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PATTERNS OF STRUCTURAL CHANGE AND MANUFACTURING DEVELOPMENT

Nobuya Haraguchi

Introduction

Economic growth has been associated with changes in economic structure. Before the Industrial Revolution in the eighteenth century, the world economy grew very slowly and changed structure very little relative to the recent standard (Kuznets, 1966; Maddison, 2003). Modern economic growth has been characterised by an increase in population and an even faster increase in output, leading to higher growth in per capita income (Kuznets, 1966). This sustained income growth was not accompanied by the proportional increase in the outputs of different sectors but by continuous changes in the economic structure. A rapid increase in the share of industry with a decline of agricultural share, or industrialisation, initially plays a key role in catapulting the economy into a higher growth path (Ocampo et al., 2009). The importance of manufacturing relative to agriculture for economic growth has been attributed to the higher economies of scale of the former, higher income elasticity of demand for manufactured goods and higher potential of productivity catch-up of the manufacturing sector (Kaldor, 1967; Chenery et al., 1986; Rodrik, 2011; Weiss, 2011). Manufacturing normally ceases being a dominant engine of growth when countries reach a high per capita income of roughly US$14,000 (in constant 2005 purchasing power parity, PPP). Thereafter, the service sector’s contribution to the economy carries an increasingly larger weight, and the manufacturing share tends to gradually decrease, although such a description based on official statistics tends to conceal an increasingly interdependent nature of the development of manufacturing and fast growing business-related services (Franke and Kalmbach, 2005; Tahara, 2009; Tomlinson, 2012). The development of an efficient and dynamic service sector depends especially on the kind of manufacturing structure that a country has established (Guerrieri and Meliciani, 2005).

The fact that the manufacturing sector plays a key role in a country’s development makes us examine how the structure of manufacturing is associated with different stages of development. As modern economic growth has been accompanied by structural change at broadly aggregated levels of agriculture, industry and services, sustained economic growth entails structural change also at disaggregated levels within the manufacturing sector through technological upgrading and diversification and then possibly specialisation at a later stage (Imbs and Wacziarg, 2003).
As for the economy as a whole, structural change within manufacturing takes place due to: (1) demand and supply changes associated with the income level; (2) a country’s given demographic and geographic conditions; and (3) a country’s created conditions (Chenery and Syrquin, 1975). Based on a general formulation of Engel’s law as per capita income increases incremental consumer demand for some groups of goods and services tends to increase faster than for other groups (Pasinetti, 1981). On the supply side, manufacturing production tends to evolve relative to changing factor endowments as per capita income increases (Lin, 2012). Lower income countries are therefore likely to focus on relatively labour-intensive or resource-intensive activities, and higher income countries are likely to specialise in capital-intensive or technology-intensive industries. While the relationship between income levels and manufacturing structure has some elements of universality (as countries follow a more or less similar path of structural change) as income increases, geographic and demographic conditions give countries natural advantages or disadvantages in the development of certain industries (Katz, 2000). For example, holding other conditions constant, abundant natural resources endowment would tend to work against manufacturing development (Haraguchi and Rezonja, 2010; UNIDO, 2012). Finally, the course of manufacturing structural change is not determined only by the universal effects of income levels and specific demographic and geographic conditions, but there is also space for individual countries to have an autonomously evolving structure. Therefore, country-created or specific conditions, such as history, culture and policy, are also significant (Lin and Chang, 2009).

In order to illustrate the respective universality and diversity highlighted in this discussion, the second section presents the patterns of structural change for the whole economy, giving particular attention to changes in the levels of manufacturing value added and employment in the economy. It illustrates how the relative importance of the manufacturing sector changes at different income levels as countries develop. In addition to the patterns of structural change by income level, the section discusses whether the patterns have been changing over time and evaluates the extent to which there has been any shift in the weight of manufacturing in the economy recently.

Following this discussion of economy-wide structural change, the third section focuses on the manufacturing sector and provides detailed analyses of structural change within the sector in order to illustrate patterns of manufacturing development. It discusses the effect of the three major factors of structural change proposed by Chenery and Syrquin (1975), namely the income level, geographic and demographic conditions, and other country-specific factors. In addition, this section discusses the emerging trends of manufacturing development based on changes in development patterns over the last 30 years.

The fourth section reviews the temporal aspects of manufacturing structural change, first shedding light on the development speeds of individual manufacturing industries, and then on the transformation of the manufacturing sector as a whole. The section also compares the performance of recently successful countries with that of earlier industrialised countries in order to assess how the speed of the industrialisation process has been changing.

The final section synthesises the analyses of different explanatory factors for manufacturing structural change discussed in the third and fourth sections and illustrates how they are individually related to the both the universal patterns and country specificities of manufacturing development as a whole, producing unique development paths for individual countries’ manufacturing sectors.

**Structural change and manufacturing sector in the economy**

As countries’ income levels increase, the share of agriculture tends to decline while the share of services gradually increases. However, the manufacturing sector does not continuously
reduce or enlarge its weight in the economy throughout the course of country development, as it usually acts as an engine of growth only at certain stages of development. Figure 3.1 shows the estimated patterns of structural change across income levels based on panel data for 100 countries. As countries develop, the share of agriculture declines quite rapidly while other sectors increase their shares. Especially at low and lower middle income levels the share of manufacturing increases markedly, making a disproportionate contribution to economic development at a relatively early stage of development.\footnote{The increase in the manufacturing share of GDP slows down in the upper middle income stage, and its share reaches a peak (vertical line) before countries move into the high income level.}

Figure 3.1 illustrates the patterns of structural change discussed above, representing the long-term period of more than 40 years from 1963 to 2007. During that period, international development discourse has changed, globalisation has progressed, and many advanced countries have started experiencing de-industrialisation. Figure 3.2 then splits the long period into earlier and later periods (1963–1980 and 1991–2007) as a basis for comparing the development patterns for these sub-periods.

In Figure 3.2, comparing the two sub-periods A and B, it can be seen that in the earlier period the manufacturing share varied more than it did in the later period, increasing from less than 10 per cent to more than 20 per cent, with this peak value not being achieved in the later period at all. This might lead us to think that the role of manufacturing in economic development has somewhat diminished in recent years. However, this view needs to be qualified, since as more countries reach high levels of income per capita there is a larger number of countries (most of the advanced countries) experiencing a reduction in manufacturing share because

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**Figure 3.1** GDP composition by income and sector, 1963–2007. Pooled data for 100 countries.

*Source: UNIDO’s elaboration based on CIC (2009) and World Bank (2013).*
Figure 3.2 GDP composition by income and sector, (A) 1963–1980 and (B) 1991–2007. Pooled data for 100 countries.

Source: UNIDO’s elaboration based on CIC (2009) and World Bank (2013).
they have lost their advantage in manufacturing and have become service-oriented economies. Therefore, if globally the lower manufacturing share in GDP in recent years is mainly attributed to the lower manufacturing shares for the advanced high income countries, the importance of manufacturing as the engine of growth for development of lower and middle income countries might still hold.

Further, Figures 3.1 and 3.2 could be considered to be the average patterns of structural change treating the manufacturing share of any country size equally. However, if manufacturing activities are being more concentrated in large countries in recent years, country averages might underestimate the world-wide manufacturing value added share relative to those of other sectors. In this regard, it is important to look at the world manufacturing share of total world GDP. If this share is decreasing it would confirm that the relative importance of manufacturing is in decline. However, if there is no evidence of such a global decline then manufacturing activities are just being concentrated in larger countries without changing the relative size of world manufacturing value added. If this is the case then the importance of manufacturing and of the development opportunities that it can offer to countries have not changed, but some (large) countries have been more successful in developing manufacturing industries than others. It is a matter of the relative competitiveness of countries rather than of a general shift in the world-wide economic structure, and there is a possibility of hitherto unsuccessful countries reversing the trend.

Changes in the shares of manufacturing value added are shown in Figure 3.3A and B for all countries for which the data are available (covering 182 countries including 112 developing countries) based on the two different methodologies – the first being based on the country average of manufacturing value added share and the second being total manufacturing value added (hereafter called the aggregate share) divided by total GDP. The country samples used in this analysis are the same over the period 1970-2010. In the case of all countries (including advanced countries) the trend after 1990 is clear for both country average and aggregate shares – the manufacturing share has fallen. This trend is statistically significant for both methodologies. In contrast, if we take only developing countries, then the country average share shows a rising trend up to the early 1990s followed by a declining trend, but there is no statistically significant change in the aggregate share since 1970. The share of manufacturing in GDP for developing countries has not changed since 1970, always hovering around 20–23 per cent. This confirms that the importance of manufacturing in developing countries is not decreasing relative to other sectors. But it seems that in the last 20 years manufacturing production has become more concentrated in a smaller number of large countries, resulting in the recent lower manufacturing shares when calculated as country averages (rather than as aggregate shares).

On the basis of the manufacturing employment shares for all countries, as shown in Figure 3.4 for both the country average and the aggregate share methodologies, the trends for all countries are declining. However, if we limit our consideration to developing countries, the aggregate manufacturing employment share has had a statistically significant increasing trend since 1970 for the entire period and a non-declining trend after 1990, while the country average share has exhibited a declining trend since 1990.

Figures 3.3 and 3.4 show that the importance of the manufacturing sector in developing countries has not changed over the last 40 years. In 2010, manufacturing activities in developing countries added value to their economies in the same proportion as they did in 1970 and they also generated the same, if not a higher, proportion of employment. The difference between the results based on the country average and aggregate share methodologies, however, suggests that world manufacturing activities have become more concentrated in a smaller number of large countries, particularly in the last 20 years. This trend has probably reduced
the manufacturing shares for a large number of countries, leading to lower world-wide manufacturing shares if calculated on the basis of country averages. However, if those countries which have experienced higher proportions of manufacturing production in recent years were to move to a mature stage of industrialisation in the future, they too are likely to start experiencing lower manufacturing value added shares as they follow the same development path as

Figure 3.3 Manufacturing value added share, (A) all countries (182) and (B) developing countries (112). Excludes Soviet economies, includes island economies.

Figure 3.4 Manufacturing employment share, (A) all countries (106) and (B) developing countries (79).
Excludes Soviet economies.

Sources: Groningen Growth and Development Centre (2014); ILO (2013, 2014).

Note: The country sample included in the database (79 developing and 27 developed countries) is the same over the period of the analysis from 1970 to 2010. The coherence of different data sources, if used, was maximised by calculating the share of manufacturing employment in each database first and multiplying that by the total employment numbers from the Total Economy Database of the Groningen Growth and Development Centre.
the current high income countries. When that happens there will be greater opportunities for manufacturing development in many ‘follower’ developing countries, so that industrialisation will be as relevant and important for these ‘follower’ countries as it has been for others in the process of economic development.

**Structural change within manufacturing**

As the Introduction illustrates, since 1970, manufacturing industry has been the source of 20–23 per cent of total value added in developing countries. Taking into account the stronger backward linkages from manufacturing to industries other than those which exist the other way around, the overall contribution of manufacturing to the economy is likely to be higher than its value added share might suggest. Having observed manufacturing’s position within the structure of the whole economy, this section discusses structural change within the manufacturing sector.

Chenery and Syrquin (1975) argue that a country’s structural change depends on the following three factors: (i) the normal effect of universal factors that are related to the levels of income; (ii) the effect of other general factors such as country size or natural resources over which the government has little or no control; (iii) the effects of the country’s individual history, its political and social objectives, and the specific policies the government has followed to achieve these. Below, we illustrate factor (i), namely the relationships between structural changes within the manufacturing sector and income levels. We then examine the effects of geographic and demographic conditions, namely country size, population density and natural resource endowment. Finally, we review different countries’ experiences with structural change within the manufacturing sector in order to shed some light on factor (iii). At the end of the chapter, the Appendix explains the regression analysis and the data used for the estimations of structural change.

**Structural change in manufacturing along income levels**

*Value added*

Figure 3.5 presents the estimated patterns of structural change within the manufacturing sector, illustrating how ten major manufacturing industries (based on the ISIC revision three at the two digit level) develop at different income stages. The vertical lines separate four development stages which exhibit distinct manufacturing structures. In the first stage, at very low income levels, there are commonly three industries which dominate the manufacturing sector: food and beverages, textiles and wearing apparel. These three industries are closely related to basic human needs, and usually exist before industrialisation ‘takes off’. In this ‘early’ stage, labour-intensive industries clearly have higher development potential in terms of value added, and their growth rates are also not much lower than those of emerging capital-intensive industries.

The ebb and flow of labour-intensive and capital-intensive industries become apparent in the second stage. The slowdown of the labour-intensive industries becomes increasingly noticeable as the manufacturing structure gradually shifts from labour-intensive to capital-intensive orientation. By the time that countries reach around $10,000 GDP per capita, many capital-intensive industries start surpassing the value added levels of textiles and wearing-apparel industries.

In the third stage, capital-intensive industries take a dominant position in terms of output. These industries, which include resource-processing industries such as basic and fabricated metals, as well as those which use 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 will be increasingly apparent in this stage.
In the final stage at a very high income levels, labour-intensive industries, except for the food and beverage industry, decline and even some capital-intensive industries, such as resource-processing industries, start slowing down. Those which tend to sustain fast growth of value added are the chemicals, machinery and equipment, and electrical machinery and apparatus industries.

The development stages for all 18 manufacturing industries for which data are available are listed in Table 3.1. The early industries are mostly those which are relatively labour-intensive and/or are domestic-oriented industries. The middle industries include those which process natural resources to produce material inputs for other manufacturing industries. Finally, those that belong to the late industries tend to have a higher level of intensity in the application of technology and knowledge to production and, except for rubber and plastics, they produce capital or consumption goods for final use by firms or households.

Figure 3.5 contains clear estimated curves for the development patterns of manufacturing industries. However, this might give a false sense that the reliabilities of estimation are the same among industries and across income levels. Challenges and risks facing countries vary according to the characteristics of industries and stages of development, in addition to country-specific factors. Thus, there will be a tendency for countries to deviate from the estimated line, with greater variations for certain industries and at certain stages of development.

Figure 3.6 shows the estimated development patterns of industries with 95 per cent confidence intervals, indicating some important characteristics of manufacturing development. First of all, there are large differences between the performances of industries which play a crucial role in the relatively early stages of development. Textiles and wearing-apparel industries have wider confidence intervals around the estimated lines indicating a higher level of uncertainty with respect to the development of these industries. This suggests that risks facing countries are relatively high at early stages of development. The most difficult part of industrialisation can be to start it – that is, take-off of industrialisation.
A characteristic shared especially among middle and late industries is a high level of uncertainty in the early and mature stages of their development. As seen in Figure 3.6, their confidence intervals are wider at the lower and higher income ends, with a narrower interval for middle incomes. This suggests that at low incomes, when industrialisation 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, after the industrial sector has taken off and has accumulated some experience the differences in performance between countries at the same income level become smaller. As countries come close to 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 have wider differences in performance.

The greater uncertainty in manufacturing development from this stage onwards is attributed to the fact that countries are graduating from manufacturing development based on the acquisition of existing technologies from advanced countries and are moving to a stage where they have to take more risks in generating knowledge and technology themselves in order to directly compete with technology leaders (Lee 2013). At high incomes, countries which are successful in invention and innovation can sustain high growth 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 avoid premature de-industrialisation, to promote technological development and to generate employment in manufacturing, as well as related service industries, so that the manufacturing industry continues to contribute to a country’s development.

### Employment

The employment element of manufacturing structural change, as shown in Figure 3.7, is quite different from the value added element depicted in Figure 3.5. Food and beverages, textiles and wearing-apparel industries are the three major sources of manufacturing employment, with no other industries coming close to the peak employment levels of these industries at any income level. The food and beverages industry is a major and stable source of employment for all countries regardless of income levels. Textiles industries create jobs at earlier stages of development.

### Table 3.1 Development stages of manufacturing industries

<table>
<thead>
<tr>
<th>Stage</th>
<th>Industries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early</td>
<td>Food and beverages, tobacco, textiles, wearing apparel, wood products, publishing, furniture</td>
</tr>
<tr>
<td></td>
<td>Non-metallic minerals</td>
</tr>
<tr>
<td>Middle</td>
<td>Coke and refined petroleum</td>
</tr>
<tr>
<td></td>
<td>Paper</td>
</tr>
<tr>
<td></td>
<td>Basic metals</td>
</tr>
<tr>
<td></td>
<td>Fabricated metals</td>
</tr>
<tr>
<td>Late</td>
<td>Rubber and plastic</td>
</tr>
<tr>
<td></td>
<td>Motor vehicles</td>
</tr>
<tr>
<td></td>
<td>Chemicals, machinery and equipment, electrical machinery and apparatus, precision instruments</td>
</tr>
</tbody>
</table>

Notes: Manufacturing sub-sectors are classified into early, middle and late industries where sub-sector shares in GDP peak before $6,500 GDP per capita in PPP (constant 2005 price), between $6,500 and $15,000, and after $15,000, respectively. These income ranges correspond to our three income classifications – low and lower middle, upper middle and high incomes – in terms of GDP per capita PPP. In the table, industries are listed on the basis of those that peak at the lowest income level to those that peak the highest income level in terms of their value added shares in GDP. Industries that peak approximately at the same income level are listed horizontally.
Figure 3.6 Confidence intervals for the estimated patterns, value added: (A) early industries; (B) middle industries; (C) late industries.

Source: UNIDO’s elaboration based on Penn World Tables Version 8.0 and UNIDO (2014).
Structural change and manufacturing development

than wearing-apparel industries. Unlike food and beverages and other industries, textiles and especially wearing-apparel industries reduce employment relatively fast once they reach their peak employment levels. The late industries steadily increase their employment and reach their peak employment levels, which are lower than those of the three labour-intensive industries discussed here, at a relatively high income level.

**Impacts of demographic and geographic conditions on manufacturing structures**

**Country size**

Past studies acknowledge that country size has an overarching influence on economic structural change (Chenery and Taylor, 1968; Haraguchi and Rezonja, 2011), with marked effects on both the intercepts and the slopes. This means that estimation of the industrial development patterns needs to use data samples classified according to country size.9

Some of the development patterns found in small countries (Figure 3.9) are similar to those for large countries (Figure 3.8). Labour-intensive industries develop at a relatively early stage, and capital-intensive industries only surpass the value added 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 tend to develop earlier in small countries, and after they reach their peak levels of output they decline relatively rapidly. The growth rates among industries at high income levels vary much more than those found in small countries. One particular industry which has a very different development path in small countries compared
with large countries is the motor vehicle industry. The level of its development is much lower in small countries, and unlike the case of large countries, it does not sustain growth at high incomes, suggesting the importance of the domestic market for this industry.
Keesing and Sherk (1971) show that population density plays an important role in patterns of trade and development. Densely populated areas appear to have a greater impact, in particular, on the levels of exports of manufactured goods relative to primary products. This suggests that population density could affect the patterns of manufacturing development, with population density being determined by the simple division of a country’s population size by the country’s total area.

The negative impact of natural resource abundance on industrialisation is well documented. A country’s natural resource base affects patterns of industrialisation in two related ways. First, orientation toward industrialisation occurs due to a lack of natural resources, which induces countries to find an alternative export base (Chenery and Syrquin, 1975). This is an explanation of why resource-poor countries are likely to specialise more in manufacturing than resource-rich countries. Second, as Sachs and Warner (2001) explain, the reasons why countries rich in natural resources tend to have a lower level of manufacturing development can be related to the ‘natural resource curse’ or ‘Dutch disease’ arguments, related to the cost disadvantage for tradable, typically manufacturing, sectors due to the rise in domestic prices, including input costs and wages, driven by the natural resource sector and its impact on the foreign exchange rate.

Figure 3.10 summarises the effects of high population density (left column) and high natural resource endowments (right column) on manufacturing development. The industries in which these conditions have positive (or negative) effects are listed in the upper (or lower) cells. For both the population density and the natural resources columns, industries are listed from those which are most positively affected to those which are most negatively affected by the respective conditions. A positive (or negative) effect means that the development pattern of the industries in Figure 3.5 shifts upward (or downward), so that value added per capita in that industry at a given income level is higher (or lower) than might be expected due to these effects.

Generally speaking, high population density tends to have positive effects on manufacturing development, especially for capital- and technology-intensive industries, while high natural resource endowment tends to have the opposite effect – a negative impact on manufacturing development in general and capital- and technology-intensive industries in particular. The result of the impact of high population density suggests that densely populated countries possess logistical and 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 the machinery and equipment and electrical machinery industries. As would be expected on the basis of the discussion in this section, high natural resource endowments have negative impacts on most manufacturing industries.

Country-specific conditions

Besides income levels and country-specific conditions, such as demographic and geographic conditions, country-created effects influence the patterns of manufacturing development. Country-created conditions are related to institutions, history and policies, which produce systematic and consistent differences in the potential levels of manufacturing development across countries over a long period of time. As seen in the examples of the Republic of Korea (KOR), Malaysia (MYS), and Sri Lanka (LKA) in Figure 3.11, countries can deviate from the estimated pattern positively (above) or negatively (below). In terms of their development trajectories, however, these three countries tend to follow the general development patterns of industries, as seen in their more or less parallel movements along the estimated lines (solid lines). The similarity in development patterns also generally applies to other countries.
Country-specific conditions can be estimated by a regression with country fixed effects as seen in the example of food and beverages in large countries. Figure 3.12 shows the relationship between per capita income and manufacturing value added per capita by country with deviations from the line explained by the country dummies. Some countries (A) have characteristics which give them distinct advantages over others, in relation to industry value added per capita for a given level of income, while others (B) have characteristics which give them a lower performance consistently over a long period of time.

If country-specific effects (indicated by the country fixed effects dummy in the regression analysis) have an influence on the potential level of manufacturing development, one needs to ask whether such effects are mostly related to the development of the manufacturing sector as a whole, or if they are specific to subsectors of manufacturing (such as food and beverages, wearing apparel, motor vehicles, etc.). Such country-specific effects provide useful evidence for the design and application of types of industrial policies, and the priorities between policies, that countries might consider. Table 3.2 classifies countries, which reported data for at least 12 out of 18 industries, into three groups based on whether their country-specific conditions across different manufacturing industries are consistently favourable or unfavourable. It is interesting to note that 60 per cent of the countries have a consistent condition, either favourable or

Table 3.2 Classification of countries based on country-specific conditions across manufacturing industries.

<table>
<thead>
<tr>
<th>High population density</th>
<th>High resource endowments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly positive</td>
<td>Strongly positive</td>
</tr>
<tr>
<td>Machinery and equipment</td>
<td>Basic metals</td>
</tr>
<tr>
<td>Electrical machinery</td>
<td></td>
</tr>
<tr>
<td>Rubber and plastics</td>
<td></td>
</tr>
<tr>
<td>Chemicals</td>
<td></td>
</tr>
<tr>
<td>Precision instruments</td>
<td></td>
</tr>
<tr>
<td>Non-metallic minerals</td>
<td></td>
</tr>
<tr>
<td>Wood products</td>
<td></td>
</tr>
<tr>
<td>Fabricated metals</td>
<td></td>
</tr>
<tr>
<td>Motor vehicles</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Strongly negative</td>
<td>Strongly negative</td>
</tr>
<tr>
<td>Wearing apparel</td>
<td>Food and beverages</td>
</tr>
<tr>
<td>Textiles</td>
<td>Wood products</td>
</tr>
<tr>
<td>Printing and publishing</td>
<td>Printing and publishing</td>
</tr>
<tr>
<td>Tobacco</td>
<td>Motor vehicles</td>
</tr>
<tr>
<td></td>
<td>Fabricated metals</td>
</tr>
<tr>
<td></td>
<td>Tobacco</td>
</tr>
<tr>
<td></td>
<td>Chemicals</td>
</tr>
<tr>
<td></td>
<td>Furniture, n.e.c.</td>
</tr>
<tr>
<td></td>
<td>Non-metallic minerals</td>
</tr>
<tr>
<td></td>
<td>Rubber and plastics</td>
</tr>
<tr>
<td></td>
<td>Machinery and equipment</td>
</tr>
<tr>
<td></td>
<td>Electrical machinery</td>
</tr>
</tbody>
</table>

Figure 3.10 Effects of high population density and high natural resource endowment.

Source: UNIDO’s elaboration based on Penn World Tables Version 8.0 and UNIDO (2014).
Figure 3.11 Manufacturing development trajectories of the Republic of Korea, Malaysia and Sri Lanka.

Source: UNIDO’s elaboration based on Penn World Tables Version 8.0 and UNIDO (2014).
unfavourable, relative to their peers (defined by similar country size and income level) across most of the manufacturing industries covered. This is evidence that there are some specific country conditions which are important for the development of the manufacturing sector as a whole. These can include long-term conditions engendered by factors like political conditions, macroeconomic stability, quality of infrastructure, and factor prices, relative to other countries at a similar GDP per capita.

To understand further the relationships between general country conditions and the development potential of manufacturing industries, the size of the coefficient on country fixed effects

![Figure 3.12](image_url)

**Figure 3.12** Country-specific effects on manufacturing development, large countries.

*Source: UNIDO’s elaboration based on UNIDO INDSTAT and Penn World Tables.*

<table>
<thead>
<tr>
<th>Consistency of manufacturing performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Consistently high performance across most manufacturing industries</td>
</tr>
<tr>
<td>2 Consistently low performance across most manufacturing industries</td>
</tr>
<tr>
<td>3 Differences in performance depending on industries</td>
</tr>
<tr>
<td>Czech Republic, Brazil, Canada, Denmark, France, Finland, Germany, Iceland, Ireland, Israel, Italy, Japan, Republic of Korea, Netherlands, Norway, Singapore, Slovenia, Spain, Sweden, UK, USA</td>
</tr>
<tr>
<td>Azerbaijan, Ethiopia, Georgia, India, Indonesia, Iran, Kenya, Kyrgyzstan, Mauritius, Mongolia, Oman, Philippines, Republic of Macedonia, Republic of Moldova, Senegal, Turkey, Egypt, Yemen</td>
</tr>
<tr>
<td>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</td>
</tr>
</tbody>
</table>

*Source: Produced by the author based on Penn World Tables version 8.0 and UNIDO INDSTAT (2014). Notes: Countries having data which could be used to calculate impact of the selected characteristics for more than 12 industries are included. Those countries which had a higher level for the country fixed effects (reflecting country-specific effects) than the average for more than 80 per cent of their reported industries were placed in the first category in the table. Those countries with lower levels for the country fixed effects than the average for more than 80 per cent of their reported industries were placed in the second category. Countries falling in neither of the above categories were placed in the third category.*
has been regressed against certain specific features of a country which can be expected to remain in place for a fairly long time and to affect the development potential of industrial development. The results reported in Table 3.3 confirm that higher unit labour cost and higher indicators for the rule of law and for infrastructure (proxied by the share of paved roads), which shape the general business climate, have negative and positive effects on the development potential of most manufacturing industries, respectively. These results provide support for the view that there would be significant benefits arising from improvements in the general business and institutional environment, which would raise the development potential across manufacturing industries in countries with a very low level of manufacturing development, before proceeding very far with ambitious industrial policies for specific manufacturing industries. Under a hostile business environment with limited development potential, industry-specific measures might not make much difference to the performance of industries, and any improved performance might not be sustainable without costly interventions.

Emerging trends within the manufacturing sub-sector, reflected in shifting patterns of value added and employment, are summarised in Table 3.4 (based on the criteria indicated in the note to the table). The tobacco and textiles industries have experienced reductions in both value added and employment levels over time. In contrast, the rubber and plastics industry

<table>
<thead>
<tr>
<th>Industry</th>
<th>Unit labour cost</th>
<th>Rule of law</th>
<th>Roads</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food and beverages</td>
<td>-0.1083 (0.3100)</td>
<td>0.2083 (6.6900)</td>
<td>0.0036 (2.6500)</td>
</tr>
<tr>
<td>Textiles</td>
<td>-0.4336 (3.7500)</td>
<td>0.2082 (6.6800)</td>
<td>0.0036 (2.6500)</td>
</tr>
<tr>
<td>Wearing apparel</td>
<td>-0.5886 (3.5400)</td>
<td>0.1977 (6.2700)</td>
<td>0.0037 (2.7800)</td>
</tr>
<tr>
<td>Chemicals</td>
<td>-0.5029 (3.3300)</td>
<td>0.2048 (6.5700)</td>
<td>0.0034 (2.5400)</td>
</tr>
<tr>
<td>Basic metals</td>
<td>0.0524 (0.2000)</td>
<td>0.2609 (8.1300)</td>
<td>0.0035 (2.4700)</td>
</tr>
<tr>
<td>Fabricated metals</td>
<td>-0.1526 (2.9500)</td>
<td>0.2090 (6.7200)</td>
<td>0.0035 (2.6000)</td>
</tr>
<tr>
<td>Electrical machinery and apparatus</td>
<td>-0.1095 (0.4500)</td>
<td>0.3048 (9.3100)</td>
<td>0.0036 (2.3600)</td>
</tr>
<tr>
<td>Motor vehicles</td>
<td>-0.0743 (0.3500)</td>
<td>0.2231 (6.8300)</td>
<td>0.0034 (2.3600)</td>
</tr>
</tbody>
</table>


Notes: The dependent variable used for the regression is the coefficient on country fixed effects. The numbers in parenthesis are t-values. Unit labour cost was calculated by nominal wages divided by real value added (ADB, 2005). 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.

Emerging trends of manufacturing industries

The development patterns of some industries have been changing over time as seen, for example, in the declining trend for value added in the textile industry in Figure 3.13. This declining trend is distinct from the decrease in the industry’s value added related to increases in individual country income per capita. The clear downward shifts of the curves for each of the four time periods shown in Figure 3.13 show a steady change in consumer demand and technology, which leads to lower value added per capita for textile industries at all income levels. This change in industry characteristics is related to changing consumer preferences for its products over time (i.e. time series analysis), which are distinctly different to demand and supply changes related to different income levels across countries at a particular point in time (i.e. cross-section analysis).

Emerging trends within the manufacturing sub-sector, reflected in shifting patterns of value added and employment, are summarised in Table 3.4 (based on the criteria indicated in the note to the table). The tobacco and textiles industries have experienced reductions in both value added and employment levels over time. In contrast, the rubber and plastics industry
has experienced increasing levels of value added and employment, making the industry relatively more important than before. Many middle and late industries have been changing their production technologies in such a way as to increase capital intensity, substituting capital for labour. Furniture is the only industry which has become more labour-intensive, while the technological characteristics of the food and beverage industry have been stable over time.

Table 3.4 Emerging characteristics of manufacturing industries since 1980

<table>
<thead>
<tr>
<th>Emerging characteristics since 1980</th>
<th>Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rising</td>
<td>Rubber and plastics</td>
</tr>
<tr>
<td>Declining</td>
<td>Tobacco</td>
</tr>
<tr>
<td>Intensifying capital use</td>
<td>Textiles</td>
</tr>
<tr>
<td></td>
<td>Paper</td>
</tr>
<tr>
<td></td>
<td>Chemicals</td>
</tr>
<tr>
<td></td>
<td>Non-metallic minerals</td>
</tr>
<tr>
<td></td>
<td>Basic metals</td>
</tr>
<tr>
<td></td>
<td>Fabricated metals</td>
</tr>
<tr>
<td></td>
<td>Electrical machinery and apparatus</td>
</tr>
<tr>
<td></td>
<td>Motor vehicles</td>
</tr>
<tr>
<td>Intensifying labour use</td>
<td>Furniture</td>
</tr>
<tr>
<td>Stable</td>
<td>Food and beverages</td>
</tr>
</tbody>
</table>


Notes: Where value added and employment have shown a statistically significant increase in all three decades since 1980 the industry has been classified as ‘Rising’. Where an industry has shown consistent reductions in both variables it has been classified as ‘Declining’. Where an industry has shown increased value added but decreased (or at least not increased) employment it has been classified as ‘Intensifying capital use’. Where there is evidence of an increase in employment and a decrease, or no change, in value added it has been classified as ‘Intensifying labour use’. If there has been no significant change in industry value added and employment it has been classified as ‘Stable’.
Speed of manufacturing development and structural change

Our analysis thus far points to certain consistent patterns of manufacturing development which countries tend to follow, even though the exact levels for industry variables differ from country to country due to country-specific effects. The speed of an individual industry’s development is therefore crucial for manufacturing upgrade, and structural change. As was seen in Table 3.1, different industries tend to emerge as leaders at different income levels. On the one hand, labour-intensive, low technology industries, such as food and beverages and wearing apparel, are major manufacturing industries for low income countries, while on the other hand, capital-intensive and technologically sophisticated industries, such as electrical machinery and apparatus and motor vehicles, are usually dominant industries in high income countries. If countries are to experience patterns of manufacturing development which are broadly associated with different income levels, it is very much in countries’ interests to develop industries within existing comparative advantages as fast as possible so as to increase income along with such development (Figure 3.5) and move on to the next emerging industries.

The speed of manufacturing development in Malaysia, Republic of Korea and Sri Lanka is shown in Table 3.5, expressed in terms of increases in value added per capita per year. The Republic of Korea developed all eight manufacturing industries much faster than Malaysia and Sri Lanka over the same income range of between US$3,000 and US$4,500. Malaysia developed five out of the eight industries faster than Sri Lanka. However, the speed and level at which a country moves along the pattern (country-specific effects) are not necessarily associated with each other. For example, Sri Lanka developed textile and basic metals industries at a higher value added per capita level than Malaysia, even though the former moved slower than the latter. The preferred situation is the case of the Republic of Korea, which moved faster than Malaysia, Sri Lanka and most other countries, also at higher levels than those countries, allowing the Republic of Korea to generate greater value added from each industry while rapidly upgrading the industrial structure.

If a country climbs rapidly up a development curve of each industry, it is expected that the country will also move to emerging new industries quickly and thus accelerate the change in industrial structure. Figure 3.14 shows how countries have changed from one broad type of industry to another. The vertical axis shows the ratio of consumer goods to capital goods.

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

Source: UNIDO’s elaboration based on CIC (2009) and UNIDO (2014).

Note: The speed is expressed as the percentage increase in value added per capita divided by the number of years taken over the range of GDP per capita from US$3,000 to US$4,500. The analysis focuses on this income range because different income ranges are associated with different growth rates and we need to use an income range where the observations of the three countries overlap.
production. Food and beverages, tobacco, wearing apparel, footwear and leather goods, and furniture industries belong to the group of consumer-goods industries, while ferrous and non-ferrous metals, machinery, vehicle building and chemicals are included in the group of capital-goods industries. The consumer-goods industries roughly correspond to our early industries while capital-goods industries are found in our classification of middle and late industries (Table 3.1). Hence a reduction in the ratio means that the manufacturing structure is becoming more capital goods-intensive.

Figure 3.14, giving the ratio of consumer to capital goods, shows that even within a group of relatively successful Asian countries there are large differences. In 1970 the manufacturing structure of the Republic of Korea was dominated by the consumer-goods industries, or so-called early industries, which generated two-thirds of manufacturing value added at that time, even more so than other Asian countries such as Malaysia and Thailand. However, over the last 35 years the Republic of Korea has rapidly transformed the structure of its manufacturing production towards capital goods industries, so that its manufacturing structure is now comparable to that of mature industrialised countries, such as the UK, Germany and Japan.

Malaysia had a more capital-goods-intensive structure than the Republic of Korea in 1970, but from that structure the proportion of capital goods in Malaysian manufacturing production increased further. However, the speed of Malaysian structural transformation was slower than that of the Republic of Korea, so that the latter caught up and overtook Malaysia by 2000 in terms of the value added share of capital-goods industries in manufacturing. Sri Lanka, as a lower middle income country, still has a high and mostly increasing ratio of consumer goods (or early industries) perhaps strengthened by the country’s economic liberalisation from the mid-1970s. In 1970 Thailand and Indonesia had a lower consumer/capital-goods ratio than the Republic of Korea and about the same level as Malaysia. However, in Thailand the ratio only started to fall from 1990, while in Indonesia it hardly changed for 30 years but has increased since 2000.

Figure 3.15 shows that a low consumer/capital-goods ratio is associated with the industrial structure of advanced countries whose manufacturing sectors are dominated by capital-goods
production and technology-intensive industries. The relatively recent case of the Republic of Korea’s industrialisation is distinguished from the experiences of the earlier industrialisers by the much higher speed of its structural transformation. Reduction of the consumer/capital-goods ratio from 2 to the current levels of around 0.5 took approximately 105 years for the UK, 100 years for Germany, 70 years for Japan, but only 35 years for the Republic of Korea. China is now industrialising at a similar pace. These recent examples indicate how quickly countries can transform their industrial structure by climbing rapidly up the development curves of individual industries, which accelerates structural change in the manufacturing sector as a whole.

Conclusions

Following Chenery and Syrquin (1975) this chapter has discussed the three major factors which shape structural change. First, the stage of development is the most fundamental force of structural change as the differences in supply and demand capabilities associated with changing income levels drive the emergence of certain industries, as outlined in the third section. At an early stage of a country’s development, low technology activities such as food and beverages, textiles and wearing-apparel production develop. These are labour-intensive industries and they are the major sources of manufacturing employment up to the upper middle income stage. As a country moves through the upper middle to the high income range, the dominant industries change from early to middle industries (such as basic metals) and then to late industries (such as electrical machinery and apparatus) with an increasingly capital and technology intensity in manufacturing production as a whole. This pattern of structural change is generally found across countries regardless of their country-specific conditions and the time periods considered.

In addition to the income level, which Chenery and Syrquin (1975) called a universal factor of structural change, country-specific factors shape manufacturing development and produce a unique path of structural change for individual countries. In the third section it was shown how a country’s given conditions, such as demographic and geographic effects over which countries have no or very limited control, affect manufacturing development. Smaller countries tend to develop labour-intensive industries at an earlier stage of development than large countries and have a limited prospect for the sustained growth of the motor vehicle industry in particular. Abundant natural resource endowment has a negative impact on the development of almost all
manufacturing industries, while a higher level of population density works especially positively for capital and technology intensive industries.

There are other country-specific conditions which raise or reduce an industry’s level of development for a given income level. The importance of the general business environment was underscored, which can affect the development potential of manufacturing industries across the board. In countries where all or most of manufacturing industries have a lower than expected manufacturing value added per capita, an initial step for policy would be to improve the general business climate, such as unit labour costs, the condition of infrastructure services, and macroeconomic and political stability before resorting to industry-specific policy measures.

In addition to country conditions, different time periods have time-specific effects on manufacturing development, increasing or decreasing the development potential of industries for a certain period across all income levels. In the discussion of this issue, time-specific effects were traced over the last 30 years in order to identify emerging trends of manufacturing development. For example, the textiles industry has been experiencing falling value added and employment, at given income levels. The most common emerging characteristic is an increase in the capital intensity of the production process. Several industries have been increasing value added with disproportionately low additional inputs of labour, or in some cases with an absolute reduction of labour.

Finally, the fourth section discussed the speed of development as another dimension of both the level of manufacturing development and of structural change across countries. Even though their development patterns in relation to income per capita might be similar, some countries, such as the Republic of Korea, moved much faster than others along their income trajectory. Historically the speed of industrialisation and structural change in recent successful countries is much faster than that experienced by Western countries and Japan during their periods of industrialisation. This suggests that an increasingly globalised world might allow developing countries with decent human and institutional capabilities and business conditions to have greater opportunities for technical and policy learning, facilitated and incentivised by international assistance and competition.

The findings of this chapter are summarised in Figure 3.16. First of all, the development stage of a country is the most fundamental factor to shape its manufacturing development and its manufacturing structure, with comparative advantage associated broadly with income level. For example, Industry A can be considered a low-technology and labour intensive industry, which rapidly develops at a relatively early stage of development (say $3,000 GDP per capita), while Industry B is a capital- and technology-intensive industry, likely to emerge and grow rapidly at a higher income (say $10,000 GDP per capita). Although particular industries have generally followed similar development patterns across the range of countries, they do not take a single path but can deviate upwards or downwards due to their country-specific conditions, such as demographic and geographic conditions, other factors including history, institutions and policy and also time-specific effects. These country- and time-specific effects not only lead to different levels of manufacturing development but also generate different speeds of development for individual industries (C) and for structural change (D).

Different schools of thought have put forward a range of factors as the primary determinants of manufacturing development. However, as discussed in this chapter and as is seen in Figure 3.16, each determinant varies in terms of where and how it affects the development of different branches of manufacturing, and it is the combination of these effects that ultimately determine the level and path of manufacturing development at both the industry and the aggregate levels.
Appendix

The equation which appears below includes fixed effects and is used for the estimation of development patterns for 18 manufacturing industries at the two digit level of International Standard of Industrial Classification. For each industry the real value added, employment and labour productivity have been estimated. The panel dataset which is used consists of time series from 1963 to 2010 from 75 to 110 countries depending on the industries and variables estimated. In addition, we assessed the effects of population density, natural resource endowment and time periods on the three dependent variables.

Real value added per capita of each industry is calculated based on an industry-specific Index of Industrial Production. Similar analyses are carried out for employment and labour productivity.

\[
\ln RVA_i^t = \alpha_1 + \alpha_2 \ln RDGP_i^t + \alpha_3 \ln RDGP_i^t + \alpha_4 \ln RDGP_i^t + \alpha_i + e_i^t
\]

\[
\ln EMP_i^t = \alpha_1 + \alpha_2 \ln RDGP_i^t + \alpha_3 \ln RDGP_i^t + \alpha_4 \ln RDGP_i^t + \alpha_i + e_i^t
\]

\[
\ln LP_i^t = \alpha_1 + \alpha_2 \ln RDGP_i^t + \alpha_3 \ln RDGP_i^t + \alpha_4 \ln RDGP_i^t + \alpha_i + e_i^t
\]

**Variables**
- \(RVA_i^t\): real value added per capita
- \(EMP_i^t\): employment/population ratio
- \(LP_i^t\): labour productivity
- \(RDGP_i^t\): real GDP per capita (in constant PPP 2005 international dollars)
- \(RDGP_i^t\): real GDP per capita squared
- \(RDGP_i^t\): real GDP per capita cubed
- \(\alpha_i\): country fixed effect
- \(e_i\): unexplained residual
- \(i\): manufacturing industry (ISIC 2 digit level – 18 industries)

**Figure 3.16** Schematic representation of the role of comparative advantage, and country-specific and time-specific effects in manufacturing development.

*Source:* Author’s elaboration.
Notes

1 The author is grateful to Mr. Charles Fang Chin Cheng and Ms. Eveline Smeets for their data processing and graphic support.

2 The relationship between growth and structural change is not of course without exceptions. A notable example is the key role that the services sector has played in India’s economic growth.

3 The stage of development at which the share of manufacturing in total value added reaches its peak depends on geographic and demographic conditions as well as other country-specific factors besides income level (Chenery and Syrquin, 1975; Haraguchi and Rezonja, 2010).

4 The income levels are defined in terms of GDP per capita at constant 2005 PPP international dollar values. To make the income classifications of countries comparable with the World Bank classification, low and lower middle, upper middle income and high income have been defined as $6,500 or less, $6,500–$15,000 and more than $15,000 respectively.

5 The countries of the former Soviet Union have been excluded in the calculations for the entire period because their disintegration and economic restructuring did not necessarily represent the long-term general trend of structural change. Nevertheless, including the economies of the former Soviet Union in the calculations does not change the country average and aggregate trends after 1990.

6 For example, in the cases of BRICS countries see Haraguchi and Rezonja (2015).

7 The income effect includes both the 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 food (Engel’s law) is the most notable feature. The supply effect, on the other hand, entails two factors of general importance: (i) the overall increase in capital stock per worker, and (ii) the increase in education and skills of all kinds. Since the combination of labour, capital, and skills varies from industry to industry, a change in factor supplies causes a systematic shift in comparative advantage as per capita income rises (Chenery 1960).

8 In order to determine labour intensity, employment per unit of value added was estimated at $5,000 and $20,000 GDP per capita because the labour intensity changes with income levels. If an industry’s labour intensity was higher than the median for 18 manufacturing industries at both income levels, it was considered labour-intensive. Among the industries presented here, the food and beverage, textiles and wearing-apparel industries are labour-intensive, while the others are relatively capital-intensive.

9 In order to classify countries into two groups of different sizes we applied thresholds to divide them into small and large countries. We then looked for the threshold level for which the development patterns for the maximum number of manufacturing industries differ statistically from one another. This was achieved by applying the Wald test. Based on our test results, we used a threshold per capita GDP of $12.5 million for the division of countries into the smaller and larger groups.

10 The natural resource proxy variable was calculated as the difference between exports and imports of crude natural resource commodities and was expressed in per capita terms. The commodities included are those categorised under SITC revision 1 in Codes 2 (crude materials, inedible, except fuels), 32 (coal, coke and briquettes), 331 (petroleum, crude and partly refined) and 3411 (gas, natural).

11 Of the 18 industries listed in Table 3.1, only industries for which population density or high natural resource endowment had statistically significant impacts are included.

12 The Republic of Korea, Malaysia and Sri Lanka were selected as examples because these three countries are within the group of large countries and have relatively long data time-series which can be used to observe their development trajectories. Also, because they are within same development stage (from approximately $3,000 to $4,500 GDP per capita) we could compare the speed of their development as discussed in Section 3.4.

References


Structural change and manufacturing development


