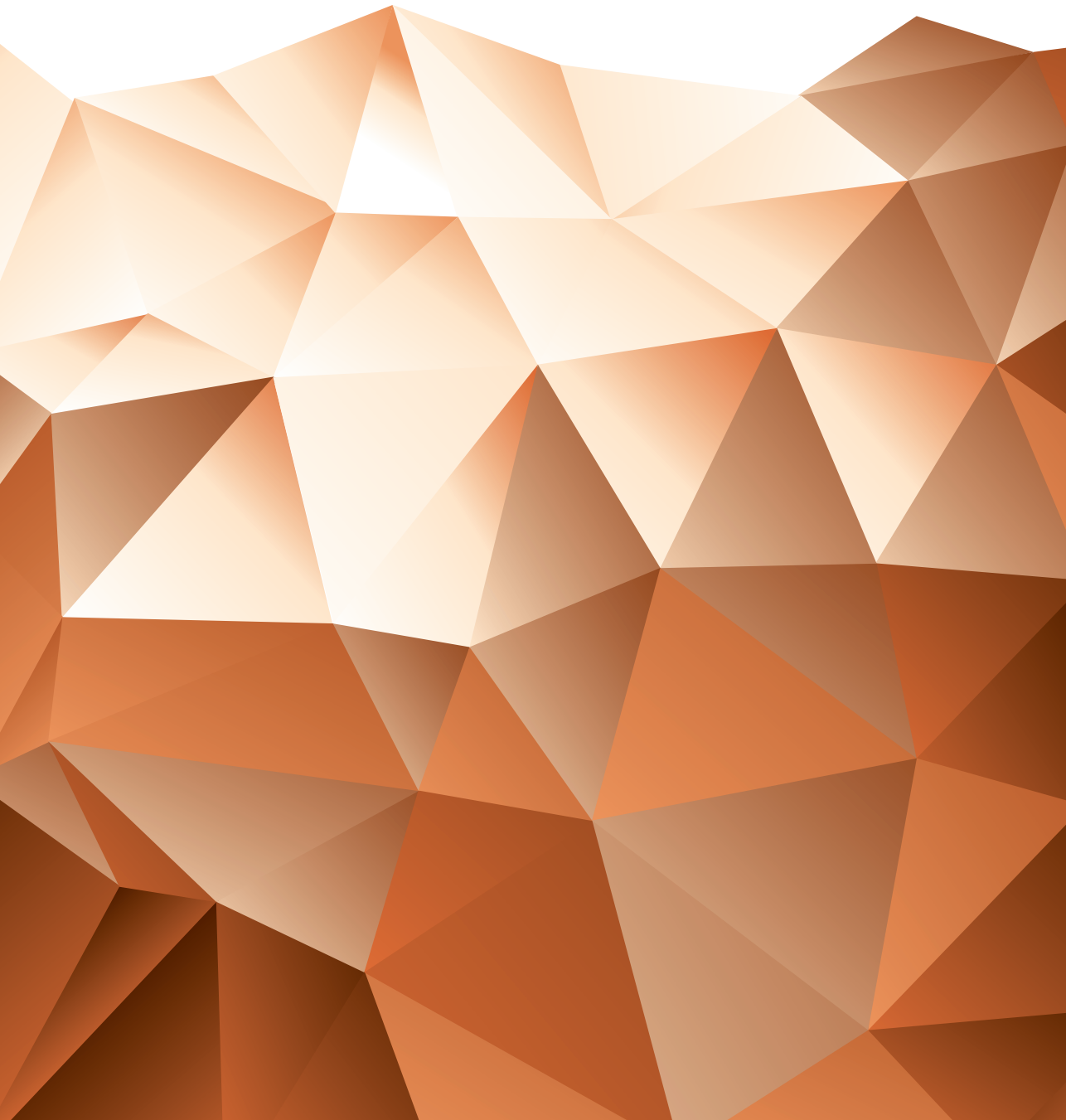
This report presents evidence of the importance of structural change in favour of manufacturing, particularly at low- and middle-income levels and discusses its policy implications. Chapter 2 summarizes the empirical evidence in relation to the engine of growth argument and discusses the empirical regularities in the patterns of change as economies grow. Chapter 3 considers issues relating to inclusion and equity. Chapter 4 addresses the environmental dimension of industrialization and shows how emissions and material use have risen as economies have grown. The experience of industrialization amongst countries classed as 'developing' 60 years ago has been very uneven, with some countries being highly successful and others much less so. Chapter 5 highlights the characteristics of a small group of successful economies. In addition, other countries in different income groups have witnessed the share of manufacturing in their economies decline. The implications of this process of 'deindustrialization' are examined in Chapter 6. Finally, Chapter 7 highlights some of the key policy issues relating to the support governments can provide to their manufacturing sector, bearing in mind the need for manufacturing development to be both inclusive and sustainable.

Notes

1. Kaldor first put forward his structural thesis of why growth rates differ between countries in his Cambridge Inaugural Lecture *Causes of the Slow Rate of Economic Growth in the United Kingdom* (Kaldor 1966) and subsequently in lectures he gave at Cornell University in 1966, published as *Strategic Factors in Economic Development* (Kaldor 1967).
2. See UNIDO's ISID operation platform https://isid.unido.org.

CHAPTER 2

PATTERNS OF MANUFACTURING DEVELOPMENT



Understanding the evolution of manufacturing

Historical data show that as economies grow, there are a number of similarities in the way in which their production structure changes, with certain activities expanding relative to others. The pattern in the development of the production structure can evolve both in terms of the balance between sectors (manufacturing, services, agriculture, mining, utilities and so forth) and in terms of intra-sectoral change (for example, in relation to different subsectors within manufacturing or between consumer and capital goods). There is no predetermined or unique path to development, and individual countries have specific features that influence the extent to which they may deviate from the general or typical pattern. Nonetheless, establishing this general pattern can inform policy since it indicates how far the structure of an economy is from the 'expected' structure, given its income level, size and other characteristics. Deviations from the general pattern can be positive if it means that the economy has specialized in high productivity dynamic activities with strong market demand. On the other hand, deviations can be negative where the economy has specialized in low productivity activities with a weak market demand.[1]

The manufacturing sector's share in GDP as income rises typically follows an inverted U-shaped path over the course of development. The per capita income at which the manufacturing sector's share reaches its peak depends on geographic and demographic conditions, other country-specific factors, as well as income level (Chenery and Syrquin 1975; Haraguchi and Rezonja 2010). Rodrik (2016) shows that manufacturing as a share of GDP peaked in western European countries, for example in Italy, Sweden and the United Kingdom, at income levels of around $14,000. He also confirms that the turning point arrives sooner and at much lower levels of income today compared to the level at which the manufacturing sector's share peaked in today's industrialized countries. Once the peak has been reached, the share of the manufacturing sector tends to decrease gradually, with the share of services in the economy rising. Such a description based on official statistics is, however, likely to conceal the increasingly interdependent nature of the development of manufacturing and the rapidly growing business-related services sector (Franke and Kalmbach 2005). The current problem is that some developing economies appear to be turning into service economies without first having fully industrialized. This is regarded as premature deindustrialization and is further discussed in Chapter 6.[2]

The previous chapter provided theoretical arguments in support of the key role ascribed to manufacturing in the process of economic development. This chapter focuses on describing the patterns in the evolution of manufacturing as a country's income changes. This type of analysis allows policymakers to 'locate' their economy relative to what might be expected given its income and other characteristics. An excessively large or excessively small manufacturing sector relative to what might be expected needs to be explained and its economic consequences assessed. Particularly at relatively low-income levels, countries with smaller than expected manufacturing sectors may be foregoing the jobs and foreign exchange earnings that a dynamic manufacturing sector can create, unless these losses can be compensated by dynamic service, agriculture or mining activities.

A brief overview of manufacturing production across the world

Table 2.1 presents the output shares of GDP by activity in different regions of the world in 2016. Generally, the richer the countries are, the lower their share of agriculture and the larger their share of services. The share of manufacturing is low in low-income countries, it is highest in upper-middle-income countries and falls again in high-income countries.

Table 2.1
The share of output in GDP by region and income, 2016

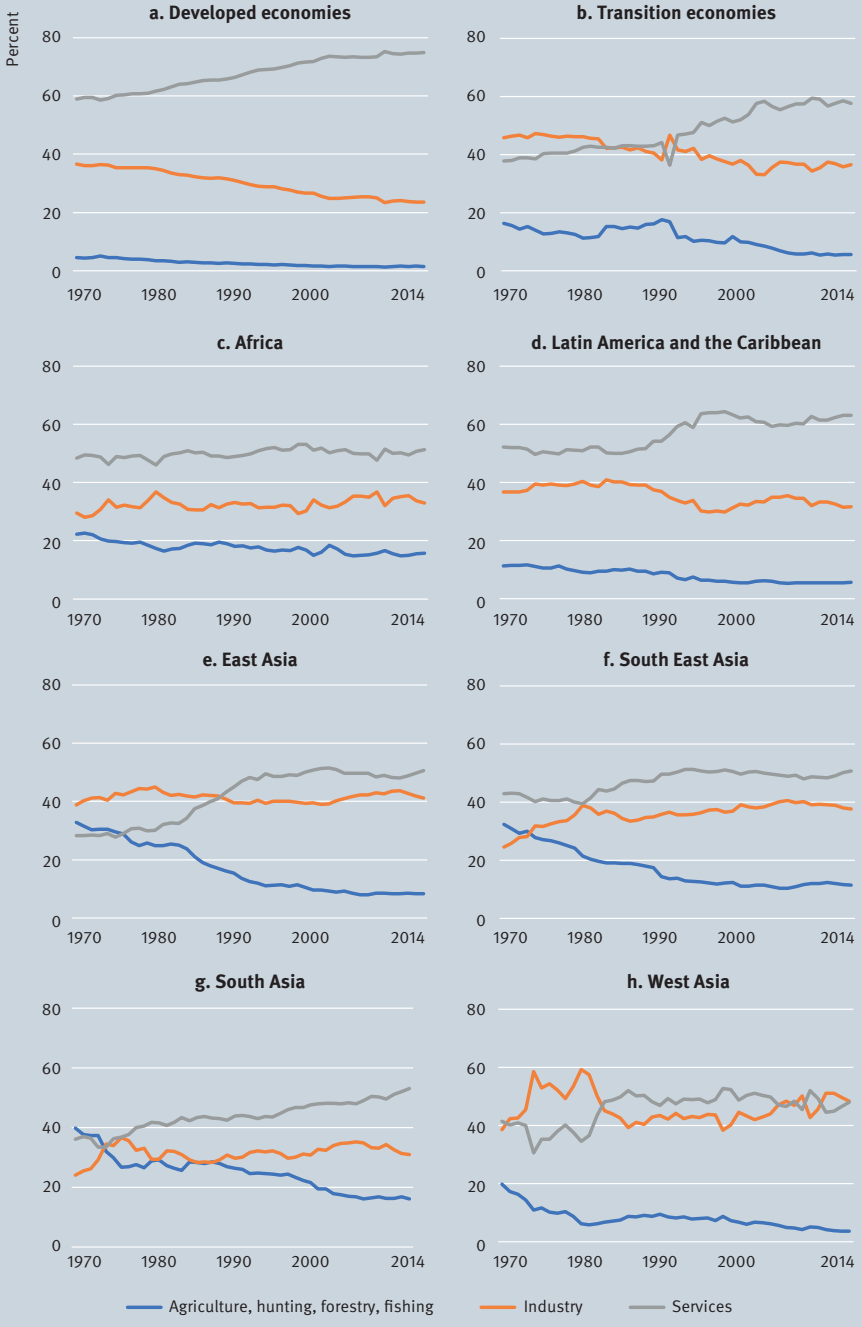
	Agriculture	Industry		Services
	Percent of GDP	Percent of GDP	Of which manufacturing's share	Percent of GDP
World	4	27	15	69
By region				
East Asia and Pacific	5	42*	32*	60
Europe and Central Asia	2	26	16	72
Latin America and the Caribbean	6	26	14	68
Middle East and North Africa	7	38	14*	53
North America	1	20	12	79
South Asia	18	28	16	54
Sub-Saharan Africa	18	24	10	58
By income				
Low-income	30	22	8	48
Lower-middle-income	17	30	16	53
Upper-middle-income	7	36*	24*	59
High-income	1	24	15	74

Note: All values for 2016 with the exception of those indicated with * which are for 2015 (in these cases, total sector shares do not add up to 100 percent). GDP is gross domestic product and in current $. Regional and income classifications are based on Appendix Tables C.1, and C.4, respectively. Economic sector classification is based on Appendix Tables C.5 and C.6.

Source: UNIDO elaboration based on World Development Indicators (World Bank 2017).

The long-term distribution of industrial production between developed and developing countries is illustrated in Figure 2.1. In developed countries, the reduction in the share of industry in GDP has been almost entirely attributable to manufacturing, whose share fell from 26 percent of GDP in 1970 to 14 percent in 2014. The transition economies and Latin America experienced a similar trend of deindustrialization, with the share of services rising relative to that of other sectors. In Asia, agriculture accounted for a significant share of GDP in 1970 at slightly more than 30 percent in East and South-East Asia, 40 percent in South Asia and 20 percent in West Asia. By 2014, the share of agriculture had declined by between 25 percent and 15 percentage points in these areas, with the main counterpart being an increase in the share of services. In West Asia, the share of industry has remained high and relatively unchanged, whilst Africa has seen relatively little structural change.

Figure 2.1
Share of economic sectors in total value added by country group, 1970-2014



Note: All values in current $. Country group classification based on UNCTADStat (2017).

Source: UNCTAD (2016), UNCTAD/TDR/2016, based on the UNCTADstat database, http://unctadstat.unctad.org.

Figure 2.1 does not distinguish between industry and manufacturing. As a complement to Figure 2.1, Table 2.2 provides two indicators of long-term change in global manufacturing activity for a different categorization of regions for six years (1970, 1980, 1990, 2000, 2010 and 2013). The top panel shows the global distribution of manufacturing output, while the lower panel presents the shares of manufacturing value added in GDP. Two conclusions stand out. First, there has been a significant relocation of manufacturing from the wealthier countries (the United States and Western Europe) to Asia, specifically China. Second, the share of manufacturing in GDP has moved differently in different regions, and not always in a manner that would have been expected a priori. Some middle- or low-income regions (Latin America and sub-Saharan Africa) have deindustrialized, while the United States—a high-income country—has avoided this fate (Rodrik 2016). In the United States, however, deindustrialization post-1970 is found in the declining share of manufacturing in total employment (see Chapter 6).

Table 2.2
Indicators of global manufacturing activity

	World	Asia (excl. China)	China	Latin America and the Caribbean	Sub-Saharan Africa	United States	Western Europe	Other
Share in global manufacturing value added								
1970	1.00	0.15	0.00	0.06	0.01	0.26	0.24	0.27
1980	1.00	0.18	0.01	0.08	0.01	0.22	0.21	0.29
1990	1.00	0.24	0.02	0.06	0.01	0.21	0.19	0.26
2000	1.00	0.24	0.06	0.07	0.01	0.24	0.16	0.22
2010	1.00	0.26	0.16	0.06	0.01	0.20	0.13	0.18
2013	1.00	0.26	0.18	0.06	0.01	0.19	0.13	0.17
Manufacturing value added share in GDP								
1970	0.17	0.16	0.09	0.20	0.14	0.13	0.22	
1980	0.16	0.16	0.16	0.20	0.15	0.12	0.20	
1990	0.16	0.19	0.18	0.19	0.15	0.12	0.19	
2000	0.17	0.19	0.29	0.19	0.13	0.13	0.18	
2010	0.18	0.21	0.36	0.17	0.11	0.13	0.18	
2013	0.18	0.20	0.36	0.16	0.11	0.13	0.18	

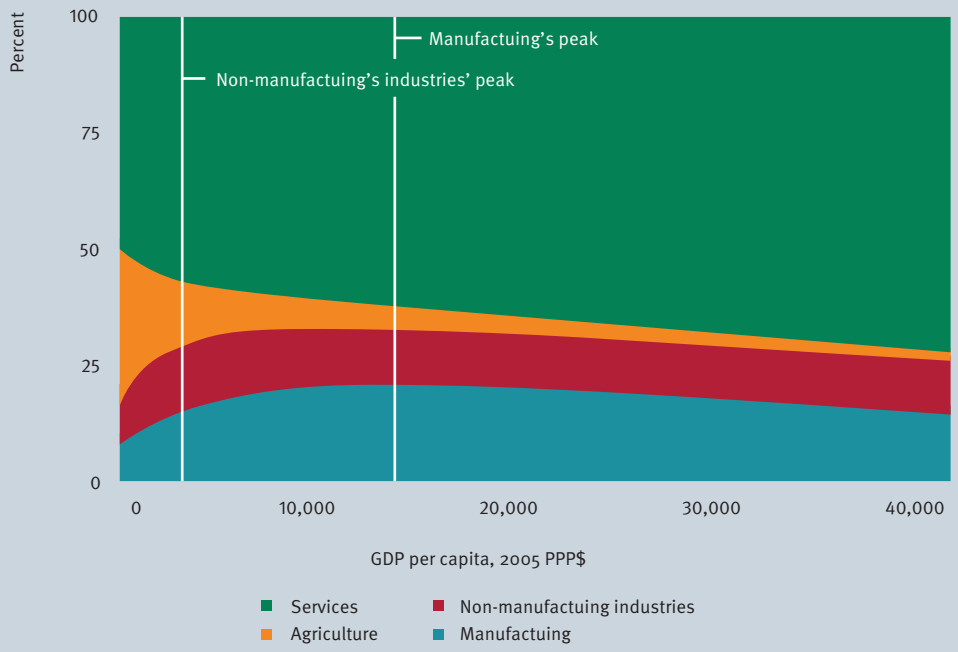
Note: All values are in 2005 constant $. GDP is gross domestic product. Manufacturing is grouped under the aggregate "Mining, Manufacturing, Utilities" in accordance with the International Standard Industrial Classification codes C-E (ISIC, Rev. 3); see Appendix Tables C.5. As the UNSD (2015) database on which the table is based does not provide pre-2005 data for China, values for the country have been imputed by backward extrapolation of the manufacturing share in this aggregate. Regional classification is based on the UNSD's (n.d.) geographic groupings, which, besides Western Europe, is aligned with Appendix C.1. Western Europe refers to Austria, Belgium, France, Germany, Liechtenstein, Luxembourg, Monaco, the Netherlands and Switzerland.

Source: Journal of Economic Growth, 'Premature Deindustrialization', 21, 2015, p.5, D. Rodrik,
© Springer Science+Business Media New York 2015. With permission of Springer. Calculations are based on the National Accounts Main Aggregates Database, by the United Nations Statistics Division, ©2015 United Nations. Reprinted with the permission of the United Nations.

As noted above, as a country's income rises, the share of different sectors in GDP changes. The classic work in this area by Chenery and Syrquin (1975) argues that a country's structural change depends on a combination of the effect of 'universal' factors that are related to its level of income[3], plus the effect of country factors, some of which, such as country size or natural resource endowment, the government has little or no control over, plus others related to policies and institutions which the government can influence.

Figure 2.2 presents estimated patterns of structural change across income levels based on panel data of 100 countries from 1963 to 2007. As countries develop, the share of agriculture declines quite rapidly, while that of the other sectors increases. At low- and lower-middle-income levels, in particular, the share of manufacturing increases rapidly, thus contributing disproportionately to economic development at a relatively early stage of development.[4] However, the increase in manufacturing share slows in the upper-middle-income stage and reaches its peak (blue vertical line) before the country moves to a high income level.

Figure 2.2
An economy's share of manufacturing peaks before it reaches high income levels



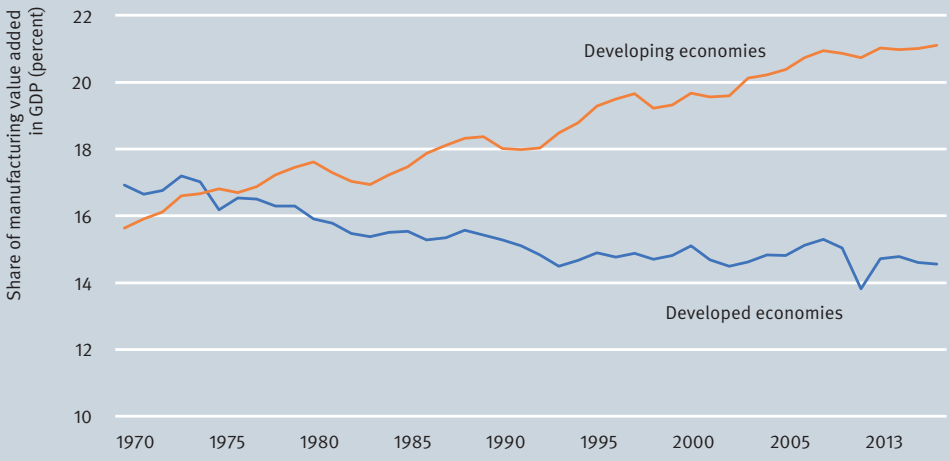
Note: All values are for the period 1963-2007, in constant prices and represent pooled data for 100 countries. GDP is gross domestic product and PPP is purchasing power parity. Manufacturing and non-manufacturing industries are comprised in accordance with the International Standard Industrial Classification codes D and C, E, respectively, (ISIC, Rev. 3); see Appendix Tables C.4 and C.5.

Source: UNIDO (2013) based on Penn World Tables 6.3 (Heston et al. 2009) and World Development Indicators (World Bank 2013).

Furthermore, the relationship between the manufacturing share in GDP and income per capita has been changing over time, with a clear tendency for the manufacturing share to decline for a given income per capita. The downward shift in the curve relating manufacturing value added in GDP to GDP per capita is confirmed in numerous studies (Dasgupta and Singh 2006, Ghani and O'Connell 2014, Haraguchi et al. 2017, Palma 2007, Rodrik 2016).

The share of manufacturing value added in GDP is illustrated in Figure 2.3 for 178 countries over the period 1970-2013, divided into developed and developing countries.[5] Developing countries show a rising trend over the 43-year period. By contrast, the share in developed countries decreased until 1993 and has remained constant since.[6] This confirms that the importance of manufacturing in developing countries as a group is rising, not decreasing, relative to other sectors. However, the weighted aggregate figure masks the fact that in the last 20 years, manufacturing production has been increasingly concentrated in a small number of large countries, particularly in China. In 2014, China contributed 18.4 percent of world manufacturing value added and was the second largest manufacturing producer following the United States (UNIDO 2015). Nonetheless, the expectation is that in the future, as those countries that have experienced a rise in manufacturing share in recent years move to a more mature stage of industrialization, they are likely to follow the same development path as the current high-income countries and to find their manufacturing share will start declining. When that happens, there will be greater opportunities for manufacturing development in the current lower-middle- and low-income countries, so that industrialization will retain the same relevance for these 'follower' economies which it had for others in previous decades.

Figure 2.3
The importance of manufacturing in economic development has not changed – but it is concentrated in fewer countries



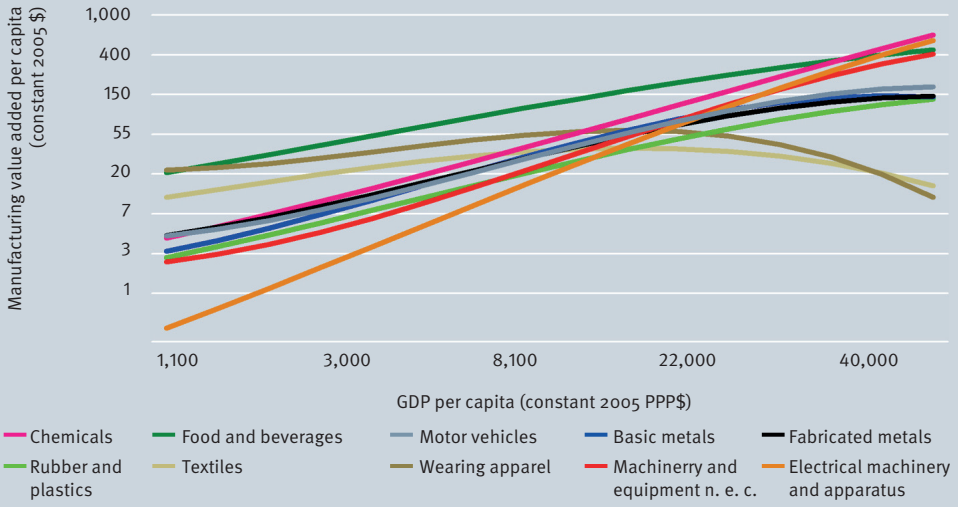
Note: All values are in constant 2005 $. GDP is gross domestic product. Income classification is based on Haraguchi et al. (2017) The group of develpoing countries excludes Ethiopia, Sudan, the USSR, Yemen and Yugoslavia, and their merged or separated countries.

Source: Haraguchi et al. (2016) based on the National Accounts Main Aggregates Database, by the United Nations Statistics Division, ©2015 United Nations. Reprinted with the permission of the United Nations.

Structural change within the manufacturing sector

As incomes rise, structural change occurs within as well as between sectors. Figure 2.4 presents the estimated patterns of structural change within the manufacturing sector, illustrating how ten major manufacturing industries or subsectors (based on the International Standard Industrial Classification (ISIC) Rev. 3 at the two-digit level) develop at different incomes. The vertical lines separate four development stages which represent distinct manufacturing structures. In the first stage at very low income levels, there are three industries that dominate the manufacturing sector: food and beverages, textiles and wearing apparel. These industries are closely related to basic human needs. In this 'early' stage of industrialization, labour-intensive industries[7] clearly have a high development potential in terms of value added and employment.

Figure 2.4
High economic potential of labour-intensive industries at early stages of economic development



Note: All values are for the period 1963–2013. GDP is gross domestic product, PPP is purchasing power parity and n.e.c. is not elsewhere classified. See manufacturing sector classification in Appendix Table C.6.

Source: UNIDO elaboration based on Haraguchi (2015) and Penn World Tables 7.1 (Heston et al. 2012).

The ebb and flow of labour-intensive and capital-intensive industries becomes apparent in the second stage of development. The slowdown of labour-intensive industries becomes increasingly noticeable as the manufacturing structure gradually shifts from a labour-intensive to capital-intensive orientation. By the time countries reach around $10,000 GDP per capita, many capital-intensive industries start surpassing the value-added levels of the textiles and wearing apparel industries. In the third stage, capital-intensive industries assume a dominant position in terms of output. These industries, which include resource-processing industries such as basic and fabricated metals, as well as those that make use of such processed materials to produce final products (including electrical machinery and motor vehicles), experience rapid growth. The difference between the growth rates of capital-intensive and labour-intensive industries becomes increasingly apparent in this stage.

In the final stage at very high income levels, the growth of labour-intensive industries—with the exception of food and beverages—declines, and even some capital-intensive industries, such as resource processing, begin experiencing a declining growth rate. Those industries that tend to sustain fast growth in terms of value added are the chemicals, machinery and equipment and electrical machinery and apparatus industries.

The stages of development (defined by the income at which their share in GDP reaches a peak) of 18 manufacturing industries for which data are available are listed in Table 2.3. The early industries are mostly those which are relatively labour-intensive or oriented towards the domestic market. The middle industries include those that process natural resources to produce material inputs for other manufacturing industries. The late industries tend to be technology- and knowledge-intensive and, except for rubber and plastics, tend to produce capital or consumption goods for final use by firms or households.

Table 2.3
Development stages of manufacturing industries

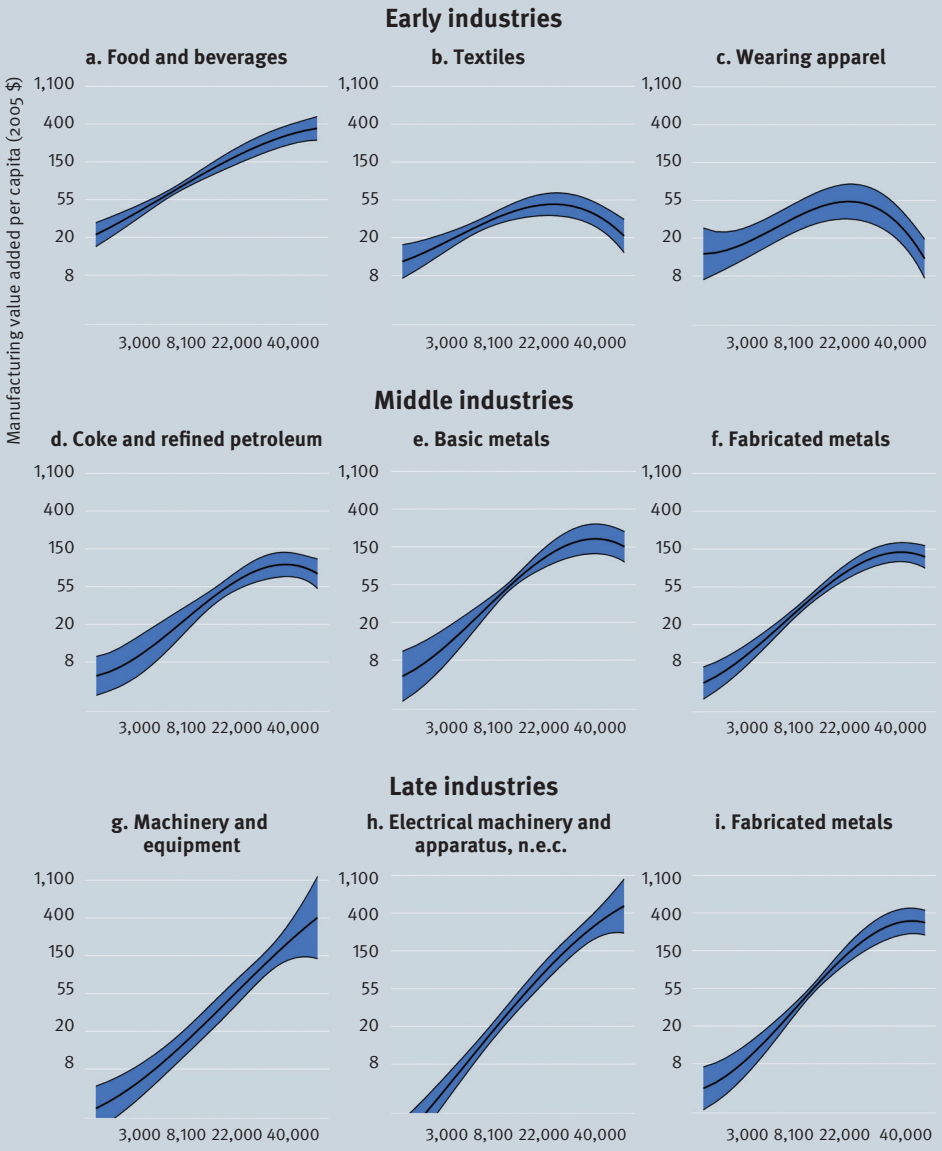
Stage	Industry
Early	Food and beverages; tobacco; textiles; wearing apparel; wood products; publishing; furniture; non-metallic minerals
Middle	Coke and refined petroleum; paper; basic metals; fabricated metals
Late	Rubber and plastics; motor vehicles; chemicals; machinery and equipment; electrical machinery and apparatus; precision instruments

Note: Industries are classified into early, middle and late industries if an industry's share in GDP (gross domestic product) is estimated to peak before $6,500 GDP per capita at constant 2005 PPP$, between $6,500 and $15,000, and after $15,000, respectively. Within each classification, industries are listed income ranges correspond to the income classifications in Appendix Table C.4. See manufacturing sector classification in Appendix Table C.6.

Source: Haraguchi (2015).

The relationship between value added in an industry and a country's income per capita can be established for a sample of countries. Figure 2.5 provides estimated curves for the development patterns of nine manufacturing industries, taken as representative of the three categories early, middle and late (Haraguchi 2016). However, countries face different challenges and risks in accordance with the characteristics of the industries and their own specific characteristics. Hence, there will be a tendency for countries to deviate from the estimated regression line, with greater variations for certain industries and at different income levels. Figure 2.5 shows the estimated patterns with 95 percent confidence intervals. It indicates that there are large differences between the performance of countries in the early industries textiles and wearing apparel, which have wide confidence intervals around the estimated lines, indicating a high level of variation with respect to the development of these industries. This suggests that with specialization in these activities, the risk countries face is relatively high in the early stages of development. For the middle and late industries examined, there is a relatively high level of variance in the early and mature stages of development. As seen in Figure 2.5, their confidence intervals are wider at the lower and higher ends of the income scale, with a narrower interval at the middle-income level. This suggests that at low incomes, when industrialization is in its initial stages, country-specific conditions tend to have a significant influence over industrial development, leading to a wider variance in performance between countries. However, once the industrial sector has moved beyond an initial early stage and has accumulated experience, the difference in performance between countries at the same income level narrows.

Figure 2.5
Country-specific conditions have a significant influence over industrial development at early stages of industrialization



Note: All values are for the period 1963-2010 and are based on a sample of large economies only, i.e. countries with 12.5 million inhabitants or more (Haraguchi 2015). The confidence intervals, indicated with blue, represent variation vis-à-vis average performance within each industry. The development stage of industries is defined in Table 2.3. n.e.c. is not elsewhere classified. Manufacturing sector classification is based on Appendix Table C.6.

Source: UNIDO elaboration based on Haraguchi (2015) and Penn World Tables 7.1 (Heston et al. 2012).

As countries approach the end of the upper-middle-income stage (at around $15,000 GDP per capita in terms of PPP in 2005 constant prices), they again exhibit wider differences in performance. The greater uncertainty in manufacturing development from the upper-middle-income level

onwards may be attributed to the fact that countries graduate from development based on the acquisition of existing technologies from advanced countries and move to a stage where they have to take more risks in generating knowledge and technology themselves to compete directly with technology leaders (Lee 2013). At higher incomes, countries that foster successful inventions and innovations can sustain high growth rates of some manufacturing industries, such as the machinery and equipment and electrical machinery and apparatus industries, as indicated by the upper-bound of their confidence intervals. Continued growth of these industries will be important to prevent premature deindustrialization, to promote technological development and to generate employment in manufacturing as well as in related service industries.

Table 2.4
Share of industry in total employment by regions, 1970-2014

	1970	1980	1990	2000-2007	2010-2014
By industrialization level					
Developed economies	36.3	35.4	31.3	26.9	23.9
Transition economies	–	–	29.7	18.2	23.0
By region					
East Asia	18.4	29.5	34.7	28.1	25.3
China	10.2	18.2	21.4	23.3	29.1
Republic of Korea	18.0	29.6	35.7	27.2	25.1
Latin America and the Caribbean	23.8	24.4	25.2	21.8	21.2
Argentina	33.7	33.8	26.2	19.8	22.7
Brazil	21.3	22.8	22.8	19.5	21.7
Chile	29.7	28.2	28.4	22.8	22.7
Mexico	24.2	28.0	28.6	27.1	25.4
North Africa	18.8	25.3	27.1	24.1	28.5
South Asia	12.7	14.0	16.7	19.5	22.8
India	11.6	11.0	13.2	18.3	21.9
South East Asia	15.1	19.9	21.9	23.5	21.8
Indonesia	10.0	13.3	17.0	18.4	19.9
Malaysia	15.4	21.4	25.6	32.5	28.2
Philippines	16.2	16.4	15.8	15.8	15.2
Thailand	7.0	10.8	13.6	19.8	20.6
Sub-Saharan Africa	10.3	12.7	13.8	13.1	16.1
South Africa	28.6	32.0	30.1	22.8	22.7
West Asia	17.7	23.3	23.1	23.3	24.9

Note: Regional values correspond to unweighted averages. Manufacturing is comprised in accordance with codes C-E of the International Standard Industrial Classification (ISIC, Rev. 3) see Appendix Tables C.5. Country classification is based on UNCTADStat (2017).

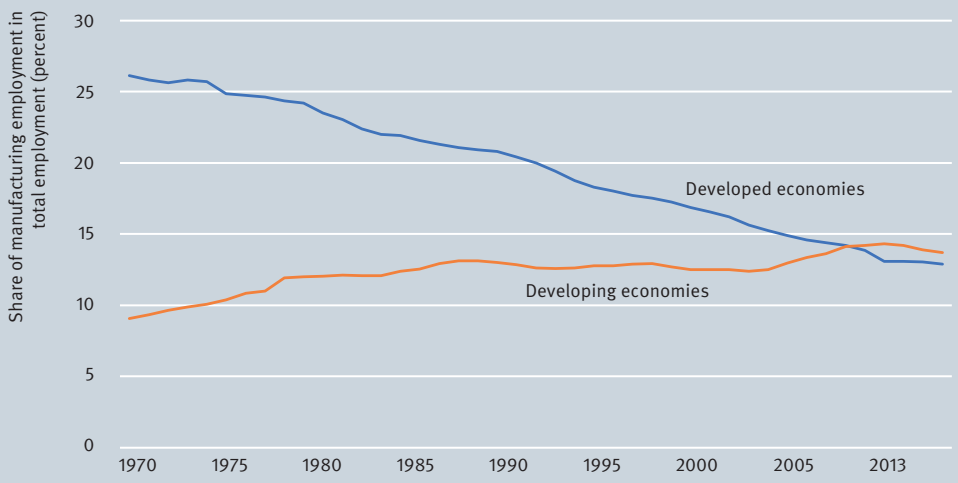
Source: UNCTAD (2016), UNCTAD/TDR/2016, based on the World Development Indicators (World Bank 2016), Total Economy Database, @ 2017 The Conference Board, Inc. Content reproduced with permission, Groningen Growth and Development Centre 10 Sector Database (Timmer et al. 2015), Key Indicators of the Labour Market (ILO 2016) and the National Accounts Main Aggregates Database, by the United Nations Statistics Division, ©2015 United Nations. Reprinted with the permission of the United Nations.

Refuting the myth of shrinking world manufacturing employment

Table 2.4 shows that since 1970, the majority of developing regions have experienced a considerable increase in the share of industrial employment in total employment. The share of industrial employment in China has increased almost three-fold and has doubled in India. The share in Latin America and the Caribbean has remained virtually stable. In most regions, except sub-Saharan Africa, industry accounts for 20 percent to 30 percent of total employment. However, for many countries, this has been attributable to the construction or mining industries rather than to manufacturing.

As a group, developed countries have substantially reduced their share of manufacturing in total employment in recent decades (Figure 2.6). This is not surprising as countries at high income levels usually experience deindustrialization, with reduced numbers of manufacturing jobs as part of the expected pattern of economic development. For developing countries, on the other hand, the share of manufacturing in their total employment has increased continually since 1970. Overall, the aggregate share of world manufacturing employment in total world employment (including in both developed and developing countries) has barely changed since 1970 (Felipe et al. 2014). However, as with the value-added share shown in Figure 2.3, there has been a concentration of manufacturing employment in a small number of large countries, most notably in China.

Figure 2.6
The aggregate share of manufacturing employment in developing economies has been on the rise since 1970

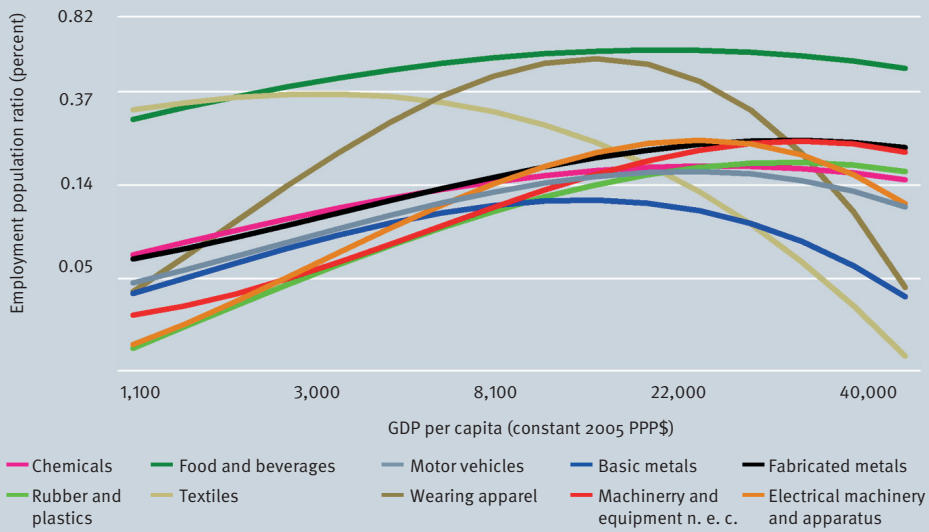


Note: Income classification is based on Haraguchi et al. (2017). The group of develpoing countries excludes Ethiopia, Sudan, the USSR, Yemen and Yugoslavia, and their merged or separated countries.

Source: Haraguchi et al. (2016) based on Groningen Growth and Development Centre 10 Sector Database 2007 (Timmer and de Vries 2007; van Ark 1996), Africa Sector Database (de Vries et al. 2013), World Input-Output Database, 2013 Release (Timmer et al. 2015), ILOSTAT (2017), Key Indicators of the Labour Market (ILO 2017) and Timmer et al. (2016).

Figure 2.7 shows employment (as a percentage of total population) across ten manufacturing subsectors as income changes. Food and beverages and textiles and wearing apparel are the three major sources of manufacturing employment, with no other industries coming close to the peak employment of these industries at any income level. Food and beverages is a major and stable source of employment for all countries across all income levels. Textiles creates more jobs at a lower income level than does wearing apparel. Unlike in other industries, the proportion of the population's employment in textiles and wearing apparel falls relatively rapidly once the peak employment level is passed. As expected, industries categorized as late industries in Table 2.3 (such as motor vehicles) reach their peak employment levels at a relatively high-income level, with their peak employment as a proportion of the population well below that of the early labour-intensive industries.

Figure 2.7
'Late' industries reach peak employment levels at a relatively high income level



Note: All values are for the period 1963-2010. GDP is gross domestic product, PPP is purchasing power parity and n.e.c. is not elsewhere classified. Employment population ratio is calculated as the share of employment in the population. See manufacturing sector classification in Appendix Table C.6.

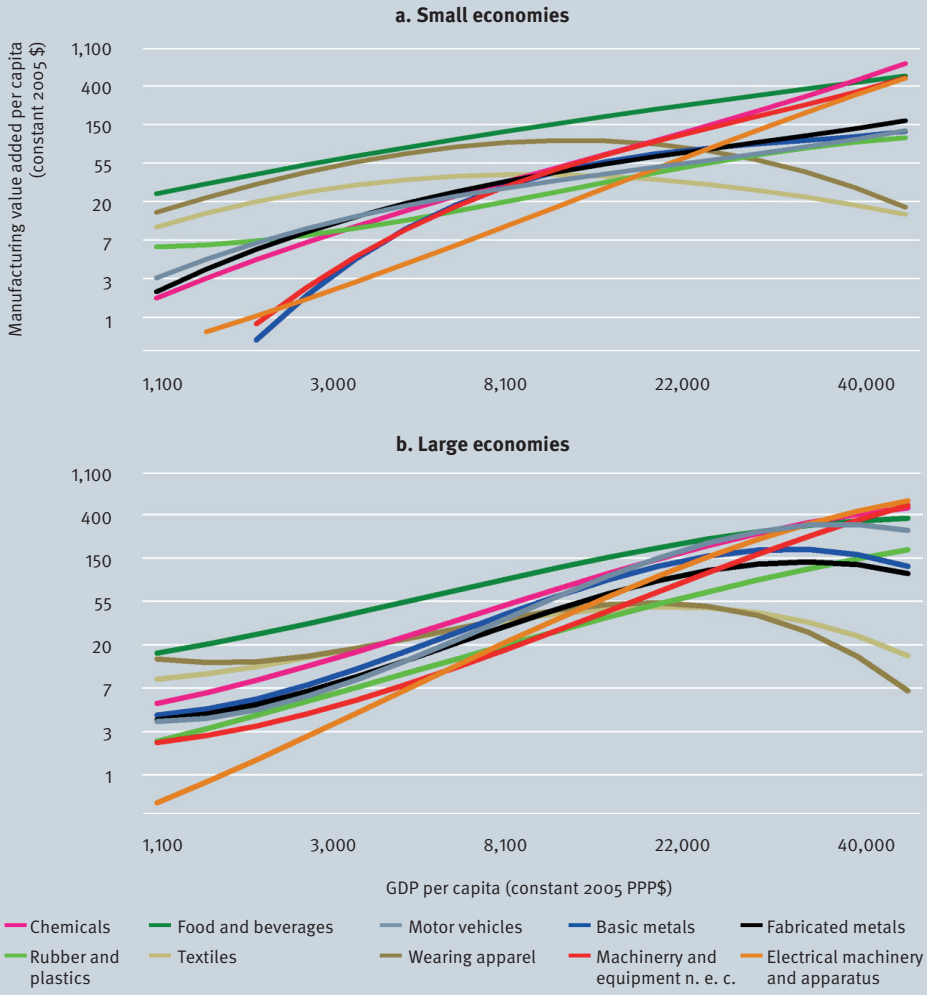
Source: UNIDO elaboration based on Haraguchi (2015) and Penn World Tables 7.1 (Heston et al. 2012).

The effects of country-specific conditions on manufacturing structural change

Past studies acknowledge that country size can have a strong influence on the pace and direction of structural change, as the size of the market is crucial for reaching economies of scale (Chenery and Taylor 1968, Haraguchi and Rezonja 2011). To separate the effect of size in our analysis, countries are classified as 'small' and 'large', using a population threshold of 12.5 million as the dividing lines (see Haraguchi [2016] for details on the methodology). The main patterns are broadly similar in both groups (see Figure 2.8). Labour-intensive industries

develop at a relatively early stage and capital-intensive ones surpass the value-added per capita levels of labour-intensive industries at around $8,000-$10,000 GDP per capita. The main difference between large and small countries is that labour-intensive industries—principally textiles and wearing apparel—tend to develop earlier in small countries. Once they reach their peak levels of output, their value-added per capita tends to decline fairly rapidly. In addition, at higher incomes, the growth rates of industries vary far more in small countries than in large

Figure 2.8
Labor-intensive industries develop earlier in small economies – otherwise, the patterns of structural change are fairly similar to those of large economies



Note: All values are for the period 1963-2010. GDP is gross domestic product, PPP is purchasing parity and n.e.c. is not elsewhere classified. The estimation sample comprises large economies. Country classification is based on Haraguchi (2015), who defines large economies as having 12.5 million inhabitants or more and small economies as having less than that. See manufacturing sector classification in Appendix Table C.6.

Source: UNIDO elaboration based on Haraguchi (2015) and Penn World Tables 7.1 (Heston et al. 2012).

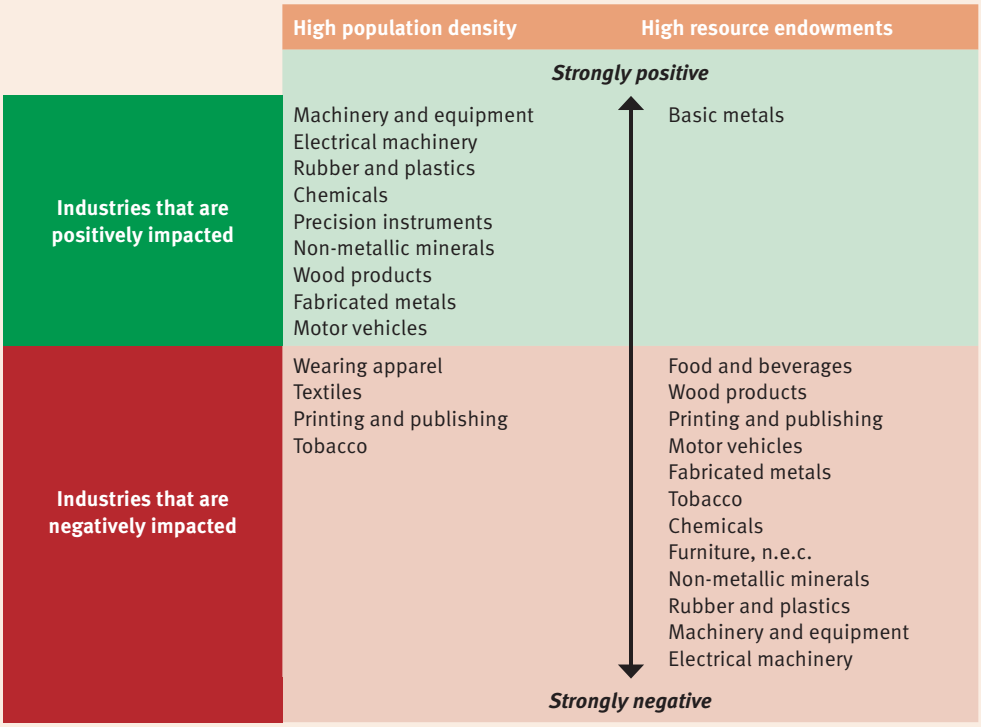
ones, as small countries need to specialize more and have a less broadly-based manufacturing structure.

Population density plays an important role for patterns of trade and development (Keesing and Sherk 1971). Densely populated areas appear to have a relatively high ratio of manufactured to primary exports, indicating that demographic conditions might affect the pattern of manufacturing development. Population density here is measured by the division of of a country's population size by its total area. The negative impact of natural resource abundance on industrialization is well documented. A country's natural resource endowments affect the pattern of industrialization through two related factors. First, countries focus on industrialization because they need to find an alternative export base due to their lack of natural resources (Chenery and Syrquin 1975). This explains why resource-poor countries are more likely to specialize in manufacturing than resource-rich countries. Second, the 'natural resource curse' or 'Dutch disease' arguments may explain why natural resource-rich countries tend to have a lower level of manufacturing development. This is due to the cost disadvantage for tradable, typically manufactured, goods created by the rise in domestic input prices and wages, driven by the demand created by the natural resources sector and its impact on the real exchange rate (Sachs and Warner 2001).

Figure 2.9 shows the effects of high population density (upper left square) and high natural resource endowments (upper right square) on manufacturing development.[8] The industries for which these conditions have positive (negative) effects are listed in the upper (lower) squares of the table. For both squares of population density and natural resources, the order in which industries are listed starts from those which are most positively affected to those which are most negatively affected by the given conditions.[9] High population density tends to have a positive effect on manufacturing development, especially for capital and technology-intensive industries, while a high natural resource endowment tends to have the opposite negative effect, both on manufacturing development, in general, and on capital- and technology-intensive industries, in particular. This result suggests that densely populated countries possess agglomeration advantages which would be especially conducive to the development of industries that involve relatively complex and lengthy production processes and supply chains, such as machinery and equipment and electrical machinery. As expected, high natural resource endowments have a negative impact on the majority of manufacturing industries. The negative impacts are especially strong on industries that require a higher level of processing.

Country-specific effects are related to institutions, history and policies, which generate systematic and consistent differences in the potential levels of manufacturing development across countries over a long period of time. If country-specific effects have an influence on the potential level of manufacturing development, they may have a greater impact on certain subsectors of manufacturing than on others.[10] Table 2.5 classifies countries that reported data for at least 12 industries into three groups, based on whether their performance across different manufacturing industries was consistently favourable or not. It is significant that 60 percent of the countries have a consistent performance, either an above or below average performance relative to their peers (defined by similar country size and income level) across most manufacturing industries. These general factors can include political stability, macroeconomic stability, quality of infrastructure and factor prices relative to other countries with a similar GDP per capita.

Figure 2.9
Potential agglomeration advantages in densely populated countries, especially for capital and technology-intensive industries



Note: n.e.c. is not elsewhere classified. See manufacturing sector classification in Appendix Table C.6.

Source: UNIDO elaboration based on Haraguchi (2015) and Penn World Tables 7.1 (Heston et al. 2012).

Table 2.5
Consistency of manufacturing performance

1. Consistently high performance across most manufacturing industries	Brazil, Czechia, Canada, Denmark, France, Finland, Germany, Iceland, Ireland, Israel, Italy, Japan, Netherlands, Norway, Republic of Korea, Singapore, Slovenia, Spain, Sweden, United Kingdom, United States
2. Consistently low performance across most manufacturing industries	Azerbaijan, Egypt, Ethiopia, Former Yugoslav Republic of Macedonia, Georgia, India, Indonesia, Islamic Republic of Iran, Kenya, Kyrgyzstan, Mauritius, Mongolia, Oman, Philippines, Republic of Moldova, Senegal, Turkey, Yemen
3. Differences in performance depending on industry	Australia, Bulgaria, China, Colombia, Costa Rica, Cyprus, Estonia, Greece, Hungary, Jordan, Kuwait, Latvia, Lithuania, Malaysia, Mexico, Morocco, Peru, Poland, Portugal, Qatar, Romania, Russian Federation, Serbia, Slovakia, South Africa, Sri Lanka, Trinidad and Tobago, Uruguay

Note: Countries that had data to calculate the fixed effects for more than 12 industries are included. In case countries have a higher than average performance of over 80 per cent of their reported industries, they are assigned to the first category in the table. Countries that have a lower performance than large countries' average for over 80 per cent of their reported industries are assigned to the second category. Countries that cannot be assigned to either of the above are placed in the third category.

Source: Haraguchi (2015)

To confirm the effects of a country's general conditions on manufacturing industries, regressions can be run to determine the relationship between the size of country fixed effects (from cross-country regressions) and factors impacting on industrial development, which seem to remain unchanged for a fairly long period. The results in Table 2.6 confirm that factors that shape the general business climate, such as the level of unit labour cost and measures of the rule of law, mostly have negative and positive effects, respectively, across all manufacturing industries. This provides support for the widely held view that significant benefits are to be obtained in improving the general business climate and institutional environment prior to embarking on any policies to support specific manufacturing industries, especially in countries with a very low level of manufacturing development. In addition, a measure of road quality is positive and significant, as expected, which can be interpreted to mean that infrastructure quality also plays an important role in manufacturing development.

Table 2.6
Correlations between country fixed effects and business conditions

Industry	Unit labour cost		Rule of law	
Basic metals	0,0524	(0.2000)	0,4894	(8.2700)
Chemicals	-0,5029	(-3.3300)	0,3282	(6.1500)
Electrical machinery and apparatus	-0,1095	(-0.4500)	0,3746	(5.4000)
Fabricated metals	-0,1526	(-2.9500)	0,4167	(8.0100)
Food and beverages	-0,1083	(-0.3100)	0,2599	(3.8800)
Motor vehicles	-0,0743	(-0.3500)	0,3427	(5.2700)
Textiles	-0,4336	(-3.7500)	0,3387	(6.4400)
Wearing apparel	-0,5886	(-3.5400)	0,2195	(3.5400)

Note: All values are for the period 1963-2010. The dependent variable in the regression is country fixed effects. The numbers in parentheses are t-values. Unit labour costs were calculated based on nominal wages divided by real value added. The variables for the rule of law and road conditions are based on the Worldwide Governance Indicators and the World Development Indicators of the World Bank, respectively. See manufacturing sector classification in Appendix Table C.6.

Source: UNIDO elaboration based on Haraguchi (2015) and Penn World Tables 7.1 (Heston et al. 2012).

On the speed of structural change

The speed of an industry's development is crucial for manufacturing upgrading and structural change. The pace of structural change depends on the time at which industrialization takes place. Romano and Traù (2017) argue that for late industrializing countries, the intra- and inter-sectoral structural adjustments have been significantly faster compared to those experienced by countries that built their manufacturing base in earlier periods.

Different industries tend to emerge at different income levels. As discussed above, labour-intensive, low-tech industries such as food and beverages and the wearing apparel industries, are major manufacturing industries for low-income countries, whereas, capital-intensive and technologically sophisticated industries, such as electrical machinery and apparatus and motor vehicles, are usually important in high-income countries. As countries move across

patterns of manufacturing development associated with different income levels—as tracked in Figure 2.4—it is important to move into activities that can be produced competitively and which offer the prospect of both rapid growth and high value-added production.

Table 2.7 illustrates the speed of manufacturing development in Malaysia, the Republic of Korea and Sri Lanka. Speed is measured as the increase in value added per capita divided by the number of years for the country to move across the range of GDP per capita from $3,000 to $4,500. The analysis uses this income range because different income ranges are associated with different growth rates, and this is the range in which the observations of the three countries overlap. Over the same income range, eight manufacturing industries each developed much faster in the Republic of Korea than in Malaysia and Sri Lanka. In addition, five out of the eight industries developed faster in Malaysia than in Sri Lanka. The pace at which a country develops at a given income level reflects country-specific effects, and the comparison illustrates the dynamism of the case of the Republic of Korea, and to a lesser extent that of Malaysia.

Table 2.7
Speed of manufacturing development in Malaysia, Republic of Korea and Sri Lanka

Industry	Malaysia	Republic of Korea	Sri Lanka
Basic metals	0.53	6.33	0.34
Chemicals	1.69	4.05	3.04
Electrical machinery and apparatus	0.77	8.10	0.42
Fabricated metals	0.29	11.51	0.04
Food and beverages	1.49	5.26	3.03
Motor vehicles	0.61	4.97	0.02
Textiles	0.70	21.47	0.43
Wearing apparel	1.40	42.97	1.81

Note: All values are for the period 1963-2010. Speed is expressed as an increase in value added per capita divided by the number of years taken over the range of GDP per capita from $ 3,000 to $ 4,500. The analysis uses this income range because different income ranges are associated with different growth rates, which allows us to look at the range in which the observations of the three countries overlap. The Republic of Korea, Malaysia and Sri Lanka were selected as examples because they belong to the group of large countries and have a relatively long time-series of data to allow for assessment of their development trajectories. See manufacturing sector classification in Appendix Table C.6.

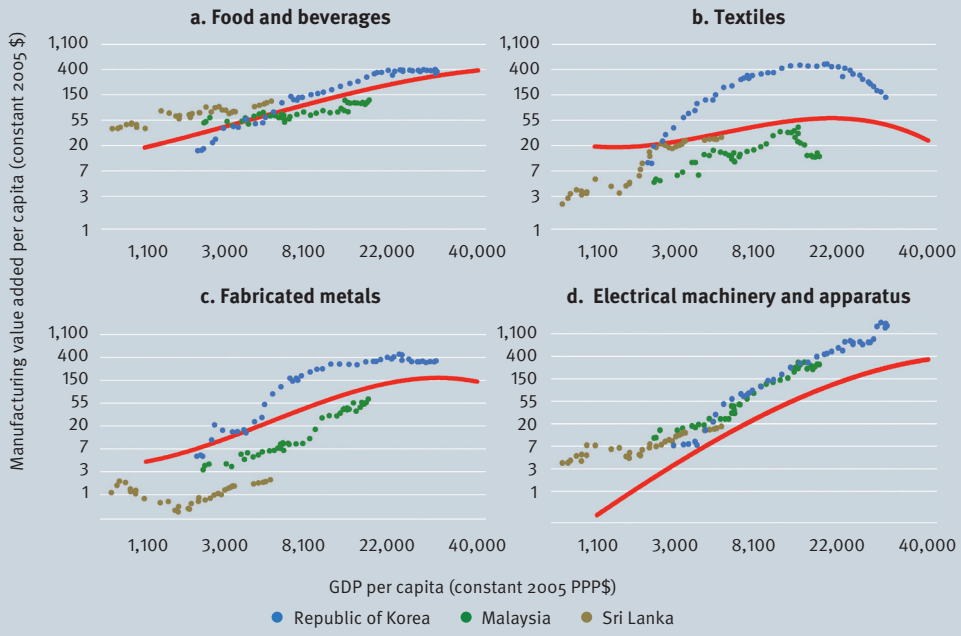
Source: UNIDO elaboration based on Haraguchi (2015) and Penn World Tables 7.1 (Heston et al. 2012).

Figure 2.10 illustrates the development trajectories in four industries–food and beverages, textiles, fabricated metals and electrical machinery and apparatus. The general pattern for the large country sub-sample is given by the solid red line. For the income range $3,000-$4,500, the Republic of Korea, is always above the line indicating a higher than expected value added at a given income level. Malaysia is only above the line for electrical machinery, whilst Sri Lanka is above it for food and beverages.

Summary

A country's stage of development, as reflected here in terms of its income level, is the most fundamental factor shaping manufacturing development and its structure. Although countries broadly tend to follow a 'given' path of development and structural change as income rises, they may deviate from that path due to country-specific conditions such as demographic and geographic conditions or other factors, including history, institutions and policy, as well as time-specific effects. These country- and time-specific effects not only result in different levels of manufacturing development, but also generate different speeds for the development of individual industries and sectors, as between countries. The policy issue is how far any deviation from the expected structure creates positive or negative long-run effects.

Figure 2.10
Country-specific conditions have a significant impact on industrial development



Note: All values are for the period 1963-2010 and are based on large economies only, i.e. countries with 12.5 million inhabitants or more (Haraguchi (2015). n.e.c. is not elsewhere classified. See manufacturing sector classification in Appendix Table C.6.

Source: UNIDO elaboration based on Haraguchi (2015) and Penn World Tables 7.1 (Heston et al. 2012).

This and the previous chapter provide strong evidence to corroborate the continued importance of the manufacturing sector in economic development (see also Haraguchi et al. 2017). This is not universal, however, as some countries can grow on the basis of natural resource or service exports, however even for these economies at some point diversification into manufacturing will be required. What has occurred since 1990 however is a concentration of manufacturing, particularly in East Asia, which has had implications for the growth prospects of both developed and other developing countries. This point is expanded further in Chapter 6 and it raises issues as to how governments of economies where manufacturing still remains relatively undeveloped need to respond.

Notes

1. For example, in the case of Mexico, Padilla Perez and Villarreal (2017) point to structural change accompanied by low productivity growth with labour reallocation from high productivity to low productivity industries.
2. The concept is not new, as it has been discussed in the economics literature since Kaldor (1966) referred to early deindustrialization in the case of the United Kingdom. It has recently attracted attention as evidence of deindustrialization has become more apparent (UNCTAD 2003, 2016).
3. The income effect includes both supply and demand effects. The demand effect is usually associated with the fact that rising income leads to changes in the composition of demand of which the decline in the share of agriculture (Engel's law) is the most notable feature. The supply effect reflects the overall increase in capital stock per worker and the increase in education and skills of all kinds.
4. Haraguchi et al. (2017) show that these trends do not vary by much when the values are taken in current prices.
5. The income level is defined in terms of GDP per capita at constant 2005 PPP values. To align the income classification of countries with the World Bank's classification, low- and lower-middle-, upper-middle- and high-income are defined as $6,500 or less, $6,500-$15,000 and more than $15,000, respectively.
6. The countries of the former Soviet Union are excluded from the calculations for the entire period because their disintegration and economic restructuring does not represent a long-term general trend of structural change. Nevertheless, including former Soviet economies in the calculations does not change the country average aggregate trends after 1990.
7. To determine labour intensity, employment per unit of value added was estimated at $5,000 and $20,000 GDP per capita. If an industry's labour intensity was higher than the median of 18 manufacturing industries at both income levels, it was considered labour-intensive. Among the ten industries examined here, food and beverages, textiles and wearing apparel industries are labour-intensive, while the others are relatively capital-intensive.
8. The natural resource proxy variable was calculated as the difference between exports and imports of crude natural resource commodities and is expressed in per capita terms. The commodities included are those categorized under SITC Rev. 1 in code 2 (crude materials, inedible, except fuels), 32 (coal, coke and briquettes), 331 (petroleum, crude and partly refined) and 3411 (gas, natural).
9. In a regression analysis across countries to relate manufacturing value-added per capita to income per capita, positive or negative effects are derived from the sign on the coefficient of the variables used to measure population density and natural resource endowments. Out of 18 industries listed in Table 2.3, only those in which population density or high natural resource endowments had a statistically significant impact are included.
10. Country-specific effects can be estimated from a cross-country regression analysis by industry relating manufacturing value-added to income with dummy variables for each country. The coefficient on the country dummy gives the 'country fixed effect' and the sign on the coefficient indicates whether performance is better or worse than expected.

CHAPTER 3

INCLUSIVE MANUFACTURING DEVELOPMENT

Promoting a more balanced world economy through industrialization

In recent years considerable attention has been given to the fact that the world economy is becoming increasingly unbalanced, in the sense that many people are being excluded from the benefits of economic growth. Poverty rates have been falling, but the absolute number of persons living in poverty is still high, with nearly 800,000 million living on less than $1.90 per day worldwide. Disparities in wealth and income across the world are still huge, and income inequality within many countries is increasing. Under-employment of labour is pervasive, particularly in developing countries, and finding employment for young people entering the labour force is a major challenge. There are serious regional imbalances in many countries, and various forms of horizontal inequality exist based on race, religion, caste and gender. Many of these imbalances and inequalities are more pronounced in the poorest countries where there is an absence of the rule of law combined with weak institutions and property rights, with the poorest often subject to environmental disasters. As noted in Chapter 1, United Nations initiatives such as the SDGs and the Paris Climate Agreement are designed to address many of these socio-economic challenges. SDG9 mirrors UNIDO's *inclusive and sustainable industrial development (ISID)* objective (UNIDO 2015a, p.1), and a key message from the organization's *Industrial Development Report 2016* is that "Reaching advanced levels of inclusive and sustainable industrial development requires not only increasing incomes but also conscious efforts to sustain growth, promote social inclusiveness and move towards greener structural transformation–as well as managing the trade-offs between them" (UNIDO 2015b, p. 1). The manufacturing sector has unique characteristics that other economic sectors do not possess. Among them, manufacturing activities are the source of relatively high productivity employment. However, it should be borne in mind that industrial employment absorbs only about one-quarter of the world's labour force. In 2010, employment in industry was only 24 percent (and in manufacturing just under 15 percent) of total world employment, compared to 29 percent in agriculture and 47 percent in services. Inclusive manufacturing development can tackle some of the inequalities and imbalances within countries, but by no means all of them.

The policy challenge for manufacturing is to create a sufficient number of jobs to pull large numbers of families out of poverty and to create the tax incomes that can be reinvested to improve public services, particularly education and health provision. This is at a time when the production of manufactured goods is taking place in an increasingly competitive global environment and the fast pace at which technology is changing is putting pressure on producers, especially if they are targeting sophisticated foreign markets. The globalization of production processes and supply chains and the spread of common consumption patterns have accelerated the specialization of manufacturing tasks. In addition, most manufacturing technology, developed in high-income countries, is subject to a skills bias in the sense that in response to relatively high unskilled wage costs in these economies, technological change is aimed at replacing unskilled with skilled labour. This demand for skills has been accompanied by higher capital investment, so that skilled labour and capital have become complements not substitutes. The trend towards a skills bias that has been present during most of the last century has intensified since the late 1970s, with the information and communication technology (ICT) revolution and the spread of computers and computer-based production systems and changes in organizational practice and the design of products and processes that this has allowed. These trends have contributed to inequalities in the labour market in terms of wage differences

between skilled and unskilled labour, and in employment opportunities for men and women in terms of differential access to education and training.

This chapter discusses the impact of manufacturing on inclusion. Since the term 'inclusive manufacturing' is multifaceted and embraces a number of issues, the chapter focuses on five main features, specifically poverty, inequality, the prospects for pro-employment manufacturing development and the effects of new technologies in manufacturing and 'servitization'.[1]

Manufacturing development and poverty

Despite economic growth and the growth in manufacturing employment that has been registered over the last 30 years, poverty rates are still high in many developing countries, particularly in Africa. The estimated poverty rates in regions of the world at the international poverty line are shown in Table 3.1.

The Millennium Development Goal of halving the poverty rate by 2015 compared with its level in 1990 was met globally, but not in all countries. It is unlikely that the new SDG1 of 'End Poverty in all its Forms Everywhere' is unlikely to be achieved, but the achievement of a 3 percent poverty rate is possible in some countries. The relationship between manufacturing output and employment growth and poverty reduction depends on the elasticity of the poverty rate with respect to output and employment growth, which in turn depends on how close new employees and their families are to the poverty line, whether it is the $1.90 a day line used by the World Bank for international comparisons or a national poverty line set by the individual country. If employment growth comes from those already above the poverty line, there will be no direct effect on poverty, although there may be indirect effects through multiplier expenditure. For manufacturing employment growth to reduce poverty rates directly, the new employment needs to come from those groups that are marginalized, either due to working in low productivity agriculture or in the petty services sector. The regions of the country in which new manufacturing employment is created will also play an important role because some regions in poor countries are much poorer than others. However, there can also be indirect effects through the multiplier impact when wages are spent.

Figure 3.1 shows the relationship between the poverty rate at the World Bank poverty line of $1.90 a day and the share of manufacturing value added in GDP across 110 countries for the years 1963-2010 (Haraguchi and Kitaoka 2015). It can be seen that there is a rough negative non-linear relationship, with the poverty head count ratio being higher the lower the

Table 3.1
Poverty rates by region

Region	1990	2005	2013
Poverty rate of population (percent)			
East Asia and Pacific	60.2	18.4	3.5
Europe and Central Asia	1.9	5.0	2.2
Latin America and the Caribbean	15.8	10.8	5.4
Middle East and North Africa	6.0	3.0	a
South Asia	44.6	33.6	15.1
Sub-Saharan Africa	54.3	50.0	41.0
World	34.8	20.5	10.7
Number of poor people (million)			
East Asia and Pacific	966.0	349 .0	71.0
Europe and Central Asia	9.0	23.0	10.0
Latin America and the Caribbean	71.0	61.0	34.0
Middle East and North Africa	14.0	9.0	a
South Asia	505.0	508.0	256.0
Sub-Saharan Africa	276.0	382.0	389.0
World	1840.0	1332.0	766.0

Note: a Estimates not shown due to very low population coverage of available survey data. PPP is purchasing power parity. Regional classification is based on World Bank (2016b).

Source: UNIDO elaboration based on World Development Indicators (World Bank 2017).

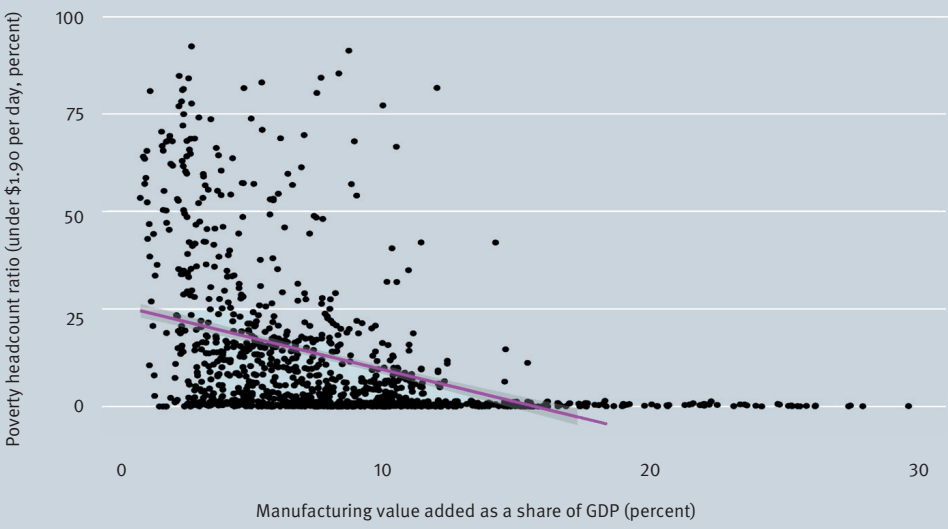
share of manufacturing value added in GDP. This reflects the higher productivity in manufacturing relative to agriculture or services. However, this relationship is by no means exact, so poverty rates and poverty reduction will depend on much more than simply the expansion of the manufacturing sector. Furthermore, even if manufacturing growth reduces the poverty rate as defined at the international poverty line, it must be borne in mind that $1.90 a day, at constant prices, is still a very low standard of living, so the challenge of reducing poverty and raising the living standards is still tremendous. If $5 a day was taken as a criterion, this would include nearly one-half of the world's population.

Manufacturing development and inequality

Not only is the average level of per capita income low in many developing countries, the distribution of income, wealth and power is also typically very unequal (usually much more unequal than in developed countries). There are two main concepts of inequality – vertical and horizontal inequality. Vertical inequality refers to how income is distributed across individuals and households and is typically measured by the Gini ratio, while horizontal inequality refers

to how different groups in society are treated based on race, religion, language, class, and gender. Inclusive manufacturing development should focus as much on horizontal as on vertical inequality.

Figure 3.1
Correlation between poverty rate (under $1.90) and the share of manufacturing value added in GDP



Note: All values are for the period 1963-2010. Poverty line is in constant 2011 PPP$ (PPP is purchasing power parity). GDP is gross domestic product.

Source: Development, 'Industrialization in the 2030 Agenda for Sustainable Development', 58, 2016, Figures 1 and 2, Nobuya Haraguchi and Kazuki Kitaoka. © Society for International Development 2016. With permission of Springer.

Table 3.2 presents the Gini ratio for a selection of countries where inequality is high. Most of the countries with a Gini ratio above 45.5 are located in Africa or Latin America and the Caribbean. South Africa is the country with the highest Gini ratio (63.4) in Africa, while Haiti is the country with the highest Gini ratio (60.8) in Latin America and the Caribbean.

Figure 3.2 shows the relationship between the Gini ratio and the share of manufacturing value added in total GDP (Haraguchi and Kitaoka 2015). There is generally a negative relationship with the Gini ratio being lowest in countries with a higher ratio of manufacturing value added to GDP. This suggests that manufacturing development could lead to greater inclusiveness by narrowing the income distribution, but clearly many other factors also determine income distribution, particularly at low levels of manufacturing development where it can be seen that the dispersion of the Gini ratio around the regression line is much greater.

Horizontal inequality excludes different groups from fully participating in the growth and development process, depriving them of various entitlements and capabilities (Sen 1999). For example, some groups may be denied access to public goods such as education and healthcare based on race, religion or caste. This impoverishes not only the group, but also the economy

at large. Inequality takes a regional dimension as well. Certain regions may be deprived of infrastructure investment because of particular groups that are located in these regions, which not only impairs the region, but limits the entire country's progress. Inclusive manufacturing development must address regional imbalances and deprived regions. A good case study is India, which as a result of its history and past growth, is characterized by huge differences in living standards across its states measured by per capita income, which at 2011 prices ranges from 12,000 Indian Rupee (a ~ $258) in Bihar to nearly 100,000 Indian Rupee (a ~ $2147) in Goa (Cherodian and Thirlwall 2015). Other related regional disparities are seen in levels of education, literacy, health, infrastructure, population growth, and investment expenditure. Industrial policy with a regional dimension can help to address this type of imbalance.

Table 3.2
Comparison of Gini ratio in high-inequality countries

Country	Year	Gini ratio	Country	Year	Gini ratio
South Africa	2011	63.4	Costa Rica	2013	49.2
Namibia	2009	61.0	Congo, Republic of the	2011	48.9
Haiti	2012	60.8	Kenya	2005	48.5
Botswana	2009	60.5	Paraguay	2013	48.3
Suriname	1999	57.6	Bolivia, Plurinational State of	2013	48.1
Central African Republic	2008	56.2	Mexico	2012	48.1
Comoros	2004	55.9	Ecuador	2013	47.3
Zambia	2010	55.6	Gambia, The	2003	47.3
Lesotho	2010	54.2	Cabo Verde	2007	47.2
Honduras	2013	53.7	Dominican Republic	2013	47.1
Colombia	2013	53.5	Venezuela, Bolivarian Republic of	2006	46.9
Belize	1999	53.3	Seychelles	2013	46.8
Brazil	2013	52.9	Malaysia	2009	46.3
Guatemala	2011	52.4	South Sudan	2009	46.3
Panama	2013	51.7	Malawi	2010	46.1
Swaziland	2009	51.5	Solomon Islands	2005	46.1
Guinea-Bissau	2010	50.7	Togo	2011	46.0
Chile	2013	50.5	Nicaragua	2009	45.7
Rwanda	2013	50.4	Mozambique	2008	45.6

Note: A Gini index of 0 represents perfect equality, while an index of 100 implies perfect inequality.

Source: UNIDO elaboration based on World Development Indicators (World Bank 2017).

Pro-employment manufacturing development

Ideally, rapid economic growth will lead to broad-based employment generation, raising the level of employment in all industries to create large numbers of diverse jobs.[2] This growth is not expected to be proportional across industries, but at a differential rate in accordance with the country's shifting endowment structures and the pattern of consumer demand. This process

Figure 3.2
Correlation between income inequality (Gini coefficient) and share of manufacturing value added in GDP

Note: All values are for the period 1963-2010. Manufacturing value added and GDP (gross domestic product) are in constant 2011 PPP$.

Source: Development, 'Industrialization in the 2030 Agenda for Sustainable Development', 58, 2016, Figures 1 and 2, Nobuya Haraguchi and Kazuki Kitaoka. © Society for International Development 2016. With permission of Springer.

creates job opportunities for a country's labour force, with different skills and experience required at different stages of development. By definition, output growth is based on a combination of employment growth and labour productivity growth, and the respective contributions of employment growth and labour productivity growth to output growth differ from industry to industry. If the growth of output is a given, determined by either domestic or foreign demand, there is a trade-off between employment growth and productivity growth. For a given growth of output, the higher productivity growth is, the lower the growth of employment. The only way that both employment growth and productivity growth can rise simultaneously is through higher output growth. The key policy to influence employment is therefore directly related to measures to support output expansion. Governments also have the option of either encouraging industries that are as labour-intensive as possible, or influencing the labour intensity of production through the choice of labour-intensive techniques of production, by providing subsidies to labour or reducing subsidies to capital (because exchange rates are over-valued, for example).

However, such a strategy only has a limited role since neither the growth potential of industries nor their labour intensity is static. Both change as a country develops and its natural and acquired comparative advantage shifts. When a country's per capita income increases, it may be a mistake to attempt to sustain the growth of 'early' industries (see Chapter 2, Table 2.3 for the classification of 'early', 'middle' and 'late' manufacturing industries) simply because they are labour intensive. This is because with rising wages they may offer less long-run growth opportunities than more capital- or skill-intensive activities. Within an industry, labour intensity is also likely to change because of factor substitution between capital and labour as a country develops and wage rates rise. Hence, as both the structure of manufacturing and the factor combinations within manufacturing change, the relative importance of job creation shifts from one industry to another.

Table 3.3 shows the employment intensity of manufacturing defined as the employment elasticity given by the ratio of the percentage change in manufacturing employment to the percentage change in manufacturing real output by region for the 1965-2004 period. The employment intensity of manufacturing is lowest in South Asia and Africa (in fact, negative) and highest in East and South-East Asia, followed by Central and Eastern Europe. In an analysis across 42 developing countries, employment intensity is positively correlated to openness to trade (measured by the Sachs-Warner index). However, the degree of employment intensity correlates negatively with levels of income, implying that countries shift away from labour-intensive towards capital-intensive industries in manufacturing in the process of development. Also, the employment intensity of manufacturing declines with higher levels of schooling, suggesting that countries with higher levels of human capital adopt more capital-intensive processes (Athukorala and Sen 2016).

Table 3.3
Employment elasticity in manufacturing by region

	1965-2004
Developed countries	0.34
By region	
Africa	-0.69
Central and Eastern Europe	0.40
East and South-East Asia	0.42
Latin America and the Caribbean	0.03
Other Asia and the Pacific	0.19
South Asia	-0.87

Note: Regional classification based on Appendix Table C.1, in which Central and Eastern Europe comprises both member and non-member countries of the European Union.

Source: Adapted from Athukorala and Sen (2016), Table 5.3, in 'Employment and Poverty', in Routledge Handbook of Industry and Development, eds. Weiss, J. and Tribe, M., New York, NY: Routledge, pp. 65-83.

At an early stage of a country's development, as labour and resources shift out of agriculture into manufacturing, four industries or subsectors are likely to be most important for manufacturing employment. The food and beverages and textiles industries are likely to be the two major sources of manufacturing employment and of value added, because these activities

relate to basic needs which often do not need to be supplied by imports. Chemicals and non-metallic minerals can also contribute to employment. In the early stage of industrialization, the chemicals industry produces basic materials, such as pesticides and fertilizers, required by agriculture. Its labour intensity is not high, but due to the high output level from an early stage of industrial development, the number of workers employed in the industry can be relatively large. The non-metallic minerals industry produces building materials, such as glass, cement and bricks, for the construction sector. At an income level of less than $2,000, only a limited number of formal enterprises will be engaged in other manufacturing activities. These four industries can support the expansion of manufacturing employment at a low-income level, providing jobs with higher productivity than those in the agricultural sector. Cross-country experience suggests there is relatively high domestic demand for these manufactured goods. Countries tend to meet such demands through domestic production without too much dependence on imports. The food and beverages and the chemicals industries, in particular, can grow in terms of both employment and value added over relatively long periods as incomes rise. Building a solid foundation for these industries early on is important for a country's inclusive manufacturing development.

A difficult challenge for countries aiming to follow the pro-employment path of manufacturing development is to diversify manufacturing from those four industries and establish new labour-intensive industries, while continuing to promote the growth and development of those initial industries. The successful establishment of the wearing apparel industry can be crucial since wearing apparel (including fur, leather products and footwear) has the potential to increase value added and employment rapidly in a relatively short period of time. This industry—broadly defined—has the capacity to employ a large number of workers in higher productive activities than in agriculture, consequently leading to a reduction in poverty. Experience in Bangladesh illustrates this, with the share of employment in textiles and the wearing apparel industries increasing from 3.7 percent in 2000 to 8.3 percent in 2013 (ADB and ILO 2016).[3] The continued development of the wearing apparel industry, including leather and footwear production, is also important in terms of building up initial institutional, policy and managerial learning, thus laying the foundation for continuous industrial upgrading by increasing investment in human resources and capital assets. Once this phase is completed, countries can break into markets previously dominated by producers from other countries. For example, in Ethiopia, the government has ambitions to take advantage of rising wage costs in parts of Asia to imitate Bangladesh's success and to transform the economy into a global manufacturing hub with a number of large industrial parks.[4]

As a result of the inevitable slowdown in the growth of early labour-intensive industries and the need to provide higher value-added jobs, the middle and late industries need to assume an increasingly important role as alternative sources of employment as economies grow. No industry in the middle and late category will generate as many jobs at any income level as the food and beverages, textiles or wearing apparel industries. To maintain and increase manufacturing employment, several middle and late industries have to develop simultaneously and start providing alternative and higher paying jobs. Thus, from a certain stage of manufacturing development, it is no longer possible to rely solely on an abundant supply of low-skilled labour, and adequately trained manpower and qualified personnel, including at various levels of management, become increasingly important. This is essential for allowing producers to keep up with the sophisticated demands of highly competitive international markets for manufactured goods.

Potential for increased gender equality through exports

Manufacturing is an important source of employment for women, particularly in export activities. Besides offering higher wages, it typically provides better benefits and tends to develop superior skills compared to jobs in the rest of the economy (Lavopa and Szirmai 2012). However, the longer-term trend appears to be that the share of female employees in manufacturing has dropped sharply from 50 percent in 1991 to 38 percent in 2014 (UNIDO 2015b). In terms of relative concentration, defined as the ratio of the share of women employed in the industrial sector to the share of men, this has also fallen, from an average of 70.2 percent in 1991 to 47.2 percent in 2013 (Table 3.4). This phenomenon has occurred in all developing regions, with African countries showing the largest decline. Even in Asia, where industrialization and export-oriented manufacturing have been more extensive, a decline in women's concentration in jobs in the industrial sector has been observed, although their relative share in total employment rose (UNCTAD 2017).

Due to higher wages in manufacturing, it might be expected that this sector would contribute to the reduction of the wage gap between men and women and that trade liberalization associated with globalization would bring convergence in men's and women's wages because it would raise the relative demand for women's labour. However, the empirical evidence is not consistent; some studies support these predictions while others show results to the contrary. One interpretation is that as the export mix moves into technologically more sophisticated goods, the demand for female labour weakens due to their poorer access to training. This suggests that women are adversely affected as industries upgrade, leading to a 'defeminization' of employment in manufacturing (Gosh 2007; Kucera and Tejani 2014; Tejani and Milberg 2010). This 'defeminization' raises questions about the potential of export-oriented manufacturing as a way of reducing gender wage inequality.

UNCTAD (2016) finds that when exports of manufactured goods grew between 1991 and 2014, the responsiveness of employment in services for women was much higher than in manufacturing itself. For example, a 1 percent increase in exports of manufactured goods from Africa was associated with a 0.34 percent increase in women's employment in services, but only a 0.12 percent increase in their employment in industry. In Latin America and the Caribbean, a 1 percent increase in exports of manufactured goods was associated with a 0.29 percent increase in women's employment in services compared with 0.14 percent in industry. In Asia, the gap was the largest, with an employment elasticity of 0.44 percent in services and 0.13 in industry. The causal mechanism suggested is twofold. First, increased competition in manufacturing, both local and international, is associated with the informalization of work, both within and outside the manufacturing sector. Second, lower cost access to more skill- and capital-intensive production technologies has both lowered the employment intensity of manufacturing and raised the relative demand for skilled labour. As women often lack access to training and education, this has created an anti-female bias. For example, for many low-income countries in Africa, women have remained employed in subsistence agriculture or moved to low-productivity services, even as manufacturing has expanded.

The impact of technology on female employment trends appears ambiguous. Manufacturing development in low- and middle-income countries has the potential to improve women's

social and economic status, as labour-intensive manufacturing industries often employ more female than male workers due to their perceived higher productivity. But their continuing concentration in these industries works against sustained gains in women's economic welfare when manufacturing becomes more technology-intensive. However, there is also some evidence indicating that in higher income technology-creating economies, there may be a shift towards greater use of female over male workers on the grounds that cognitive skills are more valuable than physical skills and that skill-intensive technologies (ICT-based) may gradually increase the relative demand for female labour (UNIDO 2013). This trend has yet to manifest itself in technology-importer developing economies.

Table 3.4
Except in West Asia, women's manufacturing employment share has dropped substantially

	1991	2013
Africa	91.8	47.9
Americas	67.9	53.1
Asia	59.3	47.2
South Asia	63.8	40.8
East Asia	75.9	33.1
West Asia	22.1	36.5
South East Asia	87.9	66.1

Note: Women's relative concentration is calculated as the three-year average of the share of women employed in the industrial sector relative to the same share for men. Data represent developing countries only and based on three-year averages. Regional classification based on (World Bank 2016b).

Source: UNCTAD (2017), UNCTAD/TDR/2017, based on the ILOSTAT database, www.ilo.org/ilostat, via World Development Indicators (World Bank 2017).

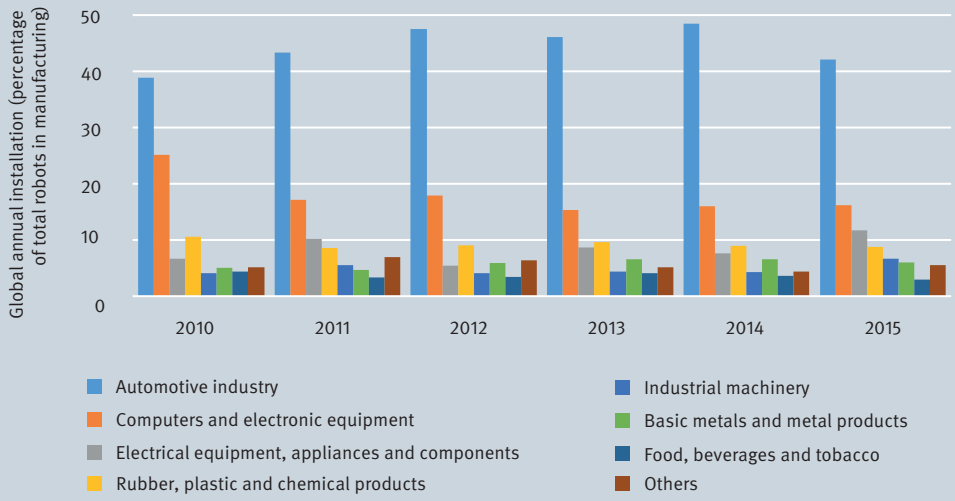
Effects of new technology and services

Technological change inevitably affects and transforms employment opportunities. Throughout modern history, there has been a recurrent fear that jobs in manufacturing will be destroyed by technology.[5] At a global level in manufacturing, this has not yet been the case, but some manual jobs have been substituted by automated methods. As manufacturing tasks have transformed, so also have the skills required to perform the new jobs. In the longer term, this phenomenon will have important implications for the inclusiveness of manufacturing. Recent technological changes, such as robotics and 3D additive printing, have been referred to as the emergence of a 'new industrial revolution.'[6] How this will impact on inclusion depends on which countries start using robots and in which manufacturing subsectors (UNCTAD 2017). Despite recent concerns surrounding the potential of robot-based automation, the use of industrial robots globally presently remains limited, with only around 1.6 million units in 2015. However, this has increased rapidly since 2010, with China mainly responsible for this growth. In manufacturing, the current use of robotics is geared towards capital-intensive rather than labour-intensive subsectors. There is a heavy concentration in three manufacturing subsectors: the automotive industry

accounts for nearly half the use of industrial robots (45 percent in 2015), followed by computers and electronic equipment (about 15 percent in 2015), and electrical equipment, appliances and components (about 10 percent) (Figure 3.3). The impact of robots on manufacturing employment depends on country-specific conditions, and robotics policy initiatives explain the differential rate of adoption between countries (UNCTAD 2017).[7]

As of yet, whilst robotics technology has advanced, fully automated production processes are still expensive and are only used in a limited range of activities. While they may have important implications for the demand for unskilled and semi-skilled labour in manufacturing in the long term, this is not yet a major issue in the short run.[8] In the longer term, the combination of robots and 3D additive printing could create new possibilities for small manufacturing businesses, with associated employment gains.

Figure 3.3
Use of industrial robots is concentrated in a few industries



Source: UNCTAD (2017), UNCTAD/TDR/2017, based on National Accounts Main Aggregates Database (UNSD 2017).

More jobs in services may also provide a partial offset to job losses from automation. There is an ongoing debate about the effects of a shift amongst manufacturers from only selling a product to selling a package of products plus related services, a process termed 'servitization'. More companies are combining manufacturing with services as a way to find more innovative ways to make themselves valuable to their customers with more time and effort spent in discussing customer requirements before the start of production. The impact of this process will depend on the type of manufacturing structure a country establishes and how far a service component is integral to the type of manufactured goods produced (Guerrieri and Meliciani 2005). Some jobs in manufacturing-related services, such as handling raw material inputs and finished products, warehousing and transport will be common to most manufactured goods. Other services such as human resource management and information technology will only be relevant for certain types of product. The service component of consumer electronics

or automobiles, for example, will be very different from that of industrial chemicals or sheet steel. Overall, it remains unclear how far manufacturing-related services can provide similar employment, income and productivity gains as manufacturing.[9]

Summary

The relevance of inclusive manufacturing development emerges from the pressing need to address the various inequalities that many countries, in particular developing countries, face. The challenge remains how to address the systemic and varied causes of exclusion. SDG 9, in particular, embraces the challenge to work for an inclusive and sustainable industrial development. What matters in terms of 'inclusive manufacturing development' is the wider distribution of the benefits from manufacturing activities through manufacturing employment and higher productivity. Manufacturing can contribute to the reduction of gaps in income, productivity, technology, skills and gender, and have a crucial impact on the creation of decent work and equitable growth, but this will require investment in both capital assets and training and the continued growth of production. Whilst much of the new technology used in developing countries will have been developed in countries with relatively high unskilled labour costs, and is therefore subject to a skills bias, low- and lower-middle-income countries, in particular, still have the option of expanding production in relatively labour-intensive activities. In addition, while manufacturing growth in higher income economies may be driven primarily by productivity improvement rather than by higher employment, employment in manufacturing-related services can offer relatively well-paid and stable employment. Nonetheless, industrial employment only absorbs about one-quarter of the world's labour force and in this sense, whilst inclusive manufacturing development has the potential to tackle some of the inequalities and imbalances within countries, it cannot resolve all of the problems of inclusion.

In a globalized world economy, the production of manufactured goods has become challenging for all countries, whether already industrialized or in the process of industrializing. The industrialization process of all countries has been affected in various ways by a series of recent events – the emergence of competitor developing countries (principally China), new technologies (such as robotics and 3D additive printing), the link between manufacturing and related services, the participation of women in the manufacturing sector and shifts towards greater trade openness, among others. How these impact on inclusiveness at the national level depends on a range of country-specific factors, including government policy. If employment creation is a pressing need for low-income populous countries, then there may be a case for considering a reorientation of policies towards more labour-intensive activities or production techniques. However, there is a clear limit to such a strategy, and beyond a certain stage of manufacturing development, it is no longer possible to rely on an abundant supply of low-skilled labour as the basis for competitiveness. Adequately trained manpower and qualified personnel, including at various levels of management, become increasingly important as economies diversify into more sophisticated and capital-intensive activities. It is up to each country to set priorities and to design policies which can support the generation of employment with high productivity, the ultimate aim being to reduce inequalities—vertical, horizontal and regional—and poverty.

Notes

1. UNIDO (2015a) and UNCTAD (2016, 2017) contain further analysis of the various aspects of 'inclusiveness', which go beyond 'inclusive manufacturing'.
2. There is evidence indicating that manufacturing employment is a better predictor of prosperity than manufacturing output (Felipe et. al. 2014).
3. See Haraguchi and Rezonja (2012) for a detailed analysis of employment across manufacturing activities.
4. See Aglionby (2017). Hawassa is the flagship industrial park with a target employment of 60,000 workers.
5. Over 50 years ago, Kaldor (1966) already predicted this phenomenon: 'It is possible, looking further ahead, that the new technological revolution –electronics and automation– will so radically reduce the labour requirements in industry as to make it possible to combine fast growth with *falling* industrial employment. But there are no signs of this yet' (p. 31).
6. See Marsh (2012) for an analysis of the key changes in modern manufacturing.
7. Elliot (2017) argues that robots will create more jobs, but will lead to greater inequality as the new jobs will be remunerated lower than before.
8. More details are in Stacey and Nicilaou (2017), Kozul-Wright (2016) and Harding (2017).
9. Ghani and O'Connell (2014) provide an optimistic assessment, with scepticism expressed by Rodrik 2014a.

CHAPTER 4

STRUCTURAL CHANGE AND ENVIRONMENTALLY SUSTAINABLE MANUFACTURING

Towards more sustainable industrialization: green technological change and increasing environmental productivity

As already discussed in previous chapters, the expansion of the manufacturing sector can create positive effects for the economy through its impact on economic growth and employment. On the other hand, manufacturing is one of the sectors with the greatest negative impact on the environment. Achieving the goal of inclusive and sustainable growth requires major efforts to be made to reduce this negative impact. This chapter shows that whilst some progress has been made, mostly in high-income countries, it has been very limited thus far, with manufacturing in general continuing to add to polluting emissions and the creation of material waste. The key policy challenge is to develop technologies that substantially reduce the environmental impact per unit of manufacturing output ('environmental intensity') and to ensure the widespread dissemination and adoption of these technologies. Only when this occurs will the goal of sustainable growth be achievable.

The analysis of the relationship between structural change and the environment usually commences with the framework generally known as the Environmental Kuznets Curve, which, starting from the early 1990s,[1] has captured the attention of both researchers and policy makers alike. The main intuition behind this approach is that the relationship between environmental degradation and economic growth has an inverted U-shaped relationship. This means that in the first stage of economic development, income growth is generally increasingly correlated with environmental degradation, while after a certain threshold or turning point, a form of delinking occurs, so that increases in income are associated with falling, not rising, environmental impacts.

There are at least three underlying mechanisms in the environment-income relationship, generally known as scale, composition and technological effects (Carson 2010). Under the first of these, it is generally assumed that as the scale (or size) of an economy increases, the higher its anthropogenic impact on the environment. The assumption behind this effect is that the elasticity of the relationship between income and environmental degradation remains constant as income rises. The second compositional effect refers to the changing structure of an economy as income rises and services become relatively more important, and the third, the technological effect, captures technological change, which can reduce the environmental impact per unit of GDP. Below a certain income level, scale dominates and as income rises, so does environmental damage, but beyond that income level, the other effects start to reduce the environmental impact, creating the downward sloping curve.

However, the analysis is more complicated than this and the Environmental Kuznets Curve has been subject to considerable testing and debate. For example, as income rises, the composition of the economy changes, but this may have contrasting effects on the environment-income nexus. A change in composition generally means a shift towards a service- based economy, which is often assumed to be good for the environment given the lower emission intensity of the service sector per unit of output. Nevertheless, under certain conditions, this transition can also harm the environment. Many service sectors rely heavily on industrial and polluting inputs (Cainelli and Mazzanti 2013), and in addition, moving from a static to a dynamic perspective,

service sectors can have less tendency to innovate, so a shift towards them may thus decrease environmental innovation in the medium run (Baumol 1967).

Technological change will influence the relationship between income and the environment, and environmental sustainability will depend on the capacity of innovation (both technological and behavioural) to overcompensate for the scale effect of economic growth. Nonetheless, whilst green technological change and increasing environmental productivity can decrease the elasticity relationship between economic growth and the environment, thereby lowering the Environmental Kuznets Curve, it is not inevitable that this technological change occurs without policy intervention. The relevance of green technological change has been underscored by many authors who highlight the need for more radical innovation as a fundamental step in the process of decarbonization of an economy (Vollebergh and Kemfert 2005). In terms of the role of manufacturing, it is widely accepted that the innovative content of manufacturing is greater compared with services. The European Union has therefore launched a manufacturing strategy, with the aim of industry making up 20 percent of GDP by 2020. In the short term, such a strategy may increase emissions, but on the other hand, the innovation content of manufacturing can in turn reduce emissions over time.

Recent cross-country studies on the Environmental Kuznets Curve (for example Musolesi et al. 2010), have found that CO_2 emissions in high-income countries have decreased slightly in recent years, while they have increased in low- and middle-income countries. The obvious aggregate result is that total emissions worldwide are still increasing. It is worth noting that this aggregate evidence masks some underlying dynamics. First, part of the positive environmental performance of high-income economies is attributable to the process of deindustrialization, which has characterized the last few decades. One of the consequences of this phenomenon is that high-income countries have started importing polluting goods from middle-income countries.

Building on this framework, this chapter conducts a structural decomposition analysis to assess the relationship between structural change and sustainability in manufacturing. Given the focus on manufacturing, the main emphasis is on scale and technological effects. An environmentally extended input-output modelling approach is applied using the Eora Multiregional Input-Output database. The input-output approach provides a detailed picture of the structure of an economy and of the relationship between industries. It allows an assessment of the impact on the economy as a whole through inter-sectoral linkages as a result of changes in specific sectors. The decomposition analysis measures the environmental impact from manufacturing in the aggregate and separately for distinct subsectors or manufacturing industries, distinguishing between scale and technological effects as the cause of environmental impact. The analysis allows an assessment of determining which groups of countries and subsectors are improving or deteriorating in terms of environmental performance.

Measuring the environmental impact of manufacturing: data and methodology

Two separate indicators are used to measure the environmental impact of manufacturing–CO_2 emissions and material use. Information on these is based on the Eora Multiregional

Input-Output database (worldmrio.com). This covers input-output tables for 190 countries and 26 subsectors (seven of which relate to manufacturing) over the period 1990-2013. Direct CO2 emissions from manufacturing reflect the environmental pressure exerted directly from the production of manufactured goods. As this measure may be distorted in countries characterized by a low cost of electricity, a variable reflecting the amount of CO2 generated by the electricity consumed by that country and subsector as a result of manufacturing production is also calculated for each country and subsector. The total estimate of CO2 emissions is the sum of the direct and indirect effects.

As no adequate indicators exist for material waste, this analysis constructs a variable using the Eora Multiregional Input-Output database, which reflects the materials used as an intermediate input by each subsector. Four types of materials are included: fossil fuels, minerals, biomass and construction materials. Starting from this data, a variable for material use is constructed as the sum of minerals plus biomasses plus construction materials. Fossil fuels are excluded from this variable, as they are mainly used for energy purposes. The data set also includes value added at current and constant prices; in addition, dummies are applied to indicate different manufacturing subsectors.

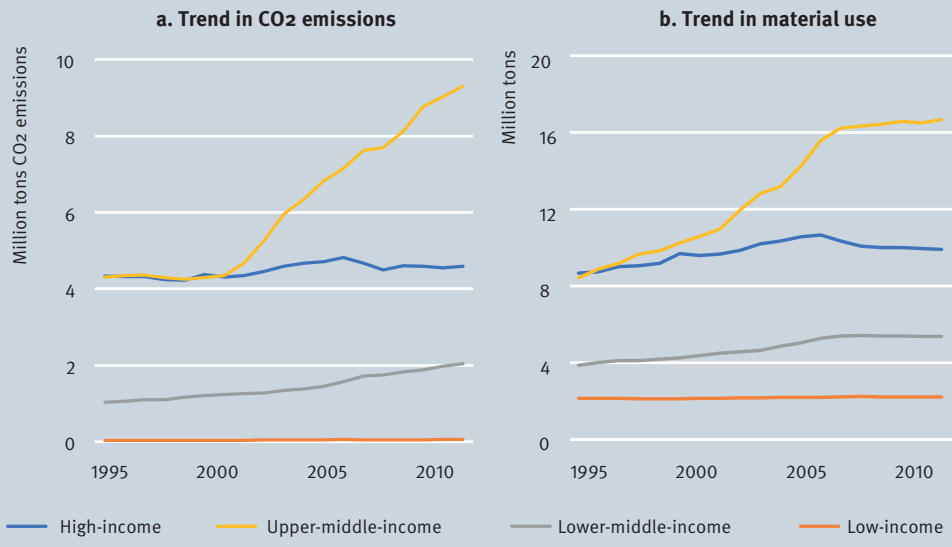
This detailed data set is used to conduct an index decomposition analysis. This approach exploits the time dimension of the panel of data, and allows a focus on how scale and technological effects influence the aggregate emission performance and material use of manufacturing worldwide. The aim is to decompose CO2 emissions and material use into two main components: a technological (or intensity) effect and a scale (or volume) effect. A composition effect is also allowed for, but it is always very small. Intensity as an indicator of environmental efficiency is measured as the ratio of CO2 emissions to value added and material use to value added. Results are presented for four different groups of countries based on the World Bank's income classification: high-income, upper-middle-income, lower-middle-income and low-income.

CO2 emissions and material use in production

Before presenting the main results, trends in CO2 production and material use are considered as a starting point for subsequent discussion. Figure 4.1 displays a significant divergence between high-income and upper-middle-income countries, with the latter experiencing a sharp increase in CO2 production since the beginning of the century and since the end of the 1990s in material use. In relation to the logic of the Environmental Kuznets Curve, high-income countries show signs of stabilizing emissions, while they continue to be on the rising segment of the inverted U-shape in upper-middle-income countries (Musolesi et al. 2010). It remains an open question how dependent the improved performance of high-income countries is on the transfer of manufacturing activity to other parts of the world economy. Figure 4.1 illustrates how the global burden of and responsibility to address climate change is currently being shared between the two wealthiest areas of the world. They also show the increasing role of non-high-income countries in the global use of energy and materials. The only positive element is the more recent stabilization in material use in the upper-middle-income group.

As far as the decomposition analysis is concerned, Figures 4.2 to 4.4 present the results for the manufacturing sector in the aggregate. Figure 4.2 decomposes the growth rates of CO_2 emissions and material use, respectively, over the period 1995-2013, into the effects of scale, composition and intensity. Manufacturing in the aggregate has created positive growth in emissions across all income groups (Figure 4.2a – blue histograms), with that growth rising as the income by group decreases. Scale and intensity/efficiency effects are both relevant, but efficiency only increases significantly for high-income countries, while it has just increased slightly for upper- and lower-middle-income countries. For these country groups, growth in the volume of the economy (orange histograms) and the slow pace of improvement in terms of efficiency (yellow histograms) are the main factors responsible for the positive growth in CO_2 emissions. These effects appear to be driving the divergence between high- and upper-middle-income countries depicted in Figure 4.1a. Changes in the composition of the manufacturing sector are found to have had a very small impact on CO_2 emissions.

Figure 4.1
Upper-middle-income countries have the largest environmental footprint



Note: All values are for the period 1995-2013. Income classification is based on Appendix Table C.4.

Source: Mazzanti and Nicolli (2017) based on the Eora Multi-Region Input-Output database (Lenzen et al. 2012; Lenzen et al. 2013).

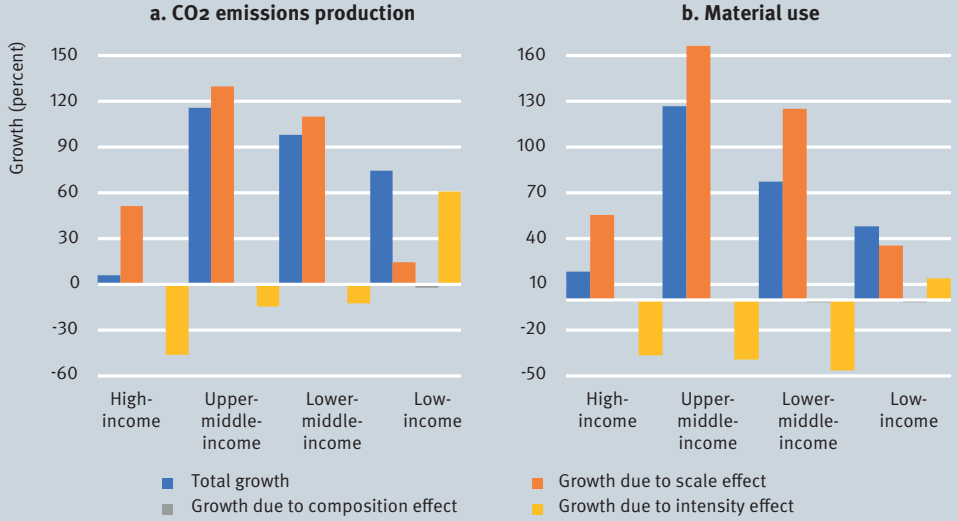
Currently, the impact of innovation in reducing environmental intensity seems to be principally featured in the manufacturing sector of high-income countries. This signals a key issue for the development of manufacturing in emerging and developing countries, especially in low-income countries, where innovation has had little or no impact in compensating for the scale effects of manufacturing growth. This lack of progress in improvements in environmental efficiency is a signal of a weak transfer of technology and knowledge from high-income areas in the world to other economies.

A similar reasoning applies to material use, which indicates positive growth over the period and across countries (Figure 4.2b). Nevertheless, the role of innovation seems stronger here

across different income groups, as the intensity effects (creating negative changes in material use), which partially compensate for scale effects, are larger than for CO_2 emissions in upper- and lower-middle-income countries. Again, the composition effect is very small.

In summary, intensity reduction effects partially compensate for the scale-driven overall increase of emissions and material use. The intensity effect is larger for high-income countries and for material use, with strong differences across income groups with regard to CO_2 emissions. This is consistent with the more complex status of CO_2 emissions as a global negative externality whose management depends on national and international policies and agreements. Material use is characterized by higher local externalities, which are more easily addressed by local policies, and the benefits from reduced material use can be more easily appropriated directly by the producers concerned.

Figure 4.2
Decomposition of CO_2 emissions production and material use



Note: All values are for the period 1995-2013. Income classification is based on Appendix Table C.4.

Source: Mazzanti and Nicolli (2017) based on the Eora Multi-Region Input-Output database (Lenzen et al. 2012; Lenzen et al. 2013).

Figure 4.3 investigates the volume (or scale) effect for both CO_2 emissions and material use, showing the absolute trend of the effect (Figures 4.3a and 4.3c) and expressing annual variations as a deviation from a base year (Figures 4.3b and 4.3d). Figure 4.3a shows the divergence in absolute levels of CO_2 production due to the volume effect between high- and upper-middle-income countries from the end of the 1990s to 2010, which was mainly driven by increasing manufacturing production in fast growing middle-income countries, especially in East Asia. However, in the post-recession years after 2010, the scale effect for upper-middle-income countries has a downward trend (yellow line). Although the causes vary from country to country, the economic slowdown due to macroeconomic factors such as the decrease in demand for commodities in high-income economies and diminishing domestic capital accumulation have—not surprisingly—affected emissions due to a weaker scale effect.

A similar pattern can be observed in Figure 4.3c in relation to material use. In this case, upper-middle-income countries also experience a sharp increase in material use due to the expansion of production. Figure 4.3 presents the variation of the scale effect with respect to the 1995 levels. The values in 2013 correspond to those reported in Figure 4.2. Again, the figures present similar patterns, with upper- and lower-middle-income countries diverging from high-income countries over the last decade.

Figure 4.3
Trend and variation in the scale effect of CO_2 production and material use

Note: All values are for the period 1995-2013. Income classification is based on Appendix Table C.4.

Source: Mazzanti and Nicolli (2017) based on the Eora Multi-Region Input-Output database (Lenzen et al. 2012; Lenzen et al. 2013).

Two implications for future sustainability emerge from these results. First, the moderate but positive increase in CO_2 emissions in high-income countries is not in line with global needs and priorities. Second, other areas in the world have not initiated a real transition towards decarbonization and are still on the increasing side of the Environmental Kuznets curve. All areas of the world still show increasing material use and the few signs of stabilization in upper-middle-income countries are linked to a slowdown in economic growth, which is likely to be reversed. This is a clear signal that more stringent resource efficiency policies and waste prevention targets should be implemented to fully decouple waste generation and material use from economic growth (Mazzanti and Zoboli 2009).

Similarly, Figure 4.4 studies the trend of the intensity effect (measuring environmental efficiency) for both CO_2 emissions and material use. It is significant that high-income and upper-middle-income countries have shown an increase in efficiency, resulting in a reduction of emissions and material intensity. Figure 4.4a shows the downward trend in the environmental intensity of CO_2 emissions in high- and upper-middle-income countries. However, upper-middle-income countries saw a potentially critical reversal of intensity trends after the downturn (2011-2013), although the intensity factor improved for these countries over the entire period, leading to a partial compensation for the scale effect. The decrease in efficiency in these countries in recent years is worth investigating further.

The same approach has been applied to the analysis of the intensity effect in material use (Figure 4.4c). In this case, efficiency increases across all income groups apart from low-income countries. By looking at variation in intensity relative to a base year Figures 4.4b and 4.4d add further evidence that low-income countries may be embedded in a form of poverty trap: for CO_2 emissions, in particular, the variations show a worrying rise in Figure 4.4b.

Decomposing the environmental footprint across manufacturing subsectors

Following the same approach as above the figures below present a similar analysis, but focus on individual subsectors within manufacturing.

In high-income countries, the food and beverages subsector shows an overall reduction in CO_2 emissions, where intensity trends are strong enough to compensate for scale effects (Figure 4.5a). Intensity improvement is strong in high-income countries, but is also significant in upper- and lower-middle-income countries. Low-income countries show no improvement in intensity. A similar pattern emerges for textiles and leather, with a negative figure for low-income countries, and a strong reduction in emissions in high-income countries (Figure 4.5b). Here, low-income countries show a decline in emissions due to a decline in output, generating a negative scale effect, i.e. any environmental improvements come at the expense of economic growth. In the wood industry, upper-middle-income countries as well as high-income countries introduced innovation processes that more than compensated for the scale effect of increasing production, and emissions have fallen in both groups (Figure 4.5c). Low-income countries have not improved in terms of efficiency and have thus witnessed a rise in CO_2 emissions.

For petroleum, chemicals and non-metallic minerals, electrical machinery and metals, which are heavy pollutant subsectors, the picture changes slightly (Figures 4.5d to 4.5f). In high-income countries, a reduction in emissions is driven by a sufficiently strong intensity reduction effect, while upper- and lower-middle-income groups generally show increases in emissions and usually improved albeit weak intensity effects. Scale effects dominate in countries with a relatively weak improvement in intensity due to a lack of stringent national policies and insufficient transfer of knowledge from more efficient regions in the world and sectors. Low-income countries have relatively low increases in emissions, but because of weak output effects, not because of improvements in intensity.

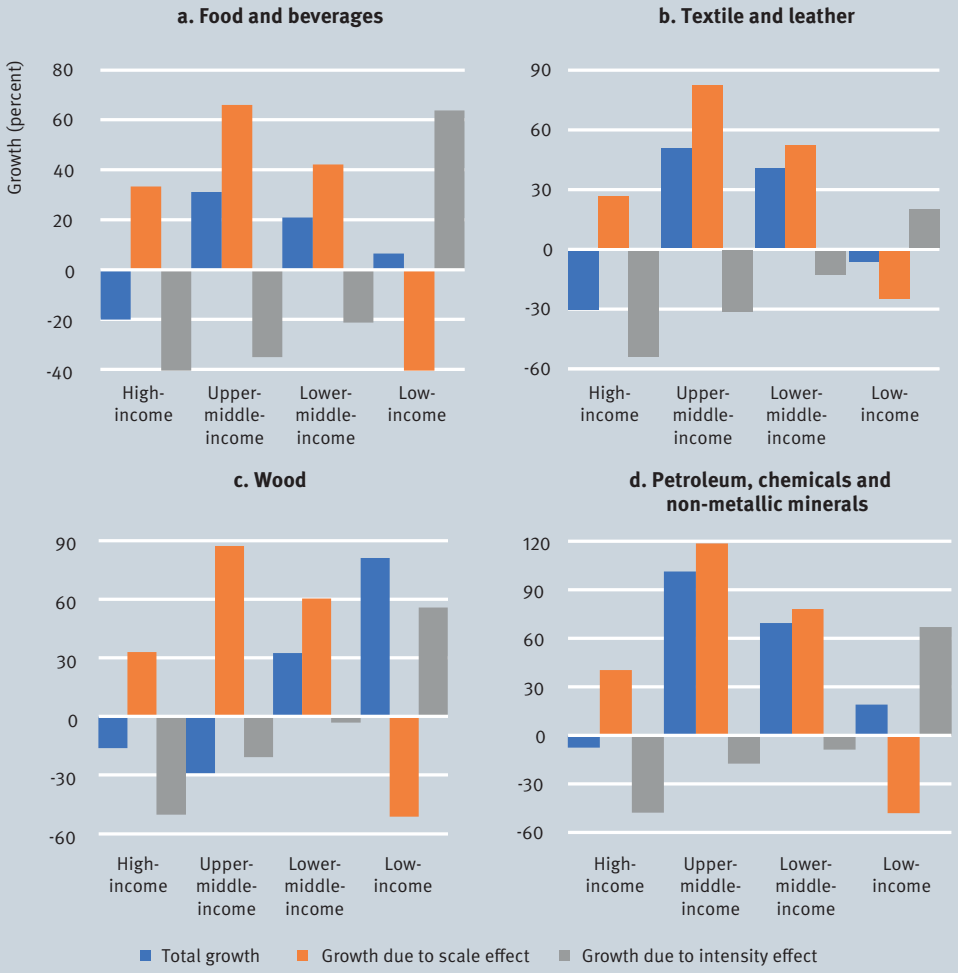
Figure 4.4
Trend and variation in the intensity effect of CO_2 production and material use

Note: All values are for the period 1995-2013. Income classification is based on Appendix Table C.4.

Source: Mazzanti and Nicolli (2017) based on the Eora Multi-Region Input-Output database (Lenzen et al. 2012; Lenzen et al. 2013).

All income groups show increasing emissions for transport equipment (Figure 4.5g). Intensity improvement to partially compensate for scale effects is only present in high-income areas. There is considerable scope for improvement, particularly in high- and upper-middle-income countries. In low-income countries, the increase in emissions is low, again due to the weak effects of scale, not improvements in intensity. Recycling shows significant intensity effects that compensate for the effects of scale in all but low-income countries, but this is only sufficient in high-income countries to create an overall reduction of emissions over the period (Figure 4.5h). The fall in emissions in low-income countries is due to a decline in output as intensity has risen.

Figure 4.5
Decomposition of CO_2 emissions across manufacturing industries



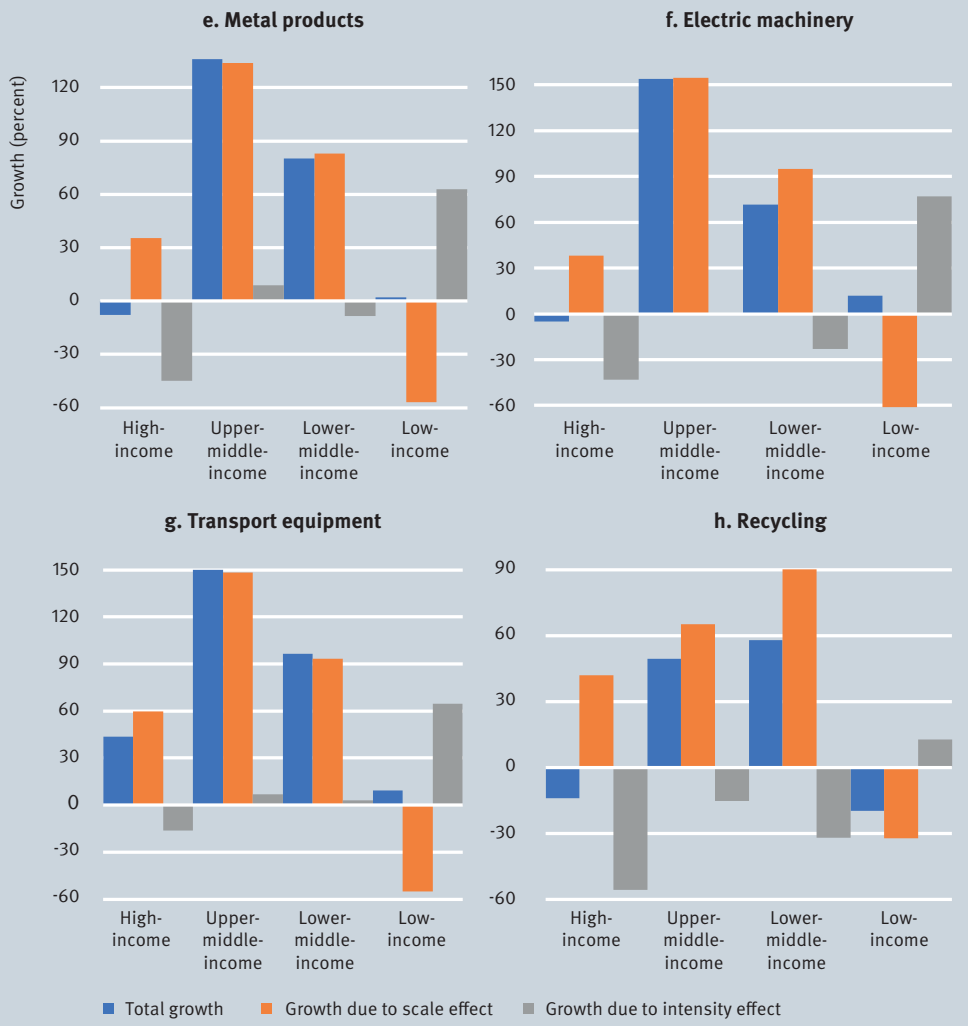
Note: All values are for the period 1995-2013. Income classification is based on Appendix Table C.4.

Source: Mazzanti and Nicolli (2017) based on the Eora Multi-Region Input-Output database (Lenzen et al. 2012; Lenzen et al. 2013).

A similar analysis is conducted for material use by subsector. The food and beverages subsector showed an overall increase in material use in all country groups except high-income countries (Figure 4.6a). Intensity improvements were achieved by all, except low-income countries, but these were not sufficient to compensate for scale effects. The decline in material use in low-income countries was attributable to a decline in output, not an improvement in efficiency because of a fall in intensity. This is an important policy message, given the importance of the industry in many low- and lower-middle-income countries and the strong links between the industry and other parts of the value chain.

For textile and leather, all four income groups, including low-income countries, showed an improvement in intensity (Figure 4.6b). In high-income countries where this subsector has shrunk relatively in size, the intensity and scale effects practically compensated for each other. In upper- and lower-middle-income countries that witnessed strong scale effects, intensity also improved, but not sufficiently to offset the impact of scale. In low-income countries, the decline in material use was driven by a combination of scale and intensity as output declined. For wood, both upper- and lower-middle-income countries as well as high-income countries introduced innovation processes that improved efficiency and reduced the intensity of material use (Figure 4.6c). Total material use declined in upper- and lower-middle-income countries, but not in high-income countries where scale effects offset the improvement in intensity. Low-income countries had no improvement in intensity and an increase in material use.

Figure 4.5 (continued)

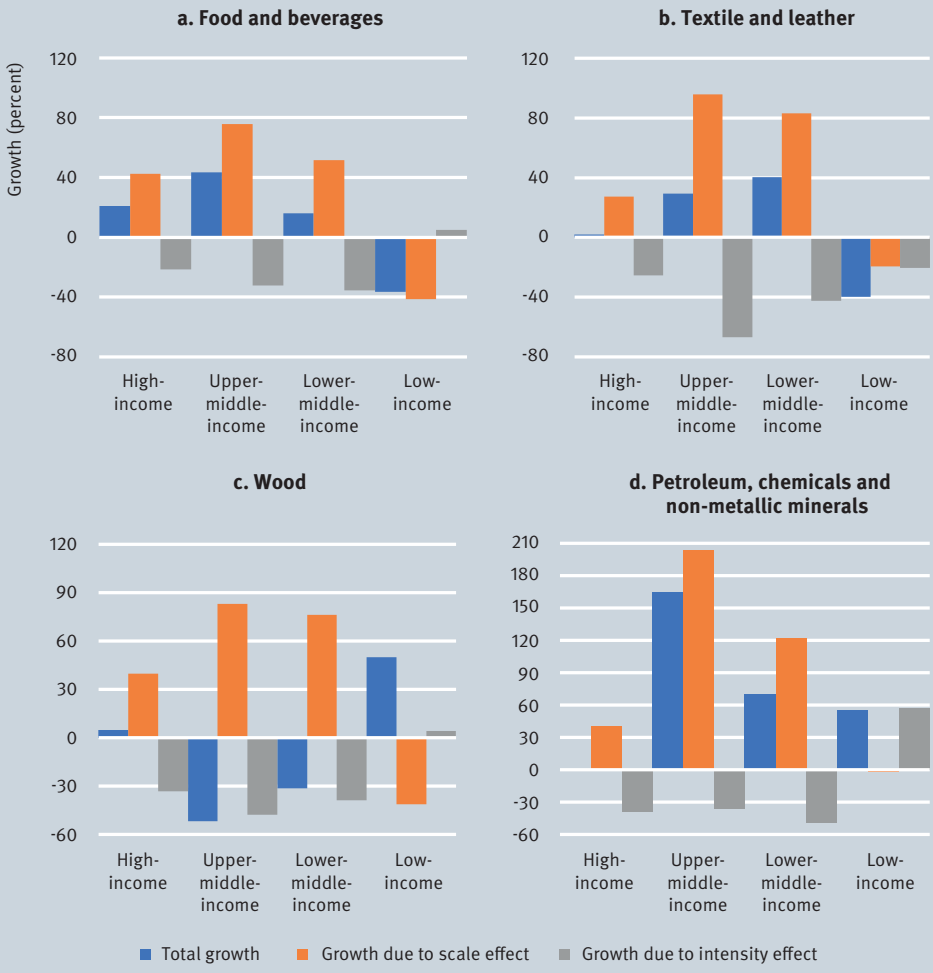


Note: All values are for the period 1995-2013. Income classification is based on Appendix Table C.4.

Source: Mazzanti and Nicolli (2017) based on the Eora Multi-Region Input-Output database (Lenzen et al. 2012; Lenzen et al. 2013).

Petroleum, chemicals and non-metallic minerals, electrical machinery and metal products are heavy polluting subsectors, where innovation is expected to be significant. Intensity reductions were achieved in all countries apart from low-income countries, but nonetheless, scale effects dominated in upper- and lower-middle-income countries (Figures 4.6d to 4.6f). In high-income countries, the scale effect of output growth precisely balanced the improvement in efficiency for petroleum, chemicals and non-metallic minerals, and there was no net growth. The intensity improvement in electrical machinery in high-income countries was strong enough to reduce material use.

Figure 4.6
Decomposition of material use across manufacturing industries

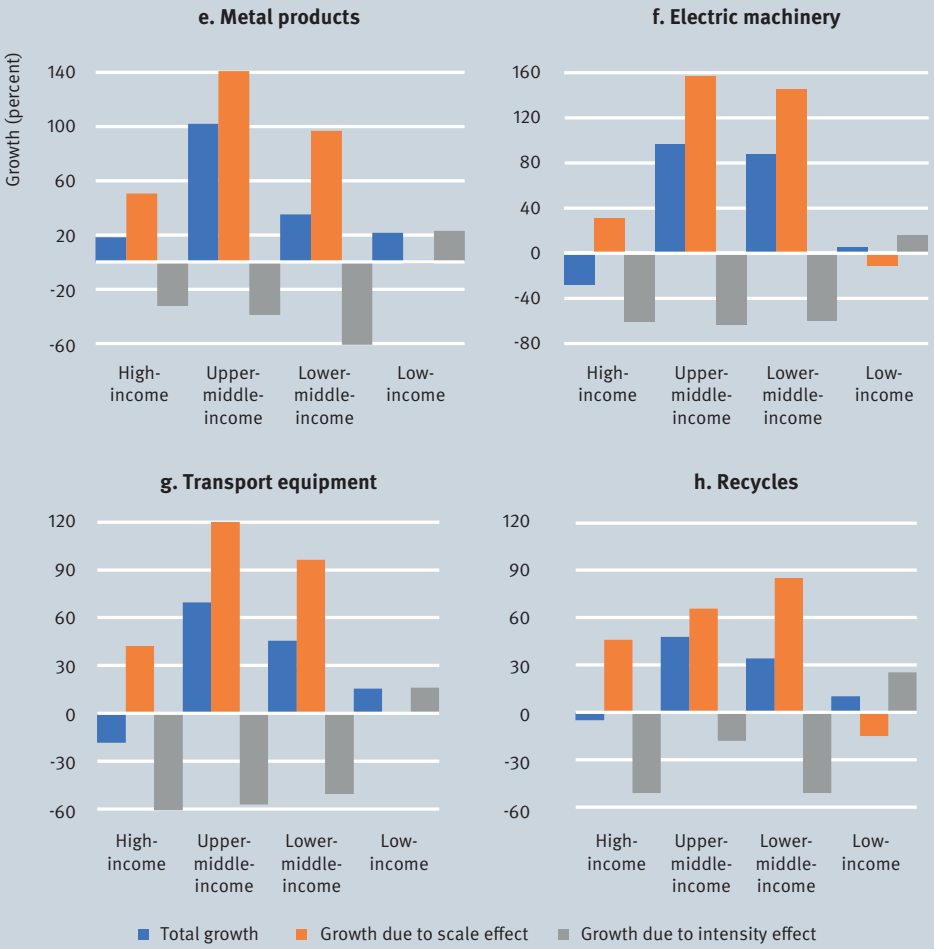


Note: All values are for the period 1995-2013. Income classification is based on Appendix Table C.4.

Source: Mazzanti and Nicolli (2017) based on the Eora Multi-Region Input-Output database (Lenzen et al. 2012; Lenzen et al. 2013).

For transport equipment, the picture differs from that of CO_2 emissions (Figure 4.6g). Intensity improvements were achieved by each group apart from low-income countries, and in high-income countries, unlike with CO_2 emissions, these were sufficient to result in a drop in total material use. Recycling showed significant intensity improvements that partially compensated for the effect of scale, but only in high-income countries were they sufficient to lead to a modest reduction of material use over the period (Figure 4.6h).

Figure 4.6 (continued)



Note: All values are for the period 1995-2013. Income classification is based on Appendix Table C.4.

Source: Mazzanti and Nicolli (2017) based on the Eora Multi-Region Input-Output database (Lenzen et al. 2012; Lenzen et al. 2013).

Summary

The manufacturing sectors in the two wealthiest areas of the world have generally been the drivers of intensity improvements. The decomposition analysis reveals clear evidence of improvements in environmental efficiency defined as a fall in the intensity measure used here. This is apparent in all but in low-income countries and is higher in the case of reductions in material use compared with CO_2 emissions. However, over the period considered, the reduced intensity, which depends on innovation generation and diffusion, is generally not large enough to compensate for the scale effects created by the expansion of production. In addition, this improvement in environmental intensity has not been transferred to low-income countries, which have witnessed a decline in environmental efficiency. In the decomposition analysis,

the composition effects were negligible compared with intensity effects, suggesting that in relation to environmental impact, innovation appears to matter more than structural change within manufacturing.

More disaggregate analysis highlights the heterogeneity within manufacturing in relation to the role of scale and intensity effects. The position broadly is that some subsectors located in high-income countries have sufficiently improved their efficiency to compensate for the scale effect through improved intensity, whilst this positive trend does not yet exist in low-income countries.

The results show a significant heterogeneity between subsectors within manufacturing, which provides a rationale for more extensive subsector-oriented policies that can provide an integrated approach towards energy and material use (Borghesi et al. 2015a, 2015b). Even if general environmental policies inevitably generate differentiated incentives across subsectors due to differences in abatement cost, there is still a case for specific policies tailored to the needs of specific areas. Subsector-based environmental tax reforms are often discussed in the context of climate change. Revenue collected from such taxes can be spent on specific goals, such as support for innovation that reduces energy intensity and strengthens the circular economy that utilizes waste in as many productive areas as possible.

There is recognition that environmental policy should be integrated with innovation and industrial policy, so that industrial and environmental objectives are consistent and trade-offs are acknowledged (Antonioli et al. 2014). There is a clear trade-off between manufacturing expansion and environmental degradation, and it is the role of policy to ensure that this is minimized by encouraging innovation to reduce environmental intensity and supporting industries with a low environmental footprint. Growth, innovation and development are intertwined: the challenge is to compensate the effects of growth on the environment by broad innovation investments (technological and non-technological, including human capital) that create higher efficiency in the use of environmental resources. Innovation is much more than patented technology, consisting of both tangible and intangible knowledge flows as well as complementary organizational change and training in terms of human capital formation, and skills development. Better social, environmental and economic performance can be achieved from the complementary use of diverse forms of innovation.

Notes

1. Among the first contributions were Grossman and Krueger (1991) and Shafik and Bandyopadhyay (1992).

CHAPTER 5

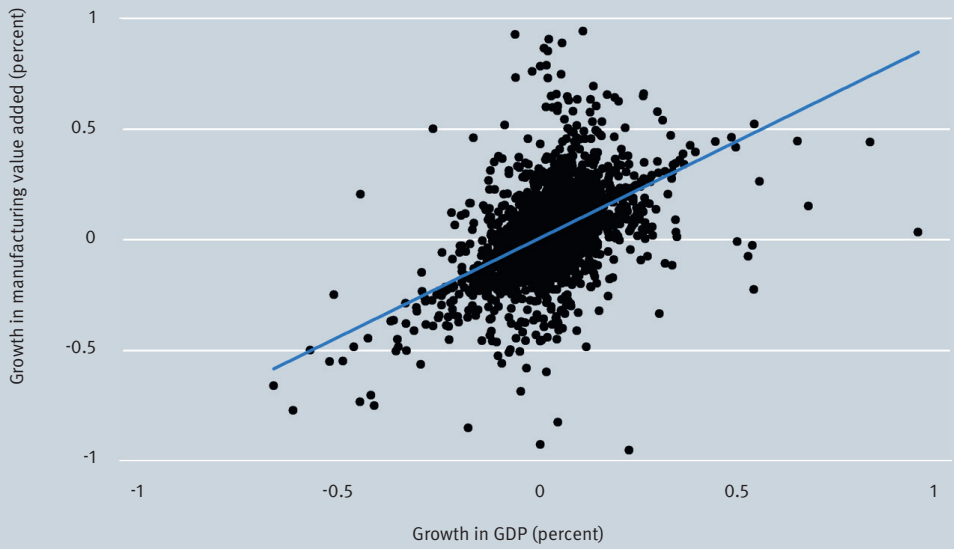
WHAT DRIVES SUCCESSFUL INDUSTRIALIZATION?

How do economies sustain rapid industrialization?

The theoretical case for industry and specifically manufacturing as a special engine of growth discussed in Chapter 1 remains valid for today's developing economies. There is considerable empirical evidence to support the industrialization-growth nexus, which is described graphically in Figure 5.1 by plotting GDP growth against manufacturing growth for a large sample of countries. Hausmann et al. (2005), for example, find that episodes of growth acceleration are often associated with an increasing role of manufacturing in the economy. Szirmai and Verspagen (2015) analyse the importance of manufacturing as a driver of economic growth using data for 88 countries (21 advanced economies and 67 developing economies) over the period 1950-2005. They report that manufacturing has a positive impact on economic growth. Cantore et al. (2014) obtain similar results using a sample of 80 countries. Whilst there is also evidence that some countries have embarked on a path of growth not driven by rapid industrialization (Diao et al. 2017; Rodrik 2016), Haraguchi et al. (2017) argue that this trend should not be interpreted as one that downplays the importance of manufacturing as an engine of growth. Using very detailed data drawn from different sources, they show that the significance of manufacturing for developing countries has not faded over the last decades, but has instead been concentrated in a small number of highly populated countries (Haraguchi et al. 2017). Wood (2017) arrives at a similar conclusion, but from a different perspective. He demonstrates that the pattern of re-distribution of manufacturing is consistent with the results of a standard model of international trade based on countries' relative factor endowments. Over time, manufacturing value added has moved towards countries in Asia, which are labour-abundant but have a scarcity of skills and land, while this trend has failed to reach land-abundant countries in Africa and Latin America.

The increasing concentration of manufacturing activity within a sub-set of the group of developing countries raises the question of what the characteristics of these countries were and how far their success in attracting manufacturing was due to their policy choices and how far it was the result of factors beyond government control such as geographical location, population structure or natural resource endowments. If common characteristics can be identified, this can inform the policy options for governments of economies wishing to emulate their success. Why have some countries—more than others—been successful in maintaining a sustained pattern of industrialization over the last decades? Policies obviously play a decisive role. For example, Newman et al. (2016) review the causes of weak manufacturing development in Africa by comparing it to successful cases in East Asia, and claim that the role of policies is key in explaining the different patterns observed in the two country groups. Rodrik (2007) discusses the role of policies in promoting industrialization and emphasizes the importance of strategic collaboration between the government and the private sector. In the context of an open economy, he argues that successful industrial policies should be based on a combination of targeted interventions to promote new export industries and a competitive exchange rate. Aghion et al. (2011) argue that sectoral policies can foster productivity and economic growth when they target the most competitive sectors. A similar argument has been put forward by promoters of the 'new structural economics' approach, namely that countries should pursue a path of development that is based on the identification and exploitation of existing and latent comparative advantage (Lin 2012).

Figure 5.1
Visualizing the industrialization growth nexus



Note: All values are for the period 1970-2014 and in constant 2005 $. GDP is gross domestic product.

Source: Martorano et al. (2017) based on the National Accounts Main Aggregates Database, by the United Nations Statistics Division, ©2015 United Nations. Reprinted with the permission of the United Nations.

Obviously, the successful and extensive experience of many Asian economies with industrialization and structural transformation over the last decades represents the most relevant example for other low- and middle-income countries. Asian countries display a set of policies and institutional conditions that have pushed rapid industrialization and structural change. Yet in contrast to the current evidence of premature deindustrialization in developing countries (Rodrik 2016), many Asian countries still exhibit a strong specialization in manufacturing alongside sustained economic growth (Diao et al. 2017; Wood 2017). The key elements for such success stories can be found, among others, in the capacity to implement a transformation based on labour-saving technological change combined with high levels of investment in human and physical capital (Aizenman et al. 2012; Martorano et al. 2017).

In light of the above, the objective of this chapter is to analyse the drivers of successful industrialization in developing countries. The analysis involves two steps. First, a group of rapid industrializers are selected by applying a simple analysis to define successful industrialization as a sustained pattern of rapid growth of manufacturing value added. Second, their experiences are examined to establish whether common factors exist. The empirical analysis of the determinants of successful cases of industrialization among a large group of emerging and developing countries is conducted for two different periods, 1971-1990 and 1991-2014. The idea of using 1990 as a turning point follows Rodrik (2016), who shows that pre- and post-1990 trends in manufacturing employment are statistically distinguishable. The post-1990 period is not only characterized by strong political changes, but is also a phase during which economic globalization began to accelerate, marking important changes in the organization of international production and thus affecting the industrialization patterns of the majority of countries. Understanding the drivers of successful and sustained processes of industrialization

raises important policy implications for a number of developing countries, particularly in sub-Saharan Africa, Latin America and South Asia, which are still underperforming in terms of industrialization and their capacity to link with regional and global production networks.

Identifying successful industrializers

A group of successful industrializers is identified by comparing their manufacturing value added growth rates and the average for the full sample. An 'episode' of industrialization is defined as any year in which the annual rate of manufacturing value added growth is higher than the corresponding average annual growth rate of the reference group or period. A larger number of episodes than the average is required to be included in the successful group. In addition, only those countries that recorded more than 75 percent episodes of above average growth (that is 16 or more years of high growth for the first period and 18 or more years of high growth for the second period) are selected (see Appendix B).

Table 5.1 provides the list of successful industrializers for each period with some summary statistics. The list is dominated by Asian countries, including the early East Asian Tigers, and newly industrialized countries during the first period, and large emerging economies as well as production hub economies involved in global and regional value chains during the second period.

These countries' manufacturing value added not only grew rapidly over a long period of time, but they also experienced structural change with increases in the share of manufacturing value added in GDP. At the beginning of the two periods, i.e. 1970 and 1991, the respective groups of successful industrializers with the exception of China had a lower share of manufacturing in GDP than the average of other developing countries (Table 5.2). After two decades, the majority of successful industrializers had a higher manufacturing share than the average of other developing countries. Even those countries that had a lower manufacturing share than the average increased their manufacturing share significantly.[1]

Aside from economy-wide structural change, such successful industrialization involves structural change within manufacturing, with a shift away from consumer goods to capital goods (Hoffman 1958). Figure 5.2 illustrates this indicator of structural change within manufacturing, with the speed of change shown by the slope of the lines for each country.[2] The Y-axis represents the ratio of consumer to capital goods value added. The required value-added data for the set of industries over the period since 1970 are limited, especially for post-1990 successful industrializers.

Table 5.1
List of successful industrializers

	Country	Total number of episodes	Number of negative episodes	Average growth in manufacturing value added for the period
1971 – 1990	Indonesia	19	0	13.5
	Malaysia	17	1	11.0
	Oman	16	3	19.0
	Republic of Korea	18	1	14.3
	Thailand	16	1	10.1
	Turkey	16	2	6.5
1991 – 2014	Bangladesh	18	0	7.7
	Cambodia	20	1	12.6
	China	20	0	9.9
	India	18	0	7.6
	Lao People's Democratic Republic	20	0	9.7
	Myanmar	20	0	15.2
	Viet Nam	21	0	10.4

Note: All values are in constant 2005 $. A successful industrializer is identified by comparing its growth in manufacturing value added to the average of other developing countries (classified as such at the point of comparison). An 'episode' of industrialization is defined as any year in which the annual growth rate of manufacturing value added is higher than the average annual growth rate of the reference group or period. To be included in the group of successful industrializers, a larger number of episodes than the average is required. In addition, only those economies that recorded more than 75 percent episodes of above average growth (16 years or more of high growth for the first period and 18 years or more of high growth for the second period) are selected. See Appendix B for details on the selection process.

Source: Martorano et al. (2017) elaboration based on the National Accounts Main Aggregates Database, by United Nations Statistics Division, ©2015 United Nations. Reprinted with the permission of the United Nations.

The figure therefore only includes four countries from the pre-1990 group, one country (India) from the post-1990 group, and the long-term trends in Germany, Japan and the United Kingdom for reference purposes. The recently successful industrializers followed the pattern of early industrializers and changed their manufacturing structure by steadily increasing the contribution of capital goods industries to total manufacturing value added relative to that of consumer goods industries. As indicated by the slope of their curves, the speed of structural change in the successful industrializers covered here was much faster than that of Germany and the United Kingdom in early periods. The Republic of Korea is an extreme example of this, as it took around 40 years to reduce the ratio from over 2 to the level commonly observed in industrialized countries (around 0.5), while it took the United Kingdom and Germany over 100 years and Japan around 70 years to achieve such a transformation.

Table 5.2
Structural transformation in successful industrializers

	Country	Successful economies	Indonesia	Malaysia	Oman	Republic of Korea	Thailand	Turkey	Other developing economies
1970	Agriculture	23.42	29.45	23.45	1.41	17.27	22.03	25.75	14.21
	Manufacturing industries	9.96	5.88	11.12	0.68	7.84	15.57	11.75	17.08
	Non-manufacturing industries	14.83	28.59	33.25	72.01	13.1	7.76	7.91	21.62
	Services	51.79	36.09	32.18	25.89	61.79	54.64	54.59	47.44
1975	Agriculture	19.73	23.38	24.33	1.45	14.92	20.05	21.31	12.93
	Manufacturing industries	12.73	7.63	13.44	0.67	12.12	19.24	14.34	18.07
	Non-manufacturing industries	15.19	31.86	25.51	71.73	12.51	5.98	7.96	21.16
	Services	52.36	37.13	36.72	26.14	60.45	54.74	56.39	48.23
1980	Agriculture	16.33	20.03	20.18	1.74	9.61	16.62	20.11	11.45
	Manufacturing industries	14.24	10.79	15.52	0.71	15.78	20.89	13.42	18.65
	Non-manufacturing industries	16.17	29.57	26.77	68.44	14.73	7.23	7.60	19.69
	Services	53.26	39.6	37.53	29.10	59.87	55.26	58.87	50.59
1985	Agriculture	13.94	18.58	17.95	1.28	8.83	15.67	16.54	11.85
	Manufacturing industries	16.5	15.82	15.29	2.05	17.68	20.31	15.92	18.57
	Non-manufacturing industries	15.81	24.01	27.42	67.24	13.8	9.23	8.51	17.89
	Services	53.75	41.59	39.34	29.43	59.69	54.79	59.03	52.06
1990	Agriculture	11.02	15.76	16.25	1.53	5.78	11.17	14.75	10.82
	Manufacturing industries	19.58	19.04	21.11	2.62	20.36	25.17	17.7	18.8
	Non-manufacturing industries	15.52	21.54	24.32	68.75	14.34	10.3	8.95	19.28
	Services	53.88	43.66	38.32	27.11	59.52	53.36	58.61	51.39

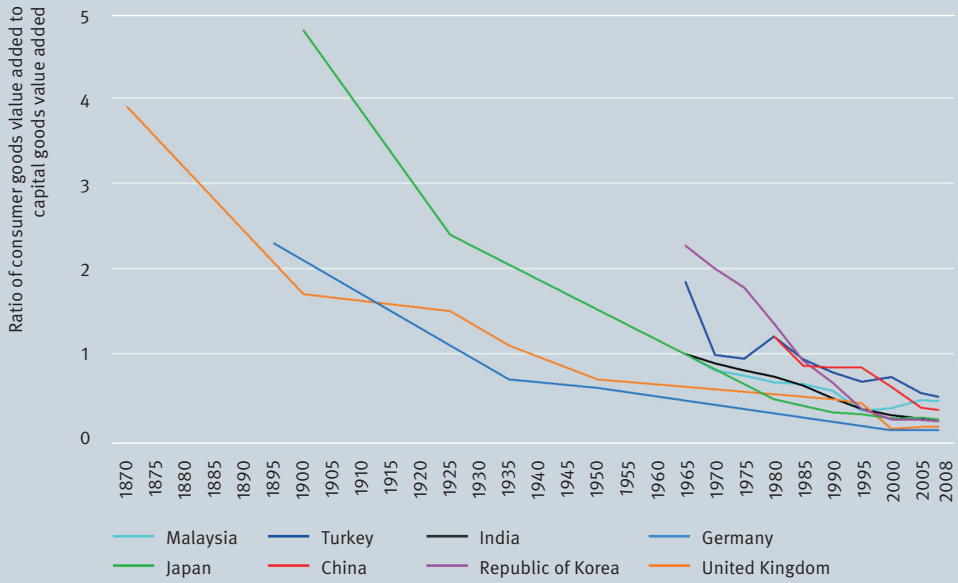
Table 5.2 (continued)

	Country	Successful economies	Bangladesh	Cambodia	China	India	Lao People's Dem. Rep.	Myanmar	Viet Nam	Other developing economies
1991	Agriculture	27.82	26.60	49.6	26.11	30.33	47.47	58.49	32.89	10.22
	Manufacturing industries	25.36	12.98	7.40	30.97	16.97	5.49	6.79	12.75	17.05
	Non-manufacturing industries	7.53	7.25	3.28	2.98	15.78	8.63	1.99	15.09	19.64
	Services	39.29	53.18	39.72	39.95	36.93	38.41	32.73	39.27	53.39
1995	Agriculture	22.20	23.51	46.97	19.58	27.32	46.25	56.94	27.68	9.76
	Manufacturing industries	28.12	15.16	7.86	32.83	19.38	6.39	7.29	13.69	17.20
	Non-manufacturing industries	10.55	8.26	5.90	8.63	14.88	10.00	2.88	18.12	19.28
	Services	39.13	53.07	39.27	38.95	38.42	37.36	32.9	40.52	53.98
2000	Agriculture	18.06	23.17	39.19	15.47	23.50	44.07	54.33	24.24	9.57
	Manufacturing industries	27.46	15.45	15.22	31.52	18.64	7.69	8.20	16.44	17.48
	Non-manufacturing industries	12.95	9.35	6.08	12.26	14.63	11.78	3.43	21.66	19.17
	Services	41.53	52.03	39.51	40.74	43.23	36.46	34.04	37.66	53.95
2005	Agriculture	14.27	20.14	32.4	12.06	19.32	36.25	46.69	21.01	9.52
	Manufacturing industries	28.53	16.53	18.79	32.34	18.88	8.53	12.8	20.49	17.27
	Non-manufacturing industries	14.83	10.69	7.58	14.68	15.36	14.7	4.71	21.02	18.32
	Services	42.37	52.63	41.23	40.93	46.43	40.52	35.8	37.48	55.06
2014	Agriculture	9.01	17.01	25.61	7.43	13.32	24.67	31.02	16.62	8.87
	Manufacturing industries	31.27	20.49	22.16	34.7	19.92	9.47	20.58	25.61	16.21
	Non-manufacturing industries	13.46	11.63	8.78	13.71	12.61	21.8	6.54	16.65	16.29
	Services	46.26	50.87	43.45	44.17	54.16	44.06	41.85	41.12	58.75

Note: All values are in percentages. See Table 5.1 for definition of successfully industrialized economies. Economic sector classification based on Appendix Tables C.5.

Source: Martorano et al. (2017) elaboration based on the National Accounts Main Aggregates Database, by United Nations Statistics Division, ©2015 United Nations. Reprinted with the permission of the United Nations.

Figure 5.2
Compared to industrialized economies, today's emerging economies have witnessed rapid structural change



Note: The speed of structural change is calculated as consumer goods value added as a share of capital goods value added. Consumer goods include (ISIC rev. 3) 15, 16, 18 and 36. Capital goods include (ISIC rev. 3) 24, 26, 27, 28, 29 and 34. See manufacturing sector classification in Appendix Table C.6.

Source: Martorano et al. (2017) elaboration based on Hoffman (1958) and Haraguchi (2014).

In terms of their manufacturing growth, Table 5.3 shows that in the first period, all successful industrializers with the exception of Turkey progressed by at least two deciles in the global distribution of manufacturing value added per capita over 1970-1990. Over 1990-2015, all successful industrializers in the second period improved their places on this measure by at least one decile. At the same time, all successful industrializers with the exception of Oman advanced by at least one decile by per capita income.[3] The association between decile improvements in per capita manufacturing value added and GDP was strong, in particular in the cases of China and the Republic of Korea–the highest performers in 1970-1990 and 1990-2015, respectively. The Republic of Korea advanced by three deciles (from third to eighth) on per capita manufacturing value added and by four deciles on per capita GDP. Over 1990-2015, China moved five deciles (from fifth to eighth) on per capita manufacturing value added and four deciles (from second to sixth) on per capita GDP.

Table 5.3
A characterization of successful industrializers

Country	Manufacturing value added per capita			GDP per capita		
	1970	1990	1970-1990 change	1970	1990	1970-1990 change
Indonesia	1	4	3	3	4	1
Malaysia	5	8	3	5	8	3
Oman	5	7	2	6	7	1
Republic of Korea	2	5	3	8	8	0
Thailand	4	6	2	3	5	2
Turkey	7	7	0	7	8	1

Country	Manufacturing value added per capita			GDP per capita		
	1990	2015	1990-2015 change	1990	2015	1990-2015 change
Bangladesh	2	3	1	1	2	1
Cambodia	3	8	5	2	6	4
China	3	4	1	2	3	1
India	1	4	3	1	2	1
Lao People's Democratic Republic	1	2	1	1	3	2
Myanmar	1	3	2	1	2	1
Viet Nam	1	3	2	1	3	2

Note: All values are in constant 2005 $. GDP is gross domestic product. China's deciles on manufacturing value added per capita for 1990 is based on value added generated by the industrial sector comprised in accordance with the International Standard Industrial Classification codes C-E of ISIC Rev. 3 (see Appendix Table C.5). The correlations between deciles changes in manufacturing value added and GDP over the periods 1970-1990 and 1990-2015 are 0.61 and 0.75, respectively.

Source: UNIDO elaboration based on World Development Indicators (World Bank 2016) and the INDSTAT2, Rev. 3 database (UNIDO 2016).

Building a model for identification

The econometric analysis aims to establish the key factors that influence the probability of a country being included in the group of successful industrializers. The set of explanatory variables used are summarized in Table 5.4. Following the literature (Chenery and Syrquin 1975; Haraguchi 2016; Lin 2012), these variables refer to economic, demographic, institutional and policy-related factors that may have affected the incidence of successful industrialization over the period of analysis.

A key variable is the level of real GDP per capita (*LGDP_PC*), which is used to account for cross-country differences in stages of development. Such differences may matter since countries that start from lower levels of economic development have more probability catching up with more advanced countries and therefore, to undertake sustained patterns of industrialization.

There is evidence that poorer countries are characterized by a higher productivity growth rate in their manufacturing sector, which creates an unconditional convergence with the technological frontier (Rodrik 2013).

To control for the role of investment, the ratio of gross fixed capital formation (private and public) to GDP (*GFCF_GDP*) is used. Higher investment is expected to promote industrialization by stimulating aggregate demand and boosting productive capacity (Weiss and Clara 2016). As a result, higher investment can play a key role in sustaining the development of national producers, thus fostering structural transformation, and can be seen as a prerequisite for long-term growth (Cornia and Martorano 2012).

Several growth theories also emphasize the crucial role of human capital in preventing returns to capital from falling and contributing to an increase in the capability for innovation and the adaptation of new technology (Romer 1986). This is clearly relevant for industrialization. To capture this effect, a variable representing human capital endowments measured by the average number of years of education of the workforce (*HC*) derived from the Barro-Lee (2013) dataset, is included.

Information on domestic credit to the private sector as a percentage of GDP is used to control for the level of financial development (*CREDIT*). The nexus between financial development and production is well known, with claims that well-functioning financial institutions boost technological innovation by selecting and funding winners in the sense of entrepreneurs with a high probability of implementing innovative processes and creating innovative products. There is a large body of literature that focuses on the role of financial systems in promoting savings and investment by individuals and firms, especially within manufacturing (Rajan and Zingales 1998).

Measures of economic policies related to international openness and integration are also included since they can—directly or indirectly—affect manufacturing development. First, the real effective exchange rate (*REER*) is included. This variable can play an important role in fostering the productive sector. Specifically, a stable and competitive exchange rate is expected to promote the growth of internationally tradable production (Martorano and Sanfilippo 2015). A competitive exchange rate is arguably more effective in promoting a nascent domestic manufacturing sector compared with import tariffs, especially in countries that specialize in labour-intensive industries (Helleiner 2011). Second, an indicator of capital account openness (*KAOPEN*) is also included. The capital account can create both positive and negative spillovers to the domestic economy, and it has been managed differently by developing countries over time. Opening to capital inflows can lower interest rates and allow firms to borrow, thus raising their investment (Chari et al. 2012). On the other hand, capital account liberalization can lead to higher volatility and economic instability (Cornia 2012).

The countries' institutional conditions also need to be considered, as stable institutions have been identified as a key precondition for economic development as well as a way of ensuring a good business climate for the private sector (Alesina et al. 1992; Xu 2010). The number of consecutive years under the current regime type (Boix et al. 2013, 2014) is used here as a proxy for political stability (*POL*). The underlying idea is that a strong and stable government can ensure the successful implementation of the long-term policies and plans necessary to promote the development of new industries.

Table 5.4
Description of variables and their impact on the incidence of successful industrialization

Variable	Description	Source
LGDP_PC	Level of real GDP per capita	INDSTAT2, Rev. 3 (UNIDO 2016)
GFCF_GDP	Gross fixed capital formation, both private and public as a percentage of GDP	
REER	Real effective exchange rate	Darvas (2012a,b)
KAOPEN	Indicator of capital account openness	Chinn and Ito (2008)
HC	Average number of years of education of the workforce	Barro and Lee (2013)
POL	Number of consecutive years of current regime type	Boix et al. (2013, 2014)
LANDLOCKED	Dummy accounting for each country's access to the sea	CEPII Market Potentials database (Mayer 2008)
GOV_INV	Investment by government on GDP	IMF Financial Data (2016)
PRIV_INV	Private investment on GDP	
LWAGE_OC	Cost of labour	Lapova et al. (2015); Haraguchi et al. (2017)
CREDIT	Domestic credit to private sector as a percentage of GDP	World Development Indicators (2016)
NAT_RES	Share of mineral rents as a percentage of GDP	
TARIFFS	Average applied tariffs	
TARIFFS M	Average applied tariffs, manufacturing sector	
LEND_RATE	Lending interest rate	Quality of Government Standard Dataset (Teorell et al. 2017)
PATENTS	Log number of patent applications	
I_DEBT	Interests on external debt	
AGE_DEP	Age dependency ratio (percentage of working age population)	
GINI	Gini coefficient	
RELIGION	Religious fragmentation	

Note: GDP is gross domestic product, which together with gross fixed capital formation is in constant 2005 $.
Source: UNIDO elaboration based on Martorano et al. (2017).

A measure of natural resource endowments, given as the share of mineral rents as a percentage of GDP (*NAT_RES*), is also added. Greater reliance on natural resources can increase cyclical fluctuations in national income and raises the probability of negative performance in the long run (Rodriguez and Sachs 1999). More specifically, Sachs and Warner (2001) use the Dutch disease argument to point out the potential detrimental effects of high natural resource rents on the development of the manufacturing sector.

Finally, factors related to geography can also impede industrialization. A dummy variable accounting for each country's access to the sea (*LANDLOCKED*) is included. Landlocked countries have fewer opportunities to trade, and such a geographic constraint can hamper the ability of those countries to increase productivity due to their limited access to large markets and consequently their limited scope to exploit economies of scale (Easterly and Levine 2003; Sachs and Warner 1995).

Analysis: the determinants of successful industrialization

Table 5.5 presents the main output of the analysis in which the variables described above are regressed against a dummy variable identifying the successful industrializers vis-à-vis other countries in the sample, for both the entire period (Column 1) and the two sub-periods (pre- and post-1990, Columns 2 and 3, respectively).

The coefficient related to the level of real GDP per capita is negative and statistically significant for the different time periods. This result is consistent with standard patterns of structural transformation identified in previous studies (Timmer et al. 2016), and confirms that countries that experienced a prolonged period of high manufacturing growth are generally those at earlier stages of economic development. This pattern is consistent across the different time periods. Though this might seem to contradict the trend of 'premature deindustrialization' in the most recent period as discussed in Chapter 6, it does not seem to be an issue in this analysis considering that the successful industrializers in the post-1990 period are Asian countries that have not been affected by this trend.

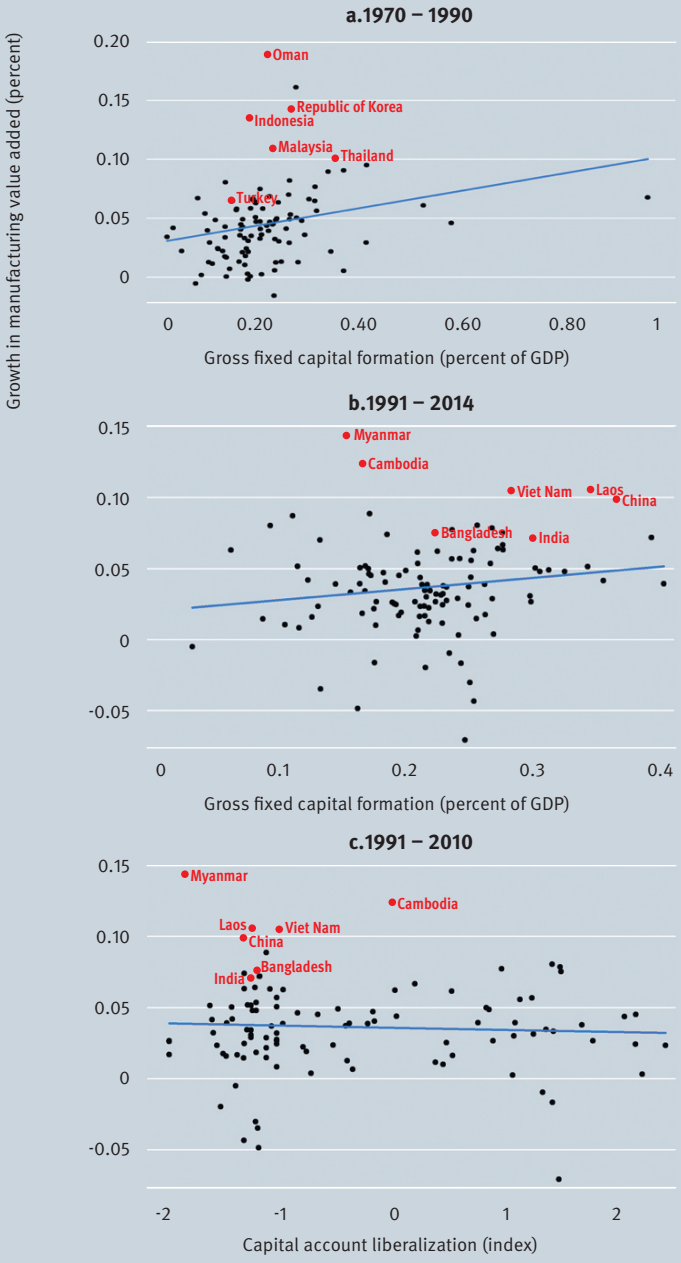
Second, Table 5.5 shows that investment was an important factor in the industrialization process over the entire period of analysis, although there are some differences when looking at the two sub-periods. While investment was a key ingredient in explaining the successful industrialization in the post-1990 period, the analysis indicates that it was less important in promoting industrialization in the pre-1990 period. One potential explanation is the characteristics of the countries considered and the models of specialization followed over time. Of the six successful industrializers over the first period, only two, namely the Republic of Korea and Thailand, had a ratio of gross capital formation to GDP higher than the global average in 1970. Development in the first wave of industrializers was mostly attributable to labour-intensive industries requiring lower capital-labour ratios, and the pre-1990 period is characterized by relatively low foreign investment inflows, which have more recently become an important component of capital formation (Amighini et al. 2017). On the other hand, investment played a key role in the development of countries such as China, India, Lao People's Democratic Republic and Viet Nam in the post-1990 period. These trends are illustrated in Figure 5.3. While the figure depicts a strong positive relationship between investment and industrialization over time, it also shows that over the period 1991–2014, successful industrializers (shown with red dots) represent a cluster with above average levels of investment to GDP compared to the rest of the countries included in the analysis.

Table 5.5
Results: Determinants of successful industrialization in different periods

Variable	(1) 1970-2014	(2) PRE-1990	(3) POST-1990
LGDP_PC	-0.444***	-0.190**	-1.701***
	[0.058]	[0.087]	[0.181]
GFCF_GDP	1.104***	-0.416	6.455***
	[0.263]	[0.325]	[0.810]
CREDIT	0.012***	0.010**	0.024***
	[0.001]	[0.004]	[0.003]
REER	-0.006***	-0.005***	-0.005*
	[0.001]	[0.001]	[0.003]
KAOPEN	-0.055	0.239***	-1.011***
	[0.035]	[0.045]	[0.181]
HC	0.062***	0.084*	0.105***
	[0.022]	[0.045]	[0.028]
POL	0.002***	-0.002	0.008***
	[0.001]	[0.002]	[0.002]
NAT_RES	-0.041**	-0.369***	-0.014
	[0.017]	[0.066]	[0.017]
LANDLOCKED	-0.528***		-0.752***
	[0.115]		[0.220]
Constant	1.839***	0.729	5.847***
	[0.455]	[0.604]	[1.041]
Observations	2,745	998	1,491

Note: Robust standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1
Source: Martorano et al. (2017) based on data sources in Table 5.4.

Figure 5.3
Rapid industrialization is fuelled by high levels of investments, especially after 1990



Note: GDP is gross domestic product. The data sample consists of developing countries only (see Appendix C.2 for industrialization level classification).

Source: Martorano et al. (2017) based on the National Accounts Main Aggregates Database, by the United Nations Statistics Division, ©2015 United Nations. Reprinted with the permission of the United Nations. Figure c. is also based on Chinn and Into (2008).

The results also show that human capital endowments, measured by the number of years of education, are among the key factors contributing to a sustained process of rapid industrialization. This result is in line with expectations. Many countries that experienced rapid industrialization, such as the early Asian Tigers (and most notably, the Republic of Korea) or more recently China, have invested in human capital to meet the increasing demand from expanding industries for an educated workforce, as well as by upgrading labour skills to match the technological requirements as industries move up the value chain (Jankowska et al. 2012). However, despite the evidence that a measure of human capital over the entire period had a strong influence on the likelihood of inclusion in the successful industrializer group, the result is weaker for the pre-1990 period. This may in part be because some of the successful countries, notably Indonesia and Thailand, did not perform as well in terms of human capital development as the global average in the period 1970-1990.

The level of credit to the private sector is an additional factor that explains countries' inclusion in the successful industrializer group, with the credit measure always being significant. It is well known that credit constraints hamper firms from exploiting investment opportunities (Levine 2005), and this is especially true in low-income settings (Aghion and Bolton 1997; Banerjee and Newman 1993). Moreover, credit availability also affects the innovation process and long-term growth (Aghion et al. 2004). Easier access to finance represents an important pre-requisite for firms to expand and for industry to grow quickly.

As regards the role of external policies, the results suggest that the successful industrializers adopted an undervalued exchange rate regime to allow the domestic sector to become more competitive, although the result is weaker for the post-1990 period. This tends to confirm the role of the exchange rate as an effective industrial policy tool, since these countries were able to promote their tradable sectors by keeping the real exchange rate low (Rodrik 2007).

Table 5.5 also shows that the coefficient measuring the degree of openness of the capital account was positive and statistically significant in the pre-1990 period, but turned negative in the post-1990 period. The result for the pre-1990 period can be explained by the model of development followed by countries included in the list of successful industrializers. During that period, the Republic of Korea and the other newly industrialized countries (Indonesia, Malaysia, Thailand) adopted more open policies to maximize the advantages from international integration in a period in which volatile financial flows were of lesser concern. By contrast, successful industrializers in the post-1990 period were those that implemented more restrictive policies towards the capital account, as shown in Figure 5.4. In this period, the coefficient on the degree of capital account openness is again significant, but is now negative. For example, the relatively closed capital account strategy gave China's economy a buffer against the negative consequences of financial crises which affected many other developing countries (Gallagher et al. 2014). A similar strategy was followed by India, which was able to reduce the volatility of its exchange rate and take advantage of the necessary policy space (Yoshino et al. 2015).

The results confirm the role of political stability as a driver of sustained industrialization over the entire period and for the post-1990 period, but not for the pre-1990 period, where the coefficient is insignificant and negative. Higher levels of stability should provide the appropriate environment to promote investment, and the negative sign is unexpected. The results also show that geographic characteristics and countries' endowments play a role. Geographic remoteness, as reflected in a landlocked location, potentially represents a major constraint

to the development of a strong industrial sector due to the difficulty of achieving economies of scale as a result of high transport costs. The coefficient on the landlocked dummy variable is negative and significant for the post-1990 period. It is omitted in the analysis for the period 1970 to 1990 due to the lack of landlocked countries in the list of successful industrializers. The Lao People's Democratic Republic is the only successful industrializer, as defined here, with no direct sea access.

Finally, as expected, the probability of a country to initiate a rapid and sustained process of industrialization reduces the higher is the dependence on natural resources. The coefficient on the natural resource variable is negative and significant over the entire period and pre-1990, but is not significant in the post-1990 period.

Other drivers

A set of additional specifications and robustness checks are introduced to take account of aspects not included in the core regressions due either to their high correlation/substitution with some of the key variables in the original analysis or the lack of a sufficient number of observations, especially for the earlier period and for some lower-income countries. Table 5.6 reports these results.

In Column 1, the investment variable is replaced by two new variables which differentiate between public and private investment. This may be of relevance, since the government can play a key role in providing basic infrastructure necessary for promoting industrialization. Recent contributions also emphasize the potential role public investment can play in terms of risk-taking, fostering technological development and innovation (Mazzucato 2013). Existing evidence also shows that in some of the successful cases of industrialization, such as in the Republic of Korea, public investment has been crucial in creating pecuniary externalities without crowding out private investment (Vos 1982). Table 5.6 confirms these assumptions and shows that private investment on its own has a positive and significant role in promoting industrialization. Both public and private investment variables are significant, and when the average marginal effect is computed, the coefficient is slightly higher in the case of public investment as compared to private investment (0.332 and 0.284, respectively).

In Column 2, the cost of labour is introduced by comparing countries according to their level of real wages per worker. Information provided in related works by Lavopa (2015) and Haraguchi et al. (2017), who collected data on the shares of manufacturing wages in total wages and on the total number of persons employed in manufacturing, have been merged to calculate an indicator of labour costs per worker. Including this variable in the model slightly reduces the number of observations, but does not affect the main results. The coefficient on the real wage variable is negative and significant, as expected, confirming another characteristic of successful industrializers, namely that their relatively lower labour cost (due, for instance, to an abundant labour force as in China or Bangladesh) has given them a competitive edge in developing a specialization in low value-added manufacturing, which can serve to initiate a process of successful industrialization.

Table 5.6
Additional determinants of successful industrialization

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
LGDP_PC	-0.492***	0.053	-0.691***	-0.586***	-2.713***	-2.724***	-0.298***	-0.364***	-0.424***	-0.516***
	[0.065]	[0.086]	[0.072]	[0.068]	[0.447]	[0.448]	[0.072]	[0.053]	[0.047]	[0.057]
GFCF_GDP	1.104***	0.388	2.097***	4.164***	21.958***	21.986***	1.319***	1.121***	1.561***	1.365***
	[0.263]	[0.308]	[0.377]	[0.922]	[3.570]	[3.579]	[0.288]	[0.251]	[0.279]	[0.263]
CREDIT	0.010***	0.019***	0.014***	0.003	0.045***	0.045***	0.012***	0.003**	0.014***	0.012***
	[0.001]	[0.002]	[0.002]	[0.002]	[0.008]	[0.008]	[0.002]	[0.001]	[0.002]	[0.001]
REER	-0.006***	-0.011***	-0.009***	-0.010***	0.007	0.007	-0.006***	-0.004***	-0.005***	-0.006***
	[0.001]	[0.002]	[0.002]	[0.002]	[0.005]	[0.005]	[0.001]	[0.001]	[0.001]	[0.001]
KAOPEN	-0.074**	0.093**	-0.133***	0.125**	-0.220**	-0.222**	-0.002	0.037	-0.026	-0.070*
	[0.035]	[0.042]	[0.049]	[0.049]	[0.097]	[0.098]	[0.037]	[0.032]	[0.036]	[0.037]
HC	0.056***	0.046	0.062***	-0.130***	0.208***	0.208***	-0.011			0.090***
	[0.021]	[0.039]	[0.022]	[0.032]	[0.065]	[0.065]	[0.018]			[0.019]
POL	0.002***	0.004***	0.001	-0.004***	0.007**	0.007**	0.002***	0.004***	0.001	0.002**
	[0.001]	[0.001]	[0.001]	[0.001]	[0.003]	[0.003]	[0.001]	[0.001]	[0.001]	[0.001]
NAT_RES	-0.043**	-0.166***	-0.012	-0.569***	-0.057*	-0.056*	-0.015	-0.032**	-0.006	-0.038**
	[0.019]	[0.040]	[0.010]	[0.109]	[0.034]	[0.034]	[0.010]	[0.016]	[0.011]	[0.016]
LAND-LOCKED	-0.669***		-0.450***		-0.951***	-0.957***	-0.582***	-0.399***	-0.560***	-0.520***
	[0.121]		[0.132]		[0.335]	[0.333]	[0.125]	[0.115]	[0.130]	[0.118]
GOV_INV	3.028***									
	[0.714]									
PRIV_INV	2.591***									
	[0.587]									

Table 5.6 (continued)

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
LWAGE_OC		-0.860***								
		[0.087]								
LEND_RATE			-0.018***							
			[0.006]							
PATENTS				0.323***						
				[0.035]						
TARIFFS					-0.014					
					[0.018]					
TARIFFS M						-0.014				
						[0.017]				
I_DEBT							-0.228***			
							[0.033]			
AGE_DEP								-0.026***		
								[0.003]		
GINI									-5.763***	
									[0.405]	
RELIGION										-0.730***
										[0.168]
Constant	1.993***	5.864***	0.108	2.645***	4.288**	4.323**	1.079**	3.619***	4.433***	2.523***
	[0.472]	[0.778]	[0.620]	[0.757]	[1.876]	[1.878]	[0.521]	[0.628]	[0.550]	[0.500]
Observations	2,617	1,354	1,785	1,233	736	736	2,426	3,072	2,944	2,745

Note: Robust standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1
Source: Martorano et al. (2017) based on data sources in Table 5.4.

The lending interest rate (in percent), representing the bank rate for meeting the financing needs of the private sector, is introduced in Column 3.[4] The coefficient is negative and statistically significant. This confirms the key role monetary policy can play in the process of industrialization, demonstrating that higher interest rates can have adverse effects on manufacturing firms by raising the cost of borrowing and thereby reducing their investment (Stiglitz 2017).

In Column 4, a variable reporting the number of patent applications as a proxy for countries' innovation potential is introduced. There is a wealth of literature on the link between the innovative capacity of a country, the ability to build national innovation systems and the sustainability of industrialization (Nelson and Winter 2009). The results indicate that the probability of being a successful industrializer is positively correlated with being innovative.
Information on trade policies, namely the average rates of applied tariffs, calculated for all goods (*TARIFFS*) and manufacturing alone (*TARIFFS M*) is included in Columns 5 and 6. Though tariffs are often used as an industrial policy tool, especially to protect infant industries (Storm

2017), here these variables are both insignificant with negative coefficients. Data coverage for these variables is poor and as averages, they reveal little about the differential impact of tariffs on manufacturing. The inconclusive result may also highlight the heterogeneity among countries, with a policy of tariff protection less compelling for labour-abundant than for labour-scarce countries, the latter being seen as those countries that are more likely to adopt import substitution policies (O'Rourke and Williamson 2017).

Column 7 introduces a variable for interest payments on external debt (percentage of gross national income) as a proxy for macroeconomic stability (*I_DEBT*). Although a stable macroeconomic environment is not a sufficient condition for promoting industrialization, it is arguably a necessary condition to stimulate investment. The results in Table 5.6 confirm these expectations, with a significant negative coefficient on the debt variable showing that countries that experienced sustained industrialization over both periods were also those with a lower debt burden and were therefore more likely to be able to free resources to foster economic growth, including through industrialization.

Demographic variables can also have an impact on industrialization. Column 8 includes a variable measuring the age dependency ratio as a percentage of the working age population (*AGE_DEP*) as a proxy for a supply side effect.[5] The coefficient on the age dependency variable is negative and statistically significant. This adds an important dimension to the factors shaping sustained industrialization, i.e. countries with 'demographic windows' are more likely to experience high manufacturing growth. In fact, demographic effects played a key role in East Asia's economic 'miracle' (Bloom and Williamson 1998; Bloom et al. 2000). More recently, another notable example is China, where industrialization has exploited the large reserves of young (mostly unskilled) workers who have been willing to move from rural to urban areas to fuel manufacturing development (Yao 2011).

Column 9 includes information on inequality as measured by the Gini coefficient. On the one hand, high disparities push many people into low-wage jobs, hampering the development of domestic markets and the process of industrialization (Murphy et al. 1989). On the other hand, high inequality tends to reduce the effectiveness of policies due to the high dependence of institutions on class-based power structures.[6] The coefficient on the inequality variable is negative and significant, so the results confirm the view that high inequality tends to be harmful for the process of industrialization, with countries that experienced rapid manufacturing value added growth belonging to the less unequal in their group.

Finally, in Column 10, an index of religious fractionalization (*REL*) is introduced to account for social stability.[7] A large strand of literature argues that less fractionalization and more social networks may promote civic engagement and contribute to industrialization (Knack and Keefer 1997; Narayan and Pritchett 1999; Putnam et al. 1993). By contrast, a more fractionalized society is expected to be less cohesive and less conducive to the development of local industries. The coefficient on the fractionalization variable is negative and significant, confirming this argument and suggesting that a more cohesive society is, on average, more likely to achieve prolonged periods of rapid industrialization.

Additional analyses reported in Appendix A show that the basic results are robust to changes in methodology, sample selection and choice of variable to define successful industrialization.

Summary

Industrialization is one of the key elements of long-term economic growth. Due to the manufacturing sector's capacity to absorb labour and enhance diversification and structural transformation, while spurring the growth of other sectors through linkages, it remains essential for many developing countries to promote industrialization. What countries can do to initiate a sustained process of strong industrialization, especially laggard countries, such as many in sub-Saharan Africa (Newman et al. 2016), remains a crucial question and lies at the core of the agenda of both national and international policymakers.

This chapter has explored whether it is possible to identify factors that are common to countries that have been able to initiate a strong and sustained process of industrialization over the last decades. Two different periods, 1970-1990 and 1991-2014, which are likely to have seen different patterns of industrialization due to significant political, technological and organizational changes between the periods, were considered. A simple methodology was developed to identify a small group of countries for each period, which have shown a pattern of industrialization that was not only rapid, but also sustained (in the sense of occurring over a relatively long-time span). Using these selected groups of countries (mostly consisting of East Asian economies), a multivariate analysis was run with the objective of identifying the key characteristics they share.

The results of the analysis show that industrialization is driven by a combination of factors, including initial economic conditions and factor endowments. Countries that are more likely to embark on a path of sustained industrialization are usually those with a lower level of income per capita, which are still specialized in activities with low productivity, a fact that is consistent with basic theories of structural transformation. Country-specific factors found to drive industrialization are demographics and geographic conditions. The former is particularly relevant since it shows that over time, countries that industrialized were those that benefited from 'demographic windows' created by a young age structure.

Factor endowments clearly play a key role, since they affect a country's comparative advantage and its pattern of development (Lin 2012; Wood 2017). The results show that industrialization is more likely to be successful in countries with low labour costs, and less likely in resource-rich economies. This is consistent with the recent pattern of redistribution of manufacturing output and employment towards some developing regions described by Wood (2017), who attributes this pattern to the availability of a low-skilled (and hence cheaper in relative terms) labour force in newly emerging Asian countries. The wearing apparel industry, for example, which, as explained above, is usually one of the major manufacturing industries for low- and lower-middle-income countries in terms of value added and employment, is labour-intensive in nature. The difficulty of substituting capital for labour in this industry makes it difficult to increase labour productivity. Consequently, the main source of competitiveness comes from a low wage level. This explains why the majority of countries cannot sustain the growth of the wearing apparel industry once their GDP per capita reaches the upper-middle-income level (Haraguchi 2016). The rise of wages over time underscores the importance of structural change within manufacturing and the need to introduce upgrading to sustain the process of industrialization. At the same time, once industrialization has started, maintaining low wages for too long can have a negative effect on the growth of the domestic market.

Governments have a number of instruments at their disposal to promote industrialization and embark on a path of sustainable development. The analysis highlights that investment—both in terms of physical and human capital—is one of the most relevant factors in explaining industrialization. Investment in physical capital is particularly crucial for increasing local production capacity. The analysis shows that this relationship holds for both publicly and privately funded capital. Public investment, in particular, could be key in providing positive externalities to the private sector and in reducing potential bottlenecks on the supply side. In fact, in several of the countries included in the group of successful industrializers, public investment played a key role by crowding-in private investments, as in the Republic of Korea in the 1960s and 1970s, or more recently in China.

Similarly, investment in the provision of a well-trained labour force is essential, since it allows an upgrade of local capabilities and skills and facilitates the process of structural transformation. Countries that grew through more advanced specialization within manufacturing, such as the early high growth East Asian economies, invested large amounts in human capital formation to meet the rapid skills demand from expanding industries.

Another area of major policy relevance is access to credit, a necessary factor to foster the growth of firms and industries by increasing their investment opportunities. Given that access to capital represents a major constraint to growth in many developing countries, it is clearly important to develop a financial system with a network of financial institutions accessible to private actors both in rural and urban areas, granting easier access to finance by firms and individuals (Lin 2012).

The above-mentioned conditions would have little effect in small domestic markets or in the absence of a stable economic and institutional setting. The analysis finds that high inequality may hamper the process of industrialization since it has negative consequences for the size of the domestic market.[8] Policies to redistribute incomes can be used to boost domestic demand, since low-income groups tend to have a higher propensity to consume. This is consistent with recent arguments about the significance of industrial policies, not only to adjust for market failures, but also to favour higher income equality (Stiglitz 2017).

The results show that those countries that achieved successful industrialization were largely those that had both macroeconomic stability—as measured by a lower degree of external indebtedness—and political and social stability. Both dimensions can contribute to the creation of a supportive investment climate, which in turn needs to build on high institutional stability. These are dimensions that have characterized the rise of emerging economies in Asia over the last decades and are currently areas that need to be addressed in low-income economies (Newman et al. 2016).

The results also provide important recommendations on the role of external policies, particularly to emphasize the role of the exchange rate as an effective industrial policy tool. Successful industrializers adopted an exchange rate regime that allowed exports to compete internationally and supported producers in the domestic market by raising the cost of imports through the domestic value of foreign currency rather than through import tariffs. A competitive, that is a relatively undervalued, exchange rate might be more effective in supporting nascent domestic manufacturing than import tariffs. This seems to have been the case for larger countries, such as China and India, which have broadened their industrial sector by keeping

their exchange rate competitive. However, it must be noted that an undervalued exchange rate that raises import costs may not be appropriate for smaller economies with less diversified exports and highly volatile terms of trade. Here, a pegged regime or dollarization might be a better strategy to reduce transaction costs, ensure price stability and increase policy credibility (Frankel 1999).

The results in relation to the role of capital account liberalization indicate that what is an effective policy can change over time. The openness of the capital account has potential consequences in terms of economic stability. The most recent group of rapid industrializers, including China and India, have followed a gradual process of capital account liberalization to reduce the volatility of their exchange rates. This is in contrast to the pre-1990 position when successful industrializers adopted more open policies towards the capital account.

Finally, policies tend to interact with one another. Consequently, the effect of single measures should be considered in combination with other policy instruments, since the effectiveness of the policy mix is likely to depend on the overall coherence and coordination of the policy package. This, for example, means that the adoption of a competitive exchange rate regime may require interventions in the currency market and the introduction of capital controls, as well as countercyclical fiscal and monetary policy.

In summary, this chapter shows that both factor endowments and policies can play a key role in the process of industrialization and, consequently, in the economic development of countries. The factors characterizing the successful group of countries analysed here show that there are some common features that are relevant to the process of industrialization across different periods and can provide a guide for policy. The successful cases cover the experiences of a small group of countries based mostly in East Asia. However, there is no unique model of industrial policy or of public intervention to promote industrialization, not even within the group of East Asian countries, with cases such as the Republic of Korea earlier on, or China and Viet Nam more recently, indicating significant differences. No simple one-size-fits-all solution exists and differences between countries in terms of size, resources, current specialization and institutional development need to be allowed for in the design of policy.

Notes

1. Oman, which is a resource-rich country, is an exception. Even though the country's manufacturing share tripled from 1970 to 1990, its share was still low at the end of the period because the country started with a very low manufacturing share of less than 1 percent.
2. In this analysis, consumer goods industries include food and beverages, wearing apparel and furniture while capital goods industries include chemicals, non-metallic minerals, fabricated metals, machinery and equipment, and motor vehicles. Although Hoffmann's original classification included tobacco in the consumer goods industries and basic metals in the capital goods industries, they were dropped here due to data limitations.
3. The case of Oman provides an instructive example of the importance of manufacturing promotion in an oil-dependent country, particularly in sustaining a high level of income as oil revenues decline. Oman moved up by three deciles on per capita manufacturing value added, from second in 1970 to fifth in 1990, while maintaining its eighth decile status by GDP per capita throughout the period.
4. More information is available at http://data.worldbank.org/indicator/FR.INR.LEND.
5. This model specification does not include the variable on education due to its high correlation (-0.75) with the age dependency ratio.
6. This was the case in Latin American countries where "the state's lack of relative autonomy precluded certain policies from being pursued" (Jenkins 1991, p. 201).
7. This index measures the probability that two randomly selected individuals from a given country will belong to a different religious group.
8. Hartmann et al. (2017) argue that under some circumstances, industrial upgrading and an increase in the complexity of the industrial structure can be accompanied by decreases in income inequality due to the co-evolution of more inclusive institutions, education systems and production networks.

CHAPTER 6

DEINDUSTRIALIZATION AND PREMATURE DEINDUSTRIALIZATION

Causes of deindustrialization

One of the most remarkable stylized facts of the world economy since the mid-1960s has been a rapid decline of manufacturing employment in high-income OECD countries, followed later by the same trend in an increasing number of middle-income countries. This phenomenon, usually referred to as 'deindustrialization', was first observed in the United States in the second half of the 1960s, then in several West European countries and Japan (especially after the oil shock of 1973), and in several Asian countries and in most 'non-maquila' Latin America and South Africa later in the 1990s.[1] However, as the exact opposite development has been taking place in a number of rapidly growing countries in Asia (henceforth 'emerging Asia'), the overall share of manufacturing employment in the world has remained stable for the last four decades at about 14 percent of the total workforce (UNIDO 2017).[2] This chapter charts this process and highlights some of the key policy implications, particularly for developing countries where manufacturing is as yet not well established.

In this chapter, 'emerging Asia' includes three first-tier NICs (the Republic of Korea, Singapore and the Taiwan Province of China), three second-tier NICs (Indonesia, Malaysia and Thailand), and three third-tier NICs (China, India and Viet Nam). Therefore, at a time of major transformation of the world economy—including the emergence of an entirely new technological paradigm (that of microelectronics, informatics and telecommunications), major economic reforms, the collapse of the Berlin Wall, rapid globalization and a major shift towards financial sector activities—what has occurred is a transfer of manufacturing jobs from a large range of countries to emerging Asia. At the same time, as will be discussed in detail below, in high-income OECD countries as well as in 'non-maquila' Latin America, deindustrialization has not been restricted to a decline in manufacturing employment, but has also been associated with a decline in the rate of growth of output, productivity and investment in manufacturing, as well as in the rest of the economy.

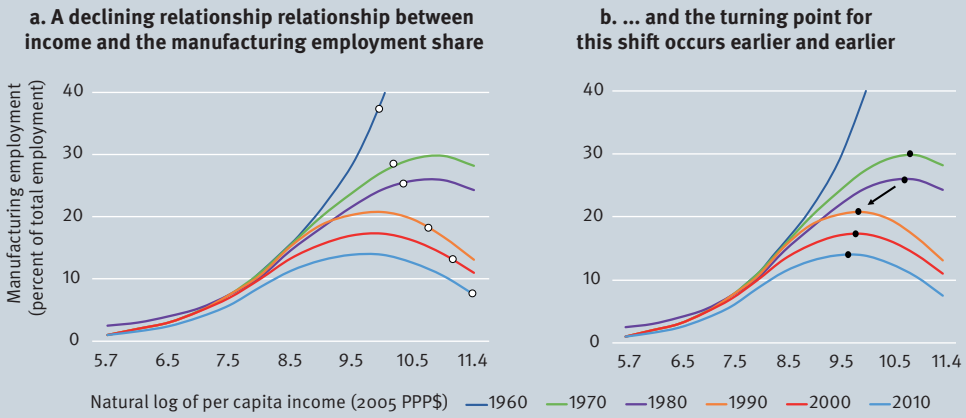
Previous eras have also witnessed major changes in the structure of employment in the process of long-term development (for example, the decline in agricultural employment after the 'Agrarian Revolution' of the 18th century), however, the speed and scale of change in manufacturing employment since the early 1970s are unprecedented. Between 1970 and 2012, manufacturing employment fell by nearly 30 million in high-income OECD countries, and its share in the total employment of these countries dropped by more than half, from 27 percent to 12 percent (UNIDO 2017). As noted earlier, a shift of employment from manufacturing towards other sectors is not a policy problem if the workers displaced are absorbed in dynamic high productivity activities, for example, in a modern service sector. It becomes a policy problem when the alternative employment is neither highly productive nor dynamic. There is a particular concern that in a number of developing countries, particularly in Latin America, the shift of employment out of manufacturing is occurring 'prematurely' in the sense that in these countries manufacturing has not reached its full potential. The policy challenge is therefore to reverse this relative decline and find ways of supporting manufacturing until those economies have sufficiently matured for a 'natural' deindustrialization process to occur.

Most analyses of deindustrialization focus on the share of manufacturing in total employment. The starting point is the inverted U-shaped relationship between the share of manufacturing in employment and income per capita, with this share first rising with income and then declining once a given threshold or turning point in terms of income level has been reached (Rowthorn and Well 1987; Rowthorn 1997). A positive interpretation of this trend is that the labour freed from manufacturing can be reallocated and readily absorbed in other higher productivity areas of the economy. In the simplest version of this analysis, deindustrialization only occurs once the threshold income level has been passed. However, the substantial drop in the share of manufacturing employment in countries with an income per capita well below the initial estimates of the threshold income, suggests that other factors are at work.

First, the relationship between the share of employment and income has been changing, causing estimates of the U-shaped relationship to fall over time, so that a given level of income per capita is now associated with a lower employment share in manufacturing than in the past (Figure 6.1). This phenomenon is of such magnitude (as illustrated in Figure 6.1a–white circles) that the conditional expectation of the share of manufacturing employment in the country in the sample with the highest income per capita in each period fell from 38 percent in 1960 to 28 percent in 1970, 25 percent in 1980, 18 percent in 1990, 14 percent in 2000 and only 8 percent in 2010.

While the reasons for this continued decline in the relationship between these two variables, and in particular, the plunge observed in industrialized countries in the 1980s, still require further research, available evidence indicates that it is likely the result of a combination of factors, including a statistical illusion with the sub-contracting of services by manufacturing companies, leading to jobs previously classified under manufacturing now appearing under services; low levels of effective demand and investment in manufacturing; and globalization–which, among other things, has encouraged multi-product transnational corporations to break up the value chain, and reallocate their labour-intensive assembly parts to low wage developing countries. However, it appears that this reallocation process as a feature of globalization has not stopped at labour-intensive industries or parts of the production process, but has continued into many high-tech, high productivity parts of the value chain as well.

Figure 6.1
Causes of deindustrialization



Note: All values are for the period 1960-2010. Income per capita is in 2005 PPP$ (purchasing power parity).
The graph lines are cross-sectional regressions for, respectively, the industrialization level in 1960, 1970, 1980, 1990, 2000 and 2010. In the six regressions, which are based on 103 countries of different industrialization levels, all parameters are significant at a 1 percent confidence level, and have an R2 value of between 61 percent and 76 percent. The circle point on each line reflects the conditional average (or conditional expectation) of the manufacturing employment share for the country with the highest per capita income in the relevant period. For all figures in this chapter, manufacturing is grouped in accordance with the International Standard Industrial Classification code D (ISIC, Rev. 3).

Source: Palma (2017) elaboration based on the ILO (2016) database Key Indicators of the Labour Market, Seventh Edition, UNIDO INDSTAT2, ISIC Rev. 3 database (UNIDO 2017b) and Groningen Growth and Development 10-Sector Database (Timmer et al. 2015).

In addition, the shift in the relationship since 1980 has been such that the threshold income per capita has also fallen, i.e. the turning point of the regressions that relate manufacturing employment and income per capita has been lowered. In 2005 international $ (at purchasing power parity), the point at which the downward trend in manufacturing employment begins, moves from $40,000 in 1980 to $20,000 in 1990, $18,000 in 2000 to $15,000 in 2010 (Figure 6.1b).

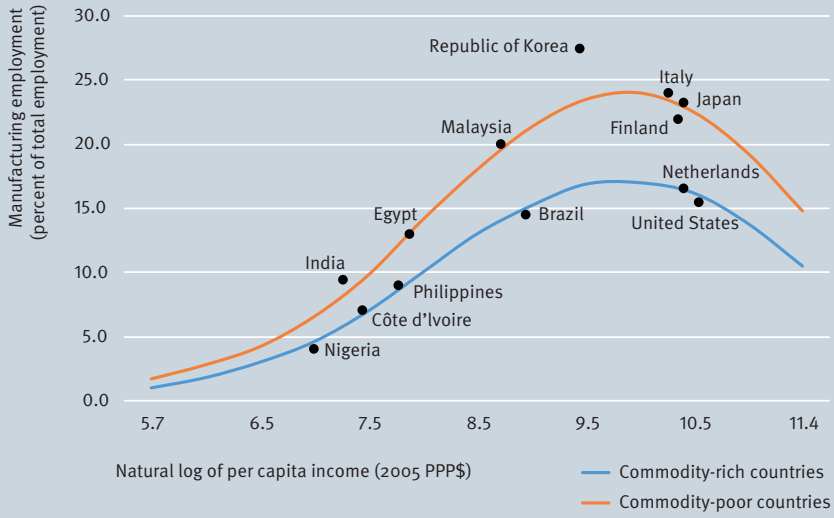
This decline in the turning point of the regressions, especially during the 1980s, illustrates how widespread the process of deindustrialization has become. Until 1980, not one country out of a 103-country sample had reached a level of per capita income that was higher than the point at which the curves began to fall. By contrast, in 1990, 20 countries had a per capita income above that critical point on the curve, while that number increased to 29 in 2000 and 32 in 2010.

However, the decline in manufacturing employment in high-income countries began in the United States in the late 1960s – that is, it started well before any country (including the United States) had approached the turning point of the curve. From the 1980s onwards, the phenomenon of deindustrialization also included the decline of the curve's turning point, which accelerated the process and saw it spread to middle-income countries.

The link between the share of employment in manufacturing and income (see Figure 6.1) disregards other factors that can affect the level of industrialization. As noted in Chapters 3 and 5, one key factor to consider is the abundance of natural resources in each country. Due to their scarcity of natural resources, some countries (such as Japan) have no choice but to follow a more intensive industrialization agenda aimed at generating a trade surplus in manufactured goods

– since that is the only way they can finance their trade deficit in natural resources (including, for example, oil). Others who are able to generate a trade surplus in natural resources are in a position to finance a trade deficit in manufacturing; thus, if they wish, they can place less emphasis on industrialization. This also applies to countries that are able to generate a trade surplus in other non-manufacturing activities, such as tourism and finance.

Figure 6.2
Different degrees of industrialization in commodity-poor and commodity-rich countries



Note: All values are for the period 1960-2010. Income per capita is in 2005 PPP$ (purchasing power parity). The two graph lines are regressions for the industrialization level in commodity-rich economies (or export services, such as tourism or finance), and economies with poor performance in commodities or services. The circle points on each line reflect the conditional average (or conditional expectation) of the indicated countries' manufacturing employment share in the relevant period. Except for the per capita income squared in the 1960 regression, which is only significant at the 5 percent confidence level, all parameters in the regressions are significant at 1 percent. The R2 values of each of the regressions are between 69 percent and 82 percent.

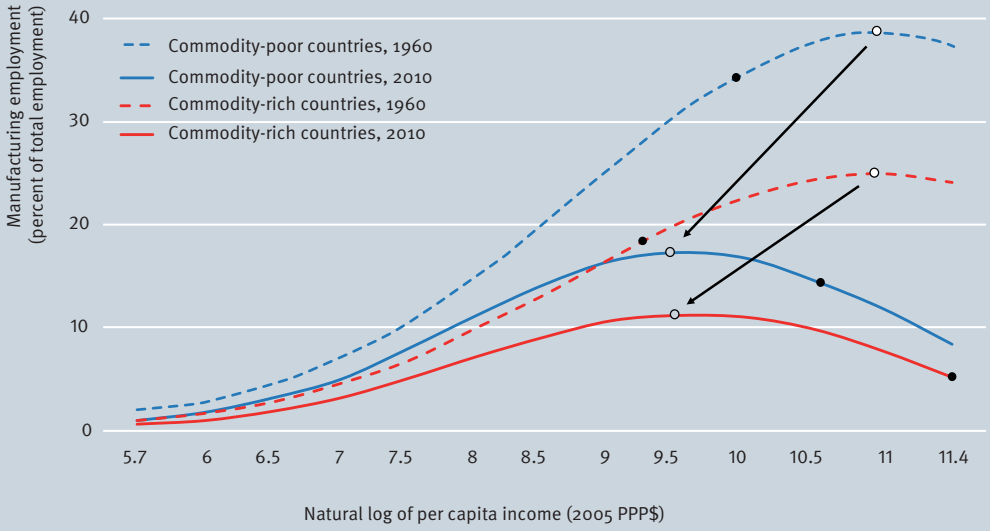
Source: Palma (2017) elaboration based on the ILO (2016) database Key Indicators of the Labour Market, Seventh Edition, UNIDO INDSTAT2, ISIC Rev. 3 database (UNIDO 2017b) and Groningen Growth and Development 10-Sector Database (Timmer et al. 2015).

Figure 6.2 illustrates the differences in the relationship between employment share in manufacturing and income per capita for two groups of countries in 1990, one group covering countries that need to generate a trade surplus in manufactured goods (put simple, 'commodity-poor') and the other consisting of countries that are rich in commodities or export services (put simple, commodity-rich) and do not need an export surplus in manufactured goods. As expected for all income levels, the countries on the blue line covering the first group have a higher employment share in manufacturing.

Although the group of countries included in the primary commodity or service category tend to reach a lower level of industrialization at each level of per capita income (and at every moment in time), it does not necessarily imply that their relative level of deindustrialization is higher over time. Figure 6.3 indicates that both groups experienced a similar relative decline in the share of manufacturing employment 1960-2010. The inflection or turning points in the commodity-poor group fell from a share of manufacturing employment of 38 percent to one of 17 percent, and in the commodity-rich group from 25 percent to 12 percent over the entire

period. This symmetry is also replicated in terms of the change in manufacturing employment in the country with the highest income per capita in each period; in these countries, as shown in Figure 6.3 (black dots), the conditional expectation fell from an employment share of 34 percent to 14 percent in the manufacturing group, and from 19 percent to 6 percent in the primary and service export group, respectively.

Figure 6.3
...but both groups have experienced a similar relative decline in manufacturing employment share



Note: Income per capita is in 2005 PPP$ (purchasing power parity). The four graph lines are regressions for the industrialization level in commodity-rich economies (or export services, such as tourism or finance) and economies poor in commodities or services – each in both 1960 and 2010. The circle points on each line reflect the inflection point of the regressions, i.e. the point at which deindustrialization begins. Square points show the conditional average of the country in each group with the highest income per capita for each period.

Source: Palma (2017) elaboration based on the ILO (2016) database Key Indicators of the Labour Market, Seventh Edition, UNIDO INDSTAT2, ISIC Rev. 3 database (UNIDO 2017b) and Groningen Growth and Development 10-Sector Database (Timmer et al. 2015).

Dutch disease

This distinction between groups of countries allows a new look at the impact of the 'Dutch disease' phenomenon on deindustrialization.[3] The Dutch disease is associated with either a sudden boom in commodity exports in already commodity-rich countries (brought about, for example, by a rapid rise in the price of a given resource, as in the case of several commodities at the time of the Korean War, the oil shock of the 1970s or the commodity boom of the 2000s); the discovery of natural resources in countries that had not previously developed these industries (such as gas in the Netherlands or oil in the United Kingdom); or the rapid development of service exports (such as tourism and finance).

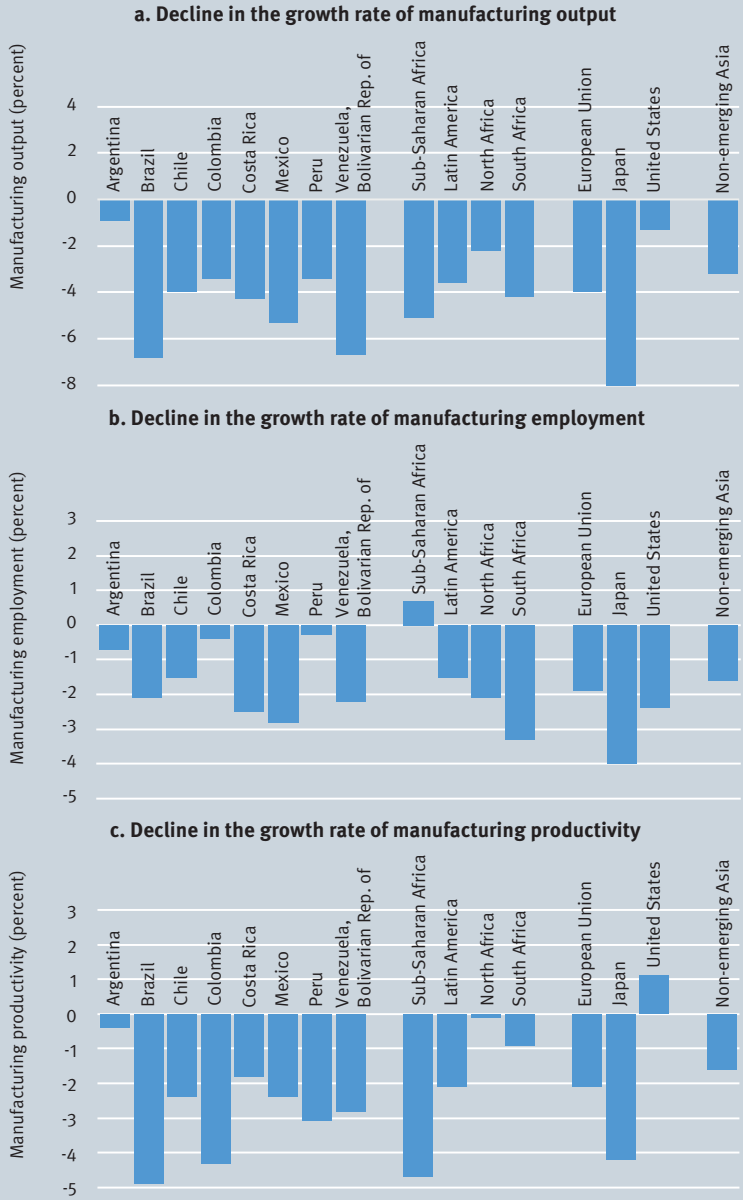
From the analysis here, the 'Dutch disease' can be interpreted as a process by which a country moves from one reference group to another—from the commodity-poor to the commodity-rich type path of industrialization—following the discovery of a natural resource, for example, or the emergence of service exports. Deindustrialization due to Dutch disease effects thus becomes the additional drop in manufacturing employment attributable to this shift from one country group to another. In the United Kingdom, for example, manufacturing employment fell by an additional five percentage points – reflecting the additional shift from the commodity-poor to the commodity-rich group. The United Kingdom both made an important natural resource discovery (North Sea oil), and registered an increased trade surplus in financial services. There was a rapidly changing trade balance; in terms of oil, this changed in the five-year period between 1979 and 1984 from a deficit of 2.2 billion pounds to a surplus of 6.6 billion; in terms of manufacturing, the trade balance fell from a surplus of 3.6 billion to a deficit of 6.3 billion. Between 1960 and 2010, manufacturing employment declined from 30.5 percent of total employment to a mere 10.7 percent in 2010 (and 9.8 percent in 2012). Had it not been for oil and financial services, this share would have been expected to fall to around 15 percent – its conditional expectation in the 2010 commodity-poor regression. In fact, its actual level that year was almost identical to what was indicated in the commodity-rich regression.

A result of policy choice

It is important to note that the group of commodity-poor countries includes not only those that are there by necessity, but also those that are there because of choice, i.e. countries that choose to follow a more intense industrialization agenda although they are rich in natural resources. Even though they could have generated a trade surplus in primary products or services, which is characteristic of a commodity-rich country, they chose to implement a 'pro-industrialization' agenda aimed at generating a manufacturing sector similar to countries from the commodity-poor group. This was the strategy followed by all Latin American countries during the immediate post-1945 period – and many started well before then based on a state-led, import-substituting industrialization agenda.

Similarly, deindustrialization can also be attributable to policy choice, most notably in the case of Brazil and the Southern Cone of Latin America, due to a sudden change in economic policy that reversed earlier support for industry. The rapid process of deindustrialization in many Latin American countries since the 1980s (and in Chile since the mid-1970s) was not caused by the new discovery of natural resources or the development of dynamic service exports– although many commodities exported by the region enjoyed a price boom in the early 2000s, and a few countries, such as the Dominican Republic and Cuba, developed a substantial tourism industry, and others, like Uruguay, expanded their finance sector. These countries' rapid deindustrialization has largely been the result of a swift reversal of economic policy and the previous development model that was introduced in the late 1980s, with a complete abandonment of their previous state-led, import-substituting pro-industrialization agenda. There was a rapid process of trade and financial liberalization, which reversed previous trade and industrial policies in the context of rapid institutional change and of a new subsidiary role for the state. Furthermore, and as opposed to the economic reforms implemented in most of Asia, this was done at a remarkable speed, leaving little time for domestic producers to adjust to the new conditions.

Figure 6.4
Decelerating manufacturing trends in the non-emerging Asian world after 1980



Note: Output and productivity are in constant 2005 national currencies. The figure shows the difference in the growth rate of output, employment and productivity in the manufacturing sector between the periods 1950-1980 and 1980-2012. In all regions, the rate of growth is the median value for all countries. In a few countries, data prior to 1980 was limited, and the growth rates in the early period therefore only reflect the years available. Latin America excludes Chile for which growth rates are calculated between the periods 1950-1972 and 1972-2012. For South Africa the periods 1950-1980 and 1994-2012 are used. North Africa refers to Morocco and Egypt. The value for non-emerging Asia is a median.

Source: Palma (2017) elaboration based Groningen Growth and Development 10-Sector Database (Timmer et al. 2015), The Conference Board Total Economy Database™, November 2017.

Although Latin America is a region with a great abundance and variety of natural resources, the pro-industrialization agenda had already succeeded by 1960 in bringing some countries to the level of industrialization characteristic of the manufacturing commodity-poor group. In Chile, for example, the reversal of the economic policy pursued as early as the 1970s had a substantial impact on the share of manufacturing employment. It fell from 22.1 percent in 1973 to just 9.8 percent in 2010. This trend was followed elsewhere in the region. What characterizes deindustrialization in Latin America as well as in South Africa, is that it was part of a deliberate policy package, and that it took place early – that is, at a much lower level of income per capita than in OECD countries. As a result, deindustrialization in these countries has been termed 'premature' (Palma 2005; 2008) in the sense that this policy package obstructed the transition to a more mature process of industrialization that would have been more self-sustained in terms of growth and that the countries lost the benefits of higher productivity and related technological change.

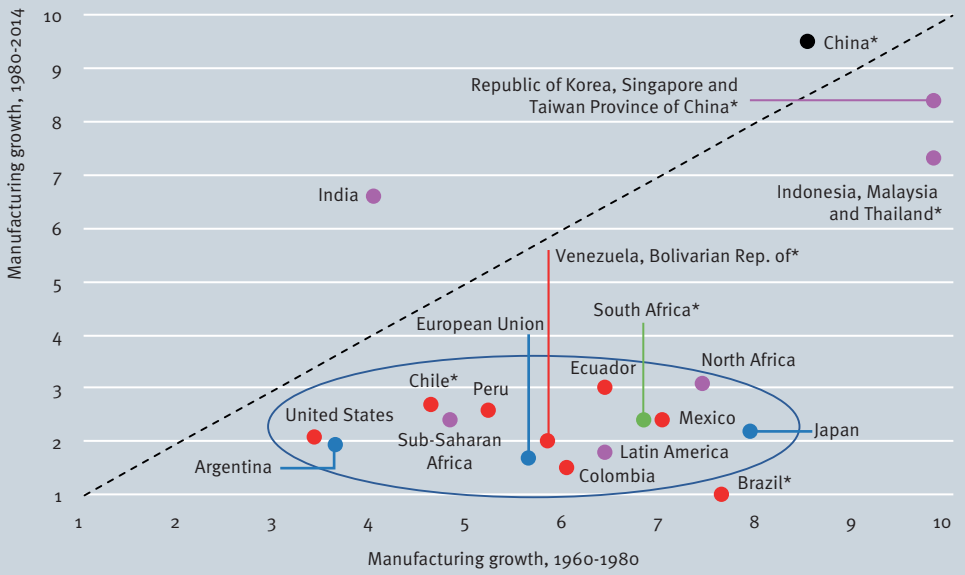
New patterns of manufacturing production in a globalized world

Figure 6.4 shows the poor performance of manufacturing in terms of output, employment and productivity growth in the non-emerging Asian world after 1980, illustrating the difference between the growth of manufacturing output, employment and productivity over two periods, namely 1950-1980 and 1980-2012. Only in the case of employment in sub-Saharan Africa and productivity in the United States is the growth higher in the second than in the first period.

Most of the analytical work on deindustrialization focuses on the decline of manufacturing employment in the non-emerging Asian world; however, Figure 6.4 shows that apart from the United States, there was a striking decline in the growth rate of manufacturing productivity in this heterogeneous group of countries. Of all the features that have characterized deindustrialization, this is the one that must have had the greatest impact on the rest of the economy. The deceleration of productivity growth in countries that are deindustrializing is surprising, as it might be expected that deindustrialization would lead to a greater concentration of manufacturing in the more productively dynamic parts of the sector.

The outcome of deindustrialization might be expected to be a manufacturing sector characterized by a greater deceleration in the growth rate of employment than in that of output. In other words, as globalization evolved, this should have led to the decline—sometimes through offshoring—of the more labour-intensive manufacturing activities (or part of the value chains) in OECD and in middle-income non-Asian countries. What was more likely to survive under these new more competitive globalized conditions should have been the more highly productive parts of manufacturing. This should have resulted in an increase in average productivity growth of what was left of manufacturing – or at the very least, some stability in this area. Surprisingly, this was generally not what happened. It appears that wage differentials became just one of the factors determining what was being transferred (directly or indirectly) to Asia in terms of manufacturing. Available evidence so far indicates that as well as the more labour-intensive activities, what was transferred to emerging-Asia was much of what simply proved to be the more tradable (that is the more mobile, or 'footloose') parts of manufacturing.

Figure 6.5
Output growth in non-emerging-Asia also declined in constant $



Note: All values are in constant 2005 $. Countries marked with a * have an output growth rate that falls outside the boundaries of the graph. This includes Brazil, with an average annual rate of growth for 1980-2014 at just 0.8 percent, and China with an annual rate of 10.9 percent (approximation). Similarly, for the period 1960-1980, the Republic of Korea and Taiwan Province of China witnessed an average annual rate of growth of 13.2 percent, and Indonesia, Malaysia and Thailand an annual rate of 11.3 percent. For South Africa only, the second growth period covers 1994-2014. The Latin America grouping depicts the weighted average of Argentina, Brazil, Chile, Colombia and Mexico; North Africa the average of Morocco and Tunisia. For Sub-Saharan Africa data for the entire region is available only from 1965.

Source: Palma (2017) elaboration based on OECD (2016), Groningen Growth and Development 10-Sector Database (Timmer et al. 2015), The Conference Board Total Economy Database™, November 2017, and World Development Indicators (World Bank 2016). Data for China is from World Development Indicators (World Bank 2014), and those for Taiwan Province of China are adapted from the National Accounts Main Aggregates Database, by the United Nations Statistics Division, ©2015 United Nations. Reprinted with the permission of the United Nations.

The decline in the rate of growth of manufacturing in the non-emerging Asian world is also confirmed when output is measured in constant $ (Figure 6.5). This indicates a huge contrast in terms of pre- and post-1980 manufacturing performance in terms of both the decelerating growth rates in the second period, as well as in the increasing homogeneity across these countries in terms of growth rates in post-1980. This contrasts with the diversity in their prior growth rates. Among this large and diverse group, there was a wide range of growth rates during the first period (1960-80)—between around 3 percent and 8 percent annually—whilst in the latter period, the range was much narrower at about 1 percent to 3 percent.

This increased homogeneity of growth rates reflecting the disappointing performance in the second period implies that the countries that were more dynamic before 1980 (such as Japan, Brazil and some North African countries) were those in which manufacturing decelerated the most. One extreme case is Brazil, where the annual average growth rate of manufacturing fell from an average of 8.2 percent (1950-1980) to 0.8 percent in the second period (or to a mere 0.4 percent if this period is extended to 2016). In turn, manufacturing productivity growth fell from a dynamic annual average of 4.2 percent (1950-1980) to an absolute decline between 1980 and 2015. In other words, while Brazil's manufacturing productivity more than trebled in the

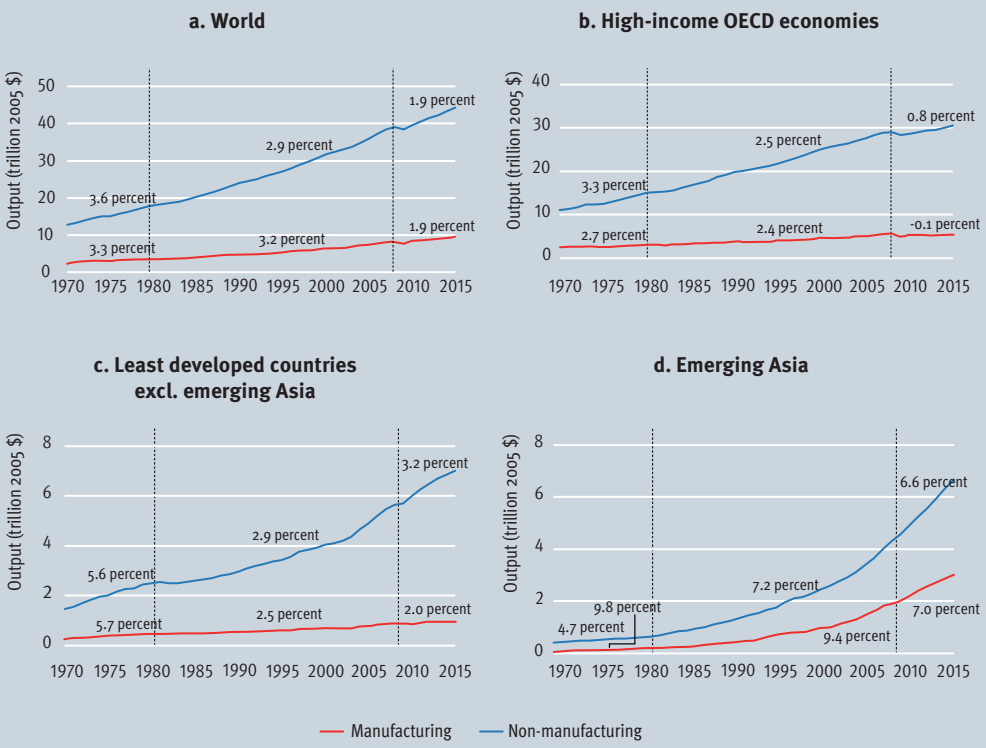
three decades between 1950 and 1980, it actually fell in the next three and a half decades (by nearly one-fifth). Surprisingly, manufacturing employment in Brazil turned out to be the least affected part of the sector after 1980, actually growing at an average rate of 1.4 percent annually (although most of this growth took place in the 1980s and 2000s), a rate that was similar to that of the Republic of Korea, Singapore and Taiwan Province of China. However, the context in which this employment creation took place, particularly in terms of productivity, was quite different. A similar development took place in Japan, where the growth rate of manufacturing output fell by 8.3 percentage points (from 9.9 percent annually in 1953-1980 to just 1.6 percent post-1980), while that of manufacturing employment fell by half that amount (by 4.1 percentage points). The growth in output per worker decreased by a similar amount.

Despite these huge asymmetries between emerging Asia and the rest of the world, the growth rate of manufacturing for the whole world remained practically unchanged in the two periods for which consistent data is available: 1970-1980 and 1980-2007/2008 (until the global financial crisis). That is, if one adds the manufacturing output of all countries for which there is information (nearly 200 countries), the overall average growth rate of manufacturing remained stable in both periods (3.3 percent and 3.2 percent, respectively) (Figure 6.4a).[4]

This relative stability of the overall growth rate of manufacturing during these two periods (that is, until the 2007/2008 global financial crisis) is also replicated in the OECD and in the developing world as a whole. In the case of the OECD, these annual rates are 2.7 percent and 2.4 percent, respectively for the two periods (Figure 6.6, top right panel), while in the developing world as a whole, they are 6.7 percent p.a. and 5.8 percent. However, as the two bottom panels of this figure indicate, there is a huge contrast in the developing world between a dynamic emerging Asia (9.8 percent annually and 9.4 percent annually, respectively), and a decelerating rest of the developing world (5.7 percent and 2.5 percent). This is particularly the case for Latin America (6.3 percent and 2.1). In fact, emerging Asia started off the first period with a manufacturing output that was only one-quarter of that of the rest of the developing world. However, by the mid-1990s, emerging Asia had already caught up with the rest of the developing world, and by the mid-2000s, it had doubled their output, trebling it in 2015. With regard to the OECD countries, the growth rate of manufacturing from 1980 until the global financial crisis in 2007/2008 differed only slightly from that in the 1970s, and the growth rate in that decade had already fallen relative to that of the 1950s and 1960s. The stable overall manufacturing growth rate in the OECD between 1970 and 2007 was the sum of diverse components. For example, there was a major contrast between the United States and Japan: while in the former, annual growth accelerated from 1.7 percent in the 1970s to 3.1 percent in 1980-2007, it fell in Japan from 4.6 percent between 1970 and 1990 to 1.6 percent in 1990-2007.

This relative stability of the growth rate of global manufacturing since 1970 ended with the financial crisis of 2007/2008, when it dropped from an annual average of 3.2 percent during 1970-2007 to around 2 percent (2007-2015). This was primarily the result of the collapse in the rate of growth of manufacturing in high-income OECD countries (from 2.5 percent annually for 1970-2007 to -0.1 percent in 2007-2015). The deceleration of manufacturing in Latin America after 2007 was another contributing factor (Figure 6.6). As a result, the dynamic growth of manufacturing in emerging Asia (7 percent annually during 2007-2015) did now not suffice to compensate for the weak performance elsewhere.

Figure 6.6
Trends in manufacturing and non-manufacturing



Note: All values are in constant 2005 $ and are weighted averages for the period 1970-2015. The percentage values in the graphs are annual average growth-rates of the respective sector during the three periods: 1970s, 1980-2007 (until the global financial crisis) and 2007-2015. The world grouping (Figure a) only includes economies with data for the entire period 1970-2015, and the group of least developed countries (Figure c) comprises those developing economies that are not included in any other group.

Source: Palma (2017) elaboration based on Groningen Growth and Development 10-Sector Database (Timmer et al. 2015), The Conference Board Total Economy Database™, November 2017, and World Development Indicators (World Bank 2016). Data for China is taken from World Development Indicators (World Bank 2014), and those for Taiwan Province of China is adapted from the National Accounts Main Aggregates Database, by the United Nations Statistics Division, ©2015 United Nations. Reprinted with the permission of the United Nations.

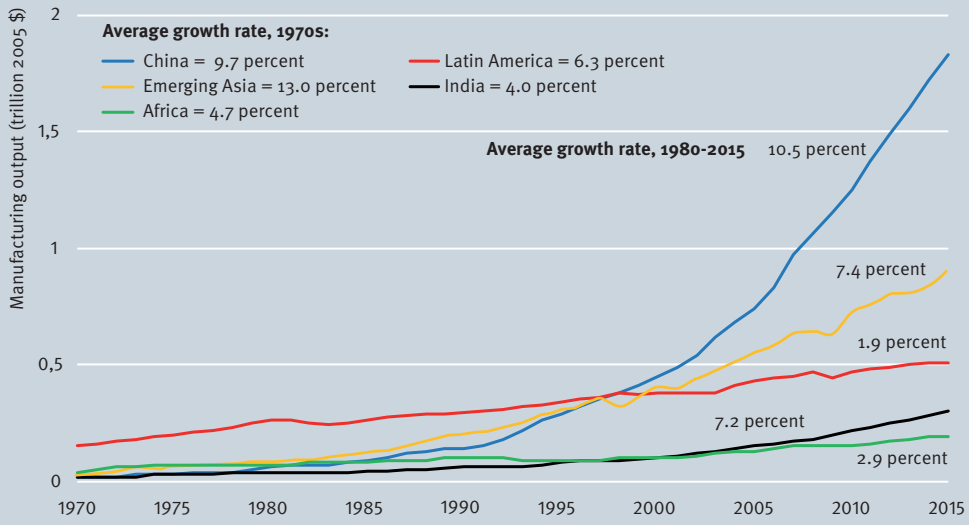
Differences in manufacturing performance among developing countries

A key feature of the world economy since 1980 has been the remarkable contrast in terms of manufacturing performance among developing countries, especially between Latin America and emerging Asia. Latin America had a dynamic manufacturing sector during the 1970s, with one of the fastest growth rates of manufacturing worldwide. In fact, its manufacturing sector grew much faster than those of the OECD, India and Africa. However, the deceleration of Latin America's growth rate in the first half of the 1980s was dramatic, followed by a weak recovery until hitting the 'super-cycle' related to commodity prices when Latin America recovered some of its dynamism. This recovery was, however, short-lived as Latin America was badly

hit by the 2007/2008 crisis, with a further deceleration in the last few years (despite the fact that many commodity prices did recover fairly quickly after the 2009 collapse). In fact, Africa registered a more dynamic manufacturing performance post-1980 than Latin America. The progressive acceleration of India's manufacturing (and non-manufacturing) sector after 1980 was remarkable, and the pace and relative stability of China's manufacturing growth since 1980 has no precedent.

Figure 6.7 compares the levels and growth rates of manufacturing output in the different countries/groups of countries in the developing world.

Figure 6.7
Sharp contrasts in the manufacturing performance of developing economies, with China leading the pack



Note: All values are in constant 2005 $ and depict the growth rate in manufacturing output in two periods: the 1970s and 1980-2015. Emerging Asia excludes China and India.

Source: Palma (2017) elaboration based on Groningen Growth and Development 10-Sector Database (Timmer et al. 2015).

The most noticeable feature is perhaps how both China and Emerging Asia (the latter excluding China and India) only caught up with Latin America's overall manufacturing output by the end of the 1990s – having both started with a level of output in 1970 that was less than one-sixth of that of Latin America. By 2015, China's manufacturing output was already 3.7 times higher than Latin America's, and emerging Asia's output was 70 percent higher. A key component of this divergence in manufacturing between Latin America and emerging Asia is the very different role the post-1980 reforms played. While in the former, the core of the economic reforms simply emphasized the need to reverse as many aspects of the previous development (and political) strategies as possible—including industrialization strategies—the policies in emerging Asia sought to continue and strengthen the already ambitious processes of industrialization.[5]

In sum, what we find after 1980 is a clear differentiation between two paths of industrialization; one in emerging Asia and another in most of the rest of the world, leading to a major shift in the geographic composition of manufacturing production – especially between Latin America and China. The collapse of the share of manufacturing in GDP in Latin America (and South Africa) has brought them to levels similar to that of many OECD countries; however, the latter deindustrialized at much higher levels of GDP per capita.

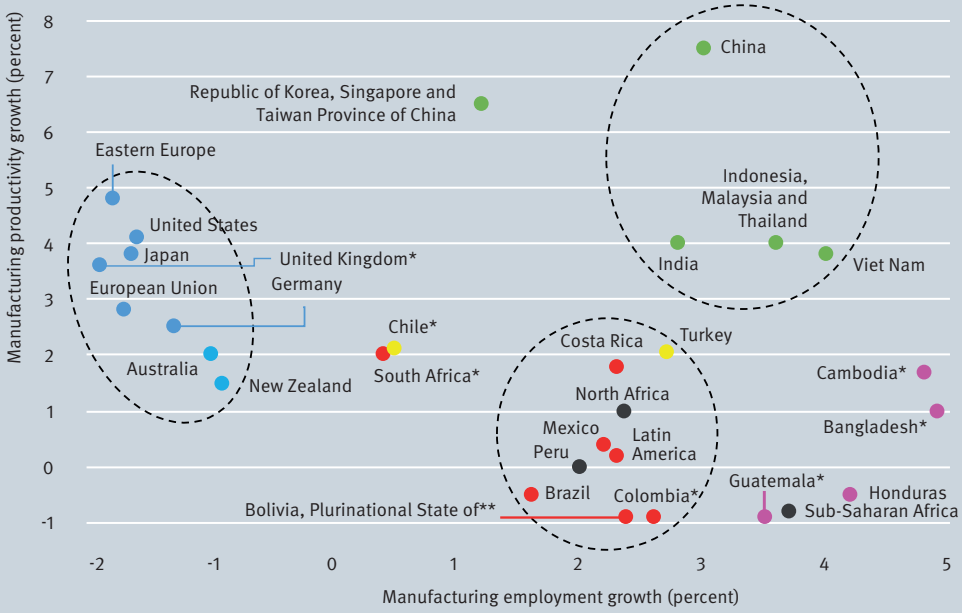
Trends in productivity and employment

The relative stability of the growth rates of global manufacturing output between 1970 and 2007 hides a major transformation that took place within manufacturing: the rapidly changing contributions of employment and productivity to output growth. For example, in OECD countries over the period 1980-2014, productivity growth was the only contributor to manufacturing growth, while in Latin America, this role was taken by employment growth. It was only emerging Asian economies that were capable of simultaneously achieving productivity growth and employment growth in manufacturing.

What characterized emerging Asia's industrialization during this period is its capacity to generate both additional productivity and employment within the manufacturing sector. While some Latin American economies (especially in 'maquila' Central America), North Africa, sub-Saharan Africa and countries such as Turkey were able to generate similar levels of additional employment in manufacturing during this period, they were unable to simultaneously achieve any significant levels of productivity growth. In turn, some low-income countries in Asia, which commenced on a path of manufacturing-led growth, such as Bangladesh and Cambodia, showed an even more remarkable capacity to generate manufacturing employment, but also only generated little productivity growth. At the same time, some OECD and Eastern European countries managed to achieve levels of productivity growth that were at least similar to those of some countries in emerging Asia, but this came at a huge cost in terms of manufacturing employment.

Thus, while emerging Asia was successful in making employment growth and productivity growth compatible within manufacturing, the option in the rest of the world was an 'either or'. For example, in Latin America, employment creation between 1980 and 2014 averaged 2 percent annually. This was, however, accompanied by stagnant average productivity growth, whilst in the previous 30 years, productivity growth had averaged 2.7 percent annually. In sub-Saharan Africa, productivity growth in manufacturing was actually negative for the entire period of 1980-2014. In emerging Asia, on the other hand, productivity growth fluctuated between 4 percent and 8 percent annually between 1980 and 2014 (Figure 6.8) due to high levels of investment and technological absorption, effective industrial policies, human capital creation and a much more dynamic entrepreneurial class.

Figure 6.8
Emerging Asia's capacity to increase both productivity and employment growth within the manufacturing sector



Note: All values are for the period 1980-2014, except Chile (1973-2014) and South Africa (1994-2014). Productivity is in constant 2005 $. Countries marked with a * have a growth rate that falls outside the boundaries of the graph. This includes Bangladesh with an employment growth of 5.8 percent, Cambodia of 5 percent and the United Kingdom of 2.5 percent; the Plurinational State of Bolivia and Colombia both registered a productivity growth rate of -1.2 percent and Guatemala of -1.7 percent. North Africa is confined to Egypt and Morocco. All values for country groupings are weighted averages, except for the European Union, which is represented by the group's median value. The Latin America group is comprised of the regional countries included in the graph; North Africa of Egypt and Morocco.

Source: Palma (2017) elaboration based on World Development Indicators (World Bank 2016), OECD (2017), Groningen Growth and Development 10-Sector Database (Timmer et al. 2015), UNIDO INDSTAT2, ISIC Rev. 3 database (UNIDO 2017b) and the ILO (2016) database Key Indicators of the Labour Market, Seventh Edition.

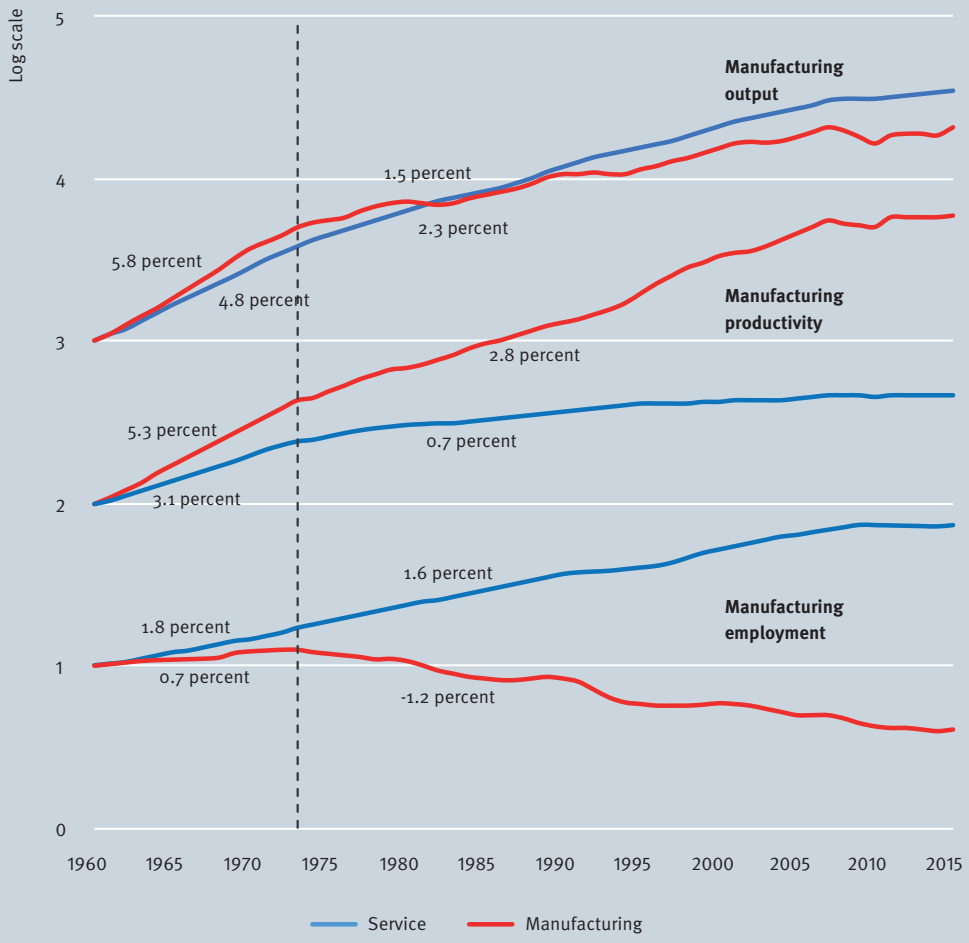
In summary, there are two clusters of countries in the non-emerging Asia world as far as manufacturing is concerned, one concentrating largely on productivity growth (the OECD and Eastern European economies) and the other on employment creation.[6] That is, one group of countries defended itself against competition from emerging Asia, mainly by abandoning or offshoring many of its labour-intensive manufacturing activities; the other group by doing the same with their 'productivity-intensive' manufacturing industries, which they left to emerging Asia. The OECD economies retained at least some of their most productivity-enhancing manufacturing activities, while the other group retained some of their employment-creating ones.

No evidence of positive deindustrialization

Deindustrialization in a positive sense implies the transfer of workers to higher productivity activities either within or outside manufacturing. The evidence from OECD economies suggests that this has not occurred. For example, Figure 6.9 illustrates the contrast between

manufacturing and services in the western European members of the European Union between 1960 and 2015. Employment in manufacturing fell by between one-fifth and three-quarters between 1973 and 2007 – that is, from the oil shock to the outbreak of the global financial crisis. In total, this amounted to about 36 million workers in the western European members of the European Union alone.[7]

Figure 6.9
Negative impact of deindustrialization on the manufacturing sector and overall economy of the western economies of the European Union



Note: The figure depicts 3-year moving averages for the western economies of the European Union except Finland and Norway. Productivity and output are in constant 2005 $.

Source: Palma (2017) based on INDSTAT 2, ISIC Rev. 3 (UNIDO 2017b), OECD (2017), Groningen Growth and Development 10-Sector Database (Timmer et al. 2015), and the National Accounts Main Aggregates Database, by the United Nations Statistics Division, ©2015 United Nations. Reprinted with the permission of the United Nations.

Figure 6.9 shows that between 1960 and 1973, manufacturing grew at a fast rate in terms of output and productivity in this group of European Union countries, with annual averages of

5.8 percent and 5.3 percent, respectively. This dynamic productivity growth was compatible with at least some increase in manufacturing employment (0.7 percent annually). As discussed above, what followed was a major decline of the growth rate of manufacturing output, productivity and employment. The average annual output growth rate fell from 5.8 percent to 1.5 percent; productivity growth dropped from 5.3 percent to 2.8 percent; and employment growth from an increase of 0.7 percent to a decline of 1.2 percent. Hence, deindustrialization in the European Union was characterized by a halving of the average productivity growth rate. In turn, productivity growth in the non-manufacturing sector of these economies also decelerated. Figure 6.9 shows that after 1973, productivity growth in services decreased from an annual average of 3.1 percent to just 0.7 percent. Among the factors that had a negative impact on productivity growth, the decline in the rate of investment is the most obvious in contrast to the increasing investment per worker in emerging Asia. Therefore, a substantial share of the European Union's labour force was transferred from high productivity (and high productivity growth potential) manufacturing to low productivity (and often low productivity growth potential) services as a characteristic feature of its deindustrialization. This phenomenon must have contributed (among other factors) to the deceleration of GDP growth after 1973; these economies moved from a median growth rate of 4.3 percent annually between 1950 and 1973 to one of 2.3 percent between then and the global financial crisis in 2007/08. This median rate fell again to a mere 0.7 percent between 2007/08 and 2015.

As deindustrialization in high-income OECD countries occurred within the context of poor overall economic performance (even if some countries performed better than others), and within the context of an unstable and uncertain domestic and international economic environment, it is difficult to derive specific information on the possible impact of deindustrialization per se on events in the rest of the economy. Attempts to link changes in manufacturing with changes in the non-manufacturing segments of an economy, as implied by Kaldor's laws, run into econometric difficulties due to the significant exogenous shocks that affected all economies over the period since 1970.[8]

Only in the United States does evidence exist of a significant relationship between manufacturing and non-manufacturing sectors. This may be attributable to the fact that unlike other non-emerging Asia economies, the United States experienced an acceleration of manufacturing productivity growth from 2.7 percent annually (1950-1973) to 3.4 percent (1973-2008). At the same time, the 2.3 percent annual growth rate of employment in non-manufacturing sectors between 1973 and 2008 was much higher than in other OECD countries, such as the United Kingdom, Germany or Japan, although the productivity growth in services was low, with employment largely driving output growth. In the United States between 1973 and 2012, there was a considerable decline in the share of manufacturing employment from 22 percent to just 8.8 percent of the labour force, and an increase in the services share from 68 percent to as much as 84 percent of total employment.

Overall, however, there is little, if any, evidence (at least so far) to support the existence of a process of deindustrialization that could be labelled 'positive deindustrialization'.

Summary

As regards deindustrialization, there is a huge diversity of experience, even among high-income OECD countries. Analysis of deindustrialization focuses on the study of structural change generated either by endogenous or by exogenous forces. Examples of the former are a shift in high-income economies towards specialized services activities, and the impact on manufacturing of the rapid growth deceleration post-1973. Also, in some high-middle-income East Asian countries (although uniquely to them), the growth of manufacturing employment declined as a result of rapid productivity growth in the sector. Examples of exogenous factors driving deindustrialization include the impact of a rapid development of service-export activities or a sudden surge in exports of primary commodities (related, for example, to the discovery of natural resources or bubbles in commodity prices). Another exogenous factor is a drastic reversal in economic policy, such as the policy change in Latin America during the late-1980s and early 1990s, which had a major impact on manufacturing. In addition, as a result of a mixture of endogenous and exogenous shocks, a few countries experienced what can be termed 'absolute' deindustrialization within the context of the collapse of national income, as was the case in some republics of the former Soviet Union following its dissolution and in periods towards the end of the last century in some countries in sub-Saharan Africa.

There is little empirical support for the hypothesis that deindustrialization is the result of decreasing income elasticity of demand for manufacturing. If that were the case, it would be quite unlikely that available data would indicate that the manufacturing sector's contribution to the world's value added and employment remained relatively stable since 1970.[9] In turn, the data do not support either the hypothesis that deindustrialization is the result of a new technological paradigm leading to a process of 'jobless growth'. However, there is strong evidence to support the view that a process of concentration of manufacturing activities in specific countries has taken place. In turn, there is also strong evidence to support the hypothesis that a fairly autonomous decline in the rate of investment in most OECD countries has affected manufacturing negatively, as a high proportion of investment expenditure tends to be directed at manufacturing.

In terms of lessons learned from high-income countries for developing ones in relation to their deindustrialization experiences, the key lesson is that 'positive' deindustrialization does not seem to exist. What seems to have triggered deindustrialization in high-income countries, especially in the United States and in Europe, is more likely the rapid decline in the growth rate of overall output and investment rather than in endogenous forces leading towards a new productive specialization characterized by dynamic high-technological services.

Experience with industrialization in emerging Asia is much more positive and offers some general guidance to follower economies. The key lesson from a relatively diverse emerging Asia is that any successful process of industrialization requires high levels of investment in specific niche activities with long-term potential for productivity growth, and that policy has played a key role in supporting this process. Different countries have provided support in different ways, but in all of them, the key factor in their successful industrialization has been their capacity to make employment growth and productivity growth compatible within their manufacturing sector. Priorities in emerging Asian countries have often not been guided by existing comparative advantage, but have focused on developing new export activities and on being successful, regardless of which new activities are selected.[10] The resulting export-

led growth has been far more profound in terms of developing domestic supply linkages with export sectors than the 'maquila-type' industrialization pursued in Mexico and Central America. The latter can be an effective mechanism to generate exports and low-wage manufacturing employment, but has not proved successful in creating productivity improvements and in accelerating economic growth.

Macro-economic policy choices also appear to have played an important role. In a highly unstable world, there are plenty of exogenous shocks that can affect economies and policies should be implemented that mitigate, not exacerbate, these. A pragmatic and consistent approach to supporting industry was pursued in emerging Asia. Drastic changes in economic policy that do not give agents time to adjust (as was the case with Latin America's economic reforms in the 1980s and 1990s) were avoided, a policy of stable and competitive exchange rates was practised and openness to foreign trade and finance was gradually regulated and liberalized.

In conclusion, while productivity growth and employment growth have tended to be substitutes in high-income OECD countries, Latin America, North Africa, sub-Saharan Africa and other countries in non-emerging Asia, reflecting opposite mechanisms to defend producers from Asian competition, growth in both productivity and employment have proved to be complements in emerging Asia. As a result, the real 'miracle' of emerging Asian countries lies not so much in their successful drive to export goods, but in the income multipliers associated with their processes of industrialization – that is, as opposed to 'maquila' Latin America, emerging Asia's 'miracle' lies in the powerful domestic linkages of their manufactured exports.

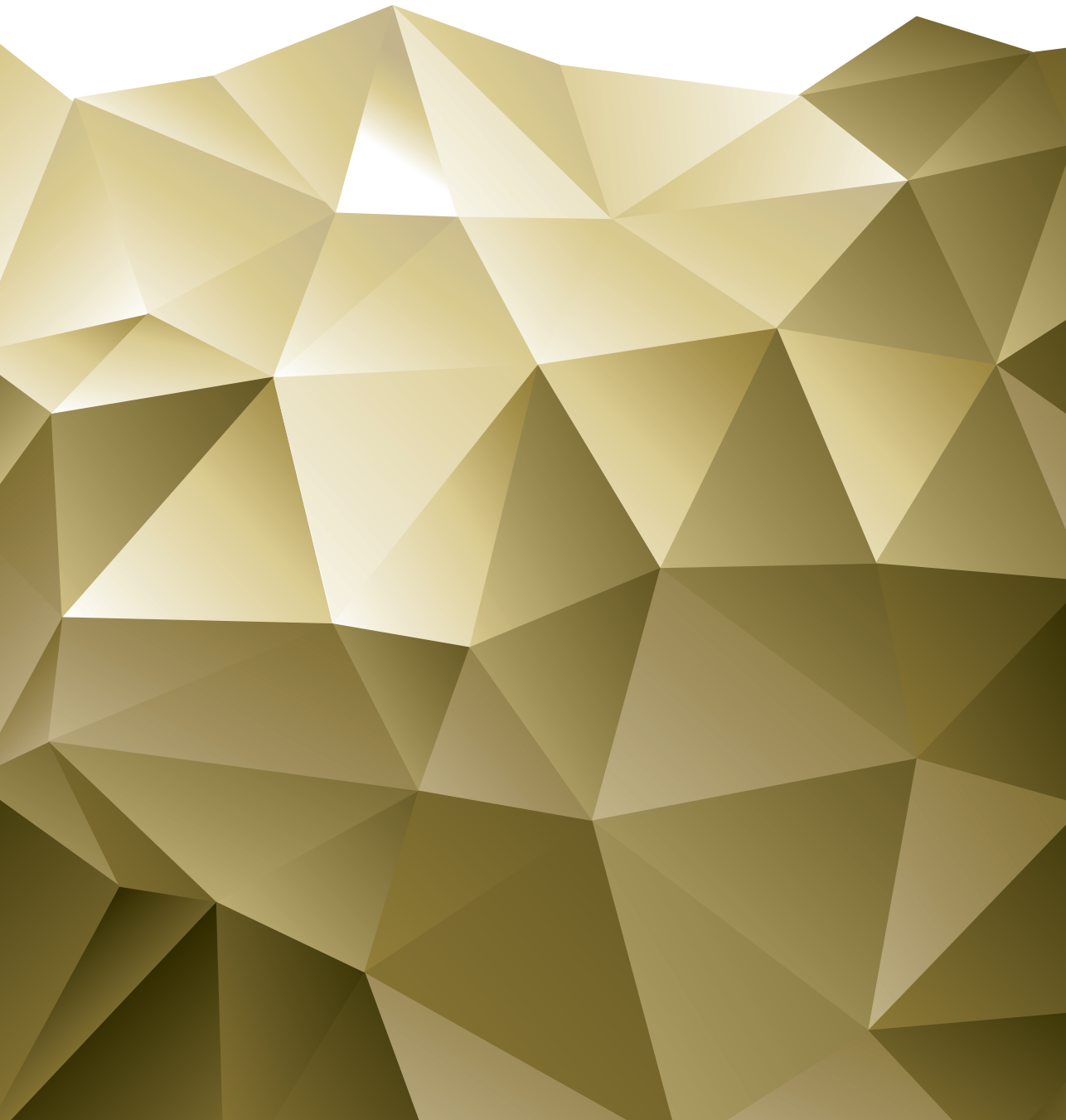
Notes

1. 'Maquila economies' refers to Mexico and Central American economies that use an export model based on duty-free processing of imported inputs and the export of the final product (usually to the United States).
2. This is the period for which the source provides data. The total excludes Eastern Europe and the former Soviet Union, as the source provides data for very few of these countries for the entire period.
3. See Palma (2017) for fuller details and the sources of the data reported here.
4. For the relative stability in this overall growth rate of manufacturing, see also Haraguchi et al. (2017).
5. For example, the President of the Brazilian Central Bank (Gustavo Franco) made this patently clear when neo-liberal reforms were introduced when asked about the primary objective of their radical package of reforms; he answered: " [Our real task] is to undo forty years of stupidity (besteira)...". (Veja 15/11/1996). This is despite the fact that for nearly thirty of those forty years, Brazil had had one of the fastest growth rates of manufacturing and of GDP in the world. Furthermore, he then added: " [The alternative in Brazil today] is to be neo-liberal or neo-idiotic (neo-burros)" (ibid.).
6. All sources are particularly meagre in terms of data for Eastern Europe and the former Soviet Union for the entire period. Although the growth rate of manufacturing output is reported as a group in the UN (2017) source, there are data for very few individual countries. Taking this group average, manufacturing output growth fell from 5.7 percent p.a. (1970-1980) to 1.5 percent (1980-2015). As the source for employment only provides data for four of these countries for the entire period (plus Montenegro), it is not possible to generalize about them in terms of employment and productivity for the whole period. In these four countries, while output growth in manufacturing decreased from an average of 7.7 percent p.a. to only 2.8 percent, respectively, employment growth in the manufacturing sector dropped from 2.5 percent annually to -1.9 percent; productivity growth remained relatively stable at 5.2 percent and 4.8 percent, respectively.

7. According to UNIDO's (2017) database, manufacturing employment (in absolute terms) between 1973 and 2007 fell in the United Kingdom by 55 percent, in Luxembourg by 47 percent, in Iceland by 45 percent, in Switzerland by 42 percent, in Germany (taking into account the problems of measurement brought about by reunification) by 42 percent, in France by 38 percent, in Belgium by 38 percent, in Denmark by 35 percent, in Sweden by 35 percent, in the Netherlands by 27 percent, in Austria by 23 percent, in Greece by 12 percent, in Italy by 10 percent and in Portugal by 8 percent. Finland and Norway are excluded due to serious problems with the measurement of manufacturing employment in these countries during the 1970s in this database. The median value is 37 percent.
8. Palma (2017) describes attempts to apply Grainger causality tests to establish whether change in a manufacturing sector has a significant predictive power to explain a change in non-manufacturing sectors for several OECD countries.
9. See also Haraguchi et al. (2017); on income elasticities of manufacturing imports, see Thirlwall (2004).
10. As a former Governor of the Central Bank of the Republic of Korea has stated: "Whenever we wanted to do something, the advocates of comparative advantage said: 'you don't have the comparative advantage for that'. In fact, we did everything we wanted, but whatever we did we did it well." cited in Wade (1992, p. 270).

CHAPTER 7

POLICIES FOR STRUCTURAL CHANGE



A changing relationship between manufacturing development and economic growth

All countries face challenges in achieving economic growth that is both high enough to raise living standards and create jobs, whilst inclusive enough to allow its benefits to be shared widely, and sustainable enough so that national and international environmental targets can be met. The evidence of this report demonstrates that at a certain stage of development industrialization, and more specifically manufacturing, can plays a key role in the achievement of inclusive and sustainable growth. This means that policy must be geared towards supporting the sector until the economy has reached a stage at which other sectors can take over as key drivers of growth.

Economic growth can be seen as a process driven by structural change as resources are transferred from slow growing or low productivity sectors to dynamic or high productivity ones. At relatively early stages of development, there are strong theoretical reasons why manufacturing can play a special dynamic role as an engine of growth. As highlighted in Chapter 1, manufacturing is seen as offering greater possibilities for higher levels of productivity, more rapid productivity growth, greater technological change and higher potential for employment creation than agriculture or services. Key empirical generalizations put forward by Nicholas Kaldor over 50 years ago—the so-called Kaldor laws—have largely been vindicated. These assert that:

- The growth of an economy is a function of the growth of its manufacturing sector; the greater the excess of manufacturing growth over the growth of the non-manufacturing sector, the higher is the growth of GDP;
- within the manufacturing sector, there is a close relationship between the growth of output and the growth of labour productivity, i.e. a rapidly expanding manufacturing sector will have high productivity growth;
- the growth of overall productivity in an economy is related to the growth of manufacturing, i.e. there is a negative relationship between employment growth outside manufacturing and total productivity growth.

Some empirical results suggest a few qualifications to the original analysis. For example, in relation to manufacturing's impact on GDP, the relationship has been found to be stronger in low- and lower-middle-income economies than in middle- and high-income economies, since the productivity and employment effects of manufacturing relative to other sectors are expected to be higher at lower income levels. In addition, there is some evidence that this relationship may have weakened post-1990 in the more globalized world economy, where positive growth effects from manufacturing only operate in economies with relatively high levels of human capital.

Cross-country analyses of the patterns of manufacturing development reveal both empirical regularities in these patterns and significant variations in country experiences due to country-specific factors. As incomes rise, the manufacturing sector's share in GDP typically follows an inverted U-shaped path. Once the peak has been reached, the share of manufacturing tends to decrease gradually and the share of the services sector rises.

However, as examined in Chapters 2 and 6, this relationship has changed over time and the maximum share of manufacturing in GDP and employment in today's economies is found at much lower levels of income compared to the point at which the now industrialized countries reached their peak of manufacturing activity. This raises serious policy concerns regarding premature deindustrialization. As economies grow, a natural process of structural change will see some sectors contract in comparison to others. This is not a policy problem if a relative fall in manufacturing sees workers transferring to dynamic and high productivity service activities. This does not appear to have happened in many countries. For example, concern has been raised about the growth-inhibiting effects of structural change in Latin America and sub-Saharan Africa, where the relative decrease in manufacturing has seen labour shift to the informal services sector or to agriculture (MacMillan and Rodrik 2011).[1]

Role of industrial policy

Measures to provide special support to manufacturing become relevant to respond to the negative effects of growth-inhibiting structural change. The precise role of industrial policy remains subject to much debate and there is no unique blueprint for governments to follow. The more successful country experiences have witnessed an adaptation of policy in form and content over time in the light of changing economic conditions. As illustrated in Chapter 3 using cross-country data, at relatively low-income levels, the key goal is to support the transfer of low-skilled workers out of agriculture into relatively labour-intensive activities using fairly simple technologies (or the simplest labour-intensive parts of a more sophisticated production process). At this stage, manufacturing employment will generally be concentrated in early industries like food and beverages and textiles and wearing apparel. The capabilities required by local producers will essentially be mastery over relatively mature production processes through technological 'know-how'. In smaller economies, most of the market for industrial goods will be overseas and trade specialization in a limited number of competitive manufacturing activities will become critically important.

As economies become more sophisticated in terms of production capabilities and as real wages rise, the industrialization process will see a relative decline in the role of labour-intensive and resource-based manufactured goods and a shift into medium-technology activities or into the labour-intensive segments of relatively high-technology goods. The capabilities required of producers will increasingly focus on the mastery of technology rather than production in terms of 'know-why' as well as 'know-how'. At this stage, the role of industrial policy is likely to shift from encouraging a relatively small number of manufacturing-intensive branches in an economy's resource endowments into one of stimulating specialization in product lines that are relatively new to the economy and involving more sophisticated technologies. Once the stage of reliance on cost advantages determined by wages or by natural resources has passed, the range of potential new products expands greatly with a considerably higher scope for 'discovery' of competitiveness. A key role for industrial policy here is to encourage dialogue with the private sector to facilitate 'product discovery' and the emergence of ideas relating to market niches or novel products. At high-income levels, industrial policy is concerned with either innovation at the technology frontier or the gradual phasing out or restructuring of uncompetitive activities, as well as with environmental concerns.

Instruments for the application of industrial policy can vary widely, including macro-level measures, in relation to exchange rate or wage policy, various forms of financial support, whether direct state investment, public-private partnerships or credit guarantees, specific interventions such as import tariffs and non-tariff barriers, tax credits and input subsidies to encourage investment, investment in human capital through education and vocational training and support for R&D either directly through research in public facilities or through tax credits for firms. Several alternative classifications of the different instruments of industrial policy are available.2 There is now a consensus that the choice of instruments per se is much less important than the need to focus support on the key constraints to new investments. These constraints are to be identified by a dialogue between government (through the agency that implements industrial policy) and the productive sector (whether private or public enterprises). Instruments are to be used flexibly so that where one is ineffective, it should be replaced by another or overall support ended. Support should be linked with performance and the achievement of targets, and should not be open-ended.

A conventional distinction is made between horizontal interventions (available to all) and vertical interventions (applied selectively), and though controversy remains over how far selectivity should be applied, there is recognition that in practice, the distinction is blurred, meaning governments are 'doomed to choose' in the sense that because resources are limited, priorities for support need to be determined if interventions are to be effective (Hausmann and Rodrik 2006). Most governments, including those of high-income economies, operate a form of selectivity with a focus on particular sectors or technologies.

The new version of industrial policy (sometimes called 'modern industrial policy') sees governments working together with the private sector in a limited number of areas to create internationally competitive activities which are new to an economy. Selectivity is necessary because of the inability of governments to do this on a genuinely vertical basis. The risk is that where there is differential treatment, producers in disfavoured sectors lobby for similar treatment and may receive it whether or not there is an economic case. To be countered effectively, not only is political will required, but also the application of economic criteria in the selection of priority areas (Weiss 2017). There are now a growing number of case studies of the implementation of industrial policy in a developing as well as a developed country context, so that the well-known East Asian story from Japan, the Republic of Korea and the Taiwan Province of China can be supplemented by evidence from elsewhere.3

The identification of successful industrializing economies in Chapter 5 reveals countries with a diversity of policy experiences and that found alternative ways of supporting manufacturing with their policies changing over time. All experienced a major shift in economic policy prior to their period of rapid manufacturing expansion and all registered a major increase in manufacturing exports and a rise in manufacturing share in GDP. Common features include a stable macro-economic environment, a competitive real exchange rate and political stability. Part of the explanation for the differences is determined by country characteristics. All but two of the successful industrializers identified in Chapter 5 are located in Asia (and hence are part of the 'emerging Asia' group highlighted in Chapter 6), but there are many differences between them. Countries with large home markets like China and India have options that are not available to countries like People's Democratic Republic of Lao and Cambodia. Other differences between the countries were determined by policy. Countries differed, for example,

in the extent to which they used import tariff protection or 'exchange rate protection' to raise profitability in manufacturing, the speed at which they liberalized foreign trade and capital controls, the extent to which they invested in education and training, how far they relied on public sector finance or foreign investment to fund manufacturing investment and the degree to which their manufacturing sector was linked with global value chains. Access to foreign technology was always important, but the means of technology acquisition vary and include licensing, joint ventures with foreign companies, foreign direct investment and transfer within global value chains. The outcomes in the emerging Asia group have been stronger incentives for manufacturing, but the route to achieve these has differed.

Manufacturing to support inclusive growth...

Support for manufacturing can also be justified in terms of its inclusion effect. As discussed in Chapter 3, there is an approximate negative correlation between the share of manufacturing in a country's GDP and the levels of both poverty and inequality, and more detailed econometric analysis has found the share of manufacturing in total employment to be a consistently significant explanatory variable for different measures of social inclusion (UNIDO 2015). The main mechanism for such a link is employment creation, either directly in manufacturing production or indirectly through jobs in manufacturing-related services and supplier activities. There is evidence that the employment multiplier, for example, is higher in manufacturing than in other sectors (Lavopa and Smirzai 2012).

Currently, industry provides around 24 percent of global employment and manufacturing around 15 percent. The globalization of production processes and consumption have accelerated the specialization of manufacturing tasks and contributed to inequalities in the labour market in terms of differences in wage and employment opportunities between skilled and unskilled labour, as well as between men and women. Overall, manufacturing is still viewed as offering higher paid and better quality jobs for an equivalent education level than services or agriculture. However, there are concerns relating to the weakening of the link between manufacturing output and employment growth, for example, due to technological change that raises capital-labour ratios and is biased towards the use of skilled rather than unskilled labour or in the case of robotics, which replaces the direct labour inputs in production.

Chapter 3 cites employment elasticity estimates which show a very low figure for Latin America and negative figures for sub-Saharan Africa and South Asia, implying that while output has grown, the number of jobs have hardly increased or have fallen. These figures only go up to 2004, the accuracy of the employment statistics may be subject to some doubt and they do not allow for indirect effects. Nonetheless, they indicate a potential problem in any future link between manufacturing growth and inclusion, since job creation is the most effective means of raising living standards and creating opportunities for as wide a segment of the population as possible. Chapter 6 draws attention to the fact that apart from the successful economies of Asia, employment and productivity growth have been substitutes in the rest of the world, so that where employment has grown, productivity has been weak and vice versa. A dynamic and inclusive manufacturing sector requires productivity and employment growth to be complements, not alternatives, in order for living standards to rise and be shared widely.

At an early stage of development, the subsectors food and beverages, chemicals, non-metallic minerals, textile and wearing apparel have been shown to be those industries most likely to generate significant employment opportunities. However, as noted above, as incomes and wages rise, it will be necessary to move beyond these early stage industries and establish competitive production in the more capital-intensive and technologically sophisticated middle and late industries identified in Chapter 2. Such a reallocation of labour may require some of the selective measures of support as discussed above such as import tariff protection, tax holidays or low-cost credit. In addition, since employment expansion is linked with investment, more general measures to improve the investment climate may be important.

There is an extensive empirical literature examining firm level data to assess how far factors generally taken to determine the investment climate, like government regulation, access to credit, corruption and quality of infrastructure, impact on employment. Some differences emerge between studies, but there is generally strong support for poor quality infrastructure and limited access to finance as key factors holding back employment (Alterido and Hallward-Dreimeier 2010; Dinh et al. 2010). There is less support for a significant impact from government regulation and specifically for restrictions in the labour market, such as high and enforced minimum wages or limitations on the dismissal of workers. On the other hand, unrealistically restrictive labour regulations can restrain investment and consequently, employment; for example, there is evidence from India that states with restrictive labour laws that are enforced have slower manufacturing and employment growth (Aghion et al. 2008; Besley and Burgess 2004).

In terms of firm size, it has been the smaller firms in the majority of countries (although the definition of small- and medium-sized enterprises varies between countries), which have created the largest number of manufacturing jobs, but generally, such firms have a significant negative association with productivity growth (Ayyagari et al. 2011). Thus, in recent years whilst small- and medium-sized firms have been a key driver of employment growth, they have not been drivers of productivity improvements within manufacturing in the majority of cases.

Evidence from these firm-level studies suggests that in addition to the more specific industrial policy measures as discussed above greater employment creation within manufacturing requires measures to support investment in general, focusing on aspects of the investment climate, which are key constraints in the context of a specific country. Firms' experiences, particularly in low- and lower-middle-income countries, suggest that primary attention should be given to the quality of infrastructure and access to finance. Where this is the case, improved road, port and rail links and reliable power supplies and a more effective system of financial intermediation should be policy priorities. Other specific constraints may be relevant in different contexts.

In relation to the factor-intensity of the technology embodied in new investment and the concerns raised by skills biases, the key is the economic efficiency of the technology in the context of a particular economy. It is possible to grant fiscal incentives to encourage a more labour-intensive pattern of investment, for example, by reducing a payroll tax where one exists or introducing a tax credit based on the number of unskilled workers employed by firms. There is a clear case for such measures in the face of a labour surplus and a wage rate that exceeds the opportunity cost of labour, because of imperfections in the labour market, be they policy-induced or due to natural rigidity (Little et al.1970). However, it is unlikely that production

which requires a labour subsidy to be competitive in the short term will survive in the longer term. The most appropriate technology will be one which allows an economy to be competitive in the product line at the long-run prices it is likely to face. In some sectors, this may be labour-intensive, whilst in others, the capital-labour ratio may be above average.

Early debates in the development literature spent considerable efforts examining the choice of technology (Huq 2016). The implication was that there was a range of alternative ways of producing a given product, which could be simplified down to a ranking by their capital to labour ratios. The concern was that where prices for labour were kept artificially high (by minimum wage legislation, for example) and were kept artificially low for capital (by interest rate controls or overvalued exchange rates for imported capital goods), technology choice by profit-maximizing firms would be distorted in a capital-using direction. Whilst for some sectors there may have been a plausible choice of technology at an adequate level of quality and cost, the scope for this choice was always exaggerated. Much of the empirical evidence suggested that it was ancillary activities rather than core production processes where labour-using choices were available and that genuinely labour-intensive alternatives for many products only existed on a small-scale basis or in the informal sector. The policy-induced distortions of factor prices noted above are now much less common, so this aspect of the choice of technique is now less of a concern.

In addition, even capital-intensive technologies can still have labour-intensive parts of their production process. The rise of global value chains has meant that whilst technological change within manufacturing has generally been skill-using and thus created a demand for skilled relative to unskilled labour, some stages or segments of production are more intensive in unskilled labour than others, and their migration to low-wage economies has created demand for such labour. In economies where this offshoring has played a major role, employment growth in export manufacturing has been significant, often for female labour, even where overall employment in manufacturing has grown slowly due to a combination of demand factors and the skills bias of technological change.

There has been an extensive debate—most of it focused on higher-income economies—on how far technological innovation has created or displaced jobs. The standard approach is to distinguish between innovation in processes—altering the system of production to reduce costs or improve quality and innovation in products—altering the product mix by creating either genuinely new products or products adapted from existing designs. Insofar as innovation of both types is central to economic growth, it is expected that in the long run, innovation will be associated with an increase in overall employment. Empirical studies of innovation-employment links have been largely focused on higher income economies and tend to show that product innovations are usually associated with employment growth, whilst the effect of process innovations is often, but not inevitably, negative. Overall, net employment usually rises with innovation (Pianta 2005; UNIDO 2013).

The significance of this for developing countries is that whilst a few upper-middle-income economies may have reached the stage of technology creators that can create technologies in line with their own resource endowments, the vast majority are technology importers. For these, the technology transferred to them has been created in response to market conditions in the innovating economies, so they import a skills bias. However, while this may imply a lower direct employment effect, if the technology allows competitive production and rapid

output growth, it will create the positive employment effect from innovation expected from the empirical results elsewhere.

On the other hand, the corollary of importing skill-using technology is that the national labour force has to have the skills and training to apply the relevant technologies. Even where only part of the production process is transferred to a developing country, the skills of the labour force will have to be adequate. Simple tasks may be dealt with through on the job training but more complex ones may require workers to undergo more rigorous secondary school education and vocational training. Hence, part of the policy support package will have to be adequate public investment in education and training. Chapter 5 shows that some of the early 'successful industrializers' experienced high growth with modest national levels of secondary education, however, as industries become more sophisticated and international competition intensifies, this option may not be open to many follower economies.

In terms of the gender perspective on inclusion, manufacturing offers the potential for relatively well-paid female jobs. It is one of the key stylized facts of recent economic history that there has been a significant rise in 'feminization' defined as rising female intensity in formal employment in low- and middle-income countries due in large part to trade liberalization and the expansion of manufactured exports (Standing 1989; 1999). These countries are seen as having had a comparative advantage in labour-intensive and female-intensive activities (like clothing or electronics assembly), with female workers preferred over males in these activities due to their lower cost and greater flexibility. The positive association between export orientation and the female employment share has been established both at a macro and micro level, although it is possible that causation runs in both directions where there is a large gender wage gap, so that export growth is due in part to low-cost female labour.

Some of these trends have been reversed more recently and women's share in industrial employment relative to men's fell in all regions (apart from West Asia) between 1991 and 2013. In relation to export manufacturing in East Asia, the female employment share declined slightly from 1996-2007. This 'de-feminization' has been explained in relation to technological change as part of an upgrading progress, as exporters move into technologically more sophisticated and higher value goods. This shift typically necessitates higher capital-labour ratios and a higher ratio of skilled to unskilled workers and can be explained as either a response to perceived demand or to competition from lower wage economies. The link between upgrading and decreasing female employment shares occurs where either female workers have less access to skills training and education or alternatively, a form of gender discrimination is practiced, whereby firms prefer to train or employ male workers for specific tasks (Tejani and Milberg 2010). Currently, evidence suggests that high export growth can have an initial potentially strong effect on female employment, but as the export product mix moves into more technologically sophisticated goods, this employment effect weakens.

As discussed in Chapter 3, the gender wage gap between male and female workers performing the same work with comparable skills is an obstacle to full inclusion. How far employment in manufacturing, particularly export-oriented production, has worked to reduce this gap is unclear. There appears to be no systematic relationship across countries between the raw wage gap (that is, unadjusted for education and other differences) and the female intensity of manufacturing employment, although there is a significant negative relationship between the capital intensity of manufacturing and the share of female employees in the work force,

implying that upgrading has come at the expense of female labour (Tejani and Milberg 2010). Attempts to test for the impact of globalization and the associated opening to trade and foreign investment on gender wage gaps have shown conflicting results (Aguayo-Tellez 2011; Seguino and Grown 2006).

In policy terms, gender imbalances require intervention at a national level to change education opportunities and to alter cultural attitudes. Where legislation establishing the right to pay equality is not in place, it needs to be introduced, but more commonly where it exists, it needs to be enforced effectively. For example, experience from Cambodia, where women make up around 70 percent of manufacturing employment, is revealing. The expansion of clothing exports has created large numbers of jobs for women, which have proved more attractive than remaining in rural areas carrying out farm-based family work. Nonetheless, for Cambodia, there are estimates suggesting that the average gender wage gap between occupations in 2009 ranged from 6 percent for skilled agricultural workers to 42 percent for machine operators (ILO 2012, Table 3.1) and the Gender Development Index (the ratio of the female to male Human Development Index) suggests a relatively high degree of gender inequality (UNDP 2015).

...with a great environmental responsibility

Chapter 4 discussed the trends in emissions and material use as a result of the expansion of manufacturing activity. Whilst in most, apart from low-income, countries, there has been a significant reduction in the intensity of emissions and material use, indicating rising environmental efficiency, this has been offset in all countries but in high-income ones by the effects of increased scale of production. Hence, emissions and material waste have continued to rise. The policy challenge is thus to speed up the spread of efficiency improvements in production and the development of 'greener' final products. Broadly speaking, this requires initiatives on three fronts; incorporating environmental costs more fully into market prices, for example, through a form of carbon tax, support for green or environment-friendly manufacturing technologies and activities, and facilitating the transfer of environmentally efficient technologies, particularly to lower income countries.

Adequate pricing of environmental effects to ensure they are fully internalized for their creators will be critical in the long run, but much remains to be achieved. Most carbon trading markets have generated prices which are well below the estimates of damage costs per tonne of CO_2 or its equivalent. For example, whilst carbon trading prices in the European Union have been around only $5/tonne, damage cost estimates in the literature are far higher (UNIDO 2015).4 In most countries, governments have preferred to subsidize renewable energy alternatives rather than pursue the direct policy of higher taxes on fossil fuel-based sources. As subsidies have to be funded, there are budgetary limits on how far this approach can adjust relative prices.
Industrial policy will increasingly need to have an environmental as well as an economic efficiency component. Many governments already provide support for green industries, often with a view to creating competitive production and first mover advantages.[5] Nonetheless, even if the motives are nationalistic, the outcomes can still create global welfare gains by spreading environmentally-friendly products or technologies (Rodrik 2014). Governments will also need to take greater initiatives in the funding of basic research to develop the technology to allow significant reductions in the environmental intensity of manufacturing production. Chapter 4

shows that progress has been achieved in this area, but it is clear that more needs to be done. The transfer of environmental technology on a non-commercial basis will be essential if low-income countries are to contribute to improved environmental intensity in production. This is something that will require a form of international collaboration as part of official development assistance.

Summary

In conclusion, this report demonstrates that manufacturing still matters as a source of productivity and jobs, and that reverses to industrialization at a relatively early stage of development will mean that countries will forego these benefits. The policy challenge is to manage the potentially competing goals of raising productivity and living standards, whilst creating or at least not shedding jobs and reducing environmental damage. This creates the need for an active policy agenda that will be essential if countries are to achieve the benefits of positive structural change.

Notes

1. More recent work revises this conclusion on Africa; see Diao et al. (2017).
2. See for example, Perez and Primi (2009), UNIDO (2013; 2017) and Warwick (2013).
3. See the country cases in Altenburg (2011), Salazar-Xirinachs et al. (2014), Crespi et al. (2014), Felipe (2015), Altenburg and Lutkenhorst (2015) and Weiss and Tribe (2016).
4. For example, in its project planning, the Asian Development Bank uses a 2016 price of USD 36/ton derived from a review of the available estimates of damage costs (ADB 2017).
5. Well-documented examples are Chinese policy towards the development of hardware for the solar energy sector, such as solar panels, and electric cars; see Mazzucato (2013) and UNIDO (2017).

APPENDICES

Appendix A

Kaldor's Growth Laws and Empirical Evidence

Kaldor's *first law* states that manufacturing is the 'engine of growth', not simply because manufacturing output is a part of total output, but for fundamental economic reasons related to induced productivity growth in both the manufacturing and non-manufacturing sectors. The proposition is that the greater the excess of manufacturing growth over non-manufacturing growth, the faster the overall growth of GDP will be. Induced productivity growth in manufacturing is related to static and dynamic increasing returns, while induced productivity in non-manufacturing sectors is related to the fact that if labour is taken out of activities characterized by diminishing returns, the average product will rise. The transfer of labour from the non-manufacturing to the manufacturing sector therefore induces productivity growth in both.

Apart from the two dynamic effects mentioned above, there is also the static effect, which relates to the fact that the expansion of manufacturing output and employment leads to a transfer of labour from low productivity sectors (where there is disguised unemployment) to higher productivity industries. The outcome is increasing overall productivity in the economy and little or no negative impact on the output of the traditional sectors, given the existence of surplus labour. According to Kaldor, this process is characteristic of the transition from 'immaturity' to 'maturity', where an 'immature' economy is defined as one in which there is a large amount of labour available in low productivity sectors that can be transferred to industry. This effect is sometimes termed 'the structural change bonus'.

Kaldor's *second law* refers to induced productivity growth in manufacturing as manufacturing expands. Originally in 1949, the Dutch economist P. J. Verdoorn found that each one percentage increase in the growth of manufacturing output is associated with a 0.5 percent increase in the growth of manufacturing labour productivity. He discovered this relationship across 15 countries, specifically Canada, Czechoslovakia, Denmark, Estonia, Finland, Germany, the Netherlands, Hungary, Italy, Japan, Norway, Poland, Switzerland, the United Kingdom and the United States. Verdoorn's work did not achieve immediate attention until 1966, when Kaldor explicitly referred to it and coined the term Verdoorn's Law in his Cambridge inaugural lecture (Kaldor 1966). The relationship can be interpreted as evidence of the existence of static and dynamic increasing returns within industry. Static returns relate to the size and scale of production, where larger production runs allow for economies of mass production. Productivity rises and costs fall. Dynamic returns relate to induced capital accumulation, incorporating new technological progress and the process of learning-by-doing, whereby labour productivity increases with a cumulative output as workers learn on the job. In agriculture and services, there is not the same scope for reaping static and dynamic returns to scale.

The test of Verdoorn's Law is given by the regressing growth of labour productivity in manufacturing on the growth of manufacturing, which provides a coefficient referred to as the

'Verdoorn coefficient'. Kaldor views the relationship as a *dynamic* one, between the growth rates (as opposed to levels) of output and productivity, which can be explained by factors such as increasing specialization among firms, positive externalities, induced technological progress and greater scope for product differentiation. This interpretation is related to Kaldor's perception that economic growth is demand-determined rather than resource-constrained. In other words, Kaldor argues that output growth is determined by the exogenous growth of effective demand, while both productivity growth and employment growth are endogenous. Kaldor (1966) points to two fundamental sources of autonomous demand, namely agriculture in the early stages of development and exports in the later stages.

Table A.1
Studies testing Kaldor's growth laws

Kaldor's Laws	Author(s) and year of publication	Sample size used for study
1st law	Chakravarty and Mitra (2009)	India
	Dasgupta and Singh (2006)	48 developing countries
	Hansen and Zhang (1996)	China: 28 regions
	Kathuria and Natarajan (2013)	India
	Marconi et al. (2016)	63 countries
	McCausland and Theodossiou (2012)	Developed countries
	Necmi (1999)	45 mostly developing countries
	Szirmai and Verspagen (2015)	92 countries
	Wells and Thirlwall (2003)	Africa: 45 countries
2nd law	Atesoglu (1993)	United States
	Bairam (1991)	Turkey
	Drakopoulos and Theodossiou (1991)	Greece
	Fingleton and McCombie (1998)	European Union: 178 regions
	Hansen and Zhang (1996)	China: 28 regions
	León-Ledesma (1999)	Spain: 17 regions
	Timmer and Szirmai (2000)	India, Indonesia, Republic of Korea and Taiwan Province of China
3rd law	Hansen and Zhang (1996)	China: 28 regions
	Wells and Thirlwall (2003)	Africa: 45 countries

Source: UNIDO elaboration.

The *third law* states that the faster the growth of manufacturing output, the faster the rate of labour transfer from the non-manufacturing to manufacturing sector, so that overall productivity growth is positively related to the growth of output and employment in manufacturing and negatively associated with the growth of employment outside manufacturing. It is difficult to test the third law directly, because it is not easy to measure productivity growth in many activities outside manufacturing, particularly service activities. But it can be tested indirectly by regressing the rate of total productivity growth in the economy as a whole on the employment

change in non-manufacturing activities, holding constant the effect of output growth in manufacturing. A negative coefficient on non-manufacturing activities supports the hypothesis that employment growth in non-manufacturing slows overall productivity growth.

Many empirical studies have tested Kaldor's laws across countries and across regions within countries. Most of these studies focus on the first two laws; only a few have been published reporting results for the third law. Most find support for Kaldor's hypotheses. Table A.1 lists a selective sample of these studies.

Appendix B

Data and Model Specification

In the analysis of 'successful' industrializers, the main source of information is the UN National Accounts Statistics, which provides, among others, annual data on manufacturing value added in constant $ over the period 1970-2014 for virtually all countries. Considering the focus on developing countries, all countries classified as high-income by the World Bank at the end of each of the periods (1970-1990 and 1991-2014) were removed from the initial sample. Also, countries with a population of less than 1 million were dropped to eliminate potential outliers from the sample.[1] The final sample included 126 countries for the period 1971-1990 and 112 countries for the period 1991-2014.[2]

Based on this sample, annual manufacturing value added growth rates were calculated and the distribution of this variable for the sample over the two periods was analysed. Table B.1 reports the mean, median and 75th percentile value for the countries included in the analysis.

Table B.1
Descriptive statistics on the key variable of interest: growth in manufacturing value added

Variable	1971-2014	Post-1990	Pre-1990
Mean	4.57	4.26	4.99
Median	3.58	3.16	4.23
75th percentile	8.06	7.50	8.82

Source: Value added data is adapted by Martorano et al. (2017) from the National Accounts Main Aggregates Database, by United Nations Statistics Division, ©2015 United Nations. Reprinted with the permission of the United Nations.

Criteria for successful industrializer

To proceed with the identification of successful industrializers, the strategy relies on a simple methodology that uses thresholds drawn directly from the observed distribution of the outcome of interest. The identification strategy builds on the following stages:

1. For each country, the average manufacturing value added growth rate during the period of analysis (1971-1990 and 1991-2014) *must be higher* than the average growth rate of manufacturing value added for the entire sample over the same period (i.e. larger than 4.26 percent in the post-1990, and larger than 4.99 percent in the pre-1990 periods);

2. An 'episode' of industrialization is defined as *any year* in which the annual rate of manufacturing value added growth is *higher than* the average annual manufacturing value added growth rate of the reference group or period;

3. A first group of industrializers is identified by grouping countries according to the number of successful episodes recorded over each of the two periods. Countries are classified as industrializers if they experienced a number of episodes *larger than* the average number of episodes for the entire distribution (i.e. 9.5 in the first and 9.9 in the second period).

In order to refine the selection and to focus on a smaller group of successful industrializers, two additional criteria are added that relate to the pattern and sustainability of the industrialization process:

4. Only those countries that recorded *less* than 25 percent negative episodes (i.e. less than 5 declines in 1970-1990 and less than 6 in 1991-2014) are included;

5. Only those countries that recorded *more* than 75 percent episodes of above average growth (i.e. 16 or more years of high growth for the first period and 18 or more years of high growth for the second period) are selected.

The model

The following baseline model is estimated:

$$industrializer_{it} = \beta \sum Z_{it} + \theta_t + u_{it}$$

where Z is a vector of factors likely to influence industrialization, *i* and *t* indicate the country and year, *qt* are the time fixed effects used to control for country invariant shocks (such as global financial crises and international commodity price fluctuations) that might have affected growth and industrialization, while *uit is the idiosyncratic error term*.

The dependent variable is a binary indicator which takes a value of 1 if the country is classified as a successful industrializer according to the definition provided in above. The dummy takes a value of 1 for the entire sub-period of interest if the country is in the group of successful industrializers. For example, while Indonesia and Oman have a value of 1 for *all* 19 years of the period 1971-1990, the value for all the years in the 1991-2014 period is 0, as neither country was classified as a successful industrializer in the second period. In view of this, the analysis uses the pooled dimension of the data applying a standard probit estimator. The results should therefore be interpreted as the influence of each factor included in Z on the probability of a country belonging to the group of successful industrializers in any given period.

Table 8 provides descriptive statistics for the entire sample disaggregated by period. The means of the two sub-periods do not differ significantly. This could be an indication of similarities among countries' policies and characteristics over the two sub-periods. The only main exceptions are represented by the variables measuring openness-related policies (REER and KAOPEN), which reflect a different international trend as regards trade and financial liberalization policies between the two sub-periods. Other changes to note are that the level of domestic credit to the private sector increased between the two periods following the process of internal liberalization, while the stability of political regimes decreased between the two periods.

Table B.3 reports a disaggregation of previous statistics distinguishing between the groups of successful industrializers and the rest of the countries for the entire period as well as for both sub-periods separately. In nearly all cases, the mean values are statistically different. The group of successful industrializers are, on average—and independently of the period considered—characterized by lower income, higher investments, higher access to credit and greater institutional stability, as well as by a lower dependence on natural resource rents and more competitive exchange rates. Other variables, such as capital openness and education, show less obvious differences over the full period, but there is a substantial difference in capital openness pre-1990 between the industrializers and the rest, with the former having a more open capital account.

Table B.2
Descriptive statistics on the overall period (1971-2014) and the two sub-periods (1971-1990) and (1991-2014)

Variable	Observations	Mean	Standard deviation	Minimum	Maximum	<1991 mean	Standard deviation	≥1991 mean	Standard deviation
MVA_GROWTH	4607	0.05	0.34	-0.95	18.14	0.05	0.14	0.05	0.44
LGDP_PC	4734	7.02	1.11	4.03	9.68	7.00	1.16	7.04	1.07
GFCF_GDP	4689	0.22	0.12	0.01	1.59	0.22	0.14	0.22	0.10
CREDIT	3849	25.69	23.85	0	166.5	23.33	17.3	27.23	27.17
REER	4106	150.09	892.56	0.38	56273.63	207.14	1363.15	107.71	66.47
KAOPEN	4058	-0.51	1.3	-1.89	2.39	-0.78	1.15	-0.31	1.36
HC	4213	5.41	2.7	-0.7	11.87	4.64	2.67	6.17	2.51
POL	3975	37.53	46.75	1	211	41.18	51.02	34.06	42.01
NAT_RES	3900	1.46	4.06	0	44.64	1.49	3.96	1.44	4.13
LAND-LOCKED	5067	0.27	0.44	0	1	0.26	0.44	0.27	0.44

Source: Martorano et al. (2017) based on the variable sources described in Chapter 5, Table 4. Value added data is adapted from the National Accounts Main Aggregates Database, by United Nations Statistics Division, ©2015 United Nations. Reprinted with the permission of the United Nations.

Table B.3
Descriptive statistics on the overall period and the two sub-periods

		All countries		Other countries		Industrializers		
Period	Variable	Mean	Standard deviation	< 1991 mean	Standard deviation	≥ 1991 mean	Standard deviation	Difference
1970 – 2014	MVA_GROWTH	0.05	0.01	0.04	0.01	0.11	0.00	-0.07
	LGDP_PC	7.02	0.02	7.03	0.02	6.85	0.06	0.18
	GFCF_GDP	0.22	0.00	0.22	0.00	0.25	0.01	-0.03
	CREDIT	25.69	0.38	24.88	0.38	36.28	1.92	-11.40
	REER	150.01	13.90	151.85	14.73	119.34	2.75	32.51
	KAOPEN	-0.51	0.02	-0.51	0.02	-0.47	0.08	-0.04
	HC	5.39	0.04	5.42	0.04	5.02	0.10	0.40
	POL	37.45	0.74	36.20	0.73	58.78	4.61	-22.58
	NAT_RES	1.46	0.06	1.51	0.07	0.67	0.14	0.84
	LANDLOCKED	0.27	0.01	0.28	0.01	0.08	0.02	0.20
1970 – 1990	MVA_GROWTH	0.05	0.03	0.04	0.00	0.12	0.01	**-0.08**
	LGDP_PC	7.00	0.03	6.96	0.03	7.71	0.08	-0.75
	GFCF_GDP	0.22	0.00	0.22	0.00	0.23	0.01	-0.01
	CREDIT	23.33	0.44	22.50	0.45	33.65	1.92	**-11.15**
	REER	207.31	32.68	211.77	34.72	136.29	5.63	**75.48**
	KAOPEN	-0.78	0.03	-0.87	0.03	0.41	0.13	**-1.28**
	HC	4.61	0.06	4.59	0.06	4.94	0.19	-0.35
	POL	41.19	1.17	40.47	1.17	52.73	6.60	-12.26
	NAT_RES	1.50	0.10	1.59	0.11	0.23	0.03	**1.36**
	LANDLOCKED	0.26	0.01	0.27	0.01	0	0	**0.27**

Table B.4 (continued)
Means comparison between successful industrializers and other countries

		All countries		Other countries		Industrializers		
Period	Variable	Mean	Standard deviation	< 1991 mean	Standard deviation	≥ 1991 mean	Standard deviation	Difference
1991 – 2014	MVA_GROWTH	0.05	0.01	0.05	0.01	0.10	0.00	**-0.05**
	LGDP_PC	7.04	0.02	7.09	0.02	6.20	0.06	**0.89**
	GFCF_GDP	0.22	0.00	0.22	0.00	0.26	0.01	**-0.04**
	CREDIT	27.23	0.56	26.42	0.56	38.16	2.98	**-11.74**
	REER	107.83	1.37	107.94	1.44	105.91	1.18	2.03
	KAOPEN	-0.31	0.03	-0.25	0.03	-1.08	0.06	**0.83**
	HC	6.17	0.05	6.27	0.06	5.07	0.10	**1.20**
	POL	33.94	0.93	32.19	0.89	65.06	6.40	**-32.87**
	NAT_RES	1.43	0.09	1.46	0.09	1.08	0.25	0.38
	LANDLOCKED	0.27	0.01	0.28	0.01	0.14	0.02	**0.14**

Note: Differences in means that are highlighted with bold are statistically significant at 5 percent.

Source: Martorano et al. (2017) based on the variable sources described in Chapter 5, Table 4. Value added data is adapted from the National Accounts Main Aggregates Database, by United Nations Statistics Division, ©2015 United Nations. Reprinted with the permission of the United Nations.

Robustness checks

Additional analyses are introduced to control for the robustness of the results. The dependent variable, measuring the successful periods of manufacturing value added growth for a relatively small group of countries (6 or 7 for each sub-period) could, in principle, be affected by the so-called 'rare events' bias. Such a bias, commonly known as a 'small sample bias', is higher the smaller the number of cases in the less frequent of the two events, and could affect the maximum likelihood estimation of a model, such as a standard probit or logit model. An alternative method consists of estimating the model through penalized likelihood. Penalized likelihood is a general approach to reducing a small sample bias in a maximum likelihood estimation.[3] Table B.4 replicates the core estimation (as reported in Table 5.5) using a penalized likelihood estimator. There are no major differences, thus reducing any potential concerns about the small size of the selected sample of successful industrializers.

Table B.4
Determinants of industrialization periods - controlling for the rare event bias

Variable	(1) 1971-2014	(2) Pre-1990	(3) Post-1990
LGDP_PC	-0.808*** [0.119]	-0.234 [0.163]	-2.948*** [0.366]
GFCF_GDP	2.058*** [0.504]	-0.141 [0.855]	10.802*** [1.438]
CREDIT	0.020*** [0.003]	0.018** [0.007]	0.043*** [0.007]
REER	0.000 [0.000]	0.000 [0.000]	-0.007 [0.008]
KAOPEN	-0.122* [0.073]	0.371*** [0.083]	-1.764*** [0.337]
HC	0.152*** [0.049]	0.182** [0.079]	0.190** [0.080]
POL	0.003** [0.002]	-0.006* [0.003]	0.015*** [0.004]
NAT_RES	-0.083* [0.044]	-0.507** [0.197]	-0.019 [0.036]
LANDLOCKED	-1.089*** [0.262]	-3.400** [1.436]	-1.417*** [0.360]
Constant	1.973** [0.918]	-1.150 [1.194]	10.336*** [2.198]
Observations	2,736	1,258	1,486

Note: Robust standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1.

Source: UNIDO elaboration based on the variable sources described in Chapter 5, Table 5.4. Value added data is adapted from the National Accounts Main Aggregates Database, by United Nations Statistics Division, ©2015 United Nations. Reprinted with the permission of the United Nations.

Second, the selection of samples used for the analysis might be questioned. One could argue that the characteristics that seem to be peculiar to the sub-group of successful industrializers may be common to other industrializers as well, this being particularly true for those countries reporting high levels of manufacturing value added growth, but which do not have a sustained pattern of growth. To deal with this issue, the successful industrializers are compared with a sub-group of other industrializers with rapid but not sustained growth. The results, not reported, are consistent with the original analysis (except for the investment variable), and strengthen the findings by showing that the characteristics discussed above appear unique to the smaller group of industrializers.

Third, the choice of variable on which the selection of successful industrializers was based may also be challenged. To some extent, periods of high growth of total manufacturing value added could be linked to more general periods of sustained economic growth, which could raise the question about whether an industrial take-off is in fact occurring. One might argue that an additional condition for determining successful industrialization is a high ratio of manufacturing value added to GDP, an indicator that can separate the growth of manufacturing from a possible link to overall economic growth.[4] To check the robustness of the results, a similar procedure to

that described is followed, but instead using the rate of growth of the manufacturing value added to GDP ratio. The list of successful industrializers is then adjusted by excluding those countries that are not found among the successful industrializers based on the new criteria. While no substantial differences are found during the pre-1990 period, a narrower selection was made for the post-1990 period, since China, Cambodia, India and Laos were excluded. Estimates were rerun on the adjusted samples, which broadly confirm the robustness of the key findings. Two striking differences emerge both relating to the post-1990 sample. First, the coefficient of political stability turns negative and significant. Such a negative coefficient might be explained by the decrease in the number of countries with long lasting regimes (China, Cambodia and India are omitted), whereas the sample of successful industrializers now mostly includes countries that have recently experienced political transitions, such as Bangladesh, Myanmar and Viet Nam. Second, the coefficient of the exchange rate now turns positive and significant, suggesting an appreciating real exchange rate has boosted manufacturing. The omission of some fast growth economies from the group has clearly affected the interpretation of the role of the exchange rate variable.

Notes

1. The excluded countries had a population lower than 1 million in terms of average value for both periods.
2. Over the period 1971-1990, the sample includes 42 African countries, 35 Asian Pacific countries, 22 American countries and 20 European countries. Over the period 1991-2014, the sample includes 47 African countries, 32 Asian Pacific countries, 19 American countries and 9 European countries.
3. This is done by the user-written STATA command firthlogit (Coveney, 2015).
4. For instance, Uganda's manufacturing value added growth rate was higher than 5 percent over the period 2004-2011, while in Equatorial Guinea, it was even higher (around 15 percent in 2007, 2008 and 2009). However, in both cases, the manufacturing value added growth rate was lower than the GDP growth rate. As a result, the growth rate of the manufacturing value added /GDP variable decreased, signalling a reduction in the importance of the manufacturing sector in these economies.

Appendix C

Country and Manufacturing Sector Classifications

Table C.1
Countries and economies by region

AFRICA				
Central Africa				
Cameroon	Chad	Equatorial Guinea	São Tomé and Principe	
Central African Republic	Congo, Republic of the	Gabon		
Eastern Africa				
Burundi	Djibouti	Ethiopia	Réunion	Somalia
Comoros	Eritrea	Kenya	Rwanda	Uganda
North Africa				
Algeria	Libya	South Sudan	Tunisia	
Egypt	Morocco	Sudan		
Southern Africa				
Angola	Lesotho	Mauritius	Seychelles	Tanzania, United Republic of
Botswana	Madagascar	Mozambique	South Africa	Zambia
Congo, Dem. Republic of the	Malawi	Namibia	Swaziland	Zimbabwe
Sub-Saharan Africa[a]				
Angola	Congo, Republic of the	Guinea-Bissau	Namibia	Swaziland
Benin	Congo, Dem. Republic of the	Kenya	Niger	Tanzania, United Republic of
Botswana	Côte d'Ivoire	Lesotho	Nigeria	Togo
Burkina Faso	Djibouti	Liberia	Rwanda	Uganda
Burundi	Equatorial Guinea	Madagascar	São Tomé and Principe	Zambia
Cabo Verde	Ethiopia	Malawi	Senegal	Zimbabwe
Cameroon	Gabon	Mali	Seychelles	
Central African Republic	Gambia	Mauritania	Sierra Leone	
Chad	Ghana	Mauritius	Somalia	
Comoros	Guinea	Mozambique	South Africa	

Table C.1 (continued)

Western Africa				
Benin	Gambia	Liberia	Nigeria	
Burkina Faso	Ghana	Mali	Senegal	
Cabo Verde	Guinea	Mauritania	Sierra Leone	
Côte d'Ivoire	Guinea-Bissau	Niger	Togo	
AMERICAS				
Latin America				
Caribbean				
Anguilla	British Virgin Islands	Dominican Republic	Martinique	Saint Vincent and the Grenadines
Antigua and Barbuda	Cayman Islands	Grenada	Montserrat	Trinidad and Tobago
Aruba	Cuba	Guadeloupe	Puerto Rico	United States Virgin Islands
Bahamas	Curaçao	Haiti	Saint Kitts and Nevis	
Barbados	Dominica	Jamaica	Saint Lucia	
Central America				
Belize	El Salvador	Honduras	Nicaragua	
Costa Rica	Guatemala	Mexico	Panama	
South America				
Argentina	Chile	French Guiana	Peru	Venezuela, Bolivarian Republic of
Bolivia, Plurinational State of	Colombia	Guyana	Suriname	
Brazil	Ecuador	Paraguay	Uruguay	
North America				
Bermuda	Canada	Greenland	United States	
ASIA AND PACIFIC				
Central Asia				
Kazakhstan	Mongolia	Turkmenistan		
Kyrgyzstan	Tajikistan	Uzbekistan		
East Asia				
China	Japan	Macao SAR, China	Singapore	
Hong Kong SAR, China	Korea, Republic of	Malaysia	Taiwan Province of China	
South Asia				
Afghanistan	Bhutan	Maldives	Pakistan	
Bangladesh	India	Nepal	Sri Lanka	
South East Asia				
Brunei Darussalam	Indonesia	Myanmar	Thailand	
Cambodia	Lao, People's Dem. Republic of	Philippines	Viet Nam	

Table C.1 (continued)

West Asia				
Armenia	Iraq	Lebanon	State of Palestine	
Azerbaijan	Israel	Oman	Syrian Arab Republic	
Bahrain	Jordan	Qatar	United Arab Emirates	
Iran, Islamic Republic of	Kuwait	Saudi Arabia	Yemen	
Other Asia and Pacific				
Australia	French Polynesia	Micronesia, Federated States of	Papua New Guinea	Tonga
Cook Islands	Guam	New Caledonia	American Samoa	Tuvalu
Korea, People's Dem. Republic of	Kiribati	New Zealand	Solomon Islands	Vanuatu
Fiji	Marshall Islands	Palau	Timor-Leste	
EUROPE				
European Union[b]				
Austria	Finland	Italy	Portugal	United Kingdom
Belgium	France	Lithuania	Slovakia	
Czechia	Germany	Luxembourg	Slovenia	
Denmark	Hungary	Malta	Spain	
Estonia	Ireland	Netherlands	Sweden	
Other European countries				
Albania	Croatia	Latvia	Poland	San Marino
Andorra	Cyprus	Liechtenstein	Moldova, Republic of	Switzerland
Belarus	Georgia	Monaco	Romania	Macedonia, Former Yugoslav Republic of
Bosnia and Herzegovina	Greece	Montenegro	Russian Federation	Turkey
Bulgaria	Iceland	Norway	Serbia	Ukraine

Note: a. Countries in Sub-Saharan Africa are also represented in in the other country groups of this classification. b. Excluding non-industrialized Europen Union economies.

Source: UNIDO (2017a) based on UNIDO (2017b).

Table C.2
Countries and economies by industrialization level

INDUSTRIALIZED ECONOMIES				
Aruba	Denmark	Ireland	Netherlands	Slovenia
Andorra	Estonia	Israel	New Caledonia	Spain
Australia	Finland	Italy	New Zealand	Sweden
Austria	France	Japan	Norway	Switzerland
Bahrain	French Guiana	Kuwait	Portugal	Taiwan Province of China
Belgium	French Polynesia	Liechtenstein	Puerto Rico	United Arab Emirates
Bermuda	Germany	Lithuania	Qatar	United Kingdom
British Virgin Islands	Greenland	Luxembourg	Korea, Republic of	United States
Canada	Guam	Macao SAR, China	Russian Federation	United States Virgin Islands
Cayman Islands	Hong Kong SAR, China	Malaysia	San Marino	
Curaçao	Hungary	Malta	Singapore	
Czechia	Iceland	Monaco	Slovakia	
DEVELOPING AND EMERGING ECONOMIES				
Emerging industrial economies				
Argentina	Colombia	Kazakhstan	Saudi Arabia	Turkey
Belarus	Costa Rica	Latvia	Serbia	Ukraine
Brazil	Croatia	Mauritius	South Africa	Uruguay
Brunei Darussalam	Cyprus	Mexico	Suriname	Venezuela, Bolivarian Republic of
Bulgaria	Greece	Oman	Thailand	
Chile	India	Poland	Macedonia, Former Yugoslav Republic of	
China	Indonesia	Romania	Tunisia	
Other developing economies				
Albania	Cook Islands	Guatemala	Montenegro	Saint Lucia
Algeria	Côte d'Ivoire	Guyana	Montserrat	Saint Vincent and the Grenadines
Angola	Cuba	Honduras	Morocco	Seychelles
Anguilla	Korea, People's Dem. Republic of	Iran, Islamic Republic of	Namibia	Sri Lanka
Antigua and Barbuda	Dominica	Iraq	Nicaragua	State of Palestine
Armenia	Dominican Republic	Jamaica	Nigeria	Swaziland
Azerbaijan	Ecuador	Jordan	Pakistan	Syrian Arab Republic
Bahamas	Egypt	Kenya	Palau	Tajikistan

Table C.2 (continued)

Barbados	El Salvador	Kyrgyzstan	Panama	Tonga
Belize	Equatorial Guinea	Lebanon	Papua New Guinea	Trinidad and Tobago
Bolivia, Plurinational State of	Fiji	Libya	Paraguay	Turkmenistan
Bosnia and Herzegovina	Gabon	Maldives	Peru	Uzbekistan
Botswana	Georgia	Marshall Islands	Philippines	Viet Nam
Cabo Verde	Ghana	Martinique	Moldova, Republic of	Zimbabwe
Cameroon	Grenada	Micronesia, Federated States of	Réunion	
Congo, Republic of the	Guadeloupe	Mongolia	Saint Kitts and Nevis	
Least developed countries				
Afghanistan	Congo, Dem. Republic of the	Lesotho	Rwanda	Timor-Leste
Bangladesh	Djibouti	Liberia	Samoa	Togo
Benin	Eritrea	Madagascar	São Tomé and Principe	Tuvalu
Bhutan	Ethiopia	Malawi	Senegal	Uganda
Burkina Faso	Gambia	Mali	Sierra Leone	Vanuatu
Burundi	Guinea	Mauritania	Solomon Islands	Yemen
Cambodia	Guinea-Bissau	Mozambique	Somalia	Zambia
Central African Republic	Haiti	Myanmar	South Sudan	
Chad	Kiribati	Nepal	Sudan	
Comoros	Lao, People's Dem. Republic of	Niger	Tanzania, United Republic of	

Note: Industrialized economies include economies with adjusted manufacturing value added per capita higher than 2,500 or a gross domestic product higher than 20,000 international PPP$ (PPP is purchasing power parity). Emerging industrial economies include economies with adjusted manufacturing value added per capita ranging between 1,000 and 2,500 or whose share of the world manufacturing value added is higher than 0.5 percent. The list of least developed countries is based on decisions of the United Nations General Assembly. All remaining economies are included in the group "other developing economies."

Source: UNIDO (2017a) based on UNIDO (2017b).

Table C.3
Differences between UNIDO's industrialization level country classification and the United Nations M49 Standards 'Standard Country or Area Codes for Statistical Use'

Economies or areas classified as 'developing' in the M49 Standards and as 'developed' by UNIDO (2017b)		Economies or areas classified as 'developed' in the M49 Standards and as 'developing and emerging industrial' by UNIDO (2017b)	
Aruba	Israel	Albania	Poland
Bahrain	Kuwait	Belarus	Romania
British Virgin Islands	Malaysia	Bosnia and Herzegovina	Serbia
Cayman Islands	New Caledonia	Bulgaria	Ukraine
Hong Kong SAR, China	Puerto Rico	Croatia	
Macao SAR, China	Qatar	Greece	
Curaçao	Korea, Republic of	Latvia	
French Guiana	Singapore	Macedonia, Former Yugoslav Republic of	
French Polynesia	United Arab Emirates	Moldova, Republic of	
Guam	United States Virgin Islands	Montenegro	

Note: The table is the result of a comparison between UNIDO (2017b) and the United Nation's M49 Standards (UNSD n.d.) for the assignment of countries or areas to specific groupings as used by the National Accounts Main Aggregates Database (UNSD 2017).

Table C.4
Countries and economies by income level

HIGH-INCOME				
Andorra	Chile	Guam	Monaco	Saudi Arabia
Anguilla	Croatia	Hong Kong SAR, China	Netherlands	Singapore
Antigua and Barbuda	Curaçao	Iceland	New Caledonia	Slovakia
Aruba	Cyprus	Ireland	New Zealand	Slovenia
Australia	Czechia	Israel	Norway	Spain
Austria	Denmark	Italy	Oman	Sweden
Bahamas	Equatorial Guinea	Japan	Poland	Switzerland
Bahrain	Estonia	Kuwait	Portugal	Taiwan Province of China
Barbados	Finland	Latvia	Puerto Rico	Trinidad and Tobago
Belgium	France	Liechtenstein	Qatar	United Arab Emirates
Bermuda	French Polynesia	Lithuania	Korea, Republic of	United Kingdom
Brunei Darussalam	Germany	Luxembourg	Russian Federation	United States
Canada	Greece	Macao SAR, China	Saint Kitts and Nevis	United States Virgin Islands
Cayman Islands	Greenland	Malta	San Marino	Uruguay
UPPER-MIDDLE-INCOME				
Albania	China	Iraq	Montenegro	Thailand
Algeria	Colombia	Jamaica	Namibia	Tonga
American Samoa	Costa Rica	Jordan	Palau	Tuvalu
Angola	Cuba	Kazakhstan	Panama	Tunisia
Argentina	Dominica	Lebanon	Peru	Turkey
Azerbaijan	Dominican Republic	Libya	Romania	Turkmenistan
Belarus	Ecuador	Macedonia, Former Yugoslav Republic of	Saint Lucia	Venezuela, Bolivarian Republic of
Belize	Fiji	Malaysia	Saint Vincent and the Grenadines	
Bosnia and Herzegovina	Gabon	Maldives	Serbia	
Botswana	Grenada	Mauritius	Seychelles	
Brazil	Hungary	Marshall Islands	South Africa	
Bulgaria	Iran, Islamic Republic of	Mexico	Suriname	

Table C.4 (continued)

LOWER-MIDDLE-INCOME				
American Samoa	El Salvador	Lao, People's Dem. Republic of	Papua New Guinea	Swaziland
Armenia	Georgia	Lesotho	Philippines	Syrian Arab Republic
Bhutan	Ghana	Mauritania	Paraguay	Timor-Leste
Bolivia, Plurinational State of	Guatemala	Micronesia, Federated States of	São Tomé and Principe	Ukraine
Cabo Verde	Guyana	Moldova, Republic of	Senegal	Uzbekistan
Cameroon	Honduras	Mongolia	Solomon Islands	Vanuatu
Congo, Republic of the	India	Morocco	South Sudan	Viet Nam
Côte d'Ivoire	Indonesia	Nicaragua	Sri Lanka	Yemen
Djibouti	Kiribati	Nigeria	State of Palestine	Zambia
Egypt	Kyrgyzstan	Pakistan	Sudan	
LOW-INCOME				
Afghanistan	Chad	Guinea-Bissau	Mali	Somalia
Bangladesh	Comoros	Haiti	Mozambique	Tajikistan
Benin	Congo, Dem. Republic of the	Kenya	Myanmar	Tanzania, United Republic of
Burkina Faso	Eritrea	Korea, Dem. People's Republic of	Nepal	Togo
Burundi	Ethiopia	Liberia	Niger	Uganda
Cambodia	Gambia	Madagascar	Rwanda	Zimbabwe
Central African Republic	Guinea	Malawi	Sierra Leone	

Source: UNIDO (2017a) based on UNIDO (2017b).

Table C.5
Economic sectors, ISIC Rev. 3

ISIC code Rev. 3	Description
A	Agriculture, hunting and forestry
B	Fishing
C	Mining and quarrying
D	Manufacturing
E	Electricity, gas and water supply
F	Construction
G	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods
H	Hotels and restaurants
I	Transport, storage and communications
J	Financial intermediation
K	Real estate, renting and business activities
L	Public administration and defence; compulsory social security
M	Education
N	Health and social work
O	Other community, social and personal service activities
P	Private households with employed persons
Q	Extra-territorial organizations and bodies

Source: UNIDO (2017a) based on UNSD (n.d.b).

Table C.6
Classification of manufacturing sectors, ISIC Rev. 3

ISIC code Rev. 3	Description
15	Manufacture of food products and beverages
16	Manufacture of tobacco products
17	Manufacture of textiles
18	Manufacture of wearing apparel; dressing and dyeing of fur
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
21	Manufacture of paper and paper products
22	Publishing, printing and reproduction of recorded media
23	Manufacture of coke, refined petroleum products and nuclear fuel
24	Manufacture of chemicals and chemical products
25	Manufacture of rubber and plastics products
26	Manufacture of other non-metallic mineral products
27	Manufacture of basic metals
28	Manufacture of fabricated metal products, except machinery and equipment
29	Manufacture of machinery and equipment n.e.c.
30	Manufacture of office, accounting and computing machinery
31	Manufacture of electrical machinery and apparatus n.e.c.
32	Manufacture of radio, television and communication equipment and apparatus
33	Manufacture of medical, precision and optical instruments, watches and clocks
34	Manufacture of motor vehicles, trailers and semi-trailers
35	Manufacture of other transport equipment
36	Manufacture of furniture; manufacturing n.e.c.
37	Recycling

Source: UNIDO (2017a) based on UNSD (n.d.b).

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