OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

UNITED NATIONS UNIVERSITY

UNU-WIDER

World Institute for Development Economics Research

Working Paper No. 2011/43

Emerging Patterns of Manufacturing Structural Change

Nobuya Haraguchi
and Gorazd Rezonja*

August 2011

Abstract

In the past, research on changes in relative importance among broad three sectors—agriculture, industry, and service—showed general patterns of a country's structural transformation along with economic development. However, there has been devoid of empirical studies investigating in the structural change within the manufacturing sector, which often plays a role of the engine in economic growth. Our analysis looks into the evolution of production structures prevailing at certain development stages while controlling for country-given characteristics such as size, resource endowments, and others. This can provide an industrial policy framework for structural change facilitation that can lead to sustained economic development in the long-run.

Keywords: industrial development, growth, industrial policy, manufacturing development patterns, comparative advantage

JEL classification: C23, L6, O14, O25

*UNIDO, email of corresponding author: N.Haraguchi@unido.org

This study has been prepared within a joint project of UNU-MERIT, UNU-WIDER, and UNIDO on Pathways to Industrialization in the 21st Century: New Challenges and Emerging Paradigms.

UNU-WIDER gratefully acknowledges the financial contributions to the project by the Finnish Ministry for Foreign Affairs, and the financial contributions to the research programme by the governments of Denmark (Royal Ministry of Foreign Affairs), Finland (Finnish Ministry for Foreign Affairs), Sweden (Swedish International Development Cooperation Agency—Sida) and the United Kingdom (Department for International Development—DFID).

ISSN 1798-7237 ISBN 978-92-9230-410-2

Acknowledgements

We thank Niki Rodousakis for stylistic revision and Walliya Premchit for helpful advice on econometrics.

Tables and figures appear at the end of the paper.

UNU World Institute for Development Economics Research (UNU-WIDER)
Katajanokanlaituri 6 B, 00160 Helsinki, Finland

Typescript prepared by Lisa Winkler at UNU-WIDER

1 Introduction

What did it take for rich countries to become economically more developed than others? One explanation can be found in the strand of growth literature linking the level of economic development with industrialization, which contends that changes in the structure of production (structural change) are accompanied by economic growth.

Referring to Simon Kuznets, Syrquin states that

> … growth and structural change are strongly interrelated. Once we abandon the world of homothetic preferences, neutral productivity growth with no systematic sectoral effect, perfect mobility, and markets that adjust instantaneously, structural change emerges as a central feature of the process of development and an essential element in accounting for the rate of pattern of growth. It can retard growth if its pace is too slow or its direction inefficient, but it can contribute to growth if it improves the allocation of resources… Syrquin (2007: 4).

The term 'structural change' most commonly refers to long-term changes in the composition of an aggregate, which may be attributable to changes in the relative significance of sectors[1] of the economy, to changes in the location of economic activity (urbanization) and to other concomitant aspects of industrialization, which are jointly referred to as structural transformation.

Studies on changes in the structure of production gained attention over half a century ago, especially with the work of Kuznets (1957), which depicts an increase in manufacturing with rising per capita income. Among the most well-known studies on structural change in addition to Kuznets' are those of Fisher (1939), Clark (1940), Chenery and Syrquin (1975) and Kader (1985). Although Chenery (1960) and Chenery and Taylor (1968) focused on development patterns in the manufacturing sector, structural change within the manufacturing sector has since then not been studied in depth. On account of renewed interest in industrial policy for economic development in recent years, revisiting the work of Chenery (1960) and Chenery and Taylor (1968) represents an appropriate starting point to revise and build on past studies in order to provide sound structural underpinnings for formulating industrial policy. As argued by Lin (2010), the optimal industrial structure differs according to stage of development and country, given features and consequently, countries in different development stages have comparative advantages in different industries. Identifying latent comparative advantages and understanding their evolutions help countries pursue welfare-enhancing industrial structural change, something many developing countries have been struggling to achieve (McMillan and Rodrik 2011). This paper will demonstrate the likely evolution of industrial structure in countries with different given and other country-specific characteristics and provide countries with a reference point to identify their current comparative advantages.

---

[1] In this paper, sector describes economic activities at the level of agriculture, industry, and services (or in the primary, secondary, and tertiary sectors). Manufacturing, which belongs to the industrial sector, is divided into sub-sectors termed 'manufacturing industries' in this paper.

The motivation of this paper is twofold. First, in light of available data and a refined estimation method, the benchmark growth patterns of each manufacturing industry, which change in relation to a given country's stage of economic development (proxied by GDP per capita level), can be identified. Notably, we believe that different income (development) levels give rise to the prosperity of different types of manufacturing industries. That is, for a given income level, there is a corresponding production level of a specific manufacturing industry, which tends to rise with income growth. However, when income level rises to a certain point, steady state production will be reached and the production level will begin to decline. Hence, structural change occurs in that a new type of industry emerges to the detriment of the previous one. Based on this analysis, we identify the growth potential of different manufacturing industries at different development stages and classify the manufacturing industries accordingly. In addition to identifying industry-specific benchmark growth patterns, the second motivation of this paper is to classify manufacturing industries based on the timing of their contribution to the economy, their growth potential, the influence of given country characteristics on their development patterns, and the reliability of such patterns.

Once the general growth patterns of manufacturing industries are established for countries with different characteristics, they can be used to examine the development patterns of countries with comparable characteristics for policy purposes. Any deviations of the actual developments from the benchmarks can then be explained by future research, possibly by looking into policy, historical, and institutional factors.

From this viewpoint, Section 2 of this paper reviews the seminal work of Chenery and others and conceptually and empirically examines their work in light of available data and econometric techniques that have improved significantly over the past four decades. In Section 3, an alternative model for assessing patterns of industrial development is proposed, which takes account of the universal effects associated with income levels, the effect of country-given features such as market size or natural resources, as well as country-specific characteristics. In Section 4, we present the results of the regression analysis and construct benchmark growth patterns. By developing an industrial typology based on our results, relevant policy implications are discussed. Finally, Section 5 concludes by providing directions for future research.

2 Review of past models for estimating manufacturing value added

This section discusses the theoretical background of the analysis and derives the equation to be estimated in order to obtain an accurate picture of structural transformation for different manufacturing industries. Our methodology builds on Chenery's basic explanation of structural change that the growth of a manufacturing industry depends on: (i) the normal effect of universal factors that are related to the levels of income[2]; (ii) the effect of other general factors such as market size or natural

[2] The income effect includes both the supply and demand effect. 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. 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 production in which labour, capital, and skills can be combined varies from industry to industry, a change in factor supplies causes a systematic shift in comparative advantage as the per capita income rises (Chenery 1960).

resources over which the government has little or no control[3]; (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 (Chenery and Syrquin 1975). Chenery's (1960) model which uses value added per capita for manufacturing industries as a dependent variable, was able to capture the universal effects of income and country size (effects (i) and (ii)). In their subsequent work, Chenery and Syrquin (1975) applied a similar analysis at a more aggregated level and looked at the changes in the share of manufacturing value added in gross domestic product (GDP) as their dependent variable.[4]

The authors could not, however, present a full picture of structural transformation at the manufacturing level based on the three aforementioned components due to: (1) data limitation at a more detailed level within manufacturing; (2) data limitations with regard to country-given features, and (3) lack of data over longer periods of time, which can capture a full development cycle indicating periods of industrialization as well as deindustrialization.

Chenery (1960) argued that supply and demand factors embedded in the level of income contribute to different patterns across sectors and thus provide a benchmark of structural transformation. The sectoral growth function contained in Chenery's original work (1960)—based on the general equilibrium model of Walras—estimated the level of production as a function of demand side variables as follows

$$X_i = D_i + W_i + E_i - M_i \quad (1)$$

where X_i is domestic production of product *i*, D_i is domestic final use of *i*, W_i is the intermediate use of *i* by other producers, E_i is the export of *i*, and M_i is the import of *i*.

Since Chenery felt it was necessary to have a sufficiently large sample size and since each demand component is a function of income level, he later decided to adopt single functions of income and population instead. This allows viewing the effects of income level and country size by using a linear logarithmic regression equation to estimate the value added level as follows

$$\log V_i = \log \beta_{i0} + \beta_{i1} \log Y + \beta_{i2} \log N \quad (2)$$

3 We refer to these as a country's given features over which the government has no, or at minimum, limited control in the short- to medium-run. The aim is to control for these features by establishing benchmark growth patterns, on the one hand, and to isolate them from country-specific features that are related to a country's given historical evolution, on the other.

4 Value added per capita is more industry-specific, therefore it is more appropriately used when studying industrial capacity potential and can either be related to industrial productivity or to respective industrial concentration in manufacturing. Value added share in GDP, on the other hand, is used to study changes in the composition of the aggregate and is more appropriately used for studying the significance of an industry within an economy, which is subject to the industry's own growth and decline, as well as that of other industries, which in turn changes the composition of an aggregate.

where V_i is per capita value added for manufacturing industry i and β_{i1} and β_{i2} represent growth elasticity and size elasticity, respectively. Cross-section data of 38 countries available for any year between 1950 and 1956 were used for this single equation. Equation (2) became the basis for subsequent structural change research and its modifications have been widely used in later studies. For example, Chenery and Talyor (1968) included a quadratic term for income as the decline in elasticities with rising income became apparent. In later years, Chenery and Syrquin applied a more general equation as shown below, allowing a non-linear effect for population and including dummy variables to identify period effects (Chenery and Syrquin 1975; Syrquin and Chenery 1989)

$$x = \alpha + \beta_1 \ln y + \beta_2 (\ln y)^2 + \gamma_1 \ln N + \gamma_2 (\ln N)^2 + \sum \delta_i T_i \qquad (3)$$

where x is a respective dependent variable, covering different aspects of structural change (usually expressed as a share in GDP), y is per capita GNP in 1980 US\$, N is population in millions, and T is a dummy variable for time periods taking a non-zero value for different periods.

It is worth mentioning the major improvements our work has contributed to that of Chenery (1960). The first improvement concerns the estimation method applied to our analysis. Instead of using cross-sectional ordinary least squares (OLS) regressions, we apply standard linear-panel data techniques which are known to be able to control for potential endogeneity problems encountered in OLS regressions. Therefore, with respect to previous empirical approaches, we expect our methodology to provide consistent and robust results. The second improvement is the reformulation of the estimation model itself. This provides for the possibility to more accurately disentangle those factors that influence structural change. The third improvement relates to the quality of our dataset which covers a set of longer time series and more countries (a maximum of 45 years and 159 countries).

In order to illustrate the inefficiency of OLS estimations in cross-sections, we take Chenery's baseline equation (2) and re-estimate it using panel data techniques and compare the results with the standard OLS method. We argue that due to the potential endogeneity bias of the dependant variable in the model, the usual OLS may yield biased and inconsistent coefficient estimates, which, however, can be avoided by using panel data methods. In the scope of our empirical model, the endogeneity bias may arise from two sources (see a review of all potential sources in Wooldrige 2002). The first one comprises omitted, unobserved country-specific effects which refer to any country characteristic not included in the regression. The second source of endogeneity is attributable to a reversed causality relationship between GDP and value added as value added is itself part of GDP, yet GDP level also relates to a country's industrial activity level. Taking these endogeneity aspects into account, we apply new estimation methods to panel data to improve the forecast quality of Chenery's baseline model. We also apply an instrumental variable estimation technique to the panel data (IV estimation) to control for the reverse causality problem. Lastly, due to the long coverage of data over the 45-year period, it is also necessary to control for time-fixed effects in our regressions. Hence, our panel specification of equation (2) is re-expressed in the equation (2') below:

$$\ln VAPC_{it} = \beta_0 + \beta_t + \beta_1 * \ln RGDPC_{it} + \beta_2 * \ln POP_{it} + u_{it} \qquad (2')$$

with β_0 being a constant term translating any effects common to all years and countries, β_t being effect-specific to year *t*, but common to all countries in order to capture common shocks in time (e.g. oil crisis), and u_{it} being the error term specific to each country and year and assumed to be log-normally distributed. We follow Chenery (1960) and use value added per capita (*VAPC*) as a dependant variable while the income effect is captured by real GDP per capita (*RGDPC*) and the size effect by population level (*POP*). Results of the regressions are reported in columns (1) – (5) in Table 1, along with the applied estimators indicated beneath the column numbers.

The regression in column (1) replicates the estimation strategy used by Chenery (1960) by applying a pooled OLS estimation (POLS) without controlling for time-fixed effects. The estimates in column (2) differ from this regression when time-fixed effects are controlled for. However, real GDP per capita and population may be correlated with country-specific effects, and the statistic of the Lagrange multiplier (LM) test in column (3) also confirms the existence of these effects in our model. Hence, the generalized least square estimator (GLS) depicted in column (3) is more consistent compared to the POLS estimator. However, modelling the country-specific effects as fixed as in column (4) is more appropriate since we reject the Hausman test with the null hypothesis that the GLS provides consistent estimates. Lastly, continuing with fixed effects regressions (FE), when controlling for the endogeneity of RGDPC, the statistics of the over-identification test reveal the consistency of the FE-IV estimator compared to the FE-within. Hence, in the remainder of this paper, we will apply country-fixed effect regressions using IV to control for potential endogeneity problems.

3 Alternative model for assessing patterns of manufacturing development

This section discusses the theoretical background of the analysis and derives the equation to be estimated to obtain an accurate picture of structural transformation. Based on Chenery's methodology, our model tries to capture the effect of the three aforementioned factors. For each manufacturing industry, we estimate the following equation

$$\ln X_{ct}^{i} = \alpha_1 + \alpha_2 * \ln RGDPL_{ct} + \alpha_3 * \ln RGDPL_{ct}^{2} + \alpha_4 * \ln POPD_{ct} + \alpha * \ln RPC_{ct} + TROPICAL_c + e_{ct}^{\ i} \qquad (4)$$

The subscripts of *c* and *t* denote country and year, respectively, whereas *i* indicates the respective manufacturing industry, where *X* is our dependent variable. However, we will base our analysis on estimating and establishing industrial benchmark growth patterns on real value added per capita (RVAPC) as a main dependent variable, and will also apply this method to value added share in GDP (VASHARE) in order to classify the industries according to their corresponding significance within an economy at different income development stages.

As for the right-hand side variables, RGDPL stands for real GDP per capita (Laspeyer adjusted), $RGDPL^2$ for real GDP per capita square, *POPD* for population density, *RPC* for resource per capita, *TROPICAL* is a dummy variable equal to one if a country belongs to a tropical zone and zero otherwise and e^{i}_{ct} stands for country-fixed effect. Dependent and explanatory variables are expressed in logarithmic terms in order to measure the elasticity of each variable.

Four remarks must be added with regard to the above specification. First, we assume that income effect is a non-linear function, i.e. real value added per capita increases at a diminishing rate with a country's development level. Second, we consider three country-given characteristics which capture the effects of population density (*POPD*), natural resource endowment (RPC), and climatic condition (*TROPICAL*) on industrial growth, aware that countries have no or little influence on these characteristics in the short- to medium-run. Third, we divide countries into two subsamples of 'small' and 'large' countries according to their population size. Following the practice of past studies (Chenery and Taylor 1968; Syrquin 1988; Chenery et al. 1986), population size is not included in the equation, but equation (4) is applied to two sub-groups of small and large countries. When a variable, in this case size, has overarching effects on other country characteristics, it is better to estimate separate patterns that are representative of more homogenous groups of countries (Chenery and Taylor 1968). A country is classified as small if its population size in the year 1983 was less than 15 million and is considered large if its population size was larger than 15 million in 1983. Note that we are aware of this arbitrary division and that population growth is not taken into account, but this threshold offers a plausible division of countries in our dataset.

3.1 Estimation issues, data, and variable description

Section 2 discussed the superiority of the fixed effect IV method compared with other estimators. Specifically, due to the time constant variable in the model (TROPICAL) we will use the Hausman-Taylor IV method which generally allows an estimation of time constant regressors while also controlling for the endogeneity problem in the same way as within the estimator.

The model is estimated for up to 159 countries over a period of 45 years from 1963–2007, with a sub-set of 107 small countries and 52 large countries. The data are taken from three sources. Industrial data are obtained from UNIDO's Industrial Statistics Database at the 2-digit level of ISIC Rev. 3 (UNIDO 2009). Series of national income data are derived from Penn World Table, while country characteristic variables come from the World Bank's World Development Indicator and Global Development Finance database (available at http://databank.worldbank.org/ddp/home.do). UNIDO's INDSTAT2 dataset has the advantage of providing a long-term series of industrial data for 22 manufacturing sectors from 1963–2006, with historical data being converted from ISIC Rev. 2. However, as many countries report industrial data as a combination of two or more sectors of ISIC Rev. 3 at the 2-digit level, we merge these sectors in our dataset and end up with 18 sectors in total. Table 2 lists all the sectors that have been merged and used in our analysis.

Literature on structural change points out that country size has a significant effect on patterns of industrial development because economies of scale, natural resource endowments, and scale of domestic demand often vary with country size (Chenery and Syrquin 1975; Chenery and Taylor 1968; Syrquin 1988; Perkins and Syquin 1989). Past empirical evidence shows that the manufacturing industry has more weight in large countries' economies at an earlier stage of development than in smaller countries. Also, the manufacturing growth of large countries usually slows down before that of smaller countries, which has more linear growth patterns across different income levels.

As for the variables required in our regressions, they are calculated as follows:

- Real value per capita (*RVAPC*) is calculated by dividing the population size of the observed country from real value added. We calculate real value added from industry level production value adjusted by the industrial index of production (IIP).
- In the model, GDP per capita (*RGDPL*) indirectly reflects the interaction between the demand effects of rising income and the supply effects of changes in factor proportions and technology, therefore, it is assumed that rising income ought to bring about relatively uniform patterns in structural transformation. Data on GDP per capita based on 2005 prices are adjusted in accordance with purchasing power parity and are retrieved from Penn tables.
- Keesing and Sherk (1971) show that population density plays an important role on patterns of trade and development. Densely populated areas appear to have a greater impact, in particular, on increased exports of manufactured goods relative to primary products. This relationship suggests that only the most densely populated, small developing countries can look forward to early successful export specialization in the manufacturing industries. Population density (*POPD*) is determined by the simple division of a country's population size by the country's total area.
- Although Chenery (1960) recognized that natural resource endowments affect the process of industrialization, he was not able to find a statistical measure of resource supply for a large number of countries and therefore excluded it from his regression equation (Chenery 1960). Resource per capita (*RPC*) is calculated as the difference between exports and imports of relevant resource commodities expressed in per capita terms. The commodities included as reported in SITC revision 1 are SITC2: crude materials, inedibles except fuels; SITC32: coal, coke, and briquettes; SITC331: petroleum, crude and partly refined; SITC3411: gas, natural gas.
- Tropical climate is likely to create adverse conditions for economic development either directly or indirectly through institutions (Sachs 2001; Easterly and Levine 2003). To control the effects of this given country condition as well as to measure such effects on manufacturing performance, a dummy variable separating countries with or without tropical conditions (*TROPICAL*) is included in the equation.

The underlying purpose of our model is to attain a relatively accurate picture of structural transformation at the detailed manufacturing level. As already indicated, the country variables included in the model, namely natural resource per capita, population density and tropical climate, are the conditions on which countries have no or limited influence. This implies that any policy approach a country might undertake is unlikely to bring about rapid changes to those variables. Once such benchmark patterns are obtained, research can focus on explaining the deviations of a country's industrial development patterns from the benchmarks by examining policy-related, institutional, and historical factors. Below we present the results based on our regressions.

4 Results

4.1 Drivers of development patterns

In Table 3 and 4, we summarize the results of the regression analysis and illustrate the marginal effect of the variables included in the model for small and large countries, respectively. In Table 5 and 6 for small and large counties, we summarize the effect (negative or positive) of income level, population density and resource endowments. The manufacturing industries in each column of Table 5 and 6 are ranked and sorted in ascending order based on their marginal effect on real value added per capita.

Table 5 reveals that the marginal income effect in small countries is positive and significant in all manufacturing industries, with the exception of the chemicals industry. Accordingly, apart from the chemicals industry, the non-linear term (lnRGDPL) is negative and significant, indicating that with the growth in GDP per capita, value added per capita initially grows and begins to decline after reaching its peak. The marginal income effect is lowest in the food and beverages industry and highest in the rubber and plastic industry.

As indicated above, population density, natural resources and tropical variables are characterized by country-given features, indicating that countries cannot exert any or only minimal influence on those variables through policy measures in the short- to medium-run. The marginal effect of population density is significant and positive for textiles, machinery and equipment, motor vehicles, printing and publishing, chemicals and wearing apparel, and negative for furniture, n.e.c., wood products, basic metals, electrical machinery and apparatus, non-metallic minerals, paper and rubber and plastic. The level of natural resource endowments is significant and positively associated with the value added level of non-metallic minerals, coke and refined petroleum, basic metals, fabricated metals, wood products, and precision instruments while negatively associated with that of electrical machinery and apparatus, chemicals, motor vehicles and printing and publishing. As expected, the impact of the tropical dummy on value added is negative across all industries. It is significant only in industries such as food and beverages, chemicals, tobacco, printing and publishing, textiles, machinery and equipment, fabricated metals, and motor vehicles.

When it comes to large countries (Table 6), apart from basic metals and precision instruments, the income effect is positive and significant. Accordingly, the non-linear term of income is negative for those industries, yet non-significant for chemicals, printing and publishing, fabricated metals, and electrical machinery and apparatus. This may indicate their linear growth trajectory and possible decline at very late stages of development. The marginal effect of income is lowest in the chemicals and highest in the wearing apparel sectors. The impact of population density on industries' value added is significant in the food and beverages, paper, printing and publishing, precision instruments, chemicals, non-metallic minerals, coke and refined petroleum, electrical machinery and apparatus, fabricated metals, machinery and equipment, basic metals, and motor vehicles sectors. Of these, the marginal effect is negative in the paper and printing and publishing industry. The marginal effect of natural resource endowment is significant in the rubber and plastic, chemicals, fabricated metals, coke and refined petroleum, motor vehicles, non-metallic minerals, food and beverages, tobacco, paper, machinery and equipment, electrical machinery, and apparatus and basic metals sectors, however, it is positive only in the sector machinery and equipment. Similarly, as for small countries, the tropical variable has a negative marginal effect on value added for all manufacturing industries and is significant in the paper, textiles, wearing apparel, rubber and plastic, printing and publishing, furniture, n.e.c., and wood products sectors.

Comparisons between small and large countries reveal that, in general, higher population density supports the industrialization of large countries while it tends to mostly support the development of non-resource-based industries in small countries. In contrast, natural resource endowment usually has a negative effect on the development of manufacturing industries in large countries, except for the sector machinery and equipment. On the other hand, this factor can be conducive to the growth of resource-based industries in small countries. Finally, tropical climate hampers manufacturing development in both small and large countries. This condition, in the case of large countries, particularly affects those industries that usually emerge at an early stage of a country's development, whereas in small countries, the negative effects may also be felt in some late industries.

4.2 Benchmark growth trajectories

Chenery's original estimation (1960) included countries with a GDP per capita of up to around US$9,300 (US$1,300 in 1960 prices). Figure 1 indicates that the pattern of industrial development is indeed more or less linear up to such a low income level. This may explain why Chenery's linear model (1960) resulted in relatively high adjusted R-squares, which convinced him that the model could be considered for assessing patterns of industrial development. The availability of long-term time series and diverse cross-section data with income per capita including both low and high income economies allows presenting more accurate patterns of industrial development indicating when and how value added per capita is likely to begin slowing down before decreasing.

Figure 1 presents the growth and decline of 18 manufacturing industries in relation to GDP per capita in small and large countries. The bar charts in Figure 1 are based on regression results from Table 2 and 3 and allow us to illustrate the evolution of individual industries relative to the rise in GDP per capita up to US$38,000. Four different elasticity thresholds are calculated in relation to GDP per capita. The first stage is characterized by the rapid growth of value added per capita with an elasticity larger than 2. At this stage, 10 per cent growth in GDP per capita would lead to more than 20 per cent growth of value added per capita. At the second stage, value added per capita grows with an elasticity between 2 and 1, at the third stage between 1 and 0 in which value added continues to grow but less than the growth rate of GDP per capita. At the fourth stage, with an elasticity smaller than 0 industries experience absolute declines in their value added per capita. The value added per capita of industries reaches its peak when elasticity reaches zero and subsequently begins to decline.

Unlike other industries that emerge at an early stage of a country's development, the value added per capita of the food and beverages industry does not show a declining trend for both small and large countries and continues to grow until a very high income level is reached. Although the result seems to confirm evidence from earlier studies (Chenery 1960; Chenery and Taylor 1968; Maizels 1968) which estimated that the income elasticity of demand for the food and beverages industry was around or less than 1, the significance of this industry should not be dismissed as it makes a sustained contribution to the economy for a long period of time.

Figure 2 shows fitted curves that are based on scatter plots of estimation results for industries representing low tech, resource based, medium and high tech industries using UNIDO's technological classification (UNIDO 2002). It reveals that differences in growth patterns do indeed exist between small and large countries. Overall, manufacturing industries of large countries start at a higher level of value added per capita than those of small countries and tend to demonstrate largely linear development patterns. Industries in small countries experience faster growth, albeit starting from a lower level of value added per capita, and reach their peak and begin declining earlier than in large countries. Hence, their industrial development patterns are more concave, as illustrated below. These results contrast an earlier study which suggests linear patterns for small countries and concave ones for large countries (Taylor 1969). Due to the limited availability of time-series data, the earlier study may have only depicted half the picture of the industrialization process, primarily exhibiting the take-off and rapid growth periods of manufacturing industries, and unable to include the deindustrialization part of the process.

4.3 Identification of the most relevant industries for a given country at its current and future stages of development

A summary of the above discussion is presented here, in which industries are classified in the following tables (Table 7 and 8) by the stage and growth potential of their development in order to determine shifts in comparative advantages. First, the column of the early, middle and late industries refers to the timing at which each industry makes the highest contribution to the economy over the span of their development. Specifically, using the share of an industry's value added in GDP as a measure of the industry's significance within an economy, we divide industries into early, middle and late industries based on the income range within each industry reaches its peak in the economy. Within each category, industries are listed in chronological order from the industry that reaches the point of highest share in the economy first. Second, an industry is classified under 'sustained growth' if it is estimated to pass the value added per capita level of US$150 during its development. If the industry is estimated to reach a level between US$20 and US$150, it is classified under 'temporary growth'. Industries that are not very likely to reach the value added per capita level of US$20 are listed under 'low growth'. To determine the reliability of their development paths, those industries whose GDP per capita accounts for less than 70 per cent of changes in valued added per capita are shown in italics. In other words, country-given features and country-specific effects have a relatively high influence over the development paths of those industries.

A comparison between Tables 7 and 8 shows that small countries have a limited number of industries with high development potential (sustained growth), and country-given features and country-specific effects tend to exert a high influence on a large number of industries, indicating a higher uncertainty of their path of industrialization. During the early stage of development, the food and beverages and chemicals sectors play an important role in small countries. Even though their contribution to the economy relative to other industries is highest before countries reach US$5,000 GDP per capita, these industries continue to support industrialization by sustaining their growth. Their sustained contribution to the economy are realized as these broad industrial classifications allow continuous changes in their product mix to take place within the same industry classifications. For example, in the case of chemicals, the industry focuses on the production of basic chemicals, such as fertilizers, at an early stage while the industry shifts to the manufacture of more capital-intensive products, such as pharmaceuticals, at a later stage as it develops.

Between the two industries, the development of the chemicals industry is influenced more by country-given features. In addition to tropical climate, which negatively affects both the food and beverages and chemicals industry, higher levels of natural resource endowments generally lower the industry's value added across income levels, while higher population density works favourably for the development of the chemicals industry. Thus, keeping in mind the importance of developing these two industries, countries need to carefully evaluate how their given features affect the development of the early industries, including the temporary growth industries rubber and plastic and textiles. The latter's development is highly dependent on country-specific factors, so countries have to study their given features as well as policy, institutional, and other conditions necessary to successfully develop the textile industry.

Among the industries whose contribution to the economy peaks in the next stage of economic development, only the paper and furniture n.e.c[5] industry can be expected to develop with a relatively high degree of certainty along with the income increase in small countries. Given that there is no sector of 'sustained growth' in this stage and the uncertainty of other industries, small countries will continue facing the precarious situation in that they have to undertake special efforts to identify sectors that are appropriate for their country characteristics rather than leaving industrialization to spontaneous development through market forces.

As small countries' GDP per capita reaches a substantially high level, say, more than US$10,000, those industries referred to as late industries in Table 7 should become relevant in the country's economy. In other words, without the successful transformation of manufacturing industries to establish those late sectors, it is unlikely for small countries to reach a high income level. Thus, for successful industrialization, small countries need to start nurturing the development of late industries long before the 'late' stage is reached. Among the late industries, the electrical machinery and apparatus, printing and publishing, and machinery and equipment industries in particular will be important for the economy as they are likely to sustain their growth even when most other industries begin to decline at a very high income level. Small countries with a relatively high population density have a better chance of developing the printing and publishing and machinery and equipment industries rather than the electrical machinery and apparatus industry. The opposite is true for countries with a low population density. Furthermore, as shown in Table 5, the electrical machinery and apparatus industry is an industry that is highly subject to the effects of the 'resource curse', although climatic conditions may not prevent the industry's development. Among the three, the development of the printing and publishing and the machinery and equipment industry are more predictable along GDP per capita increases. Country-given features account for a relatively large share of changes in the value added per capita of the electrical machinery and apparatus industry. Therefore, for the development of the latter, small countries have to evaluate how their geographic and demographic conditions affect the industry's development in light of the results of Table 7 and any possible negative effects such as high resource endowments have to be compensated by

---

5 n.e.c. = not elsewhere classified.

country-specific effects, such as improved policies and institutions over which governments have control.

In contrast to small countries, the manufacturing industries in large countries develop with a much higher degree of certainty along with the rise of income. Large countries have more industries of 'sustained growth' and fewer industries of 'low growth' than small countries, and each stage of development has at least one industry of 'sustained growth' which makes the manufacturing transformation process smoother. Accordingly, it is probably more effective for large countries to focus on removing obstacles to the functioning of the market and provide functional support to educational, skills and institutional development rather than focusing exclusively on the unique needs of each sector.

One caveat to large countries is the importance of properly managing their natural resources if endowed with a relatively high level. As demonstrated in Table 6, the level of natural resource endowments negatively affects value added per capita for many industries in large countries. In particular, key industries, whose development is crucial for deepening and advancing industrialization after the early stage of development, are especially affected by an abundance of natural resource endowments. Countries such as Canada and Mexico, have industrialized their economies despite their relatively high natural resource endowments. Large countries with similar conditions can learn from these and other successful examples.

The development classifications in Table 7 and 8, together with changes in the growth elasticities illustrated in Figure 1, indicate when, how fast, how far, and how reliably manufacturing industries develop in countries with different geographic and demographic characteristics. The analysis of this information indicates that certain paths of manufacturing development are preferable over others depending on country characteristics and there seems to be room for industrial planning, policy, and coordination for successful industrialization.

Overall, small countries begin their manufacturing development later than large countries. However, once small countries' manufacturing industries take off, they tend to grow faster than those of large countries during most of the middle-income stage before large countries once again take over small countries in terms of the manufacturing industries' value added per capita. Thus, small countries experience a relatively rapid growth and decline of their manufacturing industries while large countries are likely to see slow yet more sustainable growth. These development patterns are likely to be attributed to the difference in the weights of exports as a source of demand for their manufacturing products. The heavier reliance of small countries on external markets allows a rapid expansion of the manufacturing industries—disproportionate to their country size—when they have comparative advantages in manufacturing industries, but leads to rapid declines once they lose the advantages in the international market. As small countries reach between US$7,000 and US$12,000 GDP per capita, they lose the advantages in many of their manufacturing industries and cannot extend their development further, because their small domestic market does not constitute a significant source of demand to sustain their development. On the other hand, due to the importance of the domestic market as a source of demand, manufacturing industries in large countries develop more commensurate to the country's economic growth. The large domestic market gives their manufacturing industries the scale advantage, and it also buffers against the loss of competitiveness in the international market, thus extending the period of their development.

These general patterns of manufacturing development indicate that small countries relative to large ones need to have more detailed strategies for their manufacturing development, accompanied by contingency plans, and must carefully manoeuvre manufacturing transformation from one growth industry to another based on an understanding of their development patterns (Table 7) and the impact of country-given features on the patterns (Table 5). This proposition is based on the three findings of our paper. First, as described above, the window of opportunity for manufacturing development is only open for a relatively short period for small countries. As Figure 2 shows, the value added trend lines of small countries are often more curvilinear. Figure 1 depicts that most industries reach the stage of relative decline (in which elasticity becomes less than 1) faster than those of large countries once the fast growth period ends (when elasticity becomes less than 2 but greater than 1).

Second, as the comparison of Tables 7 and 8 reveals, there is a larger number of industries in small countries whose value added changes are explained more by country-given features and country-specific characteristics. This implies that the universal effect of income level is a less reliable determinant for industrial output levels (on average, 0.67 R-square for small countries versus 0.80 R-square for large countries). It is, therefore, more important for small countries than large ones to undertake efforts to determine how their country characteristics are likely to work as an advantage or disadvantage for the development of industries they aim to establish and, if necessary, how they can create conducive conditions for such development.

Finally, as the typologies in Tables 7 and 8 show, the fact that small countries have fewer 'sustained growth' and more 'low growth' industries means that their paths of industrialization have to be supported by shifting from one temporary growth industry to another, perhaps by pro-actively facilitating manufacturing transformation. For small countries, the food and beverages, chemicals, electrical machinery, printing and publishing, and machinery and equipment industries will be cornerstones of sustained industrialization to bring the economy to a high GDP per capita level. While understanding the significance and supporting the development of these industries early on is essential, the electrical machinery and apparatus, printing and publishing, and machinery and equipment industries will only have a significant weight in the economy at a later stage of industrialization. To bridge the early to late stages, even very small countries would need to establish at least a few successful manufacturing industries from the 'middle industries' in Table 7 to sustain their industrialization process. However, there are no 'middle industries' that could sustain growth up to a high level of value added, and most of their development patterns are uncertain due to the significant influence of country-given features and country-specific effects. Thus, small countries need to assess how their country characteristics could affect the development of the 'middle industries' based on data such as that provided in Table 5 and 7 in order to increase the likelihood of advancing their industrialization.

For example, if a small, densely populated, resource-poor country is to strategically promote industrialization, and despite the fact that an in-depth country assessment is still necessary, the country will benefit from the information provided by Table 7. As demonstrated in the table, in addition to the chemicals and food and beverages industries, a country, on average, probably has a better chance to succeed in developing its textile and/or wearing apparel industry rather than the mineral industries, such as the basic metals and non-metallic minerals industries or resource-based industries such as paper, rubber and plastics and coke and petroleum refining. However, both the textiles and wearing apparel industry's growth rate will slow down relatively quickly and reach a period of relative decline (a growth rate less than the GDP per capita growth) at a per capita income of about US$4,500 for textiles and US$8,500 for wearing apparel after the end of its rapid growth period with a GDP per capita of approximately US$1,000 to US$3,000. Hence, small countries need to foster the emergence, if not successful establishment, of late industries long before reaching such income levels, whereby the machinery and equipment industry is the best candidate in light of the country's given characteristics. As these descriptions suggest, understanding the general characteristics of manufacturing industries, such as their timing, speed, and length of development and the country conditions conducive for their growths, will provide policy makers with a rough benchmark of their country's long-term manufacturing transformation and will help elaborate policies to support industrialization.

5 Concluding remarks

Chenery and others made a seminal contribution to the conceptualization of factors that affect structural change. Their empirical studies, however, usually focused on (1) the universal effect of income on structural change, mostly at a broad aggregation of a three-sector classification, paying little attention to (2) country-given features over which the government has little or no control and (3) other country-specific effects. Building on their conceptual framework, this paper first improved the measure to account for the income effect on manufacturing transformation. The level of income explains most of the output variations for the sectors of large countries. Its explanatory power is lower for small countries, but the most important determinant of their sectoral development accounts for two-thirds of the variations, on average. This study also showed how (2) influences individual sectoral developments. The (2) accounts less for changes in value added per capita than (1); however, depending on industry, it showed statistically significant influence over their development paths. In short, a detailed analysis of (1) and (2) and their combined information allowed us to present the patterns of manufacturing transformation before the influence of country-specific factors (3), for which our model was able to control.

The in-depth analysis of the manufacturing industry at the disaggregated level reveals the basic characteristics of manufacturing sectors with regard to their timing, speed, and stage of development. The corollaries of this study naturally lead us to investigate what constitutes the country-specific effects, in our future research.

References

Chenery, H. B. (1960). 'Patterns of Industrial Growth', *The American Economic Review*, 50 (4): 624–54.

Chenery, H. B., and M. Syrquin (1975). *Patterns of Development 1950–1970*. Oxford: Oxford University Press.

Chenery, H. B., and L. Taylor (1968). 'Development Patterns: Among Countries and Over Time', *The Review of Economics and Statistics*, 50 (4): 391–416.

Chenery, H. B., and M. Syrquin (1989). 'Patterns of Development, 1950 to 1983'. Discussion Paper 41. Washington, DC: World Bank.

Chenery, H. B., S. Robinson, and M. Syrquin (1986). *Industrialization and Growth: A Comparative Study*. Oxford: Oxford University Press.

Clark, C. (1940). *The Conditions of Economic Progress*. London: Macmillan.

Easterly, W., and R. Levine (2003). 'Tropics, Germs and Crops: How Endowments Influence Economic Development', *Journal of Monetary Economics*, 50: 3–39.

Fisher, A. G. B. (1939). 'Production, Primary, Secondary and Tertiary', *Economic Record*, 15: 24–38.

Kader, A. (1985). 'Development Patterns among Countries Reexamined', *The Developing Economies*, 23 (3): 199–220.

Keesing, D. B., and D. R. Sherk (1971). 'Population Density in Patterns of Trade and Development', *American Economic Association,* 61 (5): 956–61.

Kuznets, S. (1957). 'Quantitative Aspects of the Economic Growth of Nations: II. Industrial Distribution of National Product and Labor Force', *Economic Development and Cultural Change*, 5 (4) Supplement: 1–111.

Lin, J. (2010). 'New Structural Economics: A Framework for Rethinking Development'. Policy Research Working Paper 5197. Washington, DC: World Bank.

Maizels, A. (1968). *Exports and Economic Growth of Developing Countries*. Cambridge: Cambridge University Press.

Perkins, D., and M. Syquin (1989). 'Large Countries: The Influence of Size'. In H. B. Chenery and T. N. Srinivasan (eds), *Handbook of Development Economics*, Volume II. North Holland: Elsevier Science Publishers.

McMillan, M., and D. Rodrik (2011). 'Globalization, Structural Change, and Productivity Growth'. Mimeo. Boston, MA: Harvard Kennedy School.

Sachs, J. (2001). 'Tropical Underdevelopment'. Working Paper Series 8119. Cambridge, MA: National Bureau of Economic Research.

Syrquin, M. (1988). 'Patterns of Structural Change'. In H. B. Chenery and T. N. Srinivasan (eds), *Handbook of Development Economic*, Volume I. North Holland: Elsevier Science Publishers.

Syrquin, M. (1988). 'Structural Change and Economic Development: The Role of the Service Sector', *Journal of Development Economics*, 28 (1): 151–4.

Syrquin, M. (2007). 'Kuznets and Pasinetti on the Study of Structural Transformation: Never the Twain shall meet?'. Working Paper 46. Prague/Torino: International Centre for Economic Research.

Taylor, L. (1969). 'Development Patterns: A Simulation Study', *The Quarterly Journal of Economics*, 83 (2): 220–41.

UNIDO (2002). 'Industrial Development Report 2002/2003'. Vienna: UNIDO.

Wooldridge, J. (2002). *Econometric Analysis of Cross Section and Panel Data*. Cambridge, MA: MIT Press.

Table 1: Comparison of estimators at the overall manufacturing level

Endogenous variable	(1)	(2)	(3)	(4)	(5)
ln(VAPC)	POLS	POLS	GLS	Within	IV
ln(RGDPC)	1.778***	1.704***	1.281***	1.215***	4.809***
	(0.061)	(0.065)	(0.013)	(0.015)	(0.163)
ln(POP)	0.160***	0.134***	0.208***	0.279***	2.523***
	(0.036)	(0.037)	(0.015)	(0.025)	(0.108)
N	55184	55184	55184	55184	46947
R^2	0.612	0.633	-	0.606	0.186
Country-specific effects	No	No	Random	Fixed	Fixed
Test of time-fixed effects	No	25***	12590***	19***	3465***
		F(44,138)	chi2(44)	F(44,138)	chi2(44)
Test of specific effects(a)	-	-	400000***	-	-
Hausman test W vs. GLS(b)	-	-	-	2865***	-
Hausman test IV vs. GLS(c)	-	-	-	-	2270***
Test of over-identification(d)	-	-	-	-	1704***

Notes: *** significant at 0.1% level. The time dummy variables and the constant are not reported to save space. Life expectancy is used as an instrument for RGDPC in the IV regression.

(a): Chi2(1) statistic from Breusch and Pagan LM (Lagrange multiplier) test for random effects.

(b): Chi2(2) statistic from Hausman test applied to the differences between Within and GLS estimators, without time effects.

(c): Chi2(2) statistics from Hausman tests applied to the differences between IV and GLS estimators, without time effects.

(d): Chi2(2) statistics from Hausman tests applied to the differences between IV and Within estimators, without time effects.

Source: Calculated by the authors based on regression estimations (equation 2) using INDSTAT data.

Table 2: ISIC Revision 3 classification

ISIC description	ISIC abbreviation	ISIC
Food and beverages	Food and beverages	15
Tobacco products	Tobacco	16
Textiles	Textiles	17
Wearing apparel, fur and leather products, and	Wearing apparel	18, 19
Wood products (excluding furniture)	Wood products	20
Paper and paper products	Paper	21
Printing and publishing	Printing and publishing	22
Coke, refined petroleum products, and nuclear	Coke and refined petroleum	23
Chemicals and chemical products	Chemicals	24
Rubber and plastic products	Rubber and plastic	25
Non-metallic mineral products	Non-metallic minerals	26
Basic metals	Basic metals	27
Fabricated metal products	Fabricated metals	28
Machinery and equipment n.e.c. and office, accounting, computing machinery	Machinery and equipment	29, 30
Electrical machinery, apparatus and radio, television, and communication equipment	Electrical machinery and apparatus	31, 32
Medical, precision and optical instruments	Precision instruments	33
Motor vehicles, trailers, semi-trailers, and other transport equipment	Motor vehicles	34, 35
Furniture, manufacturing n.e.c.	Furniture, n.e.c.	36

Source: UNIDO (2009).

Table 3: Regression estimations based on equation 4 for small countries

ISIC Rev. 3	Abbreviation	C	lnRGDPL	(lnRGDPL)^2	lnPOPD	lnRPC	TROPICAL	N	RHO
15	Food and beverages	-5.88***	1.89***	-0.08***	0.06	-0.04	-0.95**	1146	0.96
16	Tobacco	-14.99***	3.40***	-0.17***	-0.01	0.18	-1.37*	1073	0.98
17	Textiles	-33.74***	7.49***	-0.39***	0.20**	0.14	-1.47***	1212	0.95
18/19	Wearing apparel	-51.08***	10.43***	-0.52***	1.23***	-0.14	-1.44	1270	0.98
20	Wood products	-38.39***	9.06***	-0.50***	-1.09***	0.56***	-1.93	1225	0.99
21	Paper	-24.70***	5.15***	-0.22***	-0.28***	0.07	-0.9	1182	0.96
22	Printing and publishing	-19.48***	4.12***	-0.17***	0.34***	-0.21**	-1.46***	1133	0.95
23	Coke and refined petroleum	-35.58***	7.28***	-0.35***	-0.1	0.20*	0.52	585	0.99
24	Chemicals	1.7	-0.04	0.05	0.34***	-0.46***	-1.20*	1111	0.97
25	Rubber and plastic	-41.87***	9.56***	-0.49***	-0.22**	0	-1.66	1113	0.99
26	Non-metallic minerals	-39.56***	8.96***	-0.45***	-0.31***	0.14*	-1.16	1141	0.98
27	Basic metals	-41.09***	9.11***	-0.47***	-0.43***	0.24***	-1.37	839	0.99
28	Fabricated metals.	-40.04***	8.43***	-0.43***	-0.03	0.34**	-1.91*	1061	0.97
29/30	Machinery and equipment	-19.44***	3.71***	-0.13**	0.26*	-0.16	-1.67**	1097	0.96
31/32	Electrical machinery and apparatus	-37.53***	8.77***	-0.40***	-0.41***	-0.58***	-1.02	1156	0.98
33	Precision instruments	-35.62***	6.14***	-0.28***	-0.11	0.70***	-3.16	877	0.99
34/35	Motor vehicles	-37.62***	8.20***	-0.38***	0.28**	-0.35**	-1.99**	1096	0.95
36	Furniture, n.e.c.	-31.61***	8.49***	-0.42***	-1.63***	-0.06	-0.84	979	0.99

Notes: * p<0.10, ** p<0.05, ***p<0.01.

Source: Calculated by the authors based on regression estimations for small countries (equation 4).

Table 4: Regression estimations based on equation four for large countries

Isic Rev. 3	Abbreviation	C	lnRGDPL	(lnRGDPL)^2	lnPOPD	lnRPC	TROPICAL	N	RHO
15	Food and beverages	1.38	2.12***	-0.08***	0.30***	-1.29***	-0.86	973	0.99
16	Tobacco	-10.24***	4.86***	-0.24***	0.06	-1.32***	-0.9	918	0.97
17	Textiles	-16.13***	4.29***	-0.20***	0.15	-0.37	-0.90**	998	0.92
18/19	Wearing apparel	-25.37***	6.49***	-0.30***	0.11	-0.58	-0.97*	981	0.93
20	Wood products	-12.22***	2.95***	-0.14***	-0.11	0.02	-2.24**	934	0.98
21	Paper	-5.00*	3.49***	-0.13***	-0.32***	-1.36***	-0.79*	926	0.94
22	Printing and publishing	3.11	1.27**	-0.04	-0.56***	-0.7	-2.03**	913	0.97
23	Coke and refined petroleum	-13.09***	3.03***	-0.11***	1.22***	-0.80***	-0.98	742	1
24	Chemicals	-5.46**	0.91**	0.03	1.20***	-0.68***	-0.47	906	0.99
25	Rubber and plastic	-6.13**	2.20***	-0.08***	0.08	-0.58**	-1.13*	921	0.97
26	Non-metallic minerals	-13.45***	4.09***	-0.17***	1.20***	-1.20***	-0.73	960	0.99
27	Basic metals	9.20**	0.62	0.04	2.25***	-2.74***	-0.52	783	1
28	Fabricated metals.	-9.67**	1.76***	-0.01	1.32***	-0.78**	-0.93	881	0.99
29/30	Machinery and equipment	-10.62*	-5.18***	0.41***	1.61***	2.65***	-0.99	948	0.98
31/32	Electrical machinery and apparatus	0.07	2.73***	-0.04	1.26***	-2.69***	-0.1	968	0.98
33	Precision instruments	-12.14**	1.01	0.05	0.93***	-0.26	-2.42	795	0.99
34/35	Motor vehicles	14.96***	-4.55***	0.38***	2.26***	-1.07**	-0.29	951	0.99
36	Furniture, n.e.c.	-13.50***	3.47***	-0.15***	-0.14	-0.22	-2.15**	815	0.97

Notes: * p<0.10, ** p<0.05, ***p<0.01.

Source: Calculated by the authors based on regression estimations for large countries (equation 4).

Table 5: Marginal effect of explanatory variables on value added per capita for small countries

MARGINAL EFFECT	Income effect	Population density effect	Resource effect	Tropical effect
Negative		Furniture, n.e.c. Wood products Basic metals Electrical machinery and apparatus Non-metallic minerals Paper Rubber and plastic	Electrical machinery and apparatus Chemicals Motor vehicles Printing and publishing	Motor vehicles Fabricated metals Machinery and equipment Textiles Printing and publishing Tobacco Chemicals Food and beverages
Positive	Food and beverages Wearing apparel Tobacco Machinery and equipment Printing and publishing Paper Precision instruments Coke and refined petroleum Textiles Motor vehicles Fabricated metals. Furniture, n.e.c. Electrical machinery and apparatus Non-metallic minerals Wood products Basic metals Rubber and plastic	Textiles Machinery and equipment Motor vehicles Chemicals Printing and publishing Wearing apparel	Non-metallic minerals Coke and refined petroleum Basic metals Fabricated metals. Wood products Precision instruments	

Source: Calculated by the authors based on regression estimations for small countries (equation 4).

Table 6: Marginal effect of explanatory variables on value added per capita for large countries

MARGINAL EFFECT	Income effect	Population density effect	Resource effect	Tropical effect
Negative		Printing and publishing	Basic metals	Wood products
		Paper	Electrical machinery and apparatus	Furniture, n.e.c.
				Printing and publishing
			Paper	
			Tobacco	Rubber and plastic
			Food and beverages	Wearing apparel
			Non-metallic minerals	Textiles
			Motor vehicles	Paper
			Coke and refined petroleum	
			Fabricated metals.	
			Chemicals	
			Rubber and plastic	
Positive			Machinery and equipment	
	Chemicals	Food and beverages		
	Printing and publishing	Precision instruments		
	Fabricated metals.	Chemicals		
	Food and beverages	Non-metallic minerals		
	Rubber and plastic	Coke and refined petroleum		
	Electrical machinery and apparatus	Electrical machinery and apparatus		
	Wood products	Fabricated metals.		
	Coke and refined petroleum	Machinery and equipment		
	Furniture, n.e.c.	Basic metals		
	Paper	Motor vehicles		
	Non-metallic minerals			
	Textiles			
	Motor vehicles			
	Tobacco			
	Machinery and equipment			
	Wearing apparel			

Source: Calculated by the authors based on regression estimations for large countries (equation 4).

Table 7: Industrial classifications by stage of development and growth for small countries

	Sustained growth	Temporary growth	Low growth
Early industries			*Tobacco*
	Chemicals		
	Food and beverages		
		Rubber and plastics	
			Wood products
		Textiles	
Middle industries		Paper	
		Basic metals	
		Non-metallic minerals	
		Coke and refined petroleum	
		Fabricated metals	
		Wearing apparel	
		Furniture, n.e.c.	
Late industries	Electrical machinery and apparatus	*Motor vehicles*	
	Printing and publishing		
	Machinery and equipment	*Precision instruments*	

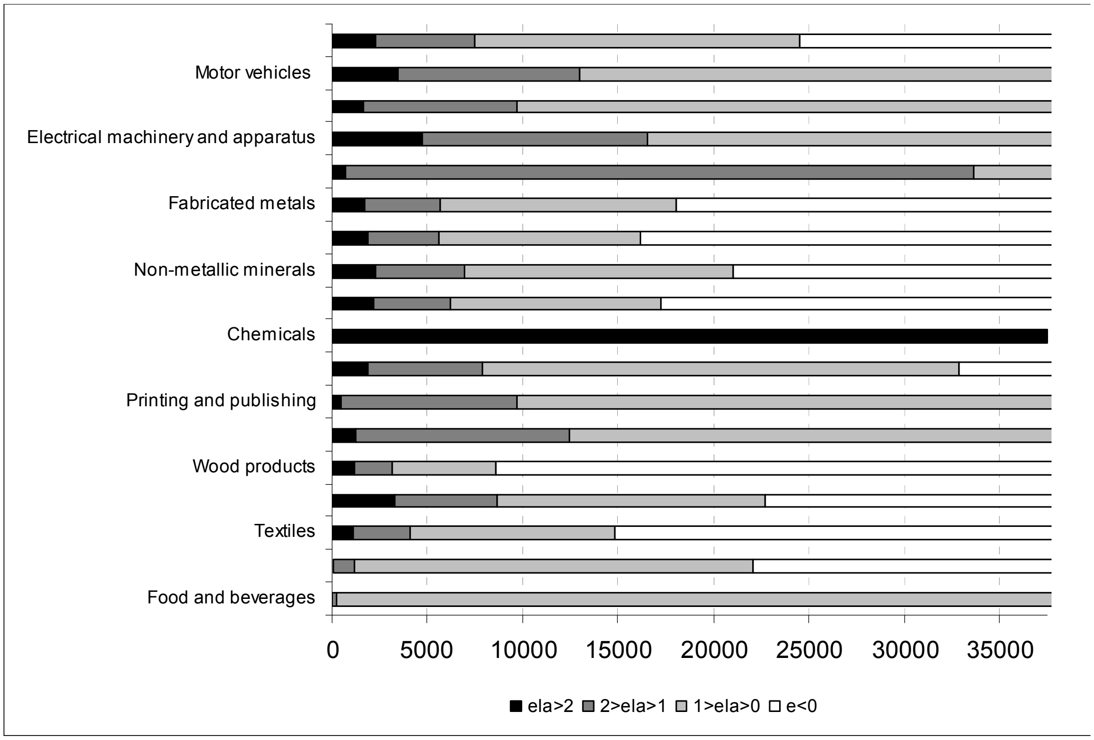
Source: Developed by the authors based on regression estimations for small (equation 4).

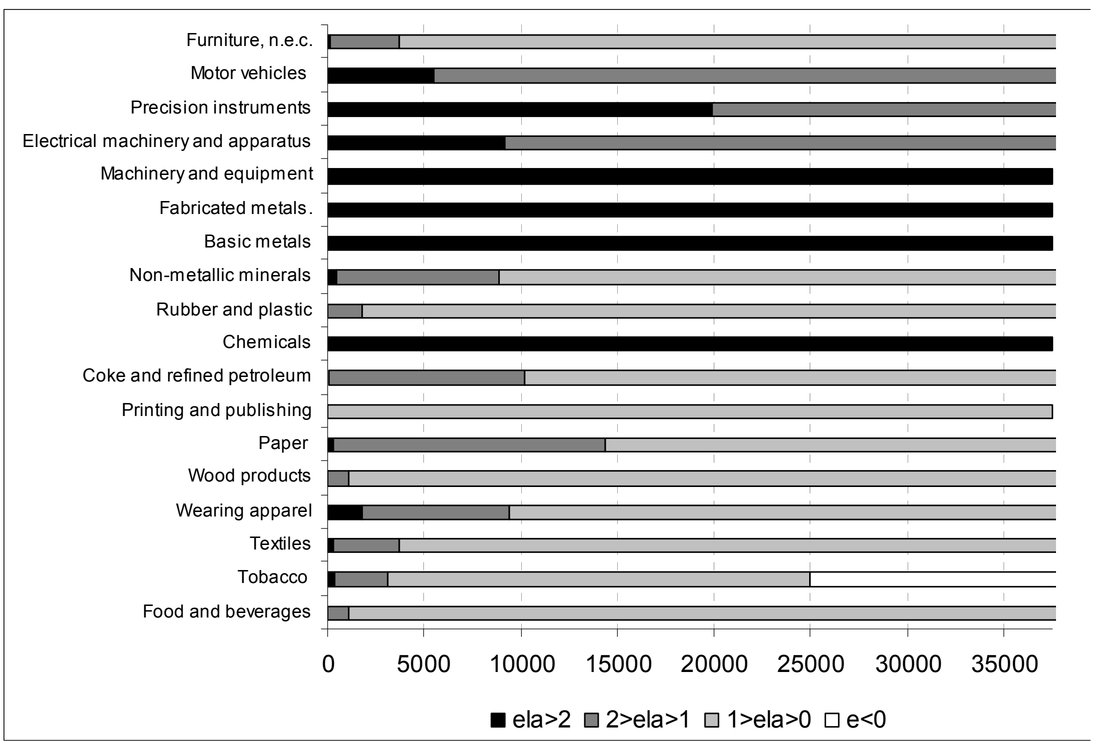
Table 8: Industrial classifications by stage of development and growth for large countries

	Sustained growth	Temporary growth	Low growth
Early industries	Food and beverages		
		Coke and refined petroleum	
	Chemicals	Wood products	
		Textiles	
			Tobacco
		Non-metallic minerals	
		Wearing apparel	
Middle industries		Furniture, n.e.c.	
	Paper		
		Rubber and plastic	
	Printing and publishing		
		Basic metals	
	Motor vehicles		
Late industries	Electrical machinery and apparatus		
	Precision instruments		
	Fabricated metals		
	Machinery and equipment		

Source: Developed by the authors based on regression estimations for large countries (equation 4).

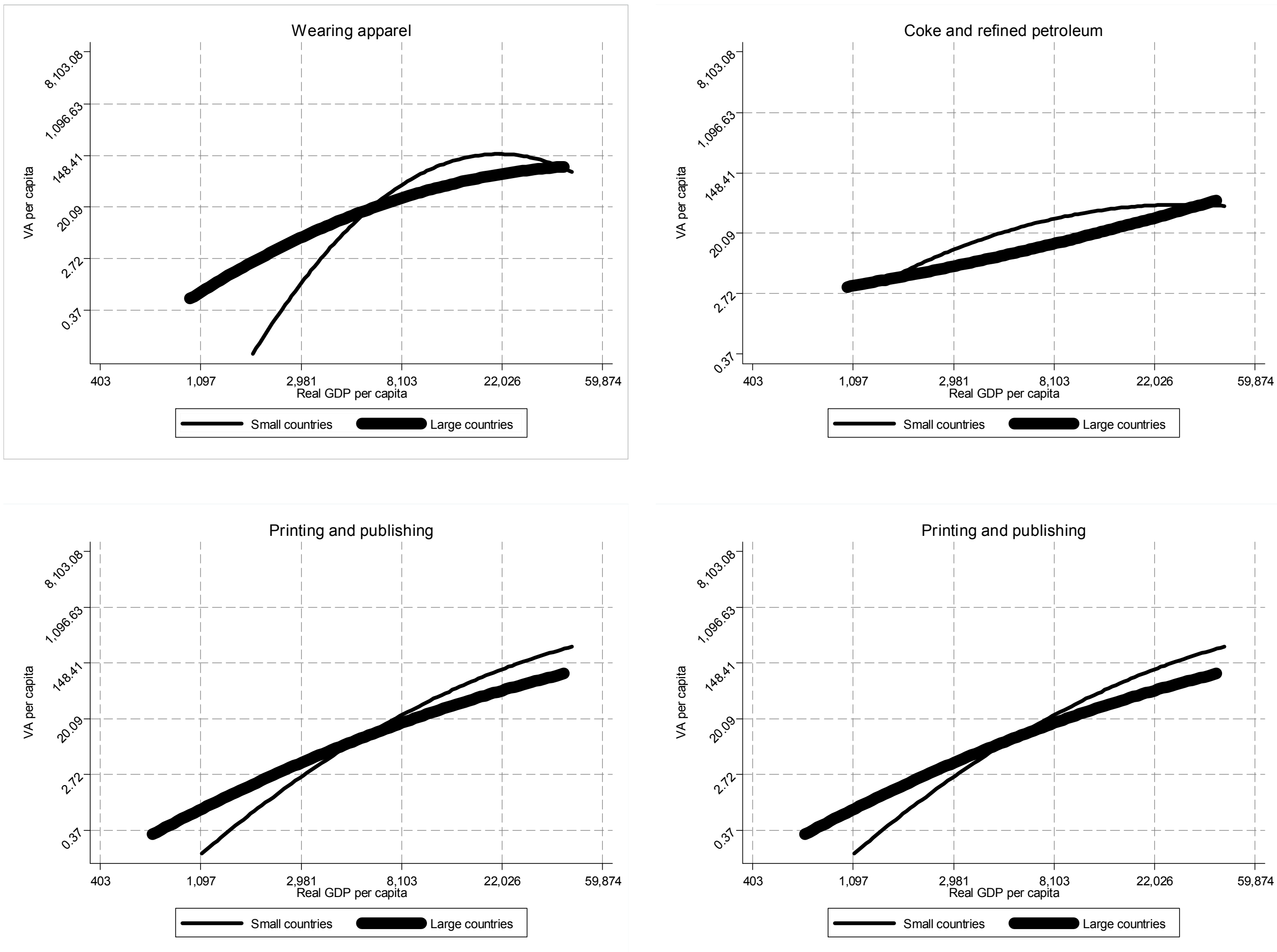
Figure 1: Growth elasticities for manufacturing industries in small and large countries





Source: Developed by the authors based on regression estimations of Table.3 and.4.

Figure 2: Development patterns of manufacturing industries in small and large countries (fitted lines)



Source: Developed by the authors based on regression estimations for small and large countries (equation 4).