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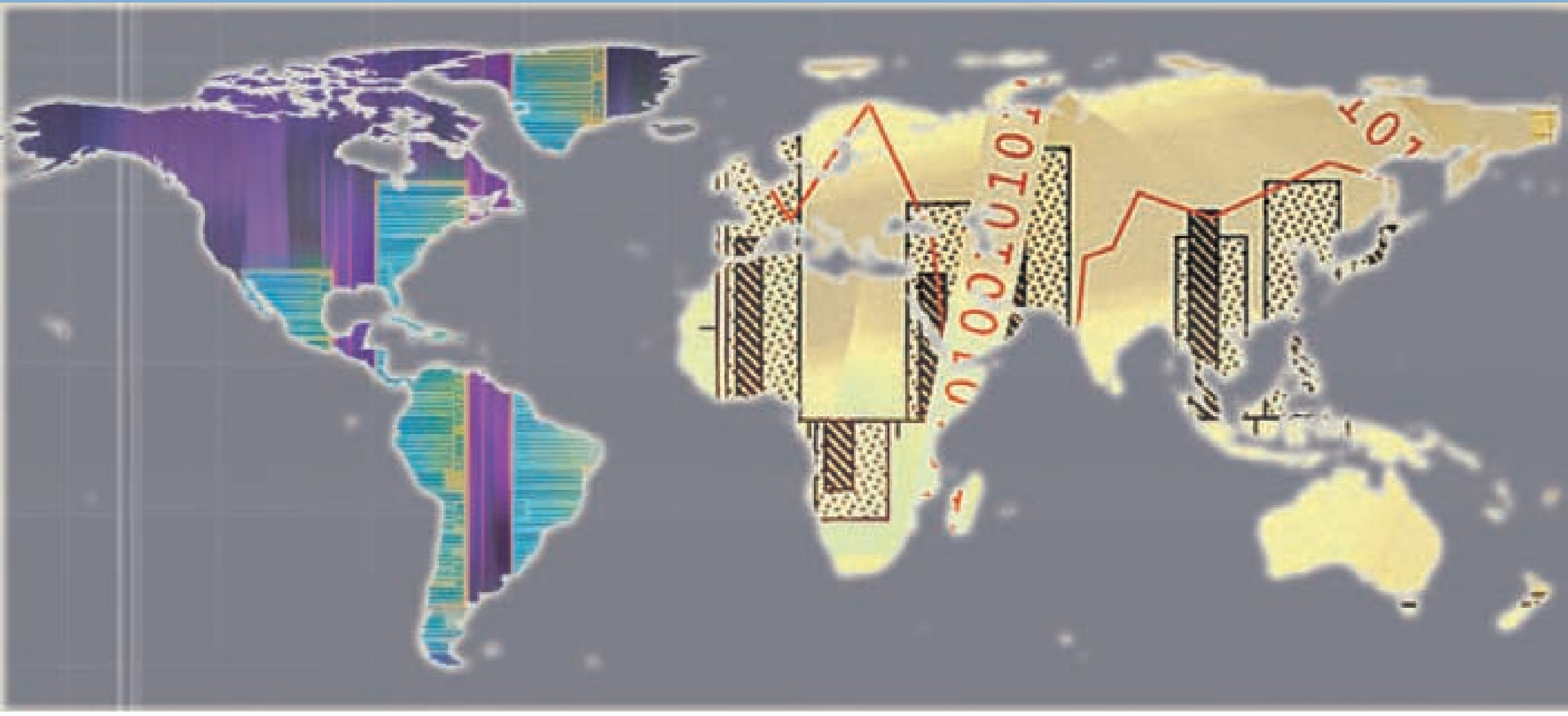

Patterns of Manufacturing Development Revisited

UNITED NATIONS
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1. Introduction

In the past, structural change was treated mainly at a broadly aggregated level—three sector classifications—to see whether the shares of the primary, industry and service sectors in economies changed as per capita incomes increased (Kuznets, 1957; Chenery and Sryquin, 1975; Kader, 1985; and Branson et al., 1998). Although Chenery (1960) and Chenery and Taylor (1968) studied the development patterns in the manufacturing sector, studies on the subject, at a detailed disaggregated level, have not been given due attention. As there is a renewed interest in industrial policy for economic development in recent years, revisiting the work of Chenery (1960) and Chenery and Taylor (1968) seems to be appropriate to find out whether their models and empirical results were valid and robust. If they were not, alternative patterns would need to be sought in order to provide sound structural underpinnings for formulating industrial policy.

From this viewpoint, the paper, first, reviews the seminal work of Chenery and associates, and conceptually and empirically examines the validity of their work in light of available data and the maturity of econometric techniques that have improved significantly over the past four decades. Second, the alternative patterns of industrial development proposed here take into consideration the universal effects associated with income levels, country-specific characteristics and time effects. Third, countries are divided into small and large samples based on the size of population, in order to draw possible systemic differences between the two groups. Fourth, based on newly reconstructed patterns, some policy implications are suggested to enhance industrial development in developing countries, and finally, the paper concludes.

2. Review of past models for estimating manufacturing output

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:

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

X_i is domestic production of product *i*,

D_i is domestic final use of *i*,

W_i is the use of *i* by other producers,

E_i is the export of *i*,

M_i is the import of *i*.

Whereas Chenery felt it was necessary to have a sufficiently large sample size, and the fact that each demand component is a function of income level, he later decided to adopt single functions of income and population instead. This decision allows one to view the effects of country size, using a linear logarithmic regression equation, to estimate the output level in the following way.

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

where V_i is per capita value added, 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.

Due to conceptual and econometrical problems with equation (2), it could not be considered as a general model for explaining the long-term patterns of industrial development. First, although Chenery rightly recognized the need for incorporating both demand and supply conditions to determine production levels (Chenery, 1960: 624-625), the model seems to be a simplified representation of only the demand side. Secondly, due to the simultaneous determination by supply and demand, output and income variables are endogenous—determined within the model. In such a case, the least square estimator, employed by Chenery, shows biased and inconsistent results. Thirdly, as determined in this paper, while demand for different manufacturing products may in fact be similar across countries with the same income level, supply capacities for manufacturing products tend to differ substantially even among countries with a similar income level. This is because country-specific characteristics, such as institutional, political, geographical and cultural factors, have a greater influence on supply than on demand. In this regard, establishing a long-term pattern of industrial growth, using the panel data method, which can separate time as well as country-specific effects from the coefficients of the variables included in the equation, is more appropriate as against the cross-section, single-period approach adopted by Chenery (1960). Finally, as evidenced in past research on structural change, the rate of industrial growth is not uniform across different stages of development but reveals a tendency to decrease as income levels increase. Hence, the adoption of a quadratic, instead of a linear, function seems to be more appropriate for the production function.

Table 1 compares Chenery's results with those derived from applying model (1) to pooled country data for the period 1963-2004. Even though the income coefficients and size coefficients do not show significantly different trends—both coefficients tend to be higher for capital-intensive sectors—the goodness-of-fit of the regressions, as indicated here by the adjusted R squares, are lower for the pooled data for most sectors despite the increased number of observations. One of the reasons could be that the linear model employed by Chenery does not adequately explain the patterns of industrial development for longer periods over the four decades. Chenery's sample included countries that were industrializing at that time, with income per capita ranging from $58 in India to $1,291 in Canada. Therefore, the pattern derived from the cross-section data might not have been able to reflect the whole cycle of development from industrialization to deindustrialization. Indeed, according to UNIDO data covering the period 1963 to 2004, most advanced countries experienced a slowdown—sometimes even a decline—in labour-intensive industries as their economies matured. This indicates that a quadratic function is again preferable to the linear function for estimating sectoral outputs.

Table 1. Comparisons between Chenery's results and pooled data regressions for estimating valued added per capita of manufacturing sectors

Sector	Income coefficients β_1		Size coefficients β_2		$\bar{R}^2$		Number of observations	
	Chenery	Pooled	Chenery	Pooled	Chenery	Pooled	Chenery	Pooled
Food and beverages	1.129	1.613	(0.001)	-0.054	0.846	0.695	31	2625
Tobacco	0.928	1.311	(0.234)	(-0.017)	0.344	0.537	32	2251
Textiles	1.444	1.398	0.401	0.182	0.770	0.574	38	2441
Clothing	1.687	1.860	(0.065)	0.019	0.837	0.633	35	2303
Wood, etc.	1.765	1.852	(0.080)	-0.067	0.815	0.638	34	2409
Paper	2.692	2.260	0.518	0.144	0.784	0.771	34	2342
Printing	1.703	2.340	0.177	(0.009)	0.854	0.796	32	2233
Rubber	1.998	2.225	0.438	0.121	0.713	0.729	32	2128
Chemicals	1.655	2.078	0.257	0.260	0.846	0.687	37	2315
Petroleum products	2.223	1.685	(1.040)	(0.015)	0.650	0.483	32	1529
Non-metallic minerals	1.617	2.103	0.164	0.078	0.747	0.770	37	2187
Metals, etc.	2.143	2.325	0.419	0.377	0.726	0.680	32	1834
Machinery, etc.	2.799	2.781	0.315	0.312	0.834	0.721	30	2123
Transport equipment	2.327	2.417	0.256	0.353	0.717	0.656	31	2106

Note: Coefficients in parenthesis are not significantly different from zero at 95 per cent confidence level.
Source: Chenery (1960) and UNIDO (2009).

Later, Chenery and Taylor (1968) used a quadratic function for the period 1950-1963, which indeed improved the R square. However, the model still could not account for the country-specific and time-period effects, as it adopted the pooled, instead of the panel, method for regressions. Hence, the problems discussed above continued to remain unsolved.

3. Alternative model for assessing patterns of manufacturing development

Taking into consideration the above discussions and possible deficiencies of past models, an alternative approach is presented in this paper. This approach takes advantage of the increased availability of cross-section and time-series data and applies a more conceptually appropriate econometric approach. Chenery recognized the need for the simultaneous determination of output levels ($Q_s = Q_d$) by integrating demand and supply factors. Therefore, this paper applies the simultaneous equation model and determines the dependent variables (output or value added per capita) and purchasing power parity (PPP) adjusted gross domestic product (GDP) per capita, which appear in both the demand and supply equations, endogenously within the model.

In an economic model, a parameter or variable is said to be endogenous when there is a correlation between the parameter or variable and the error term (Kennedy, 2003 p. 139). The Hausman test indicates that GDP per capita, which appears as an explanatory variable in both the demand and supply equations, is endogenous, that is, determined within the model itself. An attempt is made here to resolve this by including instrumental variables (IV) and applying the two-stage least squares (TSLS) regression technique. Since the concept of demand and supply corresponds better with the values of whole commodities (output) rather than value added by countries in the process of production (value added), this paper uses output per capita (OPC_{it}) as a dependent variable.

Both the dependent and explanatory variables are expressed in logarithmic terms in order to measure the elasticity of each coefficient. The subscripts of *i* and *t* denote country and year, respectively. In order to examine the general, that is, the average, pattern of sectoral development over a period of 42 years (1963 to 2004), by applying the panel data model for the simultaneous equations, it was possible to identify the fixed (country-specific) effects of cross–section data. This is equivalent to including dummy variables (*countrydummies*) for countries in each of the equations listed below. The analysis focuses on the results of this panel data model, which fixes only the country-specific effects. However, in order to examine the time effects on output, the results are compared with those based on the model which fixes both country-specific and time effects. The model is reflected in the following simultaneous equations.

(A) Demand side

$$\ln OPC_{it} = \alpha_1 + \alpha_2 * \ln GDPpc_{it} + \alpha_3 * \ln GDPpc^2{}_{it} + \alpha_4 * \ln WI_{it} + countrydummies + e_{it}{}^{d} \quad (3)$$

(B) Supply side

$$\ln OPC_{it} = \beta_1 + \beta_2 * \ln GDPpc_{it} + \beta_3 * \ln GDPpc_{it}{}^2 + \beta_4 * \ln ULC_{it} + \beta_5 * \ln P_{it} + \beta_6 * \ln PD_{it} + countrydummies + e_{it}{}^{s} \quad (4)$$

Data on output per capita (*OPC)* of the dependent variable, obtained from the UNIDO Industrial Statistics Unit, is based on the two-digit level of International Standard Industrial Classification of All Economic Activities (ISIC). Earlier revisions of ISIC to the Rev.3 classifications were converted by the Unit to obtain consistent, long-term time series data from 1963 to 2004. The data, likewise prepared by the Statistics Unit, were then deflated using the indices of industrial production.

In the model, GDP per capita (*GDPpc),* adjusted based on PPP, and output per capita *(OPC)* are endogenous variables. Rising income is expected to bring about a uniform pattern in structural change because of its interaction between the demand effects of rising income and the supply effects of changes in factor proportions and technology. For this reason, it is assumed that GDP can be included in both demand and supply equations.

The demand-side equation has fewer variables, as the income level (GDP per capita) seems to be the dominant factor that determines the overall level of private consumption, government spending and investment, as argued by Chenery (1960). In this model, however, in order to account for the diminishing nature of income elasticity of demand, the equation included a square term of ln*GDPpc.* In addition, to include the effects of changes in foreign demand for a country's production, WI (world imports) also measures the world imports of a particular commodity. In other words, it represents the level of world demand for a commodity in a given year.

In addition to GDP per capita and squared GDP per capita, the supply level of each sector is also considered to be a function of unit labour costs (*ULC*), population (*P*) and population density (*PD*). *ULC* is calculated by dividing wages by labour productivity to measure the competitiveness of the sector and embody both labour costs—as part of input price—and labour productivity—the numerator and denominator of *ULC* calculation, respectively, in this indicator. *ULC* thus "becomes an important determinant in the location of production processes" as capital becomes mobile and production footloose between countries. It is therefore more the relative prices of non-tradable inputs, namely, labour, rather than output, that matters (Edwards and Golub, 2004:1326). Turner and Van't Dack (1993) and Turner and Golub (1997) also conclude that relative unit labour costs in manufacturing have become an important indicator of competitiveness.

A country's population is introduced as an independent variable to allow for the effects of economies of scale, which is associated with productivity. According to Taylor (1969) population size has a positive impact on industry because of economies of scale and import substitution. Its positive effect on output is expected to be stronger in capital- intensive sectors, as evidenced in table 1.

Although Chenery (1960:628) was aware that relative prices can be determined not only by the level of per capita income but also by the total supply of natural resources, he was not able to find a statistical measure of resource supply for a large number of countries. He therefore excluded it from his regression equation (Chenery, 1960:630). Nevertheless, Keesing and Sherk (1971:937) have demonstrated an effective way of taking into account natural resources by using population density as follows:

"… densely populated countries are expected to demonstrate a systematic comparative advantage in manufactures and against primary products… the chief reason is that in any large sample of countries, land area per head should be positively (and its inverse, population density, negatively) highly correlated with the combined availability of mineral wealth, arable land, and other economically useful endowments from nature. Hence, densely populated countries could be expected to specialize in manufactures, and lightly populated countries in primary products, along lines suggested by a land-labor version of the Heckscher-Ohlin theory. A second reason is that countries with dense populations might be expected – as a matter of statistical likelihood – to enjoy advantages in manufacturing compared to lightly settled countries in terms of costs of (and access to) transportation, communications, distributions systems, and the like."

Keesing and Sherk (1971) show that density plays an important role on the patterns of trade and development. As indicated, densely populated areas appear to have a greater impact, in particular, on increased exports of manufactured goods relative to primary products. Their relationship suggests that only the most densely populated, small developing countries can look forward to early successful export specialization in manufacturing industries—other than those based on proximity to natural resources.

4. Results

4.1. Demand side

As shown in table 2, all the coefficients of the explanatory variables in the demand equation are significant at 99 per cent confidence level for the 18 manufacturing sectors. Manufacturing industry is sub-divided into 23 sectors at the two-digit level of ISIC Rev.3 classification. However, as data required to run simultaneous equations were available only for 18 sectors, five sectors had to be excluded from this study.[1] The adjusted R squares indicate that the goodness-of-fits of the demand-side equation are high for most sectors. The negative signs of the coefficients of $GDPpc^2$ confirm that the patterns of demand growth in relation to the increase in income levels are non-linear for all sectors, and the curvature of the trend is concave, as shown in figure 1. Chenery's original estimation (1960) included countries with a GDP per capita of up to $1,300, which is equivalent to 7.2 in the logarithmic scale. Figure 1 indicates that up to such a low income level, the pattern of industrial development is indeed more or less linear. This could be the reason why the linear model of Chenery (1960) resulted in relatively high adjusted R squares, which convinced him that the model could be considered for assessing patterns of industrial development.

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[1] The five sectors excluded in this paper are leather, leather products and footwear; office, accounting and computing machinery; radio, television and communication equipment; other transport equipment; and recycling.

Table 2. Regressions for estimating the demand for sectoral outputs: all countries (TSLS)

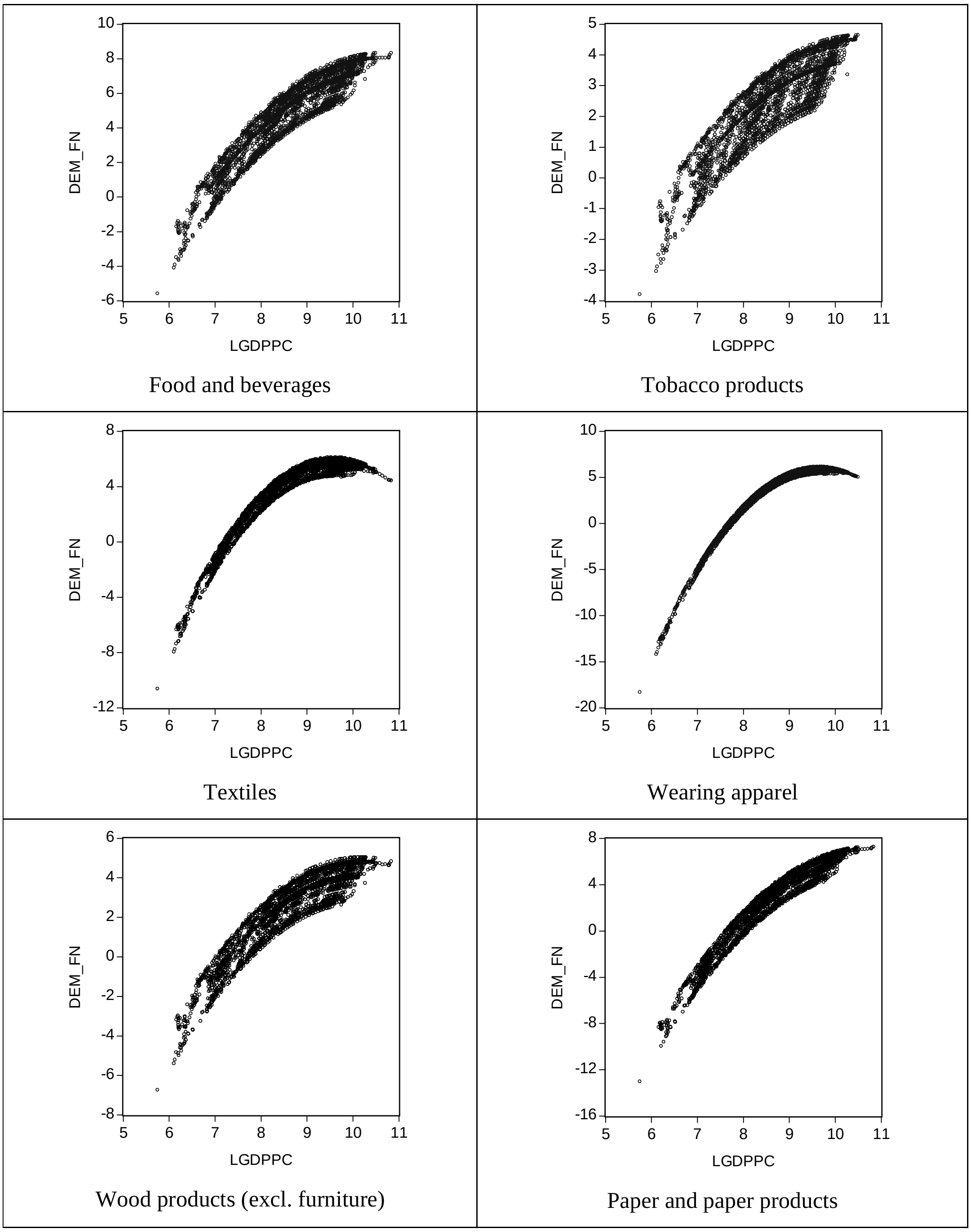
	C	GDPPC	GDPPC^2	WI	R^2_adj	SE	N
Food and beverages	-66.0452	10.0940	-0.4731	0.7665	0.9423	0.4739	2411
	0.0000	0.0000	0.0000	0.0000			
Tobacco products	-37.3362	5.8979	-0.2800	0.4612	0.8677	0.6009	2049
	0.0000	0.0000	0.0000	0.0000			
Textiles	-101.2784	20.2391	-1.0577	0.4036	0.8264	0.7539	2242
	0.0000	0.0000	0.0000	0.0000			
Wearing apparel	-144.1901	30.1892	-1.5660	0.1863	0.7881	1.0243	2121
	0.0000	0.0000	0.0000	0.0000			
Wood products (excl. furniture)	-62.1791	9.9909	-0.4910	0.6495	0.8933	0.7689	2195
	0.0000	0.0000	0.0000	0.0000			
Paper and paper products	-92.5843	15.5207	-0.7212	0.6351	0.9333	0.6411	2150
	0.0000	0.0000	0.0000	0.0000			
Printing and publishing	-61.7736	9.3245	-0.3748	0.5145	0.9404	0.6141	2031
	0.0000	0.0000	0.0000	0.0000			
Coke, refined petroleum products, nuclear fuel	-93.2368	15.5777	-0.7651	0.8001	0.9081	0.6672	1403
	0.0000	0.0000	0.0000	0.0000			
Chemicals and chemical products	-76.2371	11.1416	-0.4303	0.6132	0.9179	0.6897	2130
	0.0000	0.0000	0.0000	0.0000			
Rubber and plastic products	-79.8956	12.9316	-0.6568	0.8538	0.9291	0.6409	1933
	0.0000	0.0000	0.0000	0.0000			
Non-metallic mineral products	-91.7363	16.0952	-0.7792	0.6000	0.9411	0.5222	1995
	0.0000	0.0000	0.0000	0.0000			
Basic metals	-120.0297	22.0009	-1.0677	0.5207	0.9091	0.6985	1663
	0.0000	0.0000	0.0000	0.0000			
Fabricated metal products	-86.4276	14.8299	-0.6438	0.3972	0.9072	0.7461	1995
	0.0000	0.0000	0.0000	0.0000			
Machinery and equipment n.e.c.	-96.6746	15.7346	-0.6615	0.4910	0.9125	0.9115	1953
	0.0000	0.0000	0.0000	0.0000			
Electrical machinery and apparatus	-152.1785	28.1652	-1.3202	0.4245	0.8804	0.9823	2002
	0.0000	0.0000	0.0000	0.0000			
Medical, precision and optical instruments	-82.1435	11.7373	-0.4554	0.6109	0.9384	0.7993	1502
	0.0000	0.0000	0.0000	0.0000			
Motor vehicles, trailers, semi-trailers	-143.9917	27.7760	-1.3713	0.3962	0.8485	1.0995	1919
	0.0000	0.0000	0.0000	0.0000			
Furniture; manufacturing n.e.c.	-63.6860	10.4955	-0.4404	0.3486	0.9021	0.7608	1738
	0.0000	0.0000	0.0000	0.0000			

Notes: Shaded rows of each variables show the coefficients and the numbers below in non-shaded cells are *p*-values. C stand stands for constant term, GDPPC for gross domestic product per capita, GDPPC^2 for gross domestic product per capita square, WI for world imports, R^2_adj for adjusted explanatory power, SE for standard and N for the number of variables.

Source: UNIDO calculations, 2009.

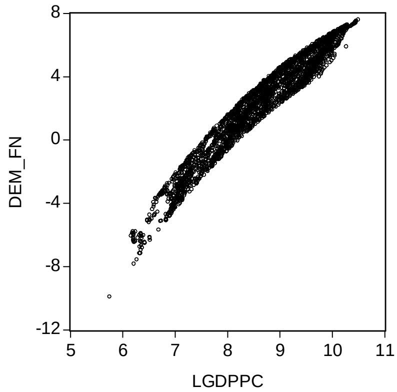
The availability of long-term time series and diverse cross-section data, with income per capita ranging from $390 to $36,000 in the sample, allows one to present more accurate patterns of industrial development showing when and how fast the demand for selected commodities started slowing down before diminishing. For example, when countries reach the PPP adjusted GDP per capita of around $15,000—roughly the current per capita income level of the Czech Republic—demand for domestic outputs of wearing apparel normally starts declining. In the case of motor vehicles, trailers and semi-trailers sector, the turning point is around $25,024. On the other hand, the medical, precision and optical instruments sector, as seen in figure 1, shows little sign of slowing down even as incomes soar. It is expected that demand for domestic outputs of this sector will not decline until the income level reaches $395,000! Contrary to popular belief and some evidence, demand for the food and beverage sector does not decline as fast as most other sectors. Earlier studies (Chenery, 1960: 633; Chenery and Taylor, 1968: 409; Maizels, 1968) estimated that the income elasticity of demand for this sector was around, or less than, 1.0. The results here show that, on average, the elasticity of the food and beverage sector is 2.248 and will reach 1.0 only when GDP per capita reaches some $15,000.

Figure 1. Output per capita, demand side, fixed and non-fixed effects, all countries



Source: Constructed by UNIDO, 2009.

Figure 1. Output per capita, demand side, fixed and non-fixed effects, all countries (Cont'd.)



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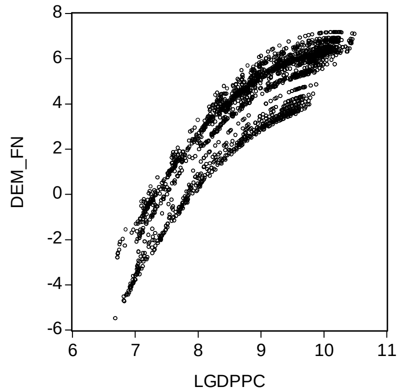
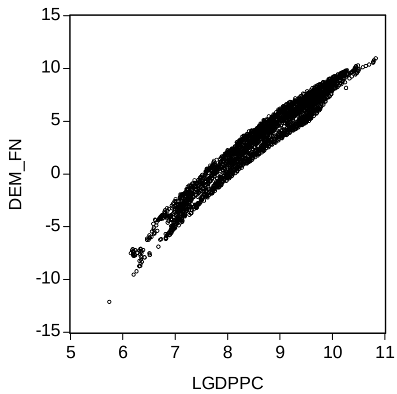
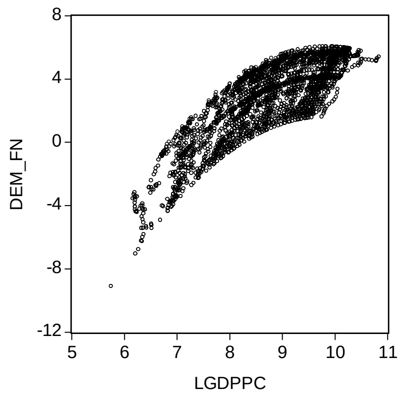


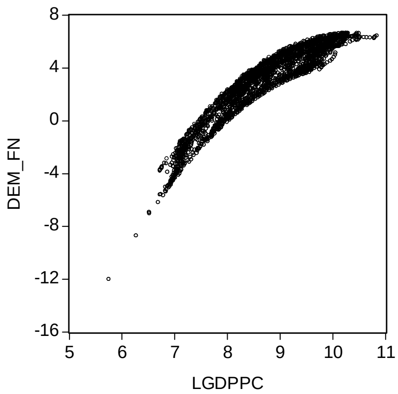
Coke, refined petroleum products, nuclear fuel



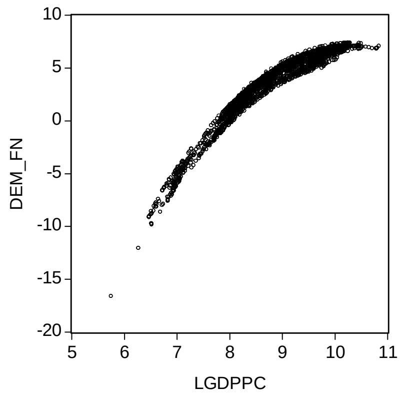
Chemicals and chemical products



Rubber and plastic products



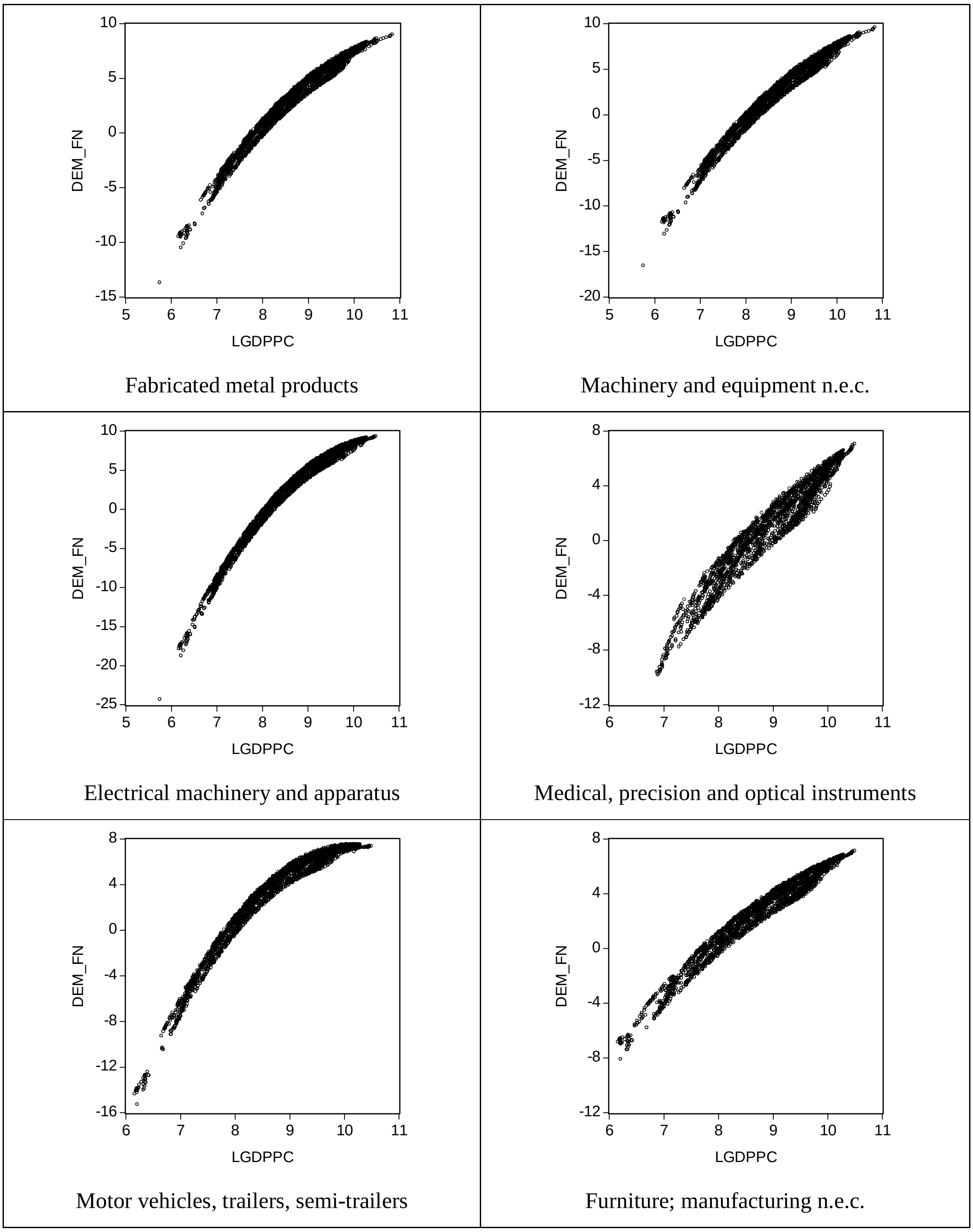
Non-metallic mineral products



Basic metals

Source: Constructed by UNIDO, 2009.

Figure 1. Output per capita, demand side, fixed and non-fixed effects, all countries (Cont'd.)



Source: Constructed by UNIDO, 2009.

A comparison of the above results with those obtained without including country dummies in the model (table 2) indicates the extent to which income and world imports explain the changes in output, and how much country-specific characteristics influence sectoral outputs on the demand side.

Table 3. Regressions for estimating the demand for sectoral outputs without country dummies: all countries (TSLS)

	C	GDPPC	GDPPC^2	WI	R^2_adj	SE	N
Food and beverages	-25.0816	1.1383	0.0184	0.7369	0.8276	0.8191	2411
	0.0000	0.0001	0.2935	0.0000			
Tobacco products	-22.3252	2.5866	-0.0817	0.3964	0.6930	0.9153	2049
	0.0000	0.0000	0.0003	0.0000			
Textiles	-6.0045	-1.2080	0.1391	0.3823	0.5890	1.1599	2242
	0.0026	0.0064	0.0000	0.0000			
Wearing apparel	-23.5167	2.9003	-0.0712	0.2789	0.6271	1.3590	2121
	0.0000	0.0000	0.0225	0.0000			
Wood products (excl. furniture)	-4.6857	-2.6469	0.2607	0.4296	0.6811	1.3292	2195
	0.0487	0.0000	0.0000	0.0000			
Paper and paper products	-28.6238	1.3725	0.0363	0.6818	0.8446	0.9781	2150
	0.0000	0.0006	0.1181	0.0000			
Printing and publishing	-7.8446	-2.6232	0.2741	0.5301	0.8728	0.8971	2031
	0.0000	0.0000	0.0000	0.0000			
Coke, refined petroleum products, nuclear fuel	-34.8492	2.6145	-0.0606	0.8277	0.7140	1.1769	1403
	0.0000	0.0016	0.2000	0.0000			
Chemicals and chemical products	-13.8653	-2.7675	0.2554	0.8600	0.8406	0.9610	2130
	0.0000	0.0000	0.0000	0.0000			
Rubber and plastic products	-31.7772	2.2575	-0.0266	0.7033	0.8665	0.8793	1933
	0.0000	0.0000	0.2192	0.0000			
Non-metallic mineral products	-37.6750	4.1140	-0.1271	0.6161	0.8495	0.8347	1995
	0.0000	0.0000	0.0000	0.0000			
Basic metals	-34.4373	2.9906	-0.0554	0.6306	0.7383	1.1849	1663
	0.0000	0.0001	0.2050	0.0000			
Fabricated metal products	3.7148	-5.3684	0.4230	0.5644	0.8132	1.0588	1995
	0.0726	0.0000	0.0000	0.0000			
Machinery and equipment n.e.c.	0.0618	-6.1346	0.4980	0.6843	0.7903	1.4114	1953
	0.9823	0.0000	0.0000	0.0000			
Electrical machinery and apparatus	-19.5778	-1.7845	0.2268	0.8138	0.7812	1.3287	2002
	0.0000	0.0020	0.0000	0.0000			
Medical, precision and optical instruments	-29.3731	-0.2433	0.1793	0.7428	0.8485	1.2536	1502
	0.0000	0.7958	0.0007	0.0000			
Motor vehicles, trailers, semi-trailers	2.9794	-5.2384	0.4295	0.4952	0.6710	1.6206	1919
	0.3636	0.0000	0.0000	0.0000			
Furniture; manufacturing n.e.c.	4.3138	-4.4574	0.3718	0.3486	0.7374	1.2458	1738
	0.0917	0.0000	0.0000	0.0000			

Note: Shaded rows of each variables show the coefficients, and the numbers below in non shaded cells are *p*-values

Source: UNIDO calculations, 2009.

Income and world imports account for 63 to 87 per cent, respectively, of the variations in output, with an average of some 75 per cent. Country-specific factors add, on average, another 13 per cent, further strengthening the explanation for output changes. Thus, overall changes in output are explained largely by the levels of income and world imports, of which the former is the dominant factor, accounting for between 50 to 80 per cent of total changes.

Next, to determine the time effects on the income elasticities of demand, table 2 is compared with table 4, which is based on the model that includes both fixed cross-section and time effects.

Table 4. Regressions for estimating the demand for sectoral outputs with both country and period dummies: all countries (TSLS)

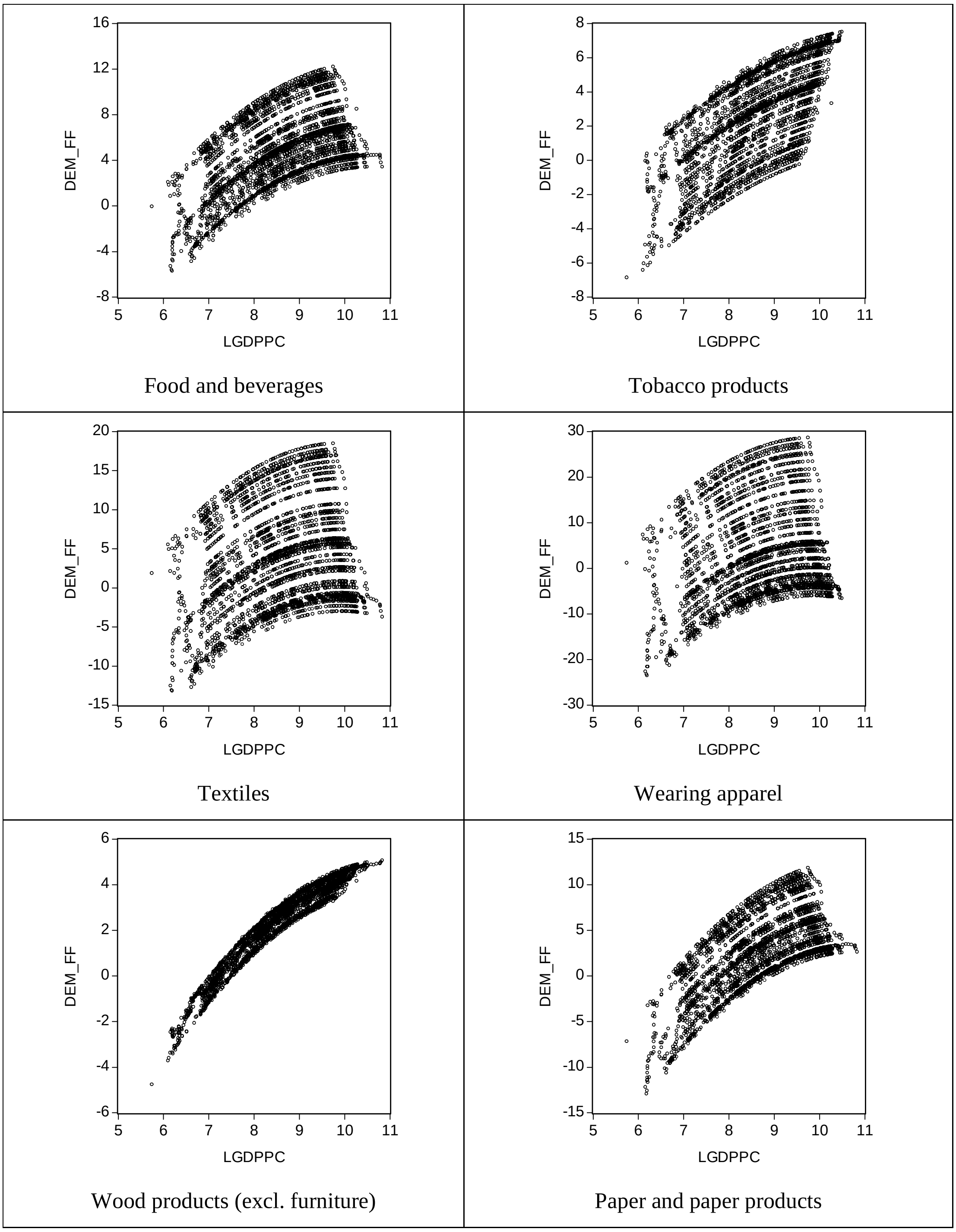
	C	GDPPC	GDPPC^2	WI	R^2_adj	SE	N
Food and beverages	18.4964	10.8149	-0.5069	-2.7149	0.9425	0.4730	2411
	0.2654	0.0000	0.0000	0.0001			
Tobacco products	-59.3094	5.5461	-0.2398	1.4795	0.8759	0.5823	2049
	0.3050	0.0000	0.0000	0.5778			
Textiles	71.3957	17.6133	-0.8866	-6.1765	0.8487	0.7037	2242
	0.4375	0.0000	0.0000	0.0973			
Wearing apparel	50.6092	29.4955	-1.4920	-7.7848	0.8053	0.9820	2121
	0.0824	0.0000	0.0000	0.0000			
Wood products (excl. furniture)	-41.2173	6.7440	-0.3042	0.3535	0.8985	0.7498	2195
	0.5345	0.0000	0.0000	0.8989			
Paper and paper products	-13.4794	16.1584	-0.7452	-2.7781	0.9304	0.6549	2150
	0.8256	0.0000	0.0000	0.2713			
Printing and publishing	25.5766	7.2571	-0.2534	-2.9014	0.9445	0.5926	2031
	0.7229	0.0000	0.0000	0.3559			
Coke, refined petroleum products, nuclear fuel	-59.2709	15.6344	-0.7630	-0.6107	0.9102	0.6594	1403
	0.0001	0.0000	0.0000	0.2930			
Chemicals and chemical products	193.3145	26.9746	-1.2768	-12.7522	0.8650	0.8845	2130
	0.1135	0.0000	0.0000	0.0080			
Rubber and plastic products	-13.6240	11.6467	-0.5794	-1.6885	0.9326	0.6248	1933
	0.4751	0.0000	0.0000	0.0358			
Non-metallic mineral products	-28.2649	17.3123	-0.8413	-2.3140	0.9408	0.5238	1995
	0.0441	0.0000	0.0000	0.0001			
Basic metals	10.0907	20.2277	-0.9468	-4.3755	0.9125	0.6851	1663
	0.5670	0.0000	0.0000	0.0000			
Fabricated metal products	-309.8869	19.5894	-0.8606	8.5736	0.8903	0.8114	1995
	0.0000	0.0000	0.0000	0.0000			
Machinery and equipment n.e.c.	-35.2851	14.5429	-0.5526	-1.8237	0.9125	0.9117	1953
	0.7101	0.0000	0.0000	0.6218			
Electrical machinery and apparatus	227.6091	40.5662	-1.9604	-17.1556	0.8507	1.0977	2002
	0.0000	0.0000	0.0000	0.0000			
Medical, precision and optical instruments	-5.8317	11.2853	-0.4204	-2.4659	0.9397	0.7908	1502
	0.9465	0.0000	0.0000	0.4890			
Motor vehicles, trailers, semi-trailers	25.4422	25.4435	-1.2185	-5.8578	0.8543	1.0785	1919
	0.3428	0.0000	0.0000	0.0000			
Furniture; manufacturing n.e.c.	-6.4952	7.0272	-0.2106	-1.4883	0.8988	0.7733	1738
	0.9588	0.0000	0.0085	0.7740			

Note: Shaded rows of each variables show the coefficients, and the numbers below in non-shaded cells are *p*-values.
Source: UNIDO calculations, 2009.

Overall, fixing time effects does not increase the adjusted R squares of the model, which already has a very high explanatory power with the inclusion of country dummies. However, fixing both country-specific and time effects provides a deeper insight of the general patterns of sectoral growth over an extended period of time, thus enabling one to see how the pattern changes with time. As seen in figure 2, the lines are spread to show annual trends. For all sectors, with the exception of the tobacco and fabricated metal products sectors, the top of the multiple lines shows the trend in the initial year (1963), while the bottom line reflects the trend in the latest year (2004). The reverse is the case for tobacco and fabricated metal products.

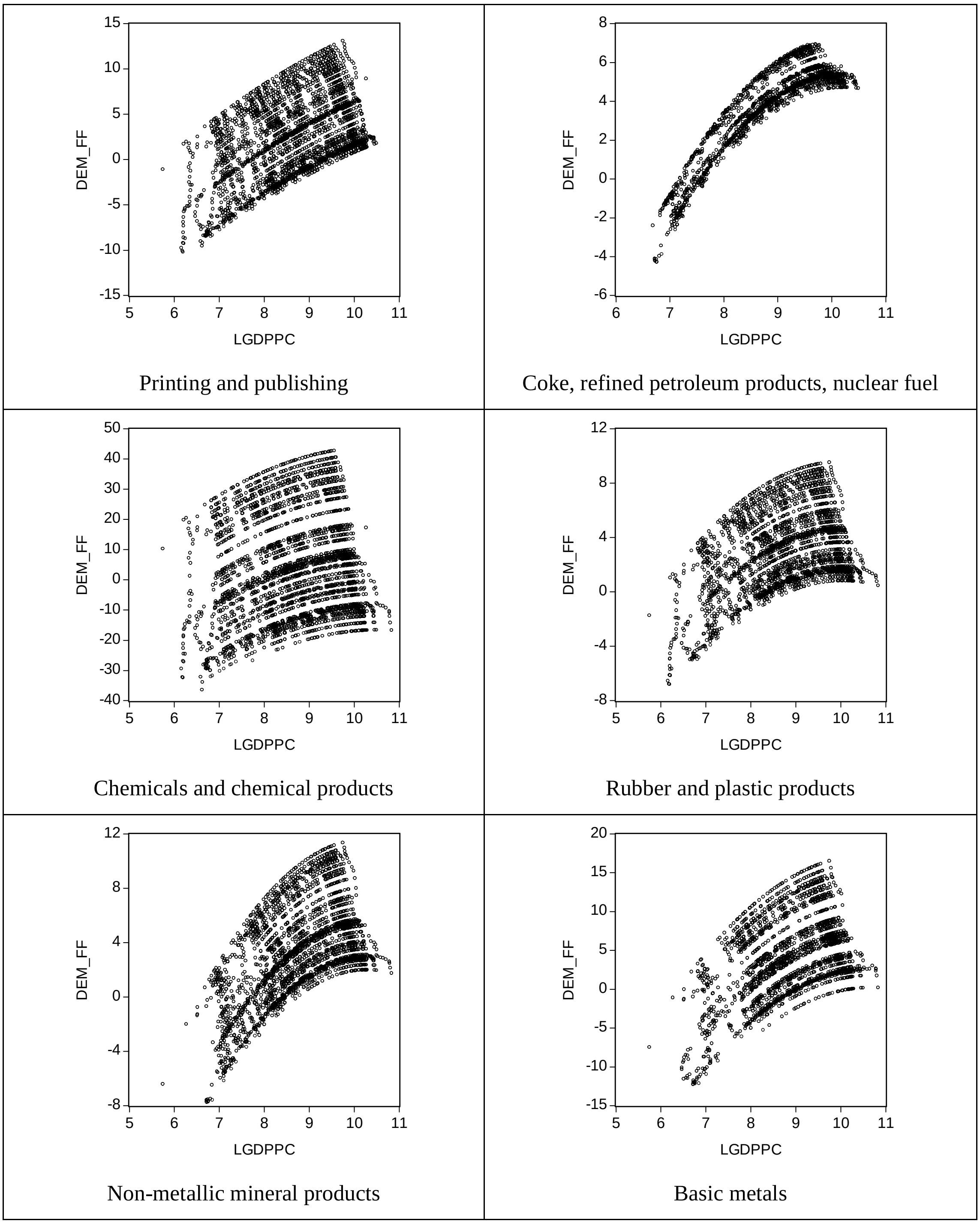
The results, applying the panel data method, reveal an important relationship between income elasticity of demand and time effects. As shown in figure 2 below, the patterns of the demand growth for the sectors are not exactly the same in different years. Generally, the trend lines of more recent years depict sharper curves, indicating a faster pace of slowing down. Especially for relatively rich countries (for example, countries with a GDP per capita exceeding $5,000), differences in income elasticities increase with time. In other words, high-income countries in 2004 experienced slower growth in demand for many manufacturing sectors as their income per capita increased, when compared with 1963. With regard to outputs of wearing apparel, for example, in 2004, countries with a per capita income of $22,000 had already reached a point where any further increase in the income level would reduce demand. However, in 1964, countries with the same income level continued to register positive growth in demand.

Figure 2. Output per capita, demand side, fixed-fixed effects: all countries



Source: Constructed by UNIDO, 2009.

Figure 2. Output per capita, demand side, fixed-fixed effects: all countries (Cont'd.)



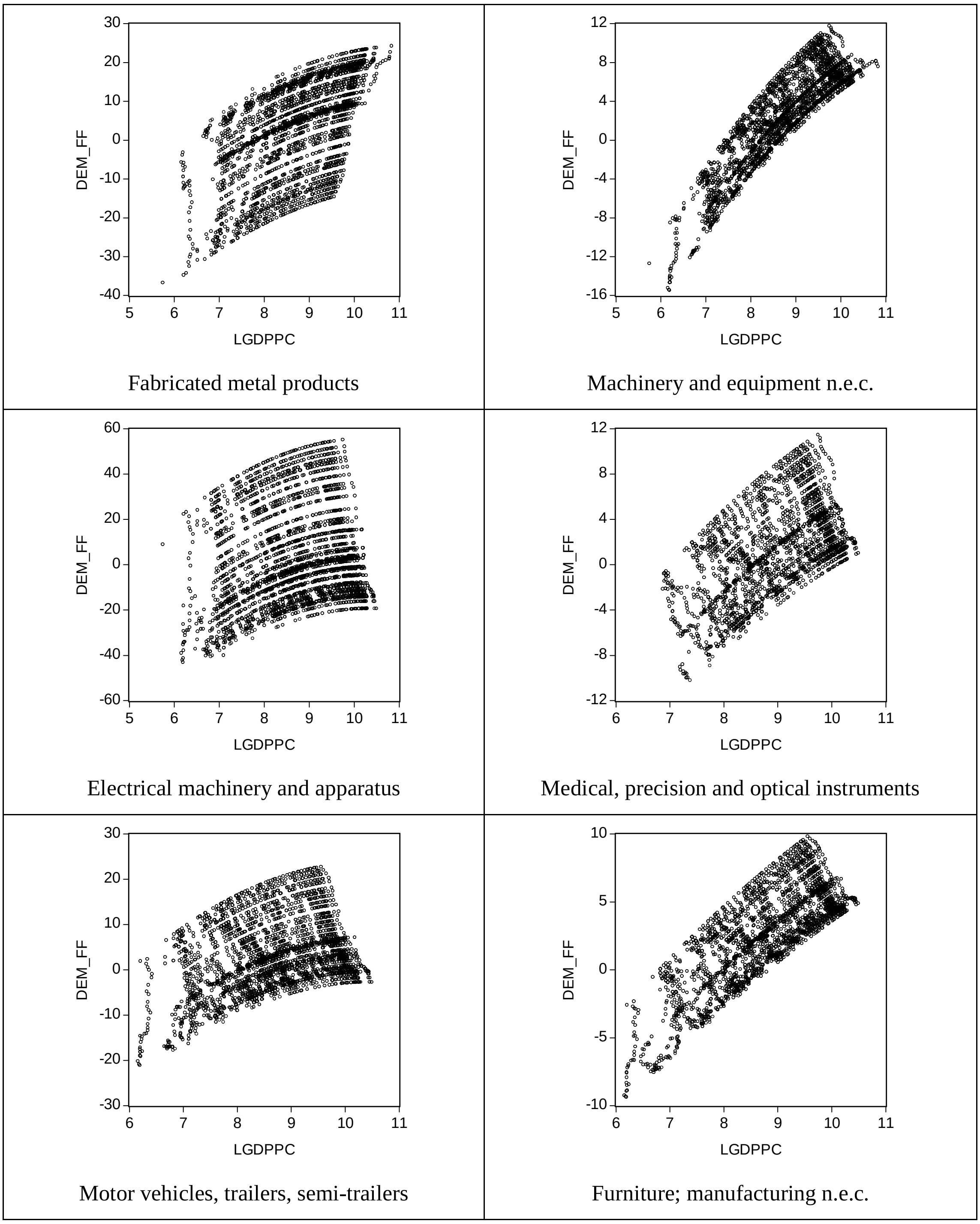
Printing and publishing | Coke, refined petroleum products, nuclear fuel

Chemicals and chemical products | Rubber and plastic products

Non-metallic mineral products | Basic metals

Source: Constructed by UNIDO, 2009.

Figure 2. Output per capita, demand side, fixed-fixed effects: all countries (Cont'd.)



Source: Constructed by UNIDO, 2009.

The relationship between output and income levels is derived by separating the time effects from the explanatory variables. No such separation, which compresses the trend lines of different years to exhibit a general long-term pattern, irrespective of time effects can be observed in figure 1. Thus, a comparison between figures 1 and 2 points out that, with the exception of the tobacco and fabricated metal products sectors, demand for outputs of other manufacturing sectors increased at all income levels with time. In other words, the results show an absolute increase in manufacturing demand, including that from domestic and foreign sources, due to global economic and population growth over the past 40 years.

4.2. Supply side

The goodness-of-fits of the equation are generally high, but in comparison to the demand-side results (table 2), despite the larger number of explanatory variables, the adjusted R squares of the supply side are lower for the manufacturing sector as a whole. This is because GDP per capita is considered to be a dominant factor, which explains the level of demand. However, to determine the level of supply more diverse factors are involved.

The signs of the quadratic terms (GDPPC^2) are negative for all sectors, except for wood products, and are significant at 99 per cent confidence level. Thus, like the demand side, the relationship between output and the income level for the supply side is non-linear, to the extent that as growth of the former diminishes and eventually becomes negative, that of the latter increases.

Population (P), which is a proxy for country size, has generally negative signs even though the coefficients for several sectors are insignificant. On the other hand, population density (PD), which reflects the level of resource scarcity, shows positive signs—except for the wearing apparel sector—with the same number of coefficients being insignificant as the population variable. These results seem to point out that generally diseconomies, rather than economies, of scale have an impact on many sectors, and thus supports past evidence (Chenery and Syrquin, 1975) that resource scarcity tends to lead to industrialization.

Finally, unit labour costs (ULC), which is the ratio of labour costs to labour productivity, have, as expected, a significantly inverse relationship to output levels. Since lower unit labour costs usually mean higher industrial competitiveness, the results support the importance of this aspect, which can be strengthened by lower wages, or higher productivity, or both.

Table 5. Regressions for estimating sectoral supplies: all countries (TSLS)

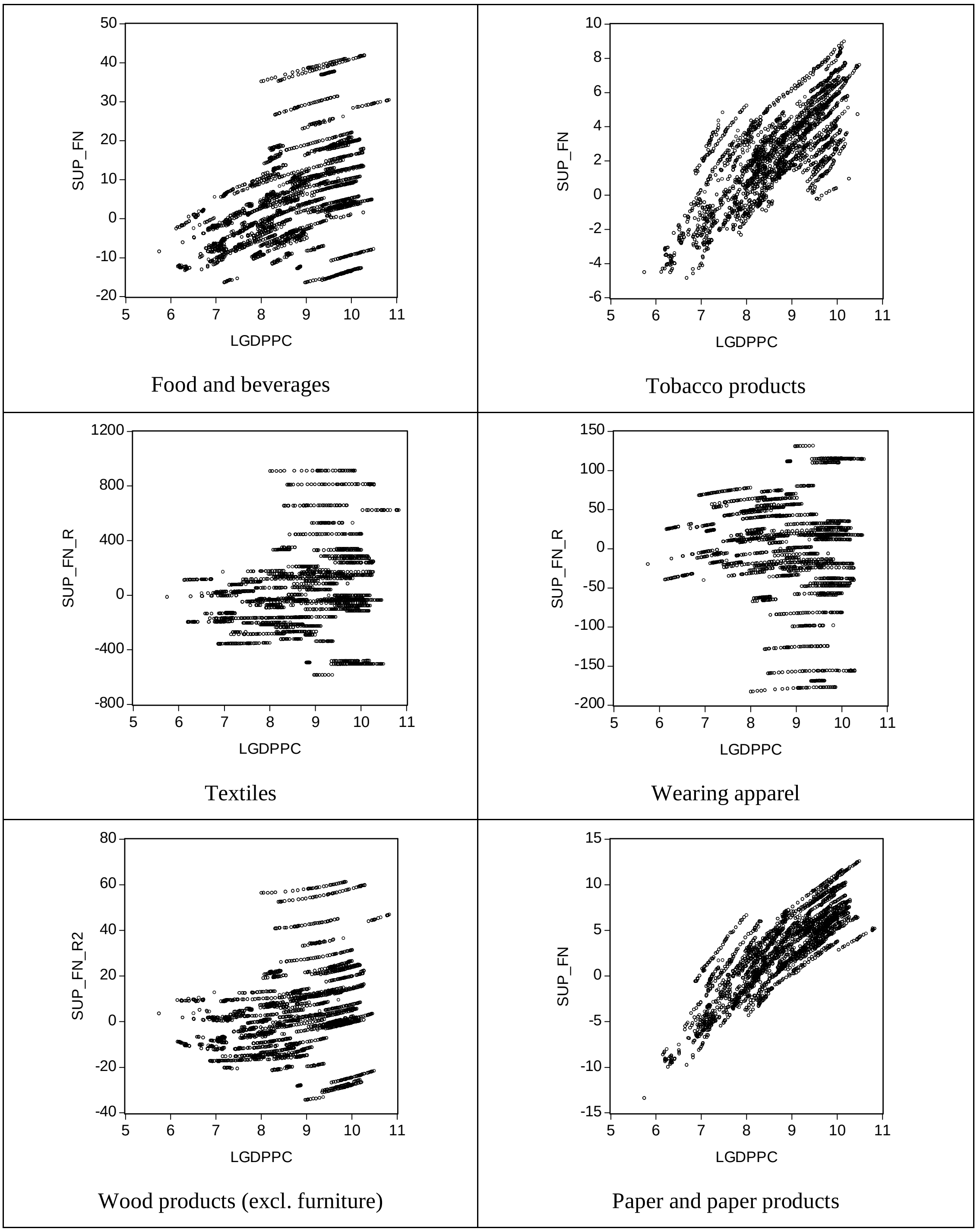
	C	GDPPC	GDPPC^2	ULC	P	PD	R^2_adj	SE	N
Food and beverages	-1.8001	8.3928	-0.3062	0.0240	-4.1894	6.1428	0.9194	0.5600	2411
	0.8477	0.0000	0.0000	0.6099	0.0000	0.0000			
Tobacco products	-34.9585	3.5936	-0.0890	-0.3179	0.5303	0.9470	0.8599	0.6184	2049
	0.3332	0.0000	0.0516	0.0000	0.8547	0.7447			
Textiles	1595.8760	20.5446	-1.0245	-0.3249	-137.7028	138.5627	0.8061	0.7968	2242
	0.0005	0.0000	0.0000	0.0000	0.0002	0.0002			
Wearing apparel	-518.6635	36.0284	-1.8451	0.0574	28.5474	-28.4272	0.7577	1.0955	2121
	0.0010	0.0000	0.0000	0.5443	0.0258	0.0267			
Wood products (excl. furniture)	149.7626	-15.4755	1.0017	-0.2283	-7.8047	9.4031	0.8380	0.9475	2195
	0.1673	0.0000	0.0000	0.0013	0.3888	0.2972			
Paper and paper products	-89.8348	11.9315	-0.4582	-0.4703	1.3178	0.3969	0.9247	0.6808	2150
	0.0000	0.0000	0.0000	0.0000	0.4127	0.8067			
Printing and publishing	81.8700	4.8992	-0.0671	-0.4259	-10.0627	11.6178	0.9328	0.6520	2031
	0.3216	0.0000	0.2017	0.0000	0.1370	0.0857			
Coke, refined petroleum products, nuclear fuel	178.4368	19.2711	-0.8660	-0.2443	-22.7503	24.8276	0.8689	0.7968	1403
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000			
Chemicals and chemical products	-10.3770	5.6264	-0.0664	-0.3664	-3.3613	5.9528	0.9175	0.6914	2130
	0.3494	0.0000	0.1787	0.0000	0.0003	0.0000			
Rubber and plastic products	-25.9093	13.5378	-0.5406	-0.1711	-4.8151	7.4986	0.8860	0.8127	1933
	0.7933	0.0000	0.0000	0.0301	0.5449	0.3469			
Non-metallic mineral products	-14.6940	12.0682	-0.5010	-0.0678	-4.7503	6.9988	0.9317	0.5623	1995
	0.2561	0.0000	0.0000	0.2312	0.0000	0.0000			
Basic metals	81.2943	20.8646	-0.9444	-0.3310	-15.3644	16.1770	0.8990	0.7364	1663
	0.3222	0.0000	0.0000	0.0000	0.0196	0.0141			
Fabricated metal products	196.5679	14.6876	-0.5822	-0.2524	-22.8186	23.8155	0.8941	0.7974	1995
	0.1066	0.0000	0.0000	0.0003	0.0217	0.0165			
Machinery and equipment n.e.c.	546.5493	12.2976	-0.4051	-0.2311	-50.8111	52.1817	0.9049	0.9502	1953
	0.0060	0.0000	0.0092	0.0084	0.0020	0.0014			
Electrical machinery and apparatus	115.6943	33.4379	-1.5413	-0.3421	-107.9292	108.6881	0.8499	1.1002	2002
	0.0005	0.0000	0.0000	0.0001	0.0001	0.0001			
Medical, precision and optical instruments	287.2042	10.1379	-0.2699	-0.1851	-29.0077	30.5072	0.9264	0.8732	1502
	0.0694	0.0000	0.0001	0.0254	0.0220	0.0161			
Motor vehicles, trailers, semi-trailers	-125.3948	24.2848	-1.1341	-0.5037	-0.0717	1.0993	0.8461	1.1083	1919
	0.0000	0.0000	0.0000	0.0000	0.9646	0.5031			
Furniture; manufacturing n.e.c.	88.8388	12.8630	-0.4984	-0.7926	-13.1307	13.3785	0.8950	0.7877	1738
	0.4727	0.0000	0.0000	0.0000	0.1894	0.1813			

Note: Shaded rows of each variables show the coefficients, and the numbers below in non-shaded cells are *p*-values.

Source: UNIDO calculations, 2009.

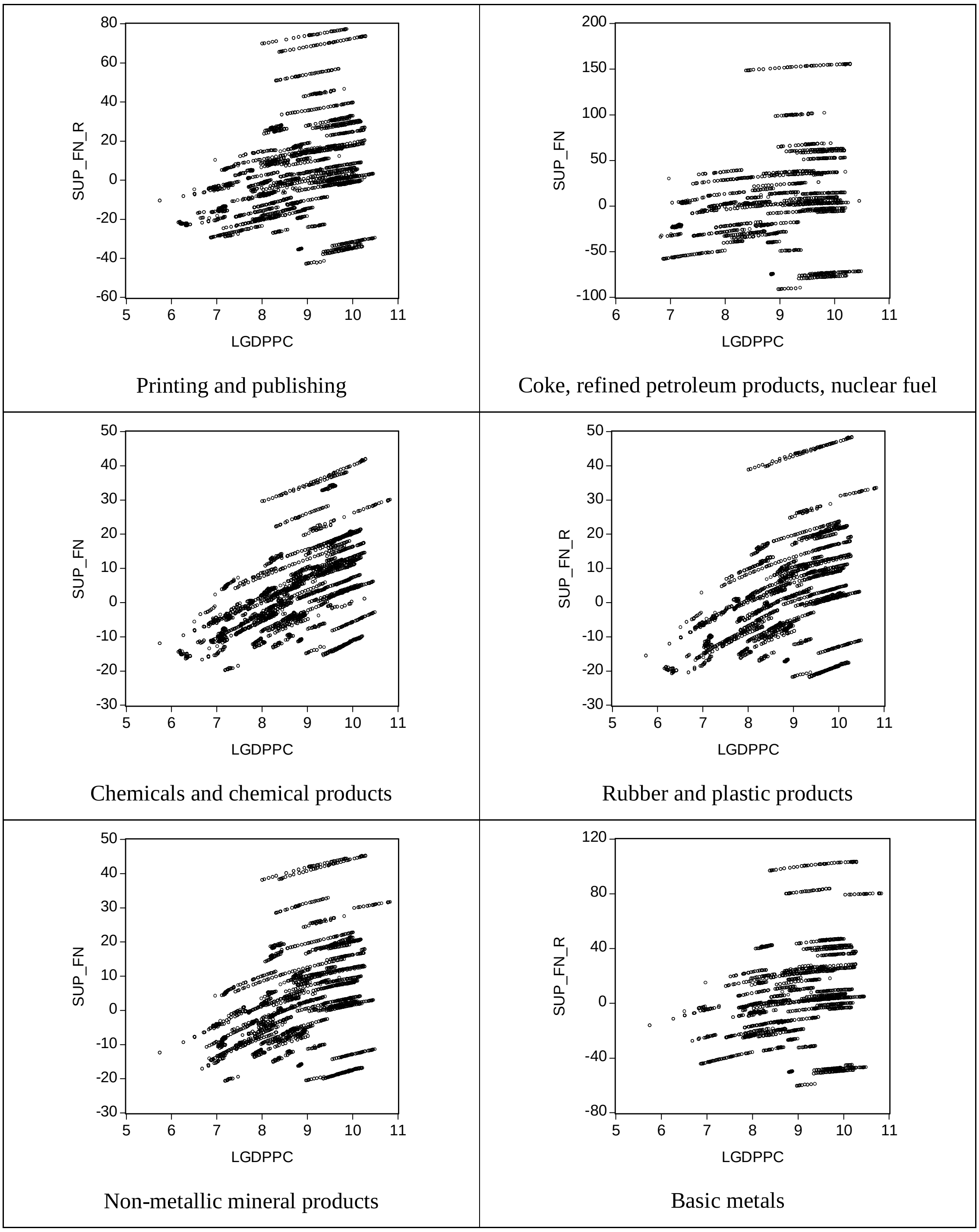
Figure 3 shows multiple lines for each sector in contrast with the demand side (figure 1), which shows that the supply levels of each sector cannot be determined by income level alone, despite a similarity in the pattern of change across countries—indicated by similar trends of separate lines in the graphs. Indeed, a comparison between the above results and the results based on models, including both cross-section and period dummies and also excluding both dummies, indicates that, on average, country-specific and time effects account for some 20 per cent of the changes in supply levels—much higher than those in demand levels (table 6). Between the two, country-specific effects have a much larger influence when determining supply levels—18 out of 20 per cent (table 7). Such evidence further underlines that the supply levels of the manufacturing sector depend more on country-specific characteristics, and cannot be approximated by the income level alone. This finding casts a doubt on the results of Chenery and associates (1960, 1968), which purport that general development patterns can be estimated by income level, country size and trade orientations without taking into consideration other country-specific characteristic and time effects. Since the demand side regressions here confirmed the dominant effect of income level for determining outputs, Chenery's equations might have focused more on the demand than the supply side. Past literature (Chenery and Syrquin, 1975; Temin, 1967) tended to be permissive about using cross-section data results for deriving patterns of industrial development over a long period of time, or at best they were not conclusive of the time effects on such patterns. This panel data study shows how the pattern, in terms of the demand elasticity, has changed over the years and its general direction for the future.

Figure 3. Output per capita, supply side, fixed and non-fixed effects: all countries



Source: Constructed by UNIDO, 2009.

Figure 3. Output per capita, supply side, fixed and non-fixed effects: all countries (Cont'd.)



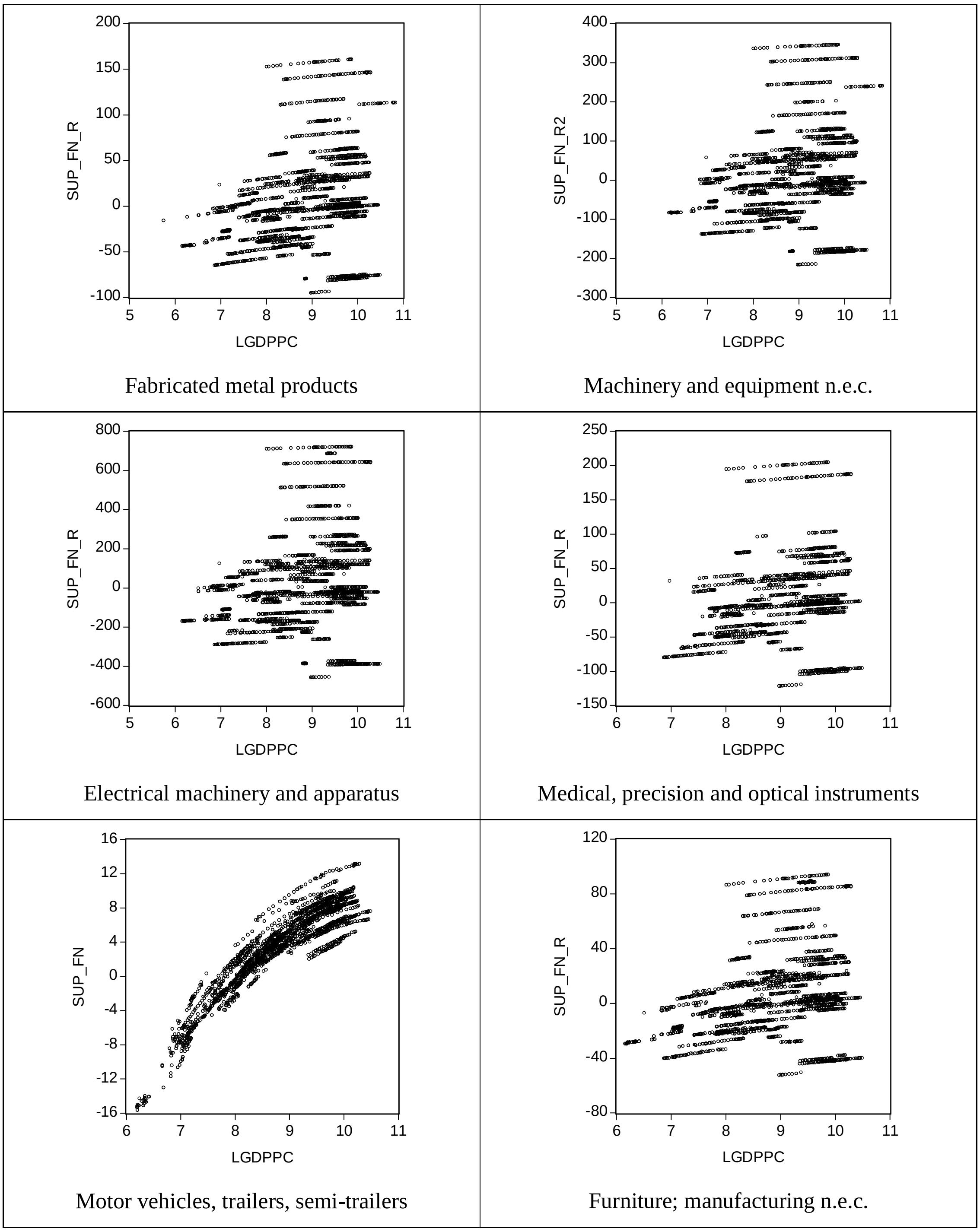
Printing and publishing | Coke, refined petroleum products, nuclear fuel

Chemicals and chemical products | Rubber and plastic products

Non-metallic mineral products | Basic metals

Source: Constructed by UNIDO, 2009.

Figure 3. Output per capita, supply side, fixed and non-fixed effects: all countries (Cont'd.)



Source: Constructed by UNIDO, 2009.

Table 6. Regressions for estimating sectoral supplies without country dummies: all countries (TSLS)

	C	GDPPC	GDPPC^2	ULC	P	PD	R^2_adj	SE	N
Food and beverages	-1.2597	-0.0259	0.1012	-0.0722	-0.0708	-0.0761	0.7144	1.0543	2411
	0.4641	0.9482	0.0000	0.1931	0.0000	0.0000			
Tobacco products	-10.1080	1.4721	-0.0061	-0.2466	-0.0413	0.1196	0.6231	1.0143	2049
	0.0000	0.0008	0.8119	0.0000	0.0063	0.0000			
Textiles	0.9445	-1.6046	0.1741	-0.4613	0.1570	0.0812	0.5795	1.1732	2242
	0.6291	0.0000	0.0000	0.0000	0.0000	0.0000			
Wearing apparel	-11.9243	2.2802	-0.0314	0.1169	-0.1559	0.0427	0.6171	1.3770	2121
	0.0000	0.0001	0.3403	0.1863	0.0000	0.0406			
Wood products (excl. furniture)	13.1071	-4.2795	0.3675	-0.4447	-0.0786	-0.1667	0.6646	1.3632	2195
	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000			
Paper and paper products	-10.3615	0.2163	0.1270	-0.6864	0.0872	-0.1933	0.7905	1.1357	2150
	0.0000	0.6518	0.0000	0.0000	0.0000	0.0000			
Printing and publishing	11.7571	-4.5604	0.4037	-0.7773	-0.0582	-0.0466	0.8179	1.0735	2031
	0.0000	0.0000	0.0000	0.0000	0.0005	0.0050			
Coke, refined petroleum products, nuclear fuel	12.0444	-3.8808	0.3314	-0.4547	-0.1166	0.2329	0.5823	1.4223	1403
	0.0124	0.0004	0.0000	0.0000	0.0001	0.0000			
Chemicals and chemical products	9.1030	-4.3297	0.3729	-0.6695	0.1701	0.0055	0.6844	1.3524	2130
	0.0003	0.0000	0.0000	0.0000	0.0000	0.7875			
Rubber and plastic products	-12.7410	0.5388	0.1028	-0.8371	0.0813	0.1603	0.7275	1.2563	1933
	0.0000	0.3187	0.0000	0.0000	0.0000	0.0000			
Non-metallic mineral products	-22.6702	3.4718	-0.0729	-0.1390	0.0548	-0.0033	0.7458	1.0849	1995
	0.0000	0.0000	0.0366	0.0563	0.0016	0.8437			
Basic metals	-25.2484	2.8466	-0.0221	-0.3105	0.3423	-0.1533	0.7203	1.2251	1663
	0.0000	0.0005	0.6317	0.0000	0.0000	0.0000			
Fabricated metal products	19.9524	-6.7002	0.5192	-0.5112	0.0741	-0.0074	0.7558	1.2106	1995
	0.0000	0.0000	0.0000	0.0000	0.0001	0.6972			
Machinery and equipment n.e.c.	14.9728	-7.1283	0.5767	-0.3164	0.2893	0.0554	0.7530	1.5317	1953
	0.0000	0.0000	0.0000	0.0016	0.0000	0.0205			
Electrical machinery and apparatus	-4.3267	-2.3344	0.2852	-0.4499	0.2736	0.0983	0.7043	1.5448	2002
	0.1483	0.0007	0.0000	0.0000	0.0000	0.0000			
Medical, precision and optical instruments	-9.5449	-2.2986	0.3248	-0.6851	0.2072	0.2145	0.7861	1.4894	1502
	0.0721	0.0504	0.0000	0.0000	0.0000	0.0000			
Motor vehicles, trailers, semi-trailers	6.4880	-4.7689	0.4234	-0.4469	0.3345	-0.0784	0.6712	1.6200	1919
	0.0543	0.0000	0.0000	0.0000	0.0000	0.0024			
Furniture; manufacturing n.e.c.	27.4385	-7.5732	0.5634	-0.8490	-0.1876	0.0359	0.7204	1.2856	1738
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0883			

Note: Shaded rows of each variables show the coefficients, and the numbers below in non shaded cells are *p*-values.

Source: UNIDO calculations, 2009.

Table 7. Regressions for estimating sectoral supplies with both country and period dummies: all countries (TSLS)

	C	GDPPC	GDPPC^2	ULC	P	PD	R^2_adj	SE	N
Food and beverages	-51.6299	8.7747	-0.3734	0.0144	0.4927	0.2093	0.9428	0.4719	2411
	0.1902	0.0000	0.0000	0.7242	0.8782	0.9484			
Tobacco products	5.5825	-4.1749	0.3570	-0.3187	-0.1753	2.0107	0.8780	0.5771	2049
	0.8920	0.7164	0.5959	0.0000	0.9397	0.3786			
Textiles	-117.7590	12.5239	-0.5896	-0.4359	4.1965	-2.8077	0.8668	0.6604	2242
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0106			
Wearing apparel	25.9388	25.0492	-1.1765	-0.0913	-13.0617	15.2255	0.8048	0.9831	2121
	0.8487	0.0000	0.0000	0.2889	0.2392	0.1712			
Wood products (excl. furniture)	152.0416	13.8974	-0.7305	-0.1737	-16.7922	14.7901	0.8986	0.7496	2195
	0.0152	0.0000	0.0000	0.0027	0.0012	0.0041			
Paper and paper products	9.0580	13.8062	-0.5996	-0.4591	-6.8103	7.3402	0.9349	0.6330	2150
	0.8903	0.0000	0.0000	0.0000	0.2055	0.1729			
Printing and publishing	-37.5267	6.8468	-0.2326	-0.3939	-0.1249	-0.0040	0.9468	0.5801	2031
	0.0184	0.0000	0.0000	0.0000	0.9215	0.9975			
Coke, refined petroleum products, nuclear fuel	124.2466	9.4233	-0.3946	-0.2931	-14.4211	16.3774	0.9210	0.6186	1403
	0.3354	0.0000	0.0000	0.0000	0.1591	0.1108			
Chemicals and chemical products	-14.5551	3.5494	0.0552	-0.4736	-2.2888	4.8013	0.9286	0.6431	2130
	0.4213	0.0005	0.3288	0.0000	0.1049	0.0009			
Rubber and plastic products	202	10.5123	-0.4781	-0.0877	-20.9721	21.9255	0.9308	0.6329	1933
	0.0424	0.0000	0.0000	0.1686	0.0099	0.0070			
Non-metallic mineral products	104.8742	15.2497	-0.7151	-0.0211	-14.9456	15.9373	0.9433	0.5126	1995
	0.0000	0.0000	0.0000	0.6985	0.0000	0.0000			
Basic metals	36.9298	19.0883	-0.8770	-0.3256	-10.7929	11.0729	0.9158	0.6720	1663
	0.0506	0.0000	0.0000	0.0000	0.0000	0.0000			
Fabricated metal products	28.3419	7.3367	-0.1942	-0.3463	-6.5402	7.9936	0.9163	0.7086	1995
	0.3206	0.0000	0.0030	0.0000	0.0067	0.0008			
Machinery and equipment n.e.c.	110.1669	5.8386	-0.0418	-0.2453	-13.4684	15.9275	0.9176	0.8846	1953
	0.3791	0.0002	0.6312	0.0017	0.1860	0.1183			
Electrical machinery and apparatus	-17.6265	28.2218	-1.2656	-0.3093	-10.7470	11.6048	0.8836	0.9692	2002
	0.4018	0.0000	0.0000	0.0001	0.0000	0.0000			
Medical, precision and optical instruments	609.3298	20.0263	-0.8855	-0.1734	-56.8516	54.9944	0.9350	0.8209	1502
	0.0000	0.0000	0.0000	0.0286	0.0000	0.0000			
Motor vehicles, trailers, semi-trailers	-226.3588	22.7776	-1.0326	-0.5941	8.4352	-7.2502	0.8572	1.0678	1919
	0.0401	0.0000	0.0000	0.0000	0.3347	0.4104			
Furniture; manufacturing n.e.c.	286.4749	16.0074	-0.7310	-0.7221	-29.3329	27.8609	0.9074	0.7398	1738
	0.0724	0.0000	0.0000	0.0000	0.0237	0.0318			

Note: Shaded rows of each variables show the coefficients, and the numbers below in non-shaded cells are *p*-values.

Source: UNIDO calculations, 2009.

5. Sectoral development patterns

Chenery and Taylor (1968) divided the manufacturing sector into three categories, depending on the stage at which they contribute to the economy. The early industries include food; leather products; and textiles. The middle industries comprise non-metallic minerals; rubber products; wood products; chemicals; and petroleum refining, while clothing; paper; printing; basic metals; and metal products belong to the late industries. The results, as shown in figure 1, reveal a slightly different picture. These sectors are better classified in table 8.

Table 8. Sector classifications by stage and speed of development

	Sustained fast growth	Temporary fast growth	Low growth
Early sectors	Food and beverages		Tobacco
Early middle sectors		Textiles	Wood Rubber and plastic
Late middle sectors	Furniture and others Printing and publishing Paper Chemicals Fabricated metals	Wearing apparel Coke and petroleum refining Non-metallic minerals Basic metals	
Late sectors	Machinery and equipment Electrical machinery Medical precision and optical Instruments	Motor vehicles and trailers	

Source: UNIDO, 2009.

In contrast to Chenery and Talyor (1968), the words, ‘early’, ‘middle’, and ‘late’ are used here to indicate the approximate sequence of development and do not necessarily mean their dominance in the economy in the respective periods. For example, the food and beverages; and tobacco sectors are often the first to grow during the early stage of industrialization. But while growth of the tobacco sector is usually low and can never become a dominant sector in the economy, the food and beverages sector could sustain rapid growth and, depending on the country, it could also become a dominant sector during a country’s development. As such, this could have strong implications also on the agricultural sector, where developing countries generally have a comparative advantage, but lack the political will and institutional basis for it to become sustainable in a way that would be pro-poor oriented. The early sectors are then followed by more resource-based sectors (early middle) and later by more labour-intensive and intermediate goods sectors (late middle). As seen in the table, sectors with a higher degree of processing tend to have higher growth sustainability. Finally, when the income per capita of a country reaches some $3,000, late sectors, such as machinery and equipment; electrical machinery; medical precision and optical instruments; and motor vehicle and trailers, could take off. Especially, since the medical precision and optical instruments sector is likely to be introduced at a very late stage of development, once it takes off, unlike other sectors, it could sustain the momentum of initial growth even when a country reaches a very advanced stage of development.

6. Development patterns classified by country size

Literature on structural change points out that country size has significant effects on the patterns of industrial development because economies of scale, resource endowments, and scale of domestic demand often vary in accordance with country size (Chenery and Syrquin, 1975; Chenery and Taylor, 1968; Syrquin, 1988). Past empirical evidence shows that the manufacturing sector of larger countries has a larger weight in their economies in the early stage of development than that of smaller countries. Also, manufacturing growth of the former group usually slows down before that of the latter group, which has more linear growth patterns across different income levels. The effects of this important exogenous factor on development patterns are accordingly investigated in the following section to see whether the longer time-series data used in this study confirm these results.[2]

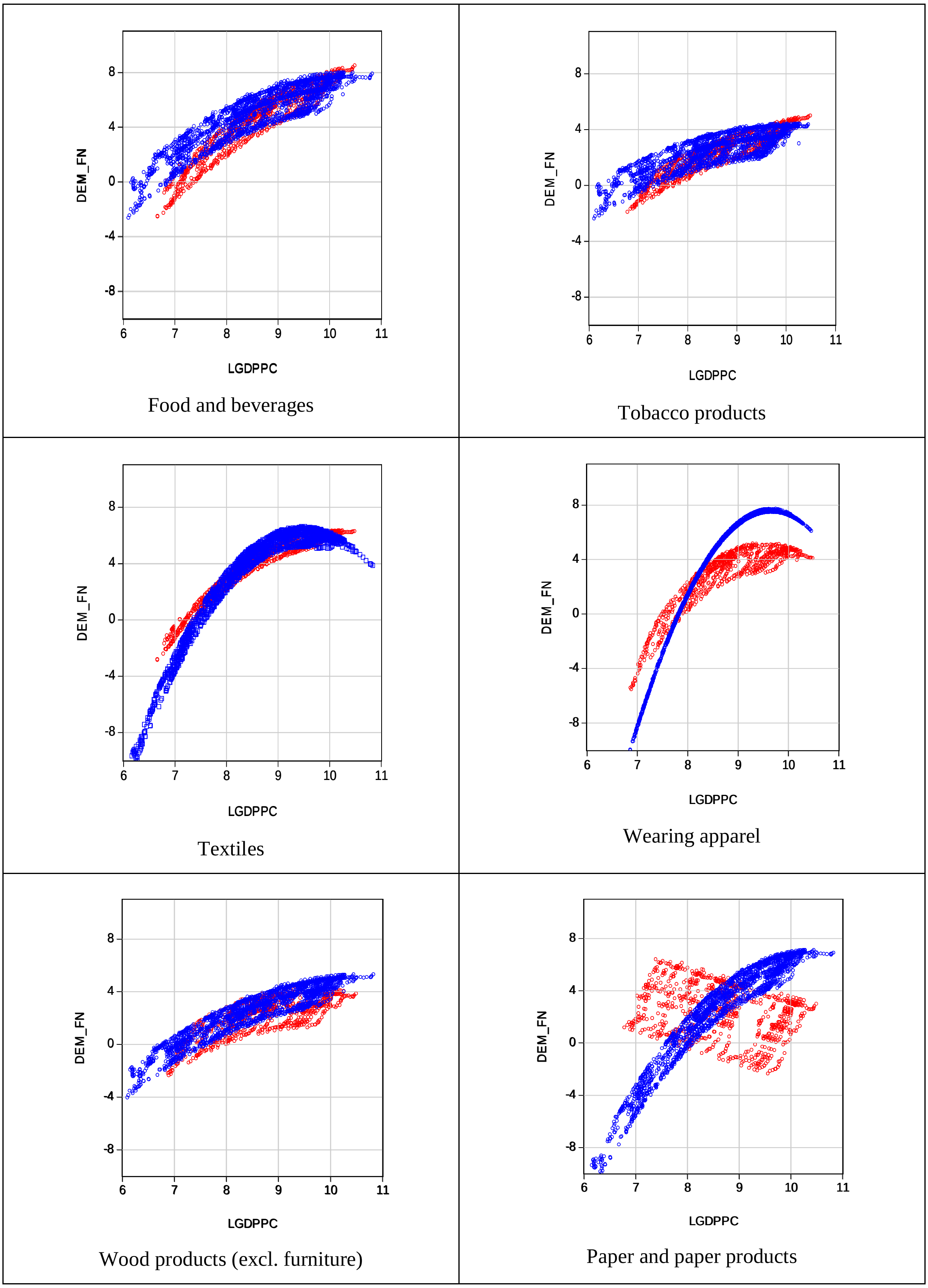
6.1. Demand side

Figure 4 shows the patterns of demand growth for sectoral outputs. The trends of large and small countries are plotted in red and blue, respectively. Overall, the widths on the scatter diagram for large countries are larger than those of small countries. This underscores that large countries tend to vary in their paths for sectoral development more than small countries. A good example is the machinery and equipment sector. At an income level of some $8,000, which is equivalent to log scale of 9 in the graph, the output per capita for the sector in smaller countries is some $54.6 (log4), while that in larger countries ranges between some $4.5 (log1.5) to $148.4 (log5). Diversity in natural and human resources seems to allow larger countries to differ in the pace and paths of development more than smaller countries.

[2] Countries with a population exceeding 15 million are classified as large countries.

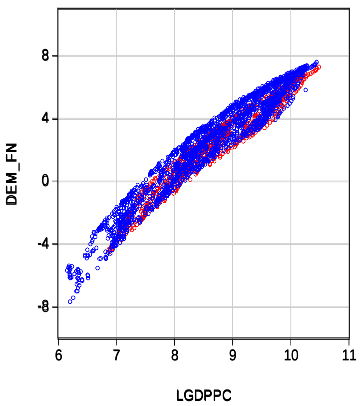
Relative to small countries, large countries exhibit higher sustainability of growth in the food and beverages; tobacco; textiles; rubber and plastic; basic metals; and motor vehicles sectors. Economies of scale and resource endowments influence the success of these sectors. On the other hand, small countries could hope for faster and longer growth in such sectors as chemicals and chemical products; machinery and equipment; and electrical machinery and apparatus—once they take off. These sectors might especially indicate the significance of international trade, which has an important impact on these dynamic sectors. Moreover, as small countries are normally expected to be integrated into the international trading system much more than large countries, they could sustain faster and longer growth of these sectors.

Figure 4. Output per capita, demand side, fixed and non-fixed effects: small and large countries

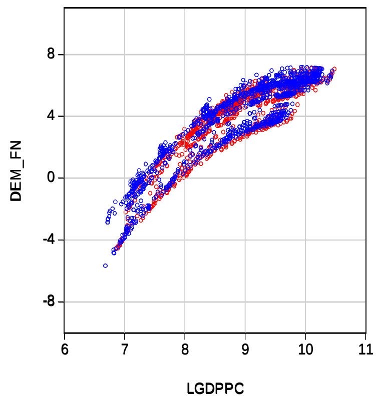


Source: Constructed by UNIDO, 2009.

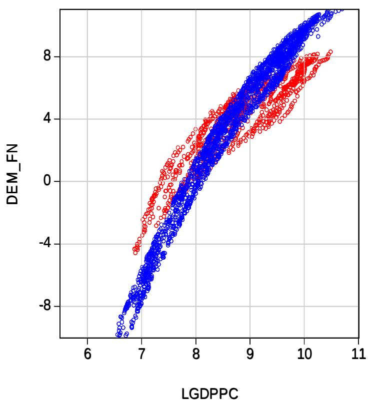
Figure 4. Output per capita, demand side, fixed and non-fixed effects: small and large countries (Cont'd.)



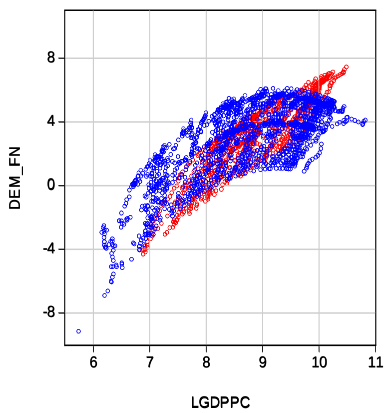
Printing and publishing



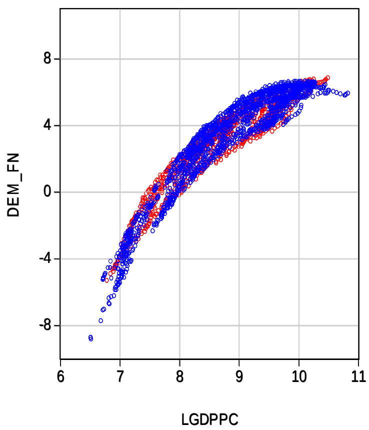
Coke, refined petroleum products, nuclear fuel



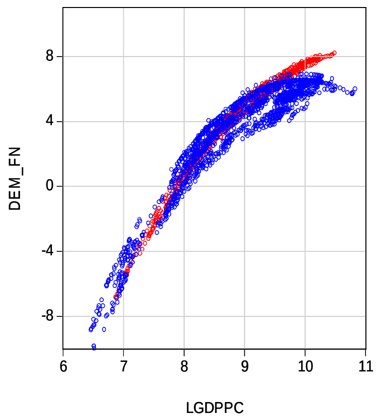
Chemicals and chemical products



Rubber and plastic products



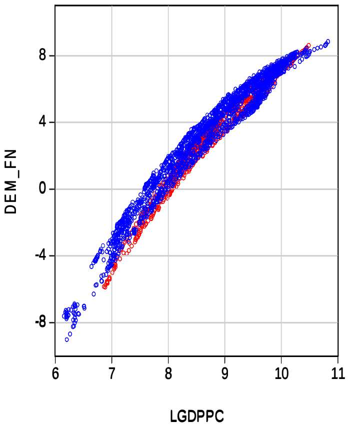
Non-metallic mineral products



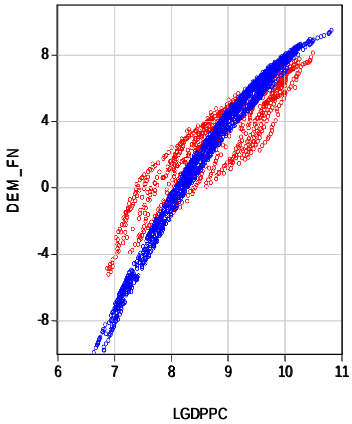
Basic metals

Source: Constructed by UNIDO, 2009.

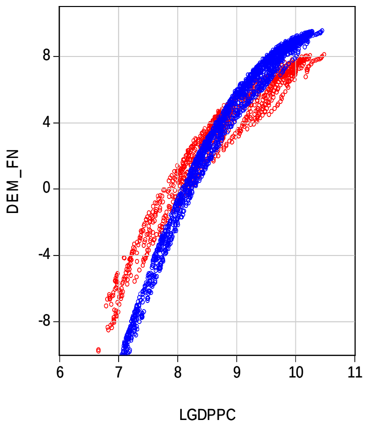
Figure 4. Output per capita, demand side, fixed and non-fixed effects: small and large countries (Cont'd.)



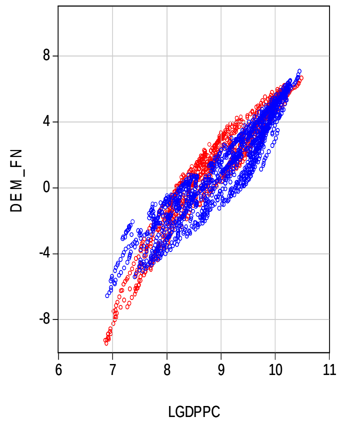
Fabricated metal products



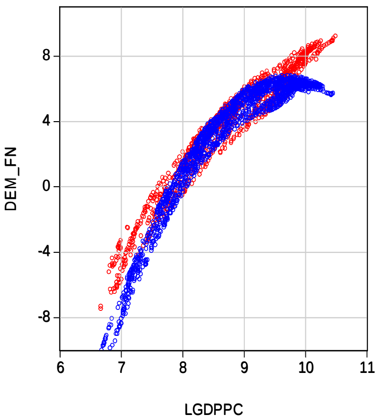
Machinery and equipment n.e.c.



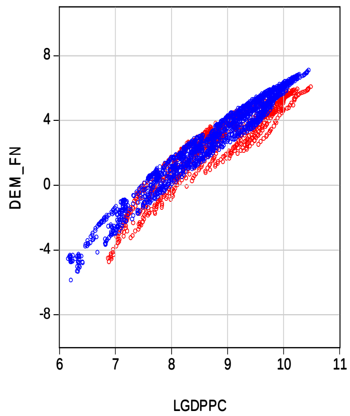
Electrical machinery and apparatus



Medical, precision and optical instruments



Motor vehicles, trailers, semi-trailers



Furniture; manufacturing n.e.c.

Source: Constructed by UNIDO, 2009.

Although, the sample of small countries used in this analysis is larger than that of large countries, as seen in table 9, the explanatory power for all sectors is higher for large countries, averaging at 92.1 per cent (87.7 per cent for small countries). This means that there is some 5 per cent difference in the way demand side variables explain variation of the dependent variable. The difference is most pronounced in sectors such as wearing apparel; wood products (excluding furniture); coke, refined petroleum products, nuclear fuel, chemicals; and chemical products; motor vehicles, trailers, semi-trailers; and furniture and manufacturing, not elsewhere classified. These are sectors where high domestic demand seems to have played an important role in the output growth of large countries. In other words, unless foreign demand is successfully captured through integration in the global trading system, smaller countries may experience problems in these sectors. Building on this domestic advantage, large countries seem to be able to respond better to growth in world imports of these sectors, as evidenced in the sectors' higher coefficients of *WI* for large countries.

A comparison of the adjusted R squares in table 9 with those in table 10—which shows the regression results, excluding country dummies—underscores the extent to which country-specific factors influence the demand growth of sectors. Large countries have five sectors, as against ten sectors in small countries, where country-specific factors explain more than 10 per cent of the changes in output levels. The difference in the importance of country-specific factors between the two groups of countries is especially large for tobacco; textiles; wood; coke, refined petroleum, nuclear fuel; basic metals; motor vehicles, trailers, semi-trailers; and furniture and other manufacturing products. In these sectors, small countries cannot expect demand to increase as predictably as large countries, with the rise in their incomes. The success of these sectors in small countries is likely to depend on, *inter alia*, their level and kind of resource endowments and growth of sectoral capabilities which allow them to take advantage of foreign demand.

Table 9. Regressions for estimating demand for sectoral outputs in large and small countries (TSLS)

		C	GDPPC	GDPPC^2	WI	R^2_adj	SE	N
Food and beverages	L.C.	-65.4773	9.8617	-0.4403	0.7081	0.9486	0.5105	778
	S.C.	-60.8978	8.9148	-0.4305	0.8474	0.9404	0.4390	1634
	L.C.	0.0000	0.0000	0.0000	0.0000			
	S.C.	0.0000	0.0000	0.0000	0.0000			
Tobacco products	L.C.	-33.9717	5.1118	-0.2173	0.3909	0.8449	0.6770	658
	S.C.	-36.3414	5.7330	-0.2861	0.5073	0.8809	0.5589	1391
	L.C.	0.0000	0.0000	0.0000	0.0000			
	S.C.	0.0000	0.0000	0.0000	0.0000			
Textiles	L.C.	-69.7203	13.2819	-0.6502	0.3140	0.8272	0.7146	765
	S.C.	-136.1088	27.8858	-1.4729	0.4100	0.8091	0.8083	1477
	L.C.	0.0000	0.0000	0.0000	0.0000			
	S.C.	0.0000	0.0000	0.0000	0.0000			
Wearing apparel	L.C.	-118.9162	23.3476	-1.2243	0.4929	0.8789	0.8429	695
	S.C.	-200.5870	43.3273	-2.2406	-0.0537	0.6677	1.2178	1426
	L.C.	0.0000	0.0000	0.0000	0.0000			
	S.C.	0.0000	0.0000	0.0000	0.0000			
Wood products (excl, furniture)	L.C.	-62.6381	9.5578	-0.4981	0.8342	0.9211	0.6765	687
	S.C.	-49.8945	7.4131	-0.3489	0.6267	0.8834	0.7935	1508
	L.C.	0.0000	0.0000	0.0000	0.0000			
	S.C.	0.0000	0.0000	0.0000	0.0000			
Paper and paper products	L.C.	-26.5959	-1.9656	0.0392	1.7817	0.9306	0.6946	670
	S.C.	-109.2695	18.9354	-0.9139	0.7103	0.9082	0.7240	1435
	L.C.	0.0000	0.0000	0.0000	0.0000			
	S.C.	0.0000	0.0000	0.0000	0.0000			
Printing and publishing	L.C.	-52.1427	7.4476	-0.2724	0.4546	0.9402	0.6426	664
	S.C.	-64.5840	9.7770	-0.4067	0.5780	0.9424	0.5904	1367
	L.C.	0.0000	0.0000	0.0000	0.0000			
	S.C.	0.0000	0.0000	0.0000	0.0000			
Coke, refined petroleum products, nuclear fuel	L.C.	-92.3927	15.2926	-0.7477	0.8063	0.9633	0.4420	609
	S.C.	-102.3380	17.5888	-0.8845	0.8364	0.8571	0.7979	794
	L.C.	0.0000	0.0000	0.0000	0.0000			
	S.C.	0.0000	0.0000	0.0000	0.0000			
Chemicals and chemical products	L.C.	-82.9295	13.0402	-0.6007	0.7424	0.9618	0.4836	714
	S.C.	-120.4664	20.7873	-0.9167	0.5176	0.8591	0.8783	1403
	L.C.	0.0000	0.0000	0.0000	0.0000			
	S.C.	0.0000	0.0000	0.0000	0.0000			
Rubber and plastic products	L.C.	-55.6281	7.4036	-0.2947	0.6830	0.9444	0.5535	679
	S.C.	-92.1530	15.6783	-0.8438	0.9729	0.9240	0.6722	1254
	L.C.	0.0000	0.0000	0.0000	0.0000			
	S.C.	0.0000	0.0000	0.0000	0.0000			
Non-metallic mineral products	L.C.	-81.7196	13.8237	-0.6482	0.5863	0.9478	0.5529	731
	S.C.	-116.4149	21.4796	-1.0727	0.6103	0.9304	0.5173	1279
	L.C.	0.0000	0.0000	0.0000	0.0000			
	S.C.	0.0000	0.0000	0.0000	0.0000			
Basic metals	L.C.	-108.7839	20.5280	-0.9568	0.2571	0.9320	0.6029	611
	S.C.	-132.1597	24.0104	-1.2053	0.7231	0.8995	0.7330	1052
	L.C.	0.0000	0.0000	0.0000	0.0000			
	S.C.	0.0000	0.0000	0.0000	0.0000			
Fabricated metal products	L.C.	-73.3109	12.0978	-0.4866	0.3287	0.9395	0.6455	674
	S.C.	-78.8321	12.9580	-0.5600	0.4990	0.8951	0.7635	1321
	L.C.	0.0000	0.0000	0.0000	0.0000			
	S.C.	0.0000	0.0000	0.0000	0.0000			
Machinery and equipment n.e.c.	L.C.	-67.3179	7.6291	-0.2932	1.0115	0.9132	0.8952	706
	S.C.	-110.7064	19.3552	-0.8434	0.3464	0.9195	0.8806	1247
	L.C.	0.0000	0.0000	0.0000	0.0000			
	S.C.	0.0000	0.0000	0.0000	0.0000			
Electrical machinery and apparatus	L.C.	-125.2898	22.3001	-1.0623	0.6143	0.8985	0.8917	714
	S.C.	-182.8202	34.6360	-1.6542	0.4152	0.8694	1.0278	1272
	L.C.	0.0000	0.0000	0.0000	0.0000			
	S.C.	0.0000	0.0000	0.0000	0.0000			
Medical, precision and optical instruments	L.C.	-95.1326	15.1322	-0.6614	0.5970	0.9554	0.7182	623
	S.C.	-28.5842	-0.2417	0.1771	0.7100	0.9291	0.8216	879
	L.C.	0.0000	0.0000	0.0000	0.0000			
	S.C.	0.0000	0.0000	0.0000	0.0000			
Motor vehicles, trailers, semi-trailers	L.C.	-96.2442	15.9194	-0.7089	0.5991	0.8948	0.9781	724
	S.C.	-178.4312	35.6998	-1.8428	0.4480	0.8277	1.1128	1195
	L.C.	0.0000	0.0000	0.0000	0.0000			
	S.C.	0.0000	0.0000	0.0000	0.0000			
Fumiture; manufacturing n.e.c.	L.C.	-67.0248	10.8065	-0.4914	0.5243	0.9426	0.6704	634
	S.C.	-46.5209	6.9461	-0.2586	0.3504	0.8655	0.8009	1104
	L.C.	0.0000	0.0000	0.0000	0.0000			
	S.C.	0.0000	0.0000	0.0000	0.0000			

Source: UNIDO calculations, 2009.

Table 10. Regressions for estimating the demand for sectoral outputs without country dummies in large and small countries (TSLS)

		C	GDPPC	GDPPC^2	WI	R^2_adj	SE	N
Food and beverages	L.C.	-38.7731	3.6295	-0.1055	0.7813	0.8884	0.7526	778
	S.C.	-24.4771	1.2977	-0.0011	0.7246	0.8391	0.7214	1634
	L.C.	0.0000	0.0000	0.0013	0.0000			
	S.C.	0.0000	0.0000	0.9497	0.0000			
Tobacco products	L.C.	-28.7159	4.1010	-0.1597	0.3508	0.7730	0.8191	658
	S.C.	-21.7851	2.4041	-0.0755	0.4271	0.6694	0.9313	1391
	L.C.	0.0000	0.0000	0.0001	0.0000			
	S.C.	0.0000	0.0000	0.0053	0.0000			
Textiles	L.C.	-21.6003	2.4129	-0.0630	0.3722	0.6997	0.9422	765
	S.C.	-0.3481	-2.4250	0.2075	0.3661	0.5405	1.2541	1477
	L.C.	0.0000	0.0007	0.1241	0.0000			
	S.C.	0.8905	0.0000	0.0000	0.0000			
Wearing apparel	L.C.	-59.5451	9.8584	-0.4418	0.4152	0.7738	1.1520	695
	S.C.	-21.3006	2.9532	-0.0847	0.2203	0.6038	1.3297	1426
	L.C.	0.0000	0.0000	0.0000	0.0000			
	S.C.	0.0000	0.0000	0.0174	0.0000			
Wood products (excl. furniture)	L.C.	-36.1367	4.1993	-0.1083	0.4155	0.8104	1.0489	687
	S.C.	-3.0778	-2.8484	0.2663	0.4248	0.6510	1.3730	1508
	L.C.	0.0000	0.0000	0.0496	0.0000			
	S.C.	0.2765	0.0000	0.0000	0.0000			
Paper and paper products	L.C.	-6.1299	-6.1541	0.3611	1.4220	0.3370	2.1467	670
	S.C.	-23.2605	0.2655	0.0917	0.6854	0.8108	1.0393	1435
	L.C.	0.5966	0.0211	0.0174	0.0000			
	S.C.	0.0000	0.5820	0.0011	0.0000			
Printing and publishing	L.C.	-32.4713	3.1883	-0.0430	0.4493	0.8653	0.9648	664
	S.C.	-7.4546	-2.7797	0.2788	0.5600	0.8877	0.8241	1367
	L.C.	0.0000	0.0005	0.4076	0.0000			
	S.C.	0.0000	0.0000	0.0000	0.0000			
Coke, refined petroleum products, nuclear fuel	L.C.	-35.2139	2.8801	-0.0548	0.7206	0.8287	0.9550	609
	S.C.	-43.4598	4.4699	-0.1818	0.9079	0.6482	1.2520	794
	L.C.	0.0000	0.0025	0.3083	0.0000			
	S.C.	0.0000	0.0002	0.0080	0.0000			
Chemicals and chemical products	L.C.	-42.9396	3.9655	-0.1116	0.8056	0.9071	0.7538	714
	S.C.	-8.3897	-3.9646	0.3183	0.8639	0.8183	0.9975	1403
	L.C.	0.0000	0.0000	0.0029	0.0000			
	S.C.	0.0001	0.0000	0.0000	0.0000			
Rubber and plastic products	L.C.	-34.0599	2.6122	-0.0377	0.7046	0.9057	0.7207	679
	S.C.	-31.9803	2.3863	-0.0385	0.7034	0.8493	0.9464	1254
	L.C.	0.0000	0.0001	0.3248	0.0000			
	S.C.	0.0000	0.0000	0.1484	0.0000			
Non-metallic mineral products	L.C.	-56.3942	8.0305	-0.3387	0.6463	0.9060	0.7420	731
	S.C.	-20.0585	0.4895	0.0700	0.5708	0.8397	0.7849	1279
	L.C.	0.0000	0.0000	0.0000	0.0000			
	S.C.	0.0000	0.3641	0.0228	0.0000			
Basic metals	L.C.	-48.8744	5.8977	-0.2188	0.7066	0.8521	0.8896	611
	S.C.	-26.1283	1.4512	0.0325	0.5588	0.6934	1.2802	1052
	L.C.	0.0000	0.0000	0.0000	0.0000			
	S.C.	0.0000	0.1752	0.5890	0.0000			
Fabricated metal products	L.C.	-37.8877	3.7683	-0.0748	0.5659	0.8731	0.9347	674
	S.C.	8.5952	-6.2347	0.4657	0.5406	0.8032	1.0458	1321
	L.C.	0.0000	0.0000	0.1339	0.0000			
	S.C.	0.0003	0.0000	0.0000	0.0000			
Machinery and equipment n.e.c.	L.C.	-34.3231	-0.1510	0.1449	1.0578	0.8285	1.2584	706
	S.C.	16.3209	-8.6899	0.6536	0.4454	0.7995	1.3902	1247
	L.C.	0.0000	0.8905	0.0209	0.0000			
	S.C.	0.0000	0.0000	0.0000	0.0000			
Electrical machinery and apparatus	L.C.	-23.0492	-0.9734	0.1809	0.8190	0.8137	1.2079	714
	S.C.	-17.4467	-2.2690	0.2563	0.8024	0.7674	1.3720	1272
	L.C.	0.0000	0.2983	0.0008	0.0000			
	S.C.	0.0000	0.0016	0.0000	0.0000			
Medical, precision and optical instruments	L.C.	-34.4008	1.0639	0.1112	0.7061	0.8770	1.1933	623
	S.C.	-34.9501	0.8818	0.1162	0.7599	0.8327	1.2623	879
	L.C.	0.0000	0.3619	0.0935	0.0000			
	S.C.	0.0000	0.5672	0.1778	0.0000			
Motor vehicles, trailers, semi-trailers	L.C.	-21.4749	-1.1974	0.2110	0.7449	0.8245	1.2636	724
	S.C.	16.5078	-7.2405	0.5366	0.3178	0.6030	1.6894	1195
	L.C.	0.0000	0.2143	0.0002	0.0000			
	S.C.	0.0001	0.0000	0.0000	0.0000			
Furniture; manufacturing n.e.c.	L.C.	-47.9550	6.5367	-0.2222	0.4169	0.8896	0.9294	634
	S.C.	11.8980	-5.6696	0.4253	0.3104	0.6877	1.2203	1104
	L.C.	0.0000	0.0000	0.0000	0.0000			
	S.C.	0.0000	0.0000	0.0000	0.0000			

Source: UNIDO calculations, 2009.

Table 11. Regressions for estimating the demands for sectoral outputs with both country and period dummies in large and small countries (TSLS)

		C	GDPPC	GDPPC^2	WI	R^2_adj	SE	N
Food and beverages	L.C.	876.3937	10.5339	-0.4678	-36.5489	0.9492	0.5076	778
	S.C.	194.4426	10.3751	-0.4964	-9.5381	0.9373	0.4501	1634
	L.C.	0.0000	0.0000	0.0000	0.0000			
	S.C.	0.0731	0.0000	0.0000	0.0280			
Tobacco products	L.C.	190.2027	4.5251	-0.1432	-9.9182	0.8524	0.6605	658
	S.C.	-4.9822	4.8653	-0.2297	-0.8033	0.8916	0.5332	1391
	L.C.	0.2704	0.0000	0.0211	0.2136			
	S.C.	0.9298	0.0019	0.0053	0.7611			
Textiles	L.C.	112.5623	11.8904	-0.5576	-6.8349	0.8495	0.6670	765
	S.C.	-383.3024	21.2542	-1.1038	11.5826	0.8516	0.7127	1477
	L.C.	0.0281	0.0000	0.0000	0.0013			
	S.C.	0.1849	0.0000	0.0000	0.3198			
Wearing apparel	L.C.	296.2640	21.5695	-1.0961	-16.2354	0.8986	0.7713	695
	S.C.	1002.5400	73.7881	-3.7427	-55.6043	0.2430	1.8380	1426
	L.C.	0.1261	0.0000	0.0000	0.0408			
	S.C.	0.0510	0.0000	0.0000	0.0099			
Wood products (excl. furniture)	L.C.	284.1692	9.3018	-0.4802	-13.6995	0.9224	0.6707	687
	S.C.	-137.1066	-5.4807	0.3246	6.8485	0.8811	0.8012	1508
	L.C.	0.0462	0.0000	0.0000	0.0234			
	S.C.	0.6107	0.0251	0.0108	0.5500			
Paper and paper products	L.C.	39.8087	-2.2646	0.0515	-0.8792	0.9290	0.7022	670
	S.C.	56.6659	28.2543	-1.3994	-7.9437	0.8645	0.8795	1435
	L.C.	0.5994	0.1455	0.5720	0.7736			
	S.C.	0.0089	0.0000	0.0000	0.0000			
Printing and publishing	L.C.	2789.5350	10.0719	-0.4016	-122.9419	0.9382	0.6531	664
	S.C.	-50.1690	7.9087	-0.3016	0.3074	0.9460	0.5711	1367
	L.C.	0.0000	0.0000	0.0000	0.0000			
	S.C.	0.0011	0.0000	0.0000	0.6041			
Coke, refined petroleum products, nuclear fuel	L.C.	-119.0619	14.0944	-0.6593	2.0312	0.9658	0.4262	609
	S.C.	330.9968	18.7234	-0.9515	-17.0663	0.8588	0.7931	794
	L.C.	0.0016	0.0000	0.0000	0.1767			
	S.C.	0.3005	0.0000	0.0000	0.1939			
Chemicals and chemical products	L.C.	-115.0471	13.6090	-0.5916	1.7699	0.9616	0.4843	714
	S.C.	841.3575	26.7126	-1.2062	-38.2350	0.8206	0.9911	1403
	L.C.	0.0863	0.0000	0.0000	0.4966			
	S.C.	0.0000	0.0000	0.0000	0.0000			
Rubber and plastic products	L.C.	350.9314	7.1322	-0.2765	-16.1632	0.9483	0.5335	679
	S.C.	-116.8105	14.1356	-0.7517	2.2660	0.9280	0.6542	1254
	L.C.	0.1116	0.0000	0.0000	0.0798			
	S.C.	0.0010	0.0000	0.0000	0.1057			
Non-metallic mineral products	L.C.	-31.2103	13.8990	-0.6171	-1.6652	0.9460	0.5620	731
	S.C.	-80.2726	19.1192	-0.9477	-0.4456	0.9340	0.5033	1279
	L.C.	0.3191	0.0000	0.0000	0.2062			
	S.C.	0.0000	0.0000	0.0000	0.4013			
Basic metals	L.C.	-41.7705	18.5629	-0.8215	-2.1237	0.9388	0.5719	611
	S.C.	64.9013	25.3004	-1.2611	-7.3379	0.8971	0.7416	1052
	L.C.	0.5237	0.0000	0.0000	0.4108			
	S.C.	0.1788	0.0000	0.0000	0.0002			
Fabricated metal products	L.C.	-182.6995	13.0269	-0.4923	4.5014	0.9377	0.6547	674
	S.C.	-85.8192	9.9417	-0.3840	1.3121	0.9002	0.7446	1321
	L.C.	0.0040	0.0000	0.0000	0.0790			
	S.C.	0.0145	0.0000	0.0000	0.3443			
Machinery and equipment n.e.c.	L.C.	794.5440	25.7480	-1.2382	-35.7717	0.8788	1.0574	706
	S.C.	315.9136	25.9147	-1.1720	-17.5175	0.9105	0.9285	1247
	L.C.	0.0058	0.0000	0.0000	0.0016			
	S.C.	0.2385	0.0000	0.0000	0.0965			
Electrical machinery and apparatus	L.C.	528.4549	21.9463	-1.0426	-25.4529	0.9147	0.8169	714
	S.C.	-336.9428	30.0741	-1.3925	7.3929	0.8860	0.9605	1272
	L.C.	0.0006	0.0000	0.0000	0.0000			
	S.C.	0.0059	0.0000	0.0000	0.1272			
Medical, precision and optical instruments	L.C.	1543.5990	18.7288	-0.8524	-67.2551	0.9559	0.7143	623
	S.C.	-3.0901	-0.8325	0.2094	-0.2243	0.9295	0.8192	879
	L.C.	0.0000	0.0000	0.0000	0.0000			
	S.C.	0.9894	0.6683	0.0443	0.9812			
Motor vehicles, trailers, semi-trailers	L.C.	531.5960	15.8611	-0.6902	-23.7597	0.8958	0.9733	724
	S.C.	-12.5237	38.5615	-1.9336	-6.7219	0.8183	1.1428	1195
	L.C.	0.0243	0.0000	0.0000	0.0099			
	S.C.	0.9505	0.0000	0.0000	0.3937			
Furniture; manufacturing n.e.c.	L.C.	-323.7383	11.0232	-0.4983	10.9954	0.9415	0.6763	634
	S.C.	-50.2632	-5.3544	0.4314	2.7314	0.8584	0.8214	1104
	L.C.	0.0088	0.0000	0.0000	0.0284			
	S.C.	0.8604	0.0403	0.0022	0.8171			

Source: UNIDO calculations, 2009.

6.2. Supply side

The relationship between income level and output supply is diverse due to the high influence of country-specific characteristics, as seen in figure 3. Thus, placing graphs on top of each other, as shown in figure 4, does not provide very meaningful information. Here instead, supply-side variables are assessed from tables to determine their influence on sectoral outputs. Table 12 presents supply-side results for large and small countries. Equation (B) for the supply side explains better the output levels of large countries than small countries for all sectors, except for tobacco products. However, for sectors indicated in bold font, the variables in the equation as a whole have a much lower explanatory power for small countries relative to large countries. The results seem to suggest that development of these sectors in small countries would be more unpredictable than that in large countries. This is due to factors inherent in small-sized countries, such as higher uncertainties, than in large-sized countries, in terms of their endowments in natural resources and the level of demand for production growth. In the case of small countries, the latter depends more on their successful integration in the international trading system.

The difference between the adjusted R squares in table 13, based on regressions excluding country dummies, and table 12 provides some idea of the extent to which country-specific factors are likely to account for changes in output levels. In addition to the weaker explanatory power of the equation for most sectors in small countries, as explained above, country-specific conditions have a much greater influence on small countries for the development of sectors such as food and beverages; tobacco; textiles; coke, refined petroleum, nuclear fuel; motor vehicles and trailers; furniture and other manufacturing products. The development paths of these sectors tend to vary enormously even within a group of small countries, depending on their country-specific characteristics.

The regression results in table 12 further show that the output levels of small countries are more sensitive to unit labour costs. This may be due to the fact that small countries not only need to be more open than large countries to industrialization, but also need to ensure that their costs are internationally competitive. The effects of population density (*PD*) is greater for small countries, indicating that being both small and resource scarce is a stronger reason for inducing industrialization. Finally, according to the signs and size of coefficients of *GDPPC*^2, small countries are likely to experience a sharper slowdown, and could also decline in a large number of sectors, as their income levels increase. Specifically, those sectors indicated by an asterisk show such trend vividly in contrast to the patterns of large countries.

Table 12. Regressions for estimating the sectoral supplies in large and small countries (TSLS)

		C	GDPPC	GDPPC^2	ULC	P	PD	R^2_adj	SE	N
Food and beverages	L.C.	1924.8860	9.9761	-0.3814	0.4627	-144.7350	146.5049	0.9325	0.5852	778
	S.C.	268.0163	8.1870	-0.3013	-0.1518	-28.0583	30.0388	0.9083	0.5445	1634
	L.C.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000			
	S.C.	0.0258	0.0000	0.0000	0.0066	0.0077	0.0043			
Tobacco products	L.C.	-3.6968	6.2250	-0.2055	-0.2809	-2.4694	2.7050	0.8308	0.7072	658
	S.C.	-4.1777	4.9668	-0.1712	-0.3448	-2.6386	4.2358	0.8725	0.5784	1391
	L.C.	0.9498	0.0000	0.0081	0.0000	0.5649	0.5275			
	S.C.	0.9410	0.0005	0.0254	0.0000	0.5934	0.3910			
Textiles*	L.C.	-199.6677	16.1874	-0.7644	-0.1699	8.7062	-8.3414	0.7984	0.7721	765
	S.C.	411.3083	34.5604	-1.7676	-0.5211	-49.6057	50.0398	0.7393	0.9446	1477
	L.C.	0.0458	0.0000	0.0000	0.0927	0.2289	0.2502			
	S.C.	0.0498	0.0000	0.0000	0.0000	0.0062	0.0057			
Wearing apparel*	L.C.	199.8208	20.6991	-1.0147	0.6783	-22.3169	24.1299	0.8747	0.8573	695
	S.C.	10102.7600	42.5393	-2.1674	-0.4164	-897.0694	896.7193	0.4119	1.6200	1426
	L.C.	0.2029	0.0000	0.0000	0.0000	0.0522	0.0356			
	S.C.	0.0000	0.0000	0.0000	0.0169	0.0000	0.0000			
Wood products (excl. furniture)	L.C.	-40.8319	7.8644	-0.3063	0.1950	-0.7549	2.7478	0.9043	0.7453	687
	S.C.	1471.9320	-55.9025	3.1498	-0.4895	-106.2468	108.9351	0.5467	1.5647	1508
	L.C.	0.6495	0.0000	0.0000	0.0553	0.9083	0.6748			
	S.C.	0.0000	0.0000	0.0000	0.0006	0.0000	0.0000			
Paper and paper products	L.C.	-3285.1730	-9.0271	0.6746	-0.2837	243.4109	-239.6741	0.9073	0.8024	670
	S.C.	8.3950	1.7667	-0.7625	-0.5765	-9.4171	11.1137	0.8861	0.8061	1435
	L.C.	0.0000	0.0000	0.0000	0.0233	0.0000	0.0000			
	S.C.	0.7640	0.0000	0.0000	0.0000	0.0002	0.0000			
Printing and publishing*	L.C.	-33.9586	3.6400	-0.0041	-0.4359	-0.0499	1.2322	0.9349	0.6705	664
	S.C.	-92.1326	7.8029	-0.2226	-0.5269	3.1842	-1.5214	0.9280	0.6596	1367
	L.C.	0.6647	0.0026	0.9495	0.0000	0.9930	0.8290			
	S.C.	0.0157	0.0000	0.0134	0.0000	0.2756	0.6073			
Coke, refined petroleum products, nuclear fuel	L.C.	-802.8733	10.5227	-0.4055	-0.2148	53.3745	-50.6288	0.9385	0.5720	609
	S.C.	155.4790	9.9063	-0.3670	-0.3226	-19.0321	21.7999	0.8278	0.8758	794
	L.C.	0.0014	0.0000	0.0000	0.0000	0.0032	0.0053			
	S.C.	0.3589	0.0003	0.0103	0.0000	0.1839	0.1287			
Chemicals and chemical products*	L.C.	-91.5629	6.3958	-0.1463	0.0581	2.6027	0.8864	0.9633	0.4735	714
	S.C.	-3.7953	24.5257	-1.0408	-0.5128	-11.4794	12.7024	0.8119	1.0148	1403
	L.C.	0.3365	0.0000	0.0016	0.4135	0.7077	0.8985			
	S.C.	0.9860	0.0000	0.0000	0.0000	0.5416	0.4994			
Rubber and plastic products*	L.C.	-294.5557	-0.8742	0.2468	0.3563	19.6247	-15.9447	0.9412	0.5686	679
	S.C.	133.2809	44.5703	-2.1705	-0.6771	-31.0570	31.9429	0.6958	1.3448	1254
	L.C.	0.0641	0.3895	0.0000	0.0004	0.0904	0.1686			
	S.C.	0.6868	0.0000	0.0000	0.0001	0.2755	0.2627			
Non-metallic mineral products	L.C.	41.4706	11.7958	-0.4586	0.7210	-8.3243	1.0451	0.9423	0.5809	731
	S.C.	2056.3920	-14.1618	0.9097	-0.4336	-175.7191	178.9860	0.8782	0.6840	1279
	L.C.	0.4058	0.0000	0.0000	0.0000	0.0235	0.0044			
	S.C.	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000			
Basic metals*	L.C.	345.6644	21.6310	-0.9928	0.0996	-33.3498	34.0727	0.9291	0.6158	611
	S.C.	3718.1810	31.1842	-1.4638	-0.3040	-330.0714	330.1891	0.8335	0.9431	1052
	L.C.	0.0000	0.0000	0.0000	0.2932	0.0000	0.0000			
	S.C.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000			
Fabricated metal products	L.C.	-238.2375	10.0670	-0.3385	0.5802	12.6208	-11.2130	0.9407	0.6388	674
	S.C.	-132.3693	13.4317	-0.5193	-0.6717	4.5898	-3.4456	0.8790	0.8200	1321
	L.C.	0.0027	0.0000	0.0000	0.0000	0.0257	0.0487			
	S.C.	0.0053	0.0000	0.0000	0.0000	0.0478	0.1450			
Machinery and equipment n.e.c.*	L.C.	-78.7700	-2.9158	0.3719	0.4479	4.1828	0.7838	0.9212	0.8527	706
	S.C.	-215.8054	19.2898	-0.7904	-0.5915	9.3229	-8.7258	0.9142	0.9088	1247
	L.C.	0.5619	0.0563	0.0000	0.0013	0.6761	0.9374			
	S.C.	0.0000	0.0000	0.0000	0.0000	0.0134	0.0228			
Electrical machinery and apparatus*	L.C.	176.5242	13.8906	-0.5092	0.2253	-19.3040	21.6828	0.8895	0.9298	714
	S.C.	701.0881	61.4401	-2.9941	-0.7930	-86.6937	85.6616	0.7394	1.4522	1272
	L.C.	0.2659	0.0049	0.0552	0.0956	0.1130	0.0709			
	S.C.	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001			
Medical, precision and optical instruments	L.C.	130.0006	14.2085	-0.5241	-0.0700	-16.2697	18.4819	0.9528	0.7385	623
	S.C.	635.7525	0.8854	0.2390	-0.2017	-57.6444	58.9936	0.9103	0.9240	879
	L.C.	0.2564	0.0000	0.0000	0.5517	0.0533	0.0280			
	S.C.	0.0030	0.7256	0.0699	0.0747	0.0018	0.0014			
Motor vehicles, trailers, semi-trailers*	L.C.	-43.8388	9.5260	-0.3036	-0.1803	-1.7366	4.3757	0.8963	0.9708	724
	S.C.	-79.4153	39.5863	-1.9700	-0.7566	-9.7863	10.0661	0.8098	1.1692	1195
	L.C.	0.7041	0.0000	0.0017	0.0533	0.8359	0.6023			
	S.C.	0.6802	0.0000	0.0000	0.0000	0.5553	0.5438			
Furniture; manufacturing n.e.c.*	L.C.	-33.3114	4.8124	-0.1013	0.3576	-0.8129	3.7592	0.9398	0.6859	634
	S.C.	-50.8000	10.9865	-0.4039	-1.0296	-1.1413	1.3937	0.8688	0.7907	1104
	L.C.	0.7660	0.0002	0.1409	0.0078	0.9215	0.6482			
	S.C.	0.1711	0.0000	0.0003	0.0000	0.7134	0.6547			

Note: Sectors in bold fonts indicate that the difference in the adjusted R squares between large and small countries is 0.1 or higher. Sectors indicated with an asterisk are those in which small countries tend to experience a much sharper slowdown in their development patterns relative to large countries.

Source: UNIDO calculations, 2009.

Unlike most earlier studies, which examined changes in the sector shares of GDP, this study estimates changes in sector output per capita as income levels increase. Therefore, the results cannot be compared. However, given the growth patterns identified here, it is not so difficult to interpret them in light of earlier studies, leading to the conclusion that the results do not seem to fully support the findings of earlier studies. The patterns presented in earlier studies (Chenery and Syrquin, 1975; Chenery and Taylor, 1968, Syrquin, 1988) may be applicable to some sectors, such as wearing apparel; chemicals; machinery and equipment; and electrical machinery where output per capita of large countries was bigger than that of small countries during the early stages of development and declined before that of small countries as income levels increased. However, large countries seem to have experienced a more sustained growth in textiles; basic metals; and motor vehicle sectors than small countries. Even those sectors that largely followed the pattern of earlier studies, the findings of panel data regressions presented here suggest that there is a high degree of uncertainty with regard to the actual paths of sector development, especially for small countries, due to the substantial influence of country-specific characteristics.

Table 13. Regressions for estimating sectoral supplies without country dummies in large and small countries (TSLS)

		C	GDPPC	GDPPC^2	ULC	P	PD	R^2_adj	SE	N
Food and beverages	L.C.	-39.0359	6.5784	-0.2539	-0.4068	0.3004	-0.0336	0.7967	1.0155	778
	S.C.	-5.0647	0.2602	0.0752	-0.0018	0.1368	-0.0016	0.7055	0.9758	1634
	L.C.	0.0000	0.0000	0.0000	0.0000	0.0000	0.2791			
	S.C.	0.0083	0.5430	0.0029	0.9784	0.0000	0.9250			
Tobacco products	L.C.	-38.7665	7.1962	-0.3218	-0.2048	0.1323	0.0953	0.7220	0.9065	658
	S.C.	-10.0743	1.0160	0.0139	-0.3022	0.0893	0.2034	0.6070	1.0155	1391
	L.C.	0.0000	0.0000	0.0000	0.0000	0.0044	0.0013			
	S.C.	0.0000	0.0545	0.6565	0.0000	0.0039	0.0000			
Textiles	L.C.	-25.1257	4.4340	-0.1663	-0.2234	0.1071	0.2234	0.6788	0.9745	765
	S.C.									
	L.C.	0.0000	0.0000	0.0004	0.0102	0.0253	0.0000			
	S.C.									
Wearing apparel	L.C.	-86.1790	16.4286	-0.8028	0.5438	0.3863	0.1716	0.7604	1.1857	695
	S.C.									
	L.C.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000			
	S.C.									
Wood products (excl. furniture)	L.C.	-45.8877	7.7235	-0.2948	-0.0267	0.1126	0.2718	0.8034	1.0679	687
	S.C.	9.7186	-4.2675	0.3669	-0.4635	0.1603	-0.2395	0.6504	1.3741	1508
	L.C.	0.0000	0.0000	0.0000	0.8054	0.0499	0.0000			
	S.C.	0.0008	0.0000	0.0000	0.0000	0.0000	0.0000			
Paper and paper products	L.C.	12.2486	-1.1305	0.1378	1.0975	-0.4202	-0.3780	0.1230	2.4690	670
	S.C.	-1.2460	-0.3510	0.1580	-0.7929	0.3795	-0.1534	0.7719	1.1412	1435
	L.C.	0.4277	0.7359	0.4696	0.0000	0.0018	0.0000			
	S.C.	0.0000	0.5185	0.0000	0.0000	0.0000	0.0000			
Printing and publishing	L.C.	-38.4324	5.8396	-0.1787	-0.1819	0.1814	0.0435	0.8261	1.0962	664
	S.C.	11.2516	-4.7029	0.4116	-1.0020	0.0075	-0.0482	0.8241	1.0315	1367
	L.C.	0.0000	0.0000	0.0188	0.0801	0.0024	0.2178			
	S.C.	0.0000	0.0000	0.0000	0.0000	0.8179	0.0138			
Coke, refined petroleum products, nuclear fuel	L.C.	-20.3963	2.4235	-0.0013	-0.4839	0.0786	0.0796	0.7488	1.1564	609
	S.C.	18.3738	-5.2640	0.3911	-0.4460	-0.0694	0.3655	0.4927	1.5034	794
	L.C.	0.0038	0.0970	0.9875	0.0000	0.2257	0.0394			
	S.C.	0.0082	0.0005	0.0000	0.0000	0.3782	0.0000			
Chemicals and chemical products	L.C.	-69.3485	11.5924	-0.5184	-0.2414	0.5986	0.1449	0.7993	1.1080	714
	S.C.	4.3914	-4.2205	0.3578	-0.2432	0.5012	0.1174	0.6688	1.3467	1403
	L.C.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000			
	S.C.	0.1361	0.0000	0.0000	0.0000	0.0000	0.0000			
Rubber and plastic products	L.C.	-55.3974	8.8484	-0.3573	-0.6172	0.3751	0.2368	0.7819	1.0960	679
	S.C.	-12.8322	0.3428	0.1088	-0.6937	0.1813	0.1597	0.7137	1.3046	1254
	L.C.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000			
	S.C.	0.0000	0.5927	0.0037	0.0000	0.0000	0.0000			
Non-metallic mineral products	L.C.	-74.1208	13.6733	-0.6392	-0.0780	0.3453	0.1613	0.8370	0.9770	731
	S.C.	-2.7745	-1.5296	0.2023	-0.0930	0.2254	0.0178	0.7460	0.9880	1279
	L.C.	0.0000	0.0000	0.0000	0.4413	0.0000	0.0000			
	S.C.	0.3662	0.0264	0.0000	0.2864	0.0000	0.3478			
Basic metals	L.C.	-99.4560	18.1689	-0.8952	0.4431	0.7567	0.0561	0.8325	0.9466	611
	S.C.	-10.6259	-1.2381	0.2147	-0.3875	0.5360	-0.2232	0.7128	1.2390	1052
	L.C.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0688			
	S.C.	0.0203	0.2346	0.0003	0.0000	0.0000	0.0000			
Fabricated metal products	L.C.	-75.7787	13.1972	-0.5944	0.6337	0.5346	0.0690	0.8447	1.0338	674
	S.C.	19.0423	-7.3683	0.5546	-0.6707	0.3181	0.0406	0.7656	1.1414	1321
	L.C.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0383			
	S.C.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0655			
Machinery and equipment n.e.c.	L.C.	-82.6502	12.9649	-0.5678	0.5184	0.8329	0.3216	0.7614	1.4840	706
	S.C.	20.5629	-9.2873	0.7100	-0.5755	0.4890	-0.0039	0.7981	1.3950	1247
	L.C.	0.0000	0.0000	0.0000	0.0025	0.0000	0.0000			
	S.C.	0.0000	0.0000	0.0000	0.0000	0.0000	0.8877			
Electrical machinery and apparatus	L.C.	-21.5296	1.5621	0.0619	-0.3635	0.2807	0.1315	0.7235	1.4713	714
	S.C.	-12.9070	-1.9952	0.2678	-0.4680	0.7070	0.1842	0.7152	1.5182	1272
	L.C.	0.0004	0.2186	0.3975	0.0121	0.0002	0.0040			
	S.C.	0.0006	0.0154	0.0000	0.0000	0.0000	0.0000			
Medical, precision and optical instruments	L.C.	-83.3600	12.3863	-0.5003	-0.0210	0.7487	0.2007	0.8426	1.3499	623
	S.C.	33.7197	-12.1303	0.8699	-0.9655	0.2344	0.2412	0.7614	1.5077	879
	L.C.	0.0000	0.0000	0.0000	0.8860	0.0000	0.0000			
	S.C.	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000			
Motor vehicles, trailers, semi-trailers	L.C.	-27.5344	2.3020	0.0327	-0.3269	0.4542	-0.0054	0.7641	1.4648	724
	S.C.	15.1807	-7.0029	0.5405	-0.5206	0.4346	-0.0188	0.6158	1.6619	1195
	L.C.	0.0000	0.0672	0.6513	0.0009	0.0000	0.9050			
	S.C.	0.0006	0.0000	0.0000	0.0000	0.0000	0.5811			
Furniture; manufacturing n.e.c.	L.C.	-56.2254	9.6449	-0.3813	-0.0563	0.1382	0.2270	0.8629	1.0359	634
	S.C.	31.7501	-8.6148	0.6067	-0.9488	-0.1044	0.0725	0.6762	1.2425	1104
	L.C.	0.0000	0.0000	0.0000	0.6850	0.0239	0.0000			
	S.C.	0.0000	0.0000	0.0000	0.0000	0.0145	0.0070			

Source: UNIDO calculations, 2009.

Table 14. Regressions for estimating sectoral supplies with both country and period dummies in large and small countries (TSLS)

		C	GDPPC	GDPPC^2	ULC	P	PD	R^2_adj	SE	N
Food and beverages	L.C.	163.2314	8.9202	-0.3790	0.3010	-15.1275	15.2724	0.9529	0.4886	778
	S.C.	79.0247	4.1684	-0.1487	-0.0845	-9.0270	9.9717	0.9448	0.4222	1634
	L.C.	0.0414	0.0000	0.0000	0.0001	0.0109	0.0091			
	S.C.	0.2768	0.0031	0.0465	0.0584	0.1626	0.1228			
Tobacco products	L.C.	-107.1097	12.1264	-0.6246	-0.3350	4.8454	-8.4281	0.8661	0.6291	658
	S.C.	39.4621	-4.4921	0.3409	-0.3579	-2.7311	4.4270	0.9031	0.5040	1391
	L.C.	0.0704	0.0000	0.0000	0.0000	0.2524	0.0527			
	S.C.	0.7806	0.7285	0.6332	0.0000	0.7399	0.6221			
Textiles	L.C.	322.1644	10.7033	-0.4770	-0.2656	-27.6451	28.6291	0.8518	0.6618	765
	S.C.	-664.9782	81.9057	-4.3316	-0.6050	25.8256	-28.7126	-0.0224	1.8707	1477
	L.C.	0.0162	0.0003	0.0066	0.0037	0.0073	0.0034			
	S.C.	0.3898	0.1753	0.1896	0.0026	0.5898	0.5775			
Wearing apparel	L.C.	183.6541	18.9189	-0.8424	0.6944	-21.2236	23.8027	0.8942	0.7878	695
	S.C.	-39.6730	63.2109	-3.1898	-0.2661	-22.9845	23.2986	0.4126	1.6190	1426
	L.C.	0.2578	0.0000	0.0000	0.0000	0.0749	0.0446			
	S.C.	0.8581	0.0453	0.0591	0.2119	0.1765	0.1680			
Wood products (excl. furniture)	L.C.	-6.6306	10.1385	-0.5364	0.1353	-2.5871	1.9951	0.9225	0.6705	687
	S.C.	365.5959	10.5814	-0.5540	-0.3454	-34.7841	32.6678	0.8944	0.7552	1508
	L.C.	0.9204	0.0000	0.0000	0.1601	0.5957	0.6804			
	S.C.	0.0011	0.0008	0.0010	0.0000	0.0003	0.0007			
Paper and paper products	L.C.	45.2067	-2.8103	0.0764	-0.4916	-1.7764	1.6766	0.9296	0.6991	670
	S.C.	99.9332	35.1193	-1.7307	-0.5307	-23.3122	22.7170	0.8131	1.0328	1435
	L.C.	0.5424	0.1014	0.4568	0.0000	0.7434	0.7583			
	S.C.	0.5256	0.0000	0.0000	0.0000	0.0920	0.1002			
Printing and publishing	L.C.	65.0780	11.6711	-0.5317	-0.4029	-8.1625	5.3764	0.9454	0.6138	664
	S.C.	-156.7198	13.6094	-0.5994	-0.4497	7.5805	-7.9197	0.9348	0.6276	1367
	L.C.	0.4056	0.0000	0.0000	0.0000	0.1571	0.3481			
	S.C.	0.0560	0.0000	0.0001	0.0000	0.2616	0.2452			
Coke, refined petroleum products, nuclear fuel	L.C.	-103.7527	7.8403	-0.2861	-0.1586	3.6903	-1.4270	0.9704	0.3966	609
	S.C.	120.0830	3.9344	-0.1369	-0.3888	-12.8607	15.1973	0.8818	0.7255	794
	L.C.	0.0726	0.0000	0.0000	0.0000	0.3743	0.7355			
	S.C.	0.5435	0.1109	0.3024	0.0000	0.4438	0.3671			
Chemicals and chemical products	L.C.	-25.8416	0.5888	0.2185	-0.0881	-1.0648	6.1642	0.9693	0.4327	714
	S.C.	149.3281	2.1321	0.1154	-0.5453	-15.8583	17.9773	0.9165	0.6760	1403
	L.C.	0.6232	0.5883	0.0010	0.2047	0.7840	0.1097			
	S.C.	0.0212	0.3904	0.3835	0.0000	0.0103	0.0033			
Rubber and plastic products	L.C.	-69.6597	1.5635	0.1525	0.3320	2.3799	1.0118	0.9410	0.5698	679
	S.C.	-297.9624	36.9711	-1.9245	-0.2637	11.3483	-12.4531	0.8359	0.9876	1254
	L.C.	0.4311	0.3022	0.0962	0.0017	0.7040	0.8754			
	S.C.	0.1699	0.0000	0.0000	0.0410	0.5373	0.5009			
Non-metallic mineral products	L.C.	-15.0636	6.8528	-0.1553	0.5353	-3.1880	6.6098	0.9483	0.5500	731
	S.C.	-23.8261	14.8255	-0.7010	-0.3756	-4.6482	5.7136	0.9404	0.4784	1279
	L.C.	0.6521	0.0000	0.0581	0.0000	0.1921	0.0075			
	S.C.	0.2611	0.0000	0.0000	0.0000	0.0114	0.0020			
Basic metals	L.C.	-48.3546	11.4999	-0.3671	0.0658	-2.6187	6.2114	0.9441	0.5466	611
	S.C.	-59.7950	26.9772	-1.3425	-0.3487	-5.7001	4.9437	0.9002	0.7303	1052
	L.C.	0.5292	0.0000	0.0000	0.4739	0.6396	0.2701			
	S.C.	0.0366	0.0000	0.0000	0.0000	0.0194	0.0427			
Fabricated metal products	L.C.	-19.0439	8.8634	-0.1993	0.5717	-3.7109	6.3714	0.9382	0.6519	674
	S.C.	-278.7535	3.8645	-0.0224	-0.6568	21.0429	-19.6448	0.9072	0.7181	1321
	L.C.	0.7620	0.1335	0.5696	0.0001	0.4448	0.1660			
	S.C.	0.0253	0.0731	0.8485	0.0000	0.0430	0.0606			
Machinery and equipment n.e.c.	L.C.	-48.0272	-14.0906	1.1264	0.4765	3.5161	5.5873	0.9352	0.7729	706
	S.C.	15.2557	6.9351	-0.1220	-0.5910	-6.0168	7.1661	0.9290	0.8269	1247
	L.C.	0.8228	0.0000	0.0000	0.0003	0.8224	0.7216			
	S.C.	0.9312	0.0929	0.5844	0.0000	0.6812	0.6281			
Electrical machinery and apparatus	L.C.	87.9924	11.4087	-0.3893	0.1070	-12.4046	16.1700	0.9247	0.7676	714
	S.C.	1405.3690	25.2957	-1.1007	-0.6249	-133.5511	134.1824	0.8923	0.9333	1272
	L.C.	0.2931	0.0000	0.0024	0.3316	0.0455	0.0085			
	S.C.	0.0002	0.0000	0.0000	0.0000	0.0001	0.0001			
Medical, precision and optical instruments	L.C.	92.2050	8.4725	-0.2505	-0.1144	-11.4679	13.9490	0.9591	0.6879	623
	S.C.	143.1050	5.7416	-0.1445	-0.1379	-15.2109	13.7393	0.9307	0.8123	879
	L.C.	0.2254	0.0000	0.0229	0.3119	0.0437	0.0125			
	S.C.	0.4763	0.0230	0.2872	0.1771	0.3773	0.4266			
Motor vehicles, trailers, semi-trailers	L.C.	-5.6076	0.8620	0.2364	-0.4146	-2.8134	7.8628	0.9115	0.8971	724
	S.C.	-259.9319	20.7699	-0.9770	-0.7633	13.0525	-12	0.8535	1.0259	1195
	L.C.	0.9673	0.7156	0.0972	0.0000	0.7809	0.4319			
	S.C.	0.2081	0.0000	0.0002	0.0000	0.4574	0.4996			
Furniture; manufacturing n.e.c.	L.C.	135.1411	16.3200	-0.7553	0.3162	-15.6443	14.9878	0.9364	0.7051	634
	S.C.	405.8446	14.7615	-0.6502	-0.9618	-41.2796	39.9487	0.8839	0.7437	1104
	L.C.	0.4648	0.0000	0.0000	0.0288	0.2520	0.2675			
	S.C.	0.1560	0.1753	0.2863	0.0000	0.0642	0.0816			

Source: UNIDO calculations, 2009.

7. Policy implications

This study examined the development patterns of 18 manufacturing sectors over 42 years—from 1963 to 2004—using the panel data approach. The findings presented here could lead to some useful policy decisions.

The results reveal that changes in demand for sector outputs are much more predictable than changes in supply—as a function of income levels. Therefore, first of all, policy makers can undertake a thorough study of the patterns of demand, which reflect the reality much better than earlier studies that were based largely on cross-section data, or combinations of such data and relatively short periods of time-series data. With a good understanding of how demand for different sectors is likely to change as a country develops, developing countries will be able to plan the course of their industrial development, prepare hard and soft (for example, institutional) infrastructure, train necessary human resources, and estimate energy requirements.

For example, the first sectors to emerge, when the process of industrialization is initiated in countries moving from a largely agrarian economy, are generally the food and beverages; and tobacco sectors. Small countries are more likely to experience the emergence of these sectors at a lower level of per capita income than large countries. Although, demand for tobacco would increase gradually, it will not increase much after countries reach a PPP adjusted per capita income level of around $8,000. In contrast, demand for the food and beverages sector would grow faster, and per capita demand for the sector could rise to as much as $3,000, while the maximum level of that for tobacco would be $70. Although largely following these patterns, as seen in figure 4, the wideness of the scatter graphs for the tobacco; and food and beverages sectors indicate relatively large differences in the development path of countries. Given these results, conscious efforts should be made by governments to upgrade infrastructure and institutional and human resources if they are to reach the upper end of the scatter graphs, which means higher output per capita, at respective income levels, as countries develop.

Following the growth of the initial sectors, if countries manage to increase the income levels, they are likely to witness growth in demand for labour-intensive and/or natural resource-based sectors, such as textiles; wood; rubber and plastic products. As indicated by the sparse, wide scatter graphs in figure 4, to meet rising demand, domestic production for the latter two sectors, especially rubber and plastic products, will grow only if countries have the right conditions in place for such production and, most importantly, the endowments of necessary natural resources. Added to this, especially in the case of small countries, demand for production in these sectors is not expected to rise to levels of most other sectors. Thus, it would not be advisable for countries without such natural resources to devote too much time or resources to the development of these natural resource-based sectors.

In contrast, an increase in demand for domestic production is more predicable for the textiles sector. Countries could witness a take-off of the sector when the PPP per capita is between $2,000 and $3,000. Demand for production will increase steadily until the per capita reaches some $10,000. Even beyond this point, per capita demand for textiles could continue to increase. However, due to the loss of comparative advantage with the rise of the income level, demand will be met more by imports. The difference between large and small countries for this sector is that the former are likely to witness higher demand at an early stage of a country's development and will be able to maintain higher sustainability in demand for domestic production even if the income level exceeds $10,000. Based on these patterns, small countries, in particular, should concentrate on the expected growth and prepare themselves well in advance for a slowdown and eventual decline of the textiles sector by supporting the development of other sectors to replace the dominant position in the economy.

When countries reach the PPP per capita of some $3,000, they should start witnessing the development of various sectors, classified as "late middle sectors" listed in table 8, to meet the growth of diverse demands. Some of these sectors could take off at this stage and could sustain growth even after the economy has reached an advanced state. On the other hand, the growth of other sectors, depending on country size and country-specific characteristics, will slow down significantly, and even decline, after reaching some $10,000 per capita. If countries have already established a strong foothold in the textiles sector during their incipient stage of industrialization, it would be natural for them to proceed downstream and expand production to meet the increasing demand for wearing apparel. If successful, this sector could be one of the fastest growing sectors for small countries, up to per capita income of some $12,000, at which stage the income elasticity of demand for the sector declines to 1.0. Non-metallic minerals; coke and petroleum refining; and basic metal products sectors seem to follow a similar industrial life cycle as wearing apparel, being viable industries for domestic production when per capita income is approximately between $3,000 and $12,000. However, the growth of coke and petroleum refining is dependent, to a large extent, on country-specific characteristics and, in the case of small countries, their characteristics would also have a high influence on the development of basic metals, which accounts for more than 20 per cent of the level of this sector's output per capita.

In contrast, though taking off at a similar income level, growth in printing and publishing; paper and paper products; chemical and chemical products; and fabricated metals are more sustainable than other 'late middle sectors' and are not likely to experience much de-industrialization even at a very high income level. In addition, since country-specific factors account less for the development of these sectors, their growth is more predictable for large and small countries alike. Given these various characteristics of the 'late middle sectors', countries might wish to engage in the establishment of domestic production capacities of more sustainable sectors by the end of the middle-income stage.

At the start of industrialization, countries should not need focus on the development of only a few sectors. On the contrary, diversity in industrial development is usually a strength rather than a weakness for countries. Awareness of which sectors are likely to slow down and when, could help countries to plan and prepare for a shift from sunset sectors to more sustainable ones. For example, shift from coke and refined petroleum; and basic metals products to higher value added and more sustainable ones, such as chemical and chemical products; and fabricated metals sectors.

Finally, when a country's income level reaches some $5,000, there will usually be sufficient demand to support the domestic production of capital goods and consumer durable products, such as machinery and equipment; electrical machinery and apparatus; medical precision and optical instruments. Country-specific characteristics would have a relatively high influence on the development of these sectors. Therefore, their growth is by no means automatic. However, as far as growth in machinery and equipment; and electrical machinery and apparatus is concerned, only marginal differences might be observed in the effects of country-specific characteristics on the sectoral development between large and small countries. Furthermore, as seen in figure 4, small countries seem to be able to prolong the growth of these sectors better than large countries. Thus, machinery and equipment; and electrical machinery and apparatus are sectors where small countries could compete with large countries, on an equal footing, if not better.

In contrast, small countries could face a much higher degree of uncertainty than large countries where growth of the motor vehicles sector is concerned, since country-specific characteristics account for a substantial part of the sector's demand. Besides, the sector could slow down and start declining when the income per capita of small countries approaches some $13,000, whereas large countries could expect growth to continue even beyond that point. In this regard, in comparison with the machinery and electrical sectors, the development of the motor vehicles sector could be much riskier for small countries. Hence, it would be better for small countries to leave the development of motor vehicle sector to market forces instead of targeting the development of the sector

As seen in figure 1, the medical precision and optical instruments sector is usually slow to take off; if it takes off at all. As this seems to be a niche sector, different from many others that follow more predictable growth as their income level increases. There are countries where the production of medical precision and optical instruments is so low even though the income level is as high as $10,000, and there are countries where output per capita for the sector is some $50 at the same level of income.

The advantage of this sector is that it seems to offer a higher value-added-to-output ratio than other sectors—even at the incipient stage of production, and the ratio would only increase in conjunction with a country's development. Furthermore, the regression results here indicate that there is no particular disadvantage for small countries, in terms of the degree of uncertainty involved, in sector development. Therefore, small and large countries alike could opt to start nurturing human resources with the necessary scientific and engineering skills way before the income level reaches the point where skills and knowledge-intensive sectors could take off, thus allowing developing countries the opportunity to enhance domestic production of such sectors in the future.

The analysis identified differences in speed, time and sustainability of demand growth for production in different sectors. Among the 18 sectors treated here, it is worth paying renewed attention to the contribution of the food and beverages sector to economic development. Past literature tended to undermine the food and beverages sector as one with low income elasticity of demand, which exhausts the potential for import substitution and export growth at fairly low income levels (Chenery and Taylor, 1968: 409). The results presented here show that at a low income level, the food and beverages sector could be the only, or one of a few, existing manufacturing sector and the main driver for further industrialization. Furthermore, contrary to past findings, contribution of this sector is not only limited to less developed economies. Countries could expect sustained growth of the sector even at a fairly high level of income. In fact, the value-added-to-output ratio of the sector tends to start rising from $3,000 per capita. This means that sustained growth together with rising per unit value added could make the food and beverages sector attractive, and allow countries with different income levels to take advantage of its potential contribution to the economy.

The level of production is determined simultaneously by demand, which is largely shaped by income levels, and the supply, which reflects a country's production capabilities underpinned by human and capital resources and geographic conditions. Therefore, the pattern of output changes, discussed above, could be complemented if viewed from the supply side.

The regression results of the supply-side equation show that population size, *P*, and population density, *PD*, are either both insignificant or, if they are significant, their effects on production are the opposite. Since population size is likely to measure the importance of economies of scale in production, the opposite sign carried by population density seems to indicate the effect of economies of scope, that is, having a positive influence due to the synergy effects of concentration on production. This would also mean the intensive use of available infrastructure and natural resources and is likely to reflect the scarcity of natural resources, as indicated by Keesing and Sherk (1971). As seen in table 5, overall, economies of scope induced by resource constraints are more important than economies of scale—at least as a determinant of supply capacity at industry level. This characterizes the industrialization of small countries more than the large, even though in around half of the 18 sectors, both *P* and *PD* are insignificant for both groups of countries. Hence the results seem to underscore that although there is no single development approach that would suit all manufacturing sectors and countries, depending on the sectors and country size, policy makers could intensify production on a selective basis and thus increase the output level.

In comparison with population and population density, the effect of unit labour costs on supply capabilities is more apparent and hence provides clearer policy implications. Table 5 points out that the lower the unit labour costs, the higher the level of output for most sectors. This indicates the importance of keeping wages low and/or having high labour productivity—the numerator and denominator of *ULC*, respectively. The output level of small countries is especially sensitive to unit labour costs, whose coefficients are significant, with 99 per cent confidence level for all 18 sectors. Small countries are likely to depend more on the successful integration into the international trading system and increases in exports for the steady expansion of their manufacturing production than large countries, whose larger domestic markets could probably relieve them from being competitive in foreign markets, relative to small countries. In the case of small countries, keeping unit labour costs low seems to be particularly effective for the growth of capital goods and consumer durable sectors, such as fabricated metals products; machinery and equipment; electrical machinery and apparatus; and motor vehicles and trailers. A 10 per cent decrease in unit labour costs, as a result of decline in wages, or an increase in labour productivity, or both, could increase the output of these sectors by more than 5 per cent.

Considering both demand- and supply-side results together, policy makers may realize that small countries tend to face more uncertainties than large countries, especially in the development of natural resource-based and scale-intensive sectors. Hence, they need to be more agile in moving from one growth sector to another, keeping in mind the different demand cycles of sectors, as illustrated in this study. To do so, governments of small countries need to make a more conscious effort when planning and preparing infrastructure and human resources, and ensure that manufacturing sectors become competitive, in terms of labour costs and productivity in international markets. On the one hand, failure to do so would be costly for small countries as their domestic markets are usually too small to support the sustained expansion of domestic production. On the other hand, the rewards of having competitive sectors could be potentially enormous because they can look forward to higher and longer-term growth in sectors such as machinery and equipment; and electrical machinery and apparatus.

Time effects on the patterns of industrial development suggest that penetration of international markets seems to be becoming increasingly important not only for small countries but also for large countries, as income elasticities of demand decline for many sectors with time. Compared with countries with same income levels in the past, rich countries especially are likely to face smaller increases in demand for domestic production as their income per capita increases. This could probably be due to the increasing propensity of purchasing more imported products than before.

8. Conclusion

This study revisited past work on the patterns of industrial development and questioned the validity of some of their findings. However, as cross-section data or combinations of cross-section and short periods of time-series data were used in past work for projecting development patterns over the years, it was not possible to derive a complete picture of the development life cycle from growth to slowdown and inevitable decline. Furthermore, by using a single demand-side equation, which does not take into account country-specific and time effects, reveals a more deterministic pattern than it is in reality. The results presented in this paper show that the development stage, represented by GDP per capita, can explain the demand for domestic outputs much better than their supply and, depending on the sector and country size, country-specific characteristics appear to influence the development pattern to a great extent.

Benefiting from the data available for the period 1963 to 2004 and for over 85 countries, this study has been able to provide a fuller picture of industrial development patterns and also to determine a universal factor of income level, consider country conditions, such as size and natural resources, and country-specific characteristics that account for such patterns. It is hoped that future research on this topic could further hone the models and provide a better understanding of country-specific characteristics.

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