DYNAMICS OF STRUCTURAL TRANSFORMATION IN SOUTH ASIA

*P.V. Srinivasan**

This paper contains an analysis of the pattern of growth and the structure of employment in various sectors of six South Asian economies (Bangladesh, Bhutan, India, Nepal, Pakistan and Sri Lanka); the trends in the technological capabilities of these countries are also examined, by characterizing the structure of their exports. It shows that although the level of sophistication is lower compared with East Asian economies, the distribution of exports in South Asian countries has shifted towards products that have a higher productivity index and are located "centrally" in product space, enabling production of several nearby goods. In terms of the summary measure of the proximity of the export basket to all currently unexploited products, high-value ones in particular, the potential for future export sophistication is seen to be the highest for India among the South Asian countries and lowest for Bhutan followed by Bangladesh. Going by the East Asian experience, the South Asian governments have an important role to play in transforming their industrial structures.

JEL Classification: F14, O20, O53.

Key words: Structural transformation, export sophistication, product space, productivity, international trade.

I. INTRODUCTION

Historical evidence from developed countries has shown that large increases in growth rates were accompanied by a shift in the structure of production, from primary to

* Evaluation Specialist, Asian Development Bank, 6 ADB Avenue, Mandaluyong City 1550, Metro Manila, Philippines (e-mail: pv.srinivasan@adb.org). The author is grateful to Benno Ferrarini for sharing with him the COMTRADE data used in this study; and Shikha Jha and three anonymous referees for valuable comments. Responsibility for any errors, however, rests solely with him. The views expressed in this paper are those of the author and do not necessarily reflect the views and policies of the Asian Development Bank (ADB) or its Board of Governors or the Governments they represent.

secondary and then to tertiary outputs. Industrial products are income-elastic and demand for these grows faster compared to income-inelastic agricultural products as incomes grow. The changes over time in the composition of output and the contributions of each sector to employment constitute the structural transformation of an economy (Kuznets, 1971). Economies that depend on primary sectors (agriculture) in their initial stages of development shift to a structure where industry and service sectors dominate as their incomes rise.

The growth process is also accompanied by increases in international trade and countries that export high-value goods that are more income-elastic are the ones that are likely to grow faster. Thus, in addition to the changes at the broad sectoral level, recent literature has emphasized the importance of structural transformation at a disaggregated level in terms of technological sophistication of different products produced by countries for their growth.[1] The growth prospects of an economy depend on its current technological capabilities and its ability to switch to production of a technologically advanced range of products. The speed at which countries can transform their productive capacities to produce goods of greater sophistication and higher value depends on "having a path to nearby goods that are increasingly of higher value" (Hausmann and Klinger, 2006).

The objective of this paper is to characterize the structural transformation process in South Asian countries and analyse its role in economic growth and contrast it with selected economies in East and South-East Asia. Structural transformation is first identified by the changing role of agriculture, industry and the service sectors, as contributors to income and employment in the economy over time. Subsequently, the changing structure of exports of each of the South Asian countries is analysed.[2] Structural transformation has implications for the nature and magnitude of growth. If growth is broad based across sectors it can generate adequate employment for the country's labour force. That is, growth can be inclusive if structural transformation of the economy is conducive to productive employment generation, utilizing the unemployed and underemployed labour force engaged in activities of low productivity.

This study covers six South Asian countries: Bangladesh, Bhutan, India, Nepal, Pakistan and Sri Lanka. In Section II there is an analysis of the pattern of growth and the structure of employment in various sectors of these economies. In the next section there is an examination of the trends in technological capabilities of these countries. Section IV contains some concluding remarks.

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1 Hausmann, Hwang and Rodrik (2007) show that countries that specialize in goods that rich countries export (namely, to specialize in technologically sophisticated goods) are likely to grow faster than countries producing other goods.

2 The analysis in this paper is along the lines of recent literature based on measures developed to obtain trends in sophistication levels of production structure of different economies (see e.g. Hidalgo (2009), ESCAP (2011), Felipe and others (2012)).

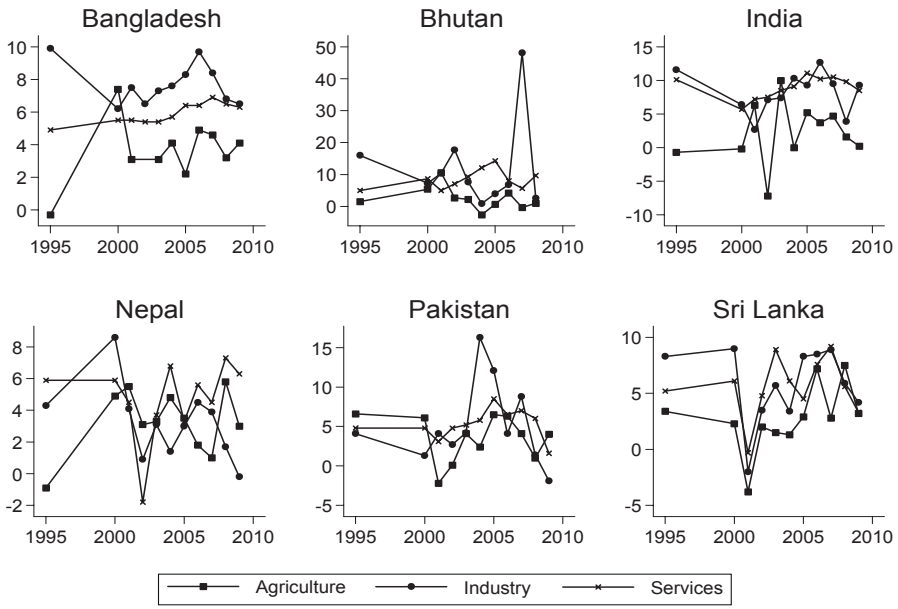
II. STRUCTURAL TRANSFORMATION OF SOUTH ASIAN ECONOMIES

Aggregate and sectoral growth trends

Per capita GDP growth has been remarkable in many of the South Asian economies. The exponential growth rate for the period 1985 to 2009 is as high as 5.4 percent per annum for Bhutan, 4.3 per cent for India and 3.7 per cent for Sri Lanka. Pakistan, Nepal and Bangladesh are slower growing countries with rates of 1.8 percent, 2.0 per cent and 2.9 per cent, respectively.

The high growth rate of per capita GDP in most of these countries is due to the impressive growth in their industry and service sectors (figure 1). It is also the case that service sector growth is more stable as reflected in the small variation for annual percentage growth of value added in services, compared with industry and agriculture, in all the countries. Agricultural growth has been the most unstable in all countries except in the case of Nepal and Pakistan where agriculture and industry are equally unstable.

Figure 1. Annual growth rate (per cent) of value added from different sectors



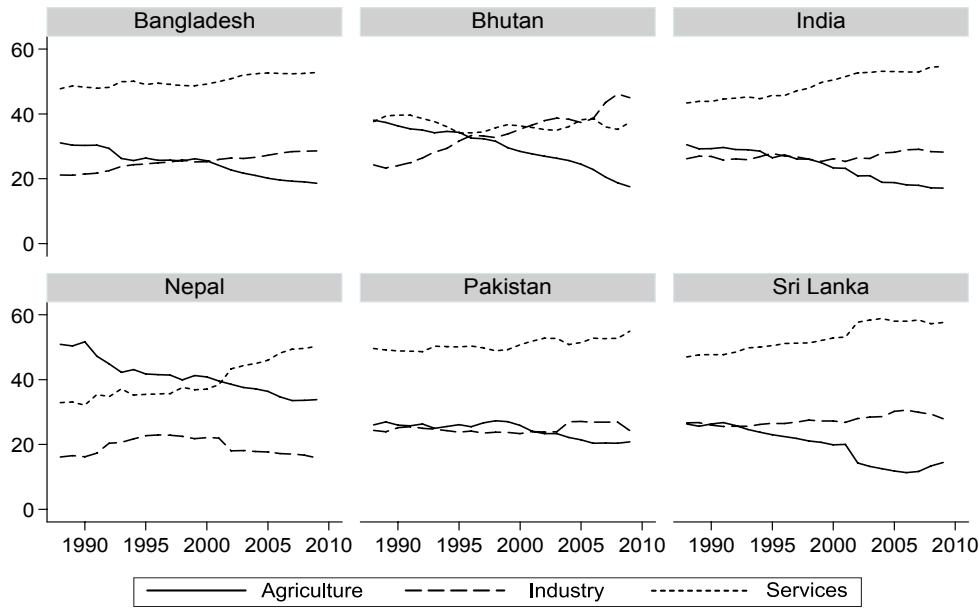
Source: Author's computations based on ADB Key Indicators 2010.

Except in the case of Nepal and Pakistan annual percentage growth in value added in the industry and service sectors is much higher compared with the agriculture sector. In Bangladesh, annual percentage growth rates in industry have been much higher compared with service and agriculture sectors during the years 1985 to 2009. Industrial value added growth varied between 6 and 10 per cent whereas that of services varied between 5 and 7 per cent. Poor agricultural growth in Bhutan is compensated for by high growth in both the industry and service sectors. India registered the highest growth rates for the service sector among all South Asian countries, namely close to or above 9 per cent in most years.

Structure of output

For most South Asian countries the share of services in GDP exceeds the shares of manufacturing and agriculture sectors (figure 2). Agriculture's share in GDP has been declining in all the countries, as is to be expected in the course of a country's development. Industry's share in GDP has been stagnant in all the countries with the exception of Bangladesh and Bhutan. The rising share of services in GDP is remarkable, particularly in Nepal, India and Sri Lanka.

Figure 2. Sector shares in gross domestic product (per cent)



Source: Author's computations based on ADB Key Indicators 2010.

In Bangladesh, the service sector as a percentage of GDP increased from 48 per cent in 1988 to 53 per cent in 2009. At the same time the industry sector increased from 21 to 29 per cent of GDP while the agriculture sector value added declined from 31 to 19 per cent over the same period. Service sector growth in Bangladesh was led by "wholesale and retail trade", and "transport, storage and communications" with strong growth in telecommunications, IT and postal services.

Bhutan is an exception in that its industry sector accounts for the greatest share of GDP; industrial value added increased from 24 per cent of GDP in 1988 to 45 per cent in 2009. The contribution of the service sector to GDP has been stable at around 38 per cent during this period, whereas agricultural value added decreased from 38 to 18 per cent.

In India, the contribution to GDP from industry increased marginally from 26 per cent in 1988 to 28 per cent in 2009. During the same period, the service sector's contribution rose from 43 to 55 per cent and agriculture's share fell from 30 to 17 per cent. Accelerated growth in services was mainly due to increased growth in communications, banking and information technology services in business. Factors such as income growth and the high income elasticity of demand for services and increased growth in foreign demand for service exports, and a decline in relative prices due to productivity gains, have been mainly responsible for this growth (Gordon and Gupta, 2004).

In Nepal, the service sector's contribution to GDP rose from 33 in 1988 to 50 per cent in 2009, while at the same time agriculture's share fell from 51 to 34 per cent. The industry sector's contribution, which peaked in 1996 at 23 per cent, fell to 16 per cent. Nepal derives a substantial share of its GDP from agriculture compared to other South Asian countries.

In Pakistan, the service sector's contribution has been close to 50 per cent since 1988, although it increased to 55 per cent in 2009. During this period, the industry sector's contribution remained stable at 24 per cent while agriculture's share reduced from 26 to 21 per cent.

The service sector in Sri Lanka contributed to 58 per cent of its GDP in 2009, by far the greatest share among all South Asian economies. The share of industry has remained stable at around 27 per cent for the last few years, while agriculture's share decreased from 26 per cent in 1988 to 14 per cent in 2009.

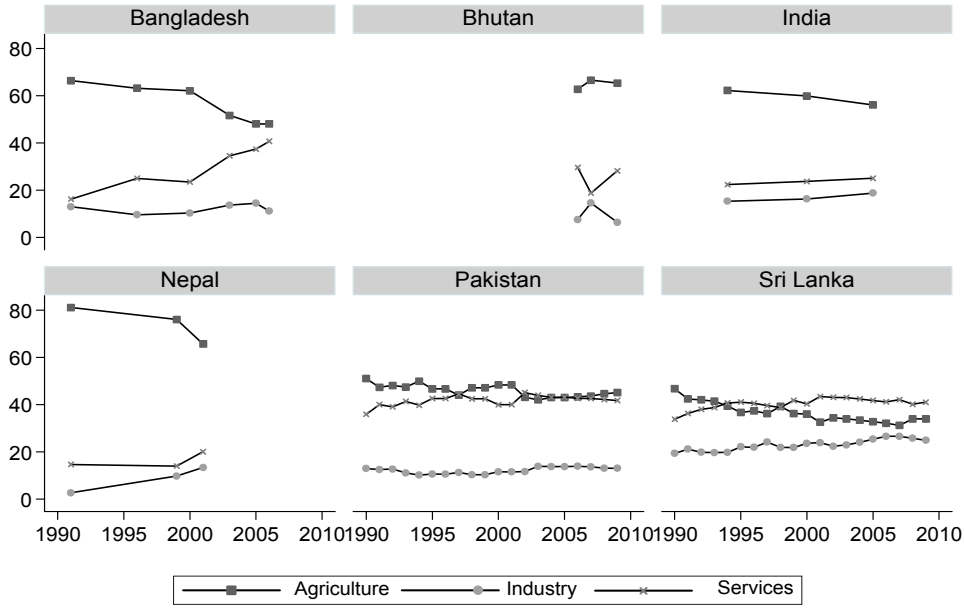
Kuznets (1971) distinguished between two phases of structural transformation. In the first phase, resources are reallocated from agriculture into industry and services and in the second, resources are allocated from both agriculture and industry into services. The share of the manufacturing sector in GDP therefore rises fast in the initial stages of development and that of the service sector increases in subsequent stages as the share of

the agricultural sector in total GDP declines progressively. The trends in figure 2 suggest that the structural shift in South Asian economies, except in the case of Bangladesh and Bhutan, is consistent with the second phase of structural transformation. In all the countries, except Bhutan, the service sector contributes to more than 50 per cent of GDP.

Structure of employment

Although the structural shift in the GDP growth pattern is apparent from the changing contributions to output from different sectors, agriculture constitutes the main source of employment in South Asia, absorbing the highest proportion of the labour force, which varies between 40 and 60 per cent. There has been, however, a significant decline in the share of employment in the agriculture sector in most countries and an increase in employment in the industrial and service sectors (figure 3). In Bhutan, agriculture still provides more than 60 per cent of employment compared to a low 34 per cent in the case of Sri Lanka. Despite the increasing growth in the service sector in India, as of 2005 this sector provides only 25 per cent of total employment compared to around 40 per cent in the case of Sri Lanka, Pakistan and Bangladesh. Inadequate job creation in India's fast-growing service sector could be due to the concentration of growth in subsectors that require more skilled labour. In general, the use of modern technology that is labour saving and capital intensive in the industrial and service sectors is resulting in the slow absorption of labour from the agriculture sector. To some extent the bias against labour-intensive industrial growth is also policy induced (for example, due to restrictive labour laws). Slow growth in jobs in non-agricultural sectors is also due to lack of policies that support development of a competitive private sector. The East Asian experience suggests that South Asian Governments need to undertake industrial policies to restructure their economies, and give importance to the development of education and skills in certain industries, while taking into account the benefits to related industries.

Figure 3. Percentage share of sectors in total employment



Source: Author's computations based on ADB Key Indicators 2010.

III. STRUCTURAL TRANSFORMATION AS REFLECTED IN THE "SOPHISTICATION" OF A COUNTRY'S EXPORTS

In this section, trends in structural transformations are examined using the concepts of "export sophistication" and "connectedness" developed by Hausmann, Hwang and Rodrik (2007) (hereinafter, HHR) and Hausmann and Klinger (2006) (hereinafter, HK). HHR and HK recognize that developed countries not only have greater productivity in terms of output per worker but produce technologically sophisticated products of high value. Structural transformation involves a process in which countries diversify their production structures by developing technological capabilities to produce and export products similar to those of advanced countries. HHR emphasize that a country's trade specialization is not necessarily determined only by its factor endowments and factor intensities of goods as suggested by the Heckscher-Ohlin model and show that a country's exports mix has important implications for its growth. They argue that there is an element of uncertainty in what a country produces because of the uncertainty involved in the successful development of a new product. Once the economy develops a high productivity good, due to knowledge spillovers, emulators are

drawn in to produce this good, setting forth the process of economic growth. The limitation of this framework is that although it characterizes the kind of structural transformation that is associated with economic growth it does not provide concrete guidance regarding how to achieve it.

Export sophistication

HHR develop a measure for a country's level of "export sophistication" (called EXPY) that captures the "productivity" level of a country's exports and can be computed from export statistics.[3] The focus on exports is justified on the grounds that a country is expected to export those goods in which it is most productive. The first step involved in the calculation of EXPY is the construction of an income or "productivity" index (called PRODY) for each commodity based on the income levels of the countries that export the commodity. PRODY can be considered to be a quantitative index that ranks traded goods according to their implied productivity. For each commodity k, $PRODY_k$ is obtained as the weighted average of per capita GDP of countries that export this commodity where the weights are the revealed comparative advantage (RCA) of each country in good k.

$$PRODY_k = \sum_c RCA_k^c \, Y^c \quad (1)$$

Revealed comparative advantage of country c in good k is given by

$$RCA_k^c = (x_k^c/X^c)/(\sum_c (x_k^c/X^c)) \quad (2)$$

where (x_k^c/X^c) is the value share of commodity k in the overall export basket of country c.

Given the productivity index of each of the traded products in the world, the productivity level associated with any particular country's export basket, EXPY is defined as the weighted average of the productivity indices of all the products in that country's export basket, where the weights are the value shares of the products in the country's total exports.

Given the productivity index of each of the traded products in the world, the productivity level associated with any particular country's export basket, EXPY is defined

[3] Hidalgo and Hausmann (2009) use an alternative measure of sophistication to depict the complexity of a productive structure based on the diversity of capabilities present in a country and their interactions. They show that cross-country differences in income can be explained by differences in this measure. The method of reflection used to produce these measures captures the diversity in non-tradable capabilities of countries. Hidalgo (2009) traces the measures of economic complexity for several countries and finds that these measures are correlated with EXPY measures.

as the weighted average of the productivity indices of all the products in that country's export basket, where the weights are the value shares of the products in the country's total exports.

$$EXPY^c = \sum_i (x_i^c/X^c)\ PRODY_i \quad (3)$$

EXPY is also interpreted as the level of sophistication of a country's exports and is positively associated with a country's income level, controlling for other variables. The growth rate of per capita GDP is found to be positively influenced by initial EXPY suggesting that countries that can position themselves higher on the productivity spectrum tend to experience higher growth.[4]

The recent trends in export sophistication (as measured by EXPY) for the South Asian countries are obtained below. The United Nations Commodity Trade Statistics Database (COMTRADE) is used for this purpose, covering 261 products at the 3-digit level for the years 1988-2008 to calculate EXPY.

At the 3-digit level, the productivity levels of products range from roughly $1,000 to $30,000 with a mean value of $16,000 (table 1).

Table 1. Descriptive statistics for the productivity index in South Asia

(US$ at 2000 prices)

Variables	Number of observations	Means	Std. dev.	Min.	Max.
Average PRODY for 1988-1993, PPP adjusted	261	16 059.57	5 173.989	1 359.116	27 418.27

Source: Author's computations based on COMTRADE data.

At the lower end of the productivity range are mainly primary goods such as rice, cotton, tobacco, cocoa, coffee and spices and basic manufactured goods such as leather, vegetable textile fibres, sugar, molasses and clothing (table 2). At the higher end of productivity are mining and advanced manufactured products such as metals, machinery (for printing, textiles, paper, power generation, etc.), medical equipment, steam turbines, engines, taps, cocks and valves (table 3).

[4] See Hausmann, Hwang and Rodrik (2007).

Table 2. Commodities with the lowest productivity values

Product code	Product name	Average PRODY for 1988-1993, PPP adjusted
264	Jute and other textile bast fibres	1 359.12
74	Tea and mate	2 271.17
223	Oilseeds (used for extraction of other fixed vegetable oils)	2 944.41
272	Fertilizers, crude	2 988.59
71	Coffee, coffee substitute	3 017.58
75	Spices	3 290.85
36	Crustaceans, molluscs, etc.	4 096.45
265	Vegetable textile fibres	4 520.00
263	Cotton	4 664.72
72	Cocoa	4 666.78
612	Leather products	5 410.85
42	Rice	5 509.29
37	Fish, etc., prepared, preserved	5 558.37
231	Natural rubber, etc.	5 567.10
61	Sugars, molasses, honey	5 798.19
422	Fixed vegetable fats and oils, other oils	5 844.53
121	Tobacco, unmanufactured	6 330.63
687	Tin	6 505.88
841	Men's and boys' clothing excluding knitwear	7 501.12
843	Men's and boys' clothing, knitted	7 532.51

Source: Author's computations based on COMTRADE data.

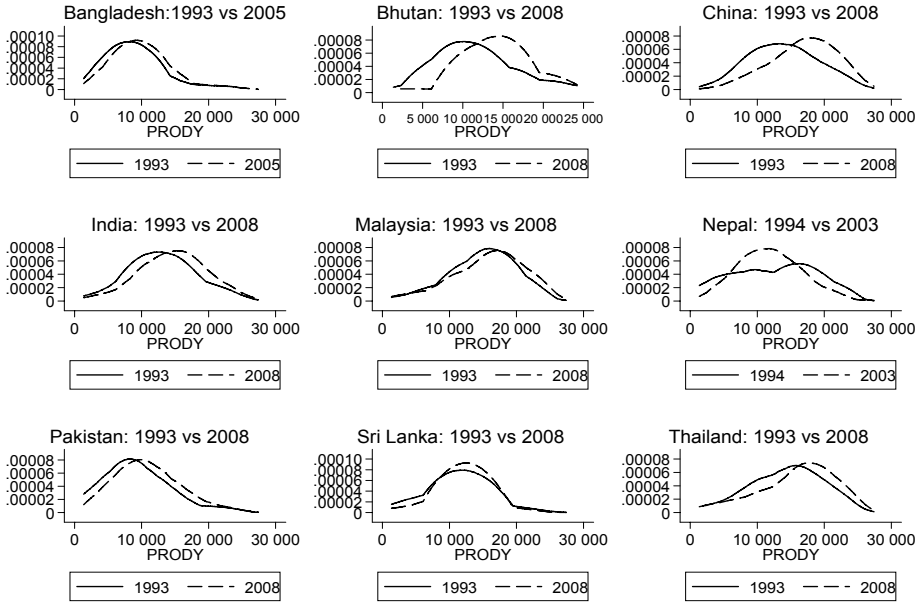
Table 3. Commodities with the highest productivity values

Product code	Product name	Average PRODY for 1988-1993, PPP adjusted
684	Aluminium	27 418.27
726	Printing and bookbinding machinery	24 219.5
731	Metal removal work tools	24 122.45
212	Fur skins, raw	23 983.85
525	Radioactive materials	23 681.36
725	Paper, pulp mill machines	23 604.43
16	Meat and edible meat offal, salted, in brine, dried or smoked	23 595.55
774	Electro-diagnostic medical and x-ray equipment	23 407.47
597	Prepared additives, liquids	23 083.66
724	Textile, leather machines	22 918.98
733	Machine tools, metalworking	22 906.68
735	Parts for machine tools	22 865.57
712	Steam turbines	22 784.4
874	Measuring, controlling instruments	22 631.71
737	Metalworking machinery	22 575.55
714	Engines, motors and non-electric parts	22 512.59
583	Monofilament plastics	22 468.23
718	Other power-generating machinery	22 409.64
541	Medicinal and pharmaceutical products, other than medicaments in group 542	22 396.62
747	Taps, cocks, valves, etc.	22 374.68

Source: Author' s computations based on COMTRADE data.

As mentioned before, the structural transformation of a country is reflected in the changing structure of its exports. We obtain below the frequency distribution of each country's exports (in value terms) with respect to the productivity values of products. Over time, the distribution of exports in most South Asian countries has shifted towards products with a higher productivity index (figure 4).

Figure 4. Distribution of export values across products with different levels of productivity



Source: Author's computations based on COMTRADE data.

The changes in distribution of exports across productivity quintiles for different time points are given in table 4. Export value shares in the top 40 per cent of PRODY values have increased in all the South Asian countries; highest in the case of India. These increases are, however, much smaller compared to the values for East Asian countries (table 5). If only the products that are exported with revealed comparative advantage are considered, very few products fall in the top 40 per cent range of productivity values. The maximum is in the case of India (15 products), which includes products such as organic chemicals, works of art, antiques, man-made fibres, tractors and electric power machinery parts. In the case of Bangladesh, only 4 products are exported with revealed comparative advantage in this range of PRODY values (parts for machine tools, coal gas, plastic waste and printed matter). In the case of Bhutan, it is just one product, which is electric current that constitutes almost 50 per cent of export values. For Sri Lanka, it is two product categories (printed matter and electric power machinery parts) and for Nepal also it is two (works of art and antiques, and Zinc). In the case of Pakistan, it is five products (table 6). As will be seen below, the low share of export values in the high-value products is reflected in a low export sophistication level for the country.

Table 4. Export shares by quintiles of productivity values (South Asian countries)

Bangladesh	**PRODY quintiles**	**1991**	**1995**	**2003**	**2007**
	Bottom 20%	88.49	87.83	91.12	82.55
	Next 20%	9.48	9.03	6.57	12.41
	Middle 20%	0.27	1.01	1.24	2.14
	Next 20%	0.58	1.33	0.84	1.74
	Top 20%	1.17	0.80	0.23	1.17
Bhutan	**PRODY quintiles**	**1993**	**1998**	**2008**	
	Bottom 20%	33.35	15.82	47.81	
	Next 20%	15.88	34.61	3.26	
	Middle 20%	21.36	15.73	0.01	
	Next 20%	29.28	33.53	48.92	
	Top 20%	0.13	0.31	0.01	
India	**PRODY quintiles**	**1993**	**1998**	**2003**	**2008**
	Bottom 20%	38.13	38.61	25.81	18.54
	Next 20%	40.92	38.11	42.32	46.84
	Middle 20%	8.63	8.85	10.47	13.40
	Next 20%	5.41	6.00	9.55	10.66
	Top 20%	6.92	8.44	11.86	10.55
Nepal	**PRODY quintiles**	**1998**	**2003**		
	Bottom 20%	31.45	45.67		
	Next 20%	63.02	33.65		
	Middle 20%	4.09	16.67		
	Next 20%	0.37	2.80		
	Top 20%	1.07	1.21		
Pakistan	**PRODY quintiles**	**1993**	**1998**	**2003**	**2008**
	Bottom 20%	61.48	67.59	67.81	65.25
	Next 20%	33.22	27.22	24.58	23.65
	Middle 20%	2.20	2.10	2.27	4.04
	Next 20%	2.53	2.51	3.63	4.11
	Top 20%	0.56	0.58	1.71	2.95
Sri Lanka	**PRODY quintiles**	**1993**	**2003**	**2008**	
	Bottom 20%	71.34	70.36	63.07	
	Next 20%	21.11	17.91	22.36	
	Middle 20%	3.98	5.35	8.42	
	Next 20%	2.60	4.63	4.56	
	Top 20%	0.96	1.75	1.59	

Source: Author's computations based on COMTRADE data.

Table 5. Export shares by quintiles of productivity values (selected East Asian countries)

China	**PRODY quintiles**	**1993**	**1998**	**2003**	**2008**
	Bottom 20%	38.38	29.82	21.93	15.76
	Next 20%	28.11	24.37	19.15	17.14
	Middle 20%	11.48	14.64	16.80	19.43
	Next 20%	15.76	20.01	24.31	26.04
	Top 20%	6.27	11.17	17.81	21.63
Malaysia	**PRODY quintiles**	**1993**	**1998**	**2003**	**2008**
	Bottom 20%	19.62	15.00	12.01	14.44
	Next 20%	40.30	34.20	36.51	36.56
	Middle 20%	11.25	10.70	10.07	9.66
	Next 20%	24.85	29.50	28.38	26.23
	Top 20%	3.98	10.59	13.02	13.12
Thailand	**PRODY quintiles**	**1993**	**1998**	**2003**	**2008**
	Bottom 20%	35.30	28.14	21.45	19.87
	Next 20%	25.57	22.27	23.92	21.25
	Middle 20%	12.85	11.05	13.80	15.98
	Next 20%	19.44	29.72	27.40	22.84
	Top 20%	6.84	8.83	13.44	20.06

Source: Author's computations based on COMTRADE data.

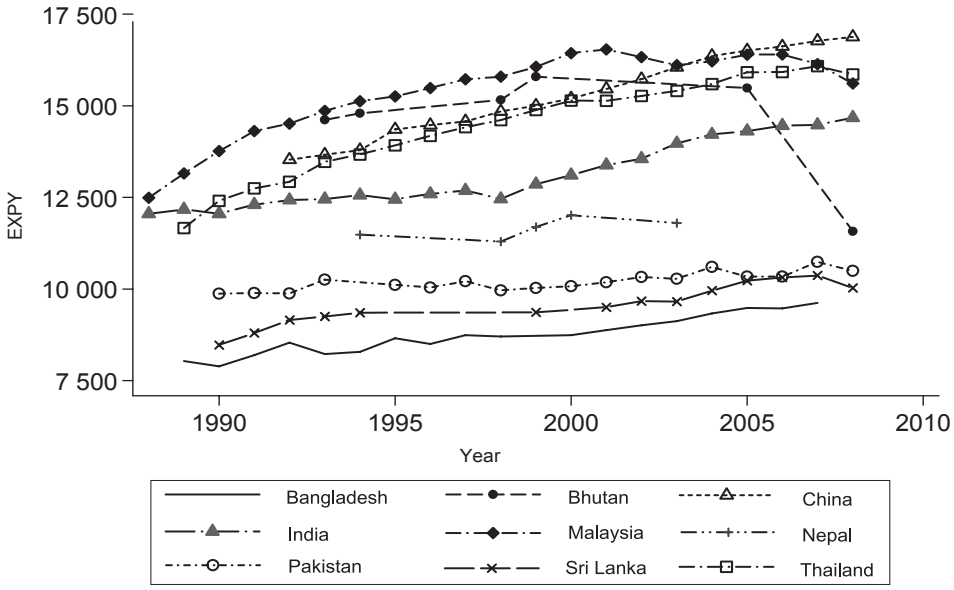
Table 6. Products exported with revealed comparative advantage and in the top 40% productivity index* values

Country	Product name	Average PRODY for 1988-1993, PPP adjusted
Bangladesh	Parts for machine tools	22 865.57
	Coal gas, water gas, etc.	20 880.48
	Plastic waste, scrap, etc.	20 770.13
	Printed matter	18 616.93
Bhutan	Electric current	19 256.51
India	Nitrogen-function compounds	21 482.54
	Other organic chemicals	21 256.6
	Synthetic colours, lakes, etc.	21 164.68
	Coal gas, water gas, etc.	20 880.48
	Works of art, antiques, etc.	20 668.5
	Tractors	20 534.13
	Steam generators, boilers, etc.	20 279.03
	Other man-made fibres	20 145.36
	Carboxylic acids, derivatives	19 933.3
	Rotating electric plant	19 753.56
	Hydrocarbons, derivatives	19 695.58
	Zinc	19 405.74
	Nails, screws, nuts, etc.	19 075.13
	Manufactures of base metals	18 992.23
	Electrical power machinery and parts	18 471.03

Source: Author's computations based on COMTRADE data.
Note: * PRODY.

Figure 5 below shows the differing levels of export sophistication among South Asian economies in comparison to some of the East Asian economies like Malaysia, Thailand and China. Bangladesh has the lowest level of export sophistication followed by Sri Lanka and Pakistan. However, export sophistication has been rising over the years in all the countries and the rise is remarkable particularly in the cases of India and East Asian countries.

Figure 5. Evolution of export sophistication in South Asian countries



Source: Author's computations based on COMTRADE data.

Determinants of export sophistication (EXPY)

As noted in HHR, the measure of export sophistication is strongly correlated with per capita GDP. Based on the time series data for each of the countries it is found that the level of export sophistication in countries is highly correlated with per capita income level (table 7). The observed correlations of EXPY with trade and inflows of FDI are mainly due to the correlations between per capita GDP and these variables.

Transformation to a modern economy is slow in many of the South Asian countries due to low diversification in exports. India, Sri Lanka and Pakistan have substantially diversified exports, but still fall far short of the diversification levels in, for example, China and Thailand (figure 6).

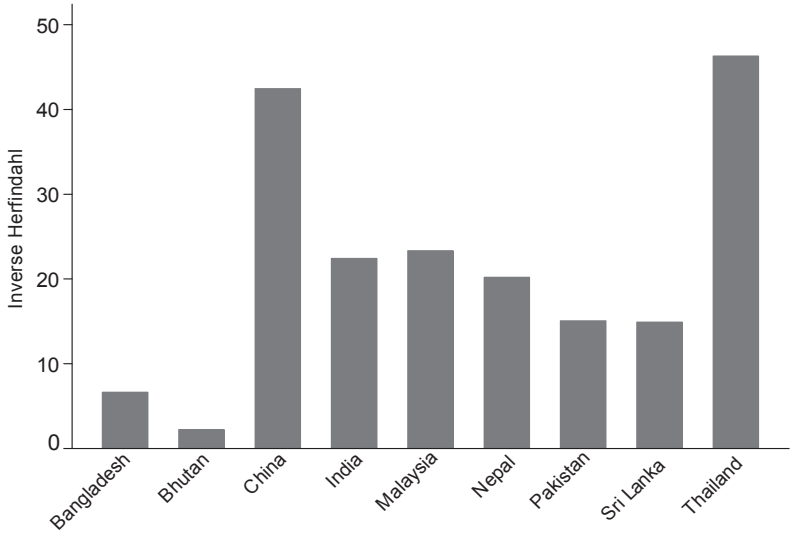
Newly industrialized countries such as the Republic of Korea and China that have been successful in strengthening their export and industrial competitiveness can offer some lessons for export diversification. For countries to move up the value chain from producing raw materials to high-value products it is necessary to boost the skills of their people, apart from providing access to capital through deepening of financial markets.

Table 7. Correlation between export sophistication and trade openness, foreign direct investment and gross domestic product per capita

	EXPY, trade/GDP	EXPY, FDI/GDP	EXPY, GDP per capita	GDP per capita, trade/GDP	GDP per capita, FDI/GDP
Bangladesh (18)	0.9377*	0.7264*	0.9659*	0.9649*	0.8190*
Bhutan (6)	-0.6263	-0.4419	-0.6921	0.9774*	0.0758
China (17)	0.7851*	-0.6248*	0.9613*	0.8351*	-0.5356*
India (21)	0.9672*	0.7735*	0.9674*	0.9868*	0.8621*
Malaysia (21)	0.9518*	-0.2703	0.8555*	0.8644*	-0.3523
Nepal (5)	-0.1984	—	0.7067	-0.2153	—
Pakistan (18)	-0.1602	0.6634*	0.8305*	-0.0639	0.8277*
Sri Lanka (14)	-0.0248	0.4759	0.9219*	-0.2337	0.5006
Thailand (20)	0.9330*	0.6241*	0.9308*	0.8813*	0.4559*

Source: Author's computations based on COMTRADE data.
Note: * indicates significance at 5 per cent level. Numbers in parentheses refer to number of observations.

Figure 6. Export diversification (Inverse Herfindahl index)*



Source: Author's computations based on COMTRADE data.
Note: * Export diversification is obtained as 1/H where H is the Herfindahl index of export shares. $H = \sum_{i=1,N} s_i^2$ where $s_i = x_i/\sum x_i$ is the value share of each product in total exports.

Export sophistication and growth

A cross-section regression using a sample of 165 countries with data between the years 1988 and 2008 reveals the relationship between export sophistication and economic growth. The dependent variable is the annual per capita growth rate of each country obtained from the difference between the initial and final years. The coefficient of initial per capita GDP is negative, indicating growth convergence and the coefficient of initial EXPY is positive and statistically significant indicating the important role of export sophistication for growth (table 8). That is, countries that initially export products with high productivity values tend to grow faster. HHR show that this result is robust and holds good under different model specifications.[5] The estimates in table 8 show that the association between export sophistication and growth is weaker (R^2 = 0.066) than that obtained in the case of HHR (R^2 = 0.35). The estimates here are based on growth rates between the years 1988 and 2008 compared to the years 1992-2003 considered in HHR. Wang, Wei and Wong (2010) show, for example, that the association between initial export sophistication and growth is not stable across different measures of sophistication. These results, however, cannot rule out a relationship between the income levels of countries and their production capabilities in terms of sophistication and complexity. Felipe and others (2012) find, for example, that high-income countries are the major exporters of more complex products and export shares of these products increase with income.

Table 8. Cross-section growth regression

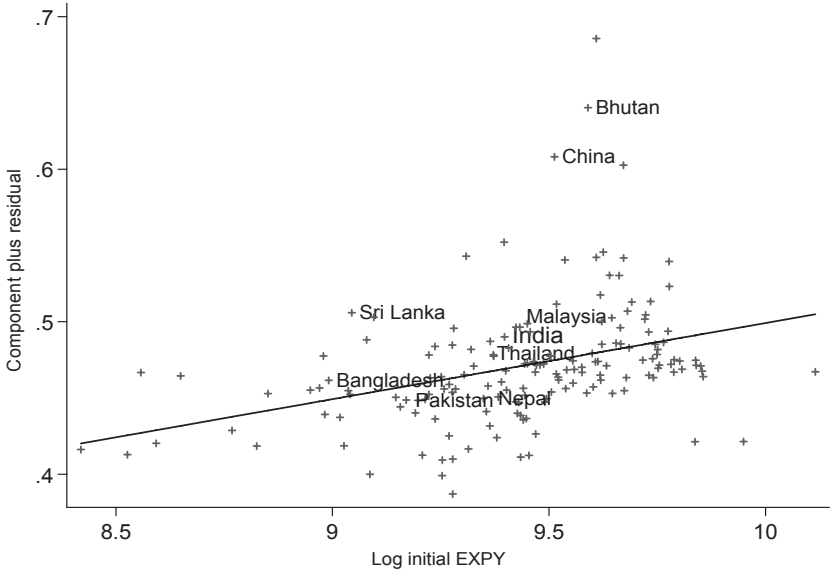
	Dependent variable: Growth rate of GDP per capita between initial and final years
Log(initial GDP per capita)	-0.0096 (-2.97)**
Log(initial EXPY)	0.0499 (3.62)**
Constant	-0.355 (-2.16)**
Number of observations	165
R^2	0.0661

Source: Author's computations based on COMTRADE data.
Note: ** indicates significance at 1% level.

[5] HHR show in fact that this relationship holds strongly in the case of low and lower middle-income countries compared with richer countries.

Figure 7 plots per capita GDP growth against initial EXPY, but after subtracting the effect of the other explanatory variable (initial GDP) on per capita GDP growth. It shows that there is a positive relationship between initial export sophistication and growth after accounting for the effect of the initial level of income on growth. This implies that in addition to policy measures that encourage exports, in general, the Government has a role to play in encouraging entrepreneurs to develop and export high-value products in order to achieve higher economic growth. Since the knowledge externalities created by innovation are not internalized there are likely to be suboptimal levels of this activity (HHR). Even if a country has a comparative advantage to potentially produce high-value products it may end up producing low-value products unless Government plays an active role in fostering innovation. The East Asian growth experience is an example where active public policy played a critical role in catching up, as regards technology, with advanced economies. Apart from providing a stable macroeconomic environment, legal framework and encouraging competitive markets, Governments in countries such as Japan and the Republic of Korea had policies aimed specifically at altering the industrial structure and promoting technological learning.

Figure 7. Partial relationship between initial export sophistication and subsequent growth



Source: Author's computations based on COMTRADE data.

Thus, apart from undertaking steps to improve trade logistics and customs and export procedures to facilitate trade, in general, the Government in collaboration with private entrepreneurs needs to identify the constraints faced in developing high-value products and provide the required support, such as tax incentives and trade protection, without unduly distorting market mechanisms.

Potential for developing export sophistication

Given that the level of export sophistication has an important bearing on economic growth, what are the prospects for a country to develop its export sophistication? HK relate the likelihood that a country develops greater export sophistication in the future to the current positioning of a country's exports in the product space. That is, how closely related are a country's current exports to high productivity products in the sense of mobility or adaptability of factors of production from one product to another? If factors can be adapted easily from the production of one product to another then the products are said to be close to each other. In general, parts of the product space can be dense where goods are distributed close to each other and parts of it can be sparse where goods are situated far from each other. If a product is in the dense part of the product space it is said to be centrally located and if it is in a sparse part it is said to be located peripherally.

HK define a measure of proximity (φ), or closeness of products. Based on the trades taking place between all countries for any year, one can obtain p(i/j), the probability that a country exports good i with revealed comparative advantage given that it exports good j with revealed comparative advantage. The greater this probability is, the greater the proximity between products i and j. Since a distance measure needs to be symmetric, the proximity between i and j is defined as

$$\varphi_{ij} = \text{Min } \{p(i/j), p(j/i)\} \quad (4)$$

Whether a product is central or peripheral is based on a measure of its centrality, which is defined as:

$$\text{Centrality}_{it} = \sum_j \varphi_{ijt} / J \quad (5)$$

where J is the maximum possible number of products.[6]

Based on 3-digit-level export data, the centrality values range between 0.05 and 0.28 with a mean value of 0.19 (table 9). A product's centrality value will be greater if it is close to several other products, or in other words, in a denser part of the product space. Conversely, if a product's centrality value is lower, it is removed from most other products

6 See Hausmann and Klinger (2007).

(or in a sparse part of the product space). It can be noticed that the densest part of the product space tends to be dominated by manufactured products and the sparsest part mostly by unprocessed primary goods (tables 10 and 11).

Table 9. Descriptive statistics for centrality measure for South Asia

Variable	Number of observations	Mean	Std. dev.	Min.	Max.
Centrality (average for 1988-1993)	261	0.19656	0.04487	0.05439	0.27659

Source: Author's computations based on COMTRADE data.

Table 10. Least central (or peripheral) products

Product code	Product name	Centrality (average for 1988-1993)
244	Cork, natural, raw and waste	0.0543903
274	Sulphur and unroasted iron pyrites	0.0643176
231	Natural rubber, etc.	0.0661762
633	Cork manufactures	0.071903
286	Uranium, thorium ores, etc.	0.0739364
284	Nickel ores and concentrates; nickel mattes	0.0792127
272	Fertilizers, crude	0.086642
264	Jute and other textile bast fibres	0.0977179
321	Coal, not agglomerated	0.0982876
881	Photographic apparatus and equipment	0.1087232
763	Sound recorders, phonographs	0.1099827
785	Cycles, motorcycles, etc.	0.1114328
345	Coal gas, water gas, etc.	0.1132215
322	Briquettes, lignite, peat	0.1139405
911	Postal packages not classified according to kind	0.1156764
687	Tin	0.1172754
422	Fixed vegetable fats and oils, other oils	0.1199897
714	Engines, motors and non-electric parts	0.1211135
268	Wool, other animal hair	0.1221932
343	Natural gas	0.1242425

Source: Author's computations based on COMTRADE data.

Table 11. Products that are highly central

Product code	Product name	Centrality (average for 1988-1993)
892	Printed matter	0.2765864
812	Plumbing, sanitary equipment, etc.	0.274293
533	Pigments, paints, etc.	0.2720924
691	Metallic structures	0.2700373
893	Plastic articles	0.2692378
716	Rotating electric plant	0.2676733
621	Rubber materials	0.2648016
692	Containers for storage or transport	0.2634526
895	Office, stationery supplies	0.2606351
581	Plastic tube, pipe, hose	0.2577854
744	Mechanical handling equipment	0.2573103
663	Mineral manufactures	0.2569276
657	Special yarn, textile fabrics	0.256697
513	Carboxylic acids, derivatives	0.2562745
699	Manufactures of base metal	0.2553734
554	Soap, cleaners, polish, etc.	0.2550222
48	Cereal preparations	0.2548453
676	Iron and steel bars, shapes, etc.	0.253457
721	Agricultural machinery (excluding tractors)	0.2532044
642	Paper, paperboard, cut to size or shape	0.2528483

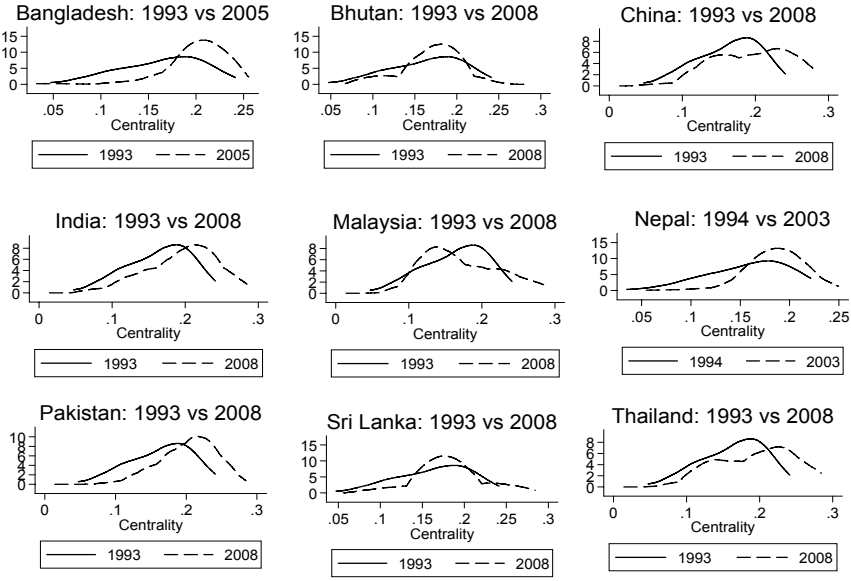
Source: Author's computations based on COMTRADE data.

If a country develops comparative advantage in a product that belongs to the dense part of the product space it leads to spillover benefits, as the capabilities can be transferred to nearby goods. Since these spillovers cannot be internalized in perfectly competitive markets the Government has an important role facilitating innovation, by providing appropriate infrastructure and policy environment. This facilitating role is in direct contrast to the interventionist role adopted by the old structural economics where market failures preventing the development of advanced capital-intensive industries are assumed to be exogenously determined by distorted price signals arising from monopolies or immobility of factors. According to the new structural economics the failure to develop advanced capital intensive industries in developing countries is endogenously determined by their endowments

(Lin, 2010).[7] "The old structural economics advocates development policies that go against an economy's comparative advantage and advise governments in developing countries to develop advanced capital-intensive industries through direct administrative measures and price distortions. By contrast, the new structural economics stresses the central role of the market in resource allocation and advises the state to play a facilitating role to assist firms in the process of industrial upgrading by addressing externality and coordination issues" (Lin, 2010).

Export data can be used to check how each country's export specialization changes over time as measured by the distribution of its exports in the centrality space. In a similar fashion to the distribution of countries' exports across productivity values, structural transformation can be seen in terms of the distribution of a country's export values shifting towards products of higher *centrality* values (figure 8).

Figure 8. Distribution of export values across centrality values



Source: Author's computations based on COMTRADE data.

[7] Lin and Monga (2010) summarize the elements of the new structural economics as: (a) a country's comparative advantage is defined by its evolving potential of its endowment structure; (b) the market provides a reliable mechanism for optimal resource allocation at any given stage of development; and (c) and the state plays a facilitating role in the process of industrial upgrading.

Estimating the potential for exporting high-value products

Based on the proximities between products, one can obtain a measure (called density) to tell how close a country's current export basket is to each of the products it currently does not export with revealed comparative advantage.[8] The density of a country's exports around a product *i* that is not currently exported by the country is given as the sum of proximities from good *i* to all products that are currently exported with comparative advantage, divided by the sum of proximities to all products.

$$\text{Density}_{it}^{c} = \sum k \, \varphi ikt \, x_{kt}^{c} / \sum k \, \varphi_{ikt} \qquad (6)$$

where $x_{kt}^{c} = 1$ if $RCA_{kt}^{c} > 1$, = 0 otherwise.

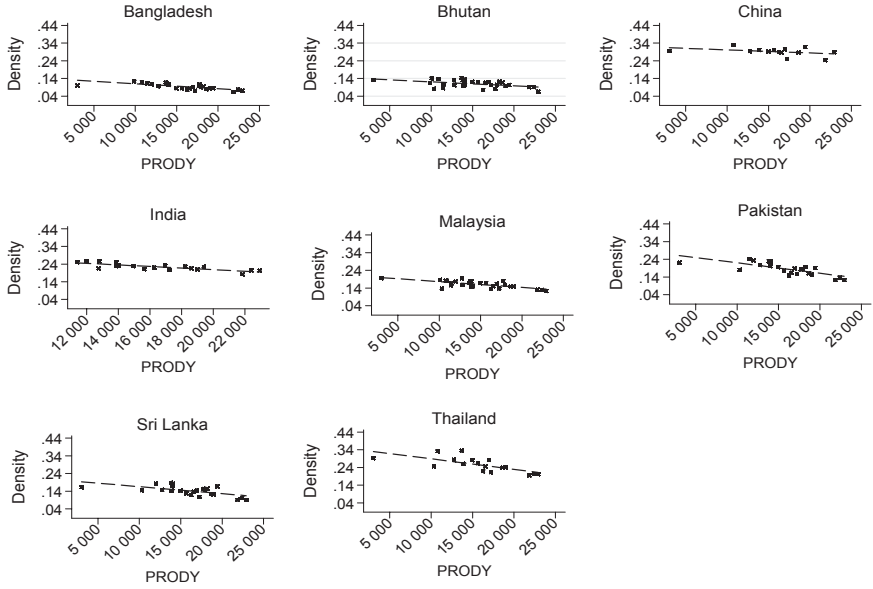
It is easy to check that the density measure lies between 0 and 1. The density measure is a highly significant determinant of structural transformation (that is, the probability of exporting a new good). Firms find it more profitable to move to nearby goods compared to farther ones as the cost of producing a new product rises with distance. Therefore, one can expect rapid structural transformation in countries that have high density around high-productivity (PRODY) goods.

The density measure can be computed for each of the products *i* that a country is currently not exporting (or exporting, but with RCA < 1). It gives an indication of the likelihood of a country developing comparative advantage in good *i* in the future, given its current export comparative advantages. The potential for future structural transformation in a country can be assessed by examining the density of the current export basket around unexploited products with different productivity (PRODY) values.

Figures 9a-9c show that, for all the countries considered, density is lower around unexploited products of high value compared to that around low-value products. This makes it difficult for countries to quickly increase the productivity level of their exports as their current exports are distant from the unexploited high-value products. This situation has not changed over the years for all the countries considered, except in the case of China.

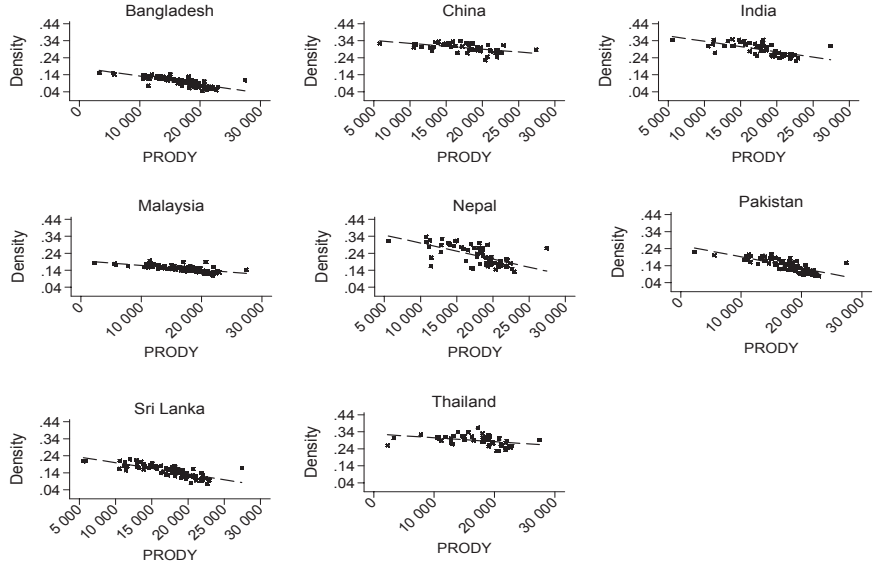
8 Hausmann and Klinger (2007).

Figure 9a. Density of exports around products that are not exported (density vs PRODY : 1993)



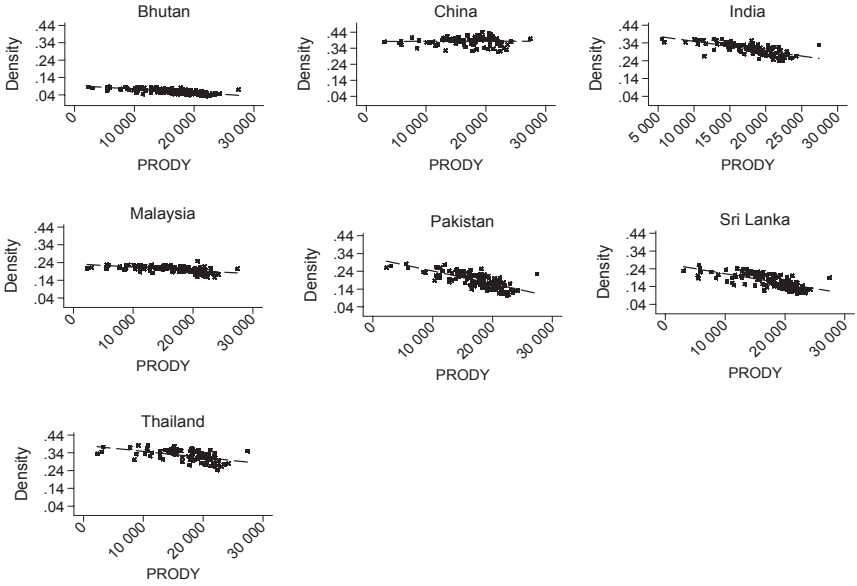
Source: Author's computations based on COMTRADE data.

Figure 9b. Density of exports around products that are not exported (density vs PRODY : 2003)



Source: Author's computations based on COMTRADE data.

Figure 9c. Density of exports around products that are not exported (density vs PRODY : 2008)



Source: Author's computations based on COMTRADE data.

Based on the estimated "densities" around different products, a summary measure called "open forest" can be obtained for each country. This measure denotes a country's productivity potential from exploiting all the products that it is currently not exporting. Hidalgo and others (2007) provide an analogy of a forest for the product space where each tree is considered a product. Each firm operating in a product is like a monkey on a tree. The monkey can easily jump to nearby trees but not to far off ones. Open forest therefore refers to the product space that can potentially be exploited given their current location in the forest (dense areas or sparse ones). They suggest that "lack of connectedness may explain the difficulty faced by countries trying to converge to the income levels of rich countries". If proximities to higher value products are low, structural transformation becomes difficult. "Open forest" is obtained as the weighted sum of PRODYs of products currently not exported, the weights being the density of the country's current export basket around each of these products.

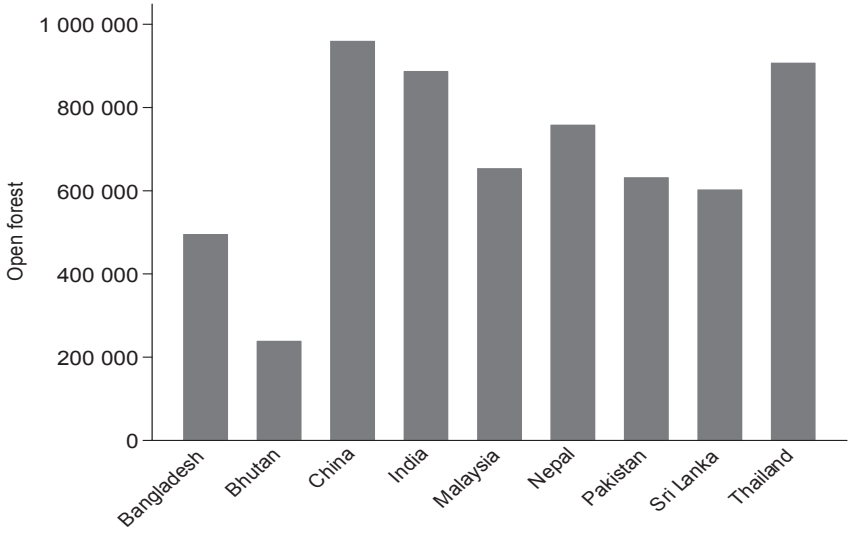
$$\text{Open forest}^c = \sum_i \text{Density}_i^c \, (1 - x_i^c) \, \text{PRODY}_i \qquad (7)$$

where $x_i^c = 1$ if $RCA_i > 1$, $= 0$ otherwise.

HK show that this variable strongly predicts the speed of structural transformation as measured by growth in the level of sophistication of exports. They argue that "the speed at which countries can transform their productive structure and upgrade their exports depends on having a path of nearby goods that are increasingly of higher value".

The open forest measure is obtained for the different countries based on the data available for the latest years (figure 10). Among the South Asian economies, India has the highest potential for structural transformation, close to the values obtained for China and Thailand. Nepal, Sri Lanka and Pakistan have slightly lower potential but comparable to that of Malaysia. Bhutan has the least potential followed by Bangladesh.

Figure 10. Potential for increasing export sophistication



Source: Author's computations based on COMTRADE data.

The factors that can explain the growth in export sophistication over the years are obtained using cross-section regressions. We notice that the initial level of export sophistication has a statistically significant influence on its future growth and is negatively related (table 12). This indicates that there is convergence across countries in terms of export sophistication. Countries with low levels of sophistication tend to advance faster as regards technology, conditional on other factors such as their initial potential given by open forest. To some extent it is also a reflection of the initial level effect on growth. Initial levels of trade openness (trade/GDP) and inflows of FDI (FDI/GDP) do not have any significant impact on the growth in export sophistication. After accounting for the effect of initial EXPY, growth in export sophistication is positively related to initial open forest (potential for export sophistication) (figure 11).

Table 12. Cross-section regression: growth in export sophistication

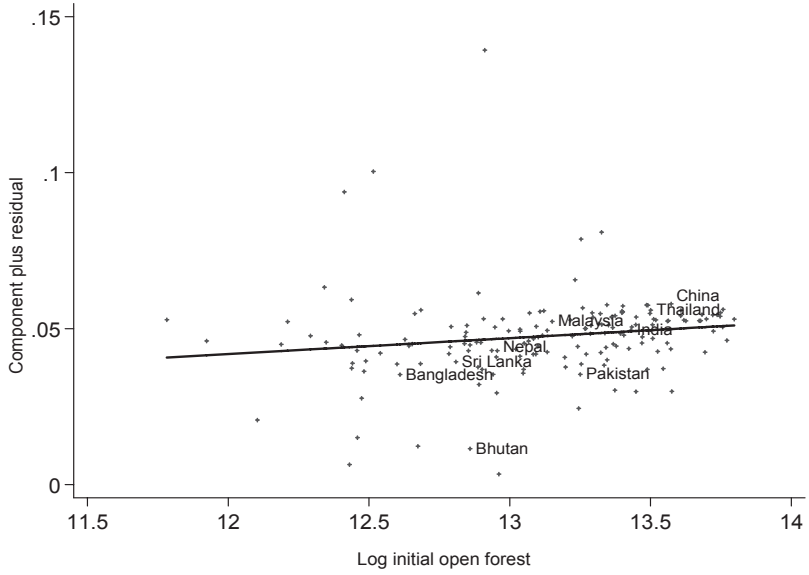
Product code	Dependent variable: growth rate of EXPY between initial and final years		
Log (initial EXPY)	-0.0373 (-7.77)[a]	-0.0367 (-9.27)[a]	-0.0365 (-9.33)[a]
Log (initial trade/GDP)	-0.0014 (-0.47)	—	—
Log (initial FDI/GDP)	0.0003 (0.15)	0.0008 (0.40)	—
Log (initial "open forest")	0.0039 (1.19)	0.0037 (1.61)[b]	0.0036 (1.61)[b]
Constant	0.315 (5.68)[a]	0.303 (5.63)[a]	0.304 (7.65)[a]
Number of observations	114	164	165
R^2 adjusted	0.3408	0.3419	0.3458

Source: Author's computations based on COMTRADE data.

Notes: [a] Indicates significance at 1% level.

[b] Indicates significance at 10% level.

Figure 11. Partial relationship between initial open forest and growth in export sophistication



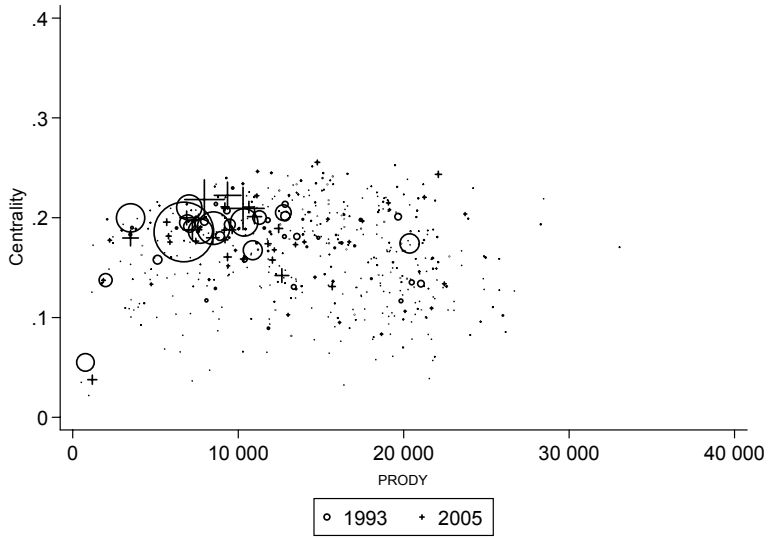
Source: Author's computations based on COMTRADE data.

Note: Open forest is a measure of the productivity potential from exploiting all the currently untraded products based on the density of the current export basket around these products.

Product space: centrality versus productivity index

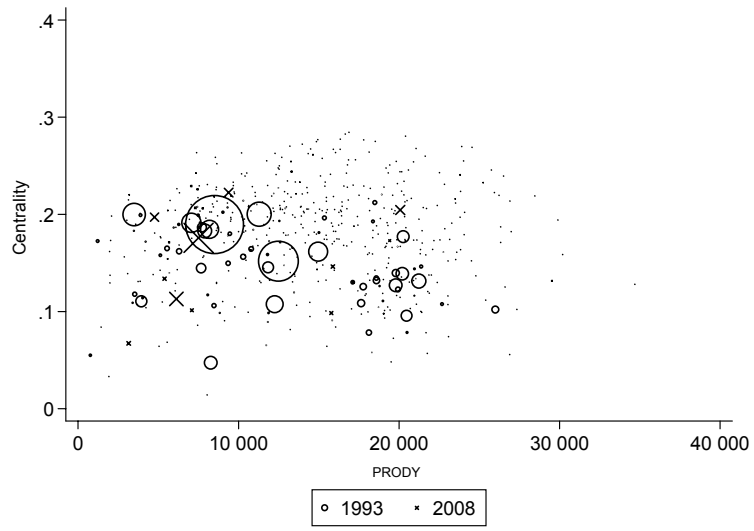
The product space can be characterized by the two measures defined above: (a) the centrality of a product, which indicates the potential for factor substitutability across products; and (b) the income or productivity index of a product (PRODY). One can obtain the distribution of each country's exports across both these characteristics and examine how this distribution changes over time. The pattern of specialization by different countries is revealed by the location of its exports in the product space. Exports of less developed countries are likely to be mostly peripheral (concentrated on products that are less central). They are also more likely to be concentrated in products with low productivity value. Shifts in these distributions can be expected for economies undergoing structural transformation. Figures 12-20 below depict the location of export values in the product space for different countries. In the case of Bangladesh we see that compared to the year 1993, in 2005 most of the export values continue to be low on productivity value but have moved up slightly to denser parts of the product space. In the case of Bhutan, there has been no appreciable change in its position in the product space between the years 1993 and 2008. India's export values, however, moved up on both the centrality and productivity scales between 1993 and 2008. For the East Asian economies, such as China, Malaysia and Thailand, the picture clearly shows that export values have substantially moved up to high-productivity values and also to denser parts of the product space. In the case of Sri Lanka many products in the export basket belong to the denser parts of product space in 2008. But in terms of export values a substantial part of the basket is in the low-productivity region as in 1993. Many more products in Nepal's export basket are centrally located in 2003 compared to 1994. Similarly, in the case of Pakistan quite a few products in 2008 are more centrally located compared to 1993, but a large part of exports in value terms remain in the low-productivity range. These results can also be looked at from the perspective of countries' capabilities, as in Hidalgo and Hausmann (2009). According to them a country's productive structure evolves from two sources: finding new products from combinations of the capabilities they already have, and accumulating new capabilities. Countries that are below the income expected from their capability endowment are yet to develop all of the products that are feasible with their existing capabilities.

Figure 12. Product space (1993 versus 2005): Bangladesh



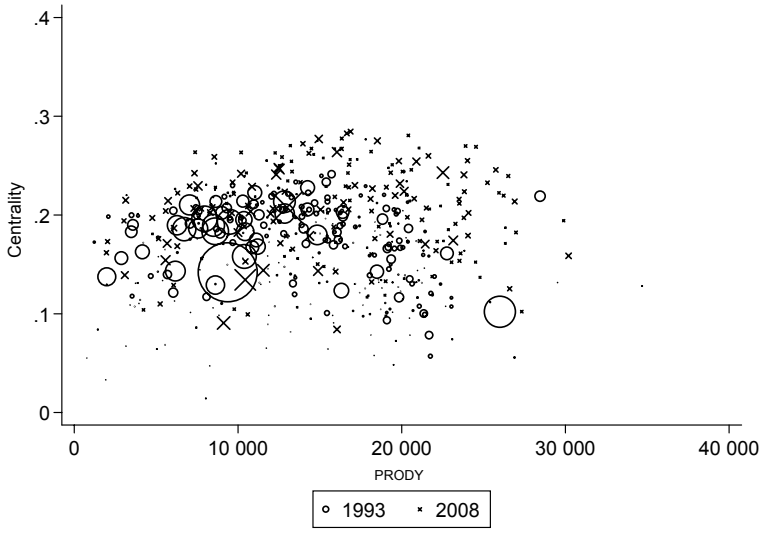
Source: Author's computations based on COMTRADE data.
Note: The size of the indicator is proportional to the value of exports.

Figure 13. Product space (1993 versus 2008): Bhutan



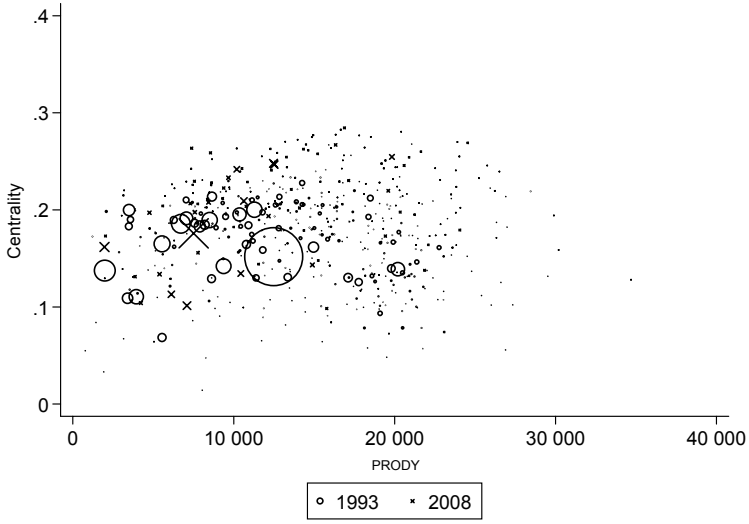
Source: Author's computations based on COMTRADE data.

Figure 14. Product space (1993 versus 2008): India



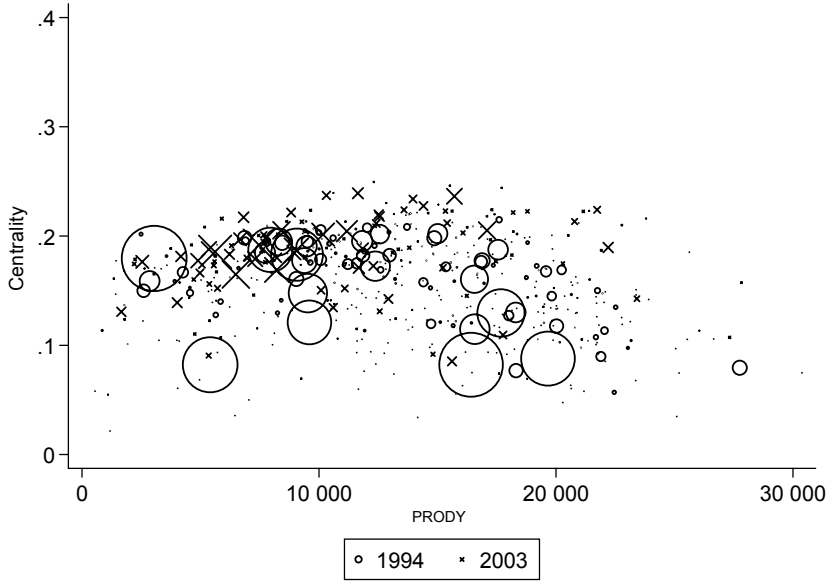
Source: Author's computations based on COMTRADE data.

Figure 15. Product space (1993 versus 2008): Sri Lanka



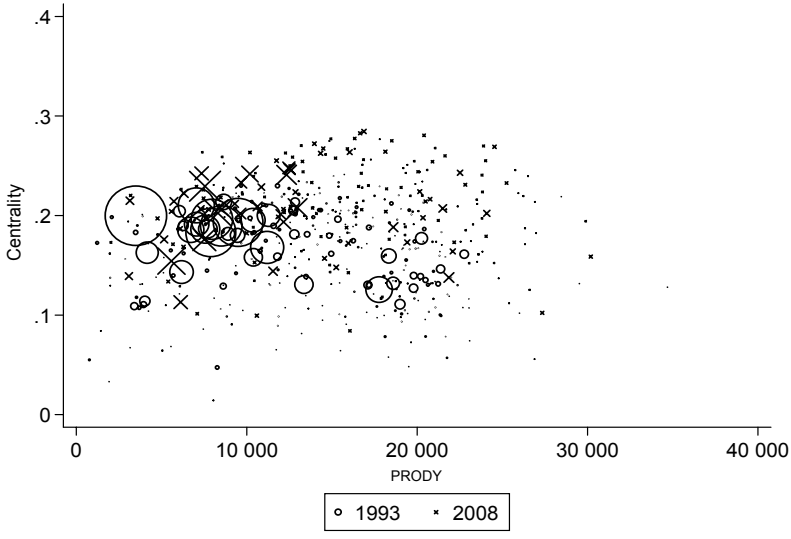
Source: Author's computations based on COMTRADE data.

Figure 16. Product space (1993 versus 2003): Nepal



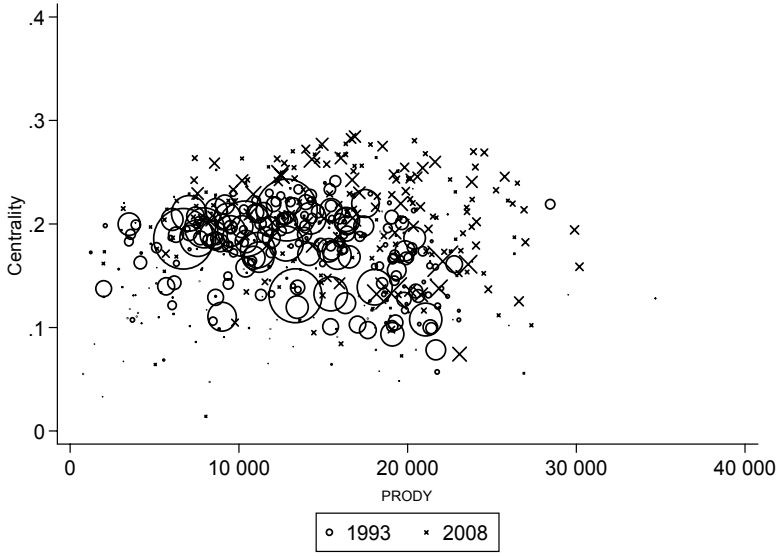
Source: Author's computations based on COMTRADE data.

Figure 17. Product space (1993 versus 2008): Pakistan



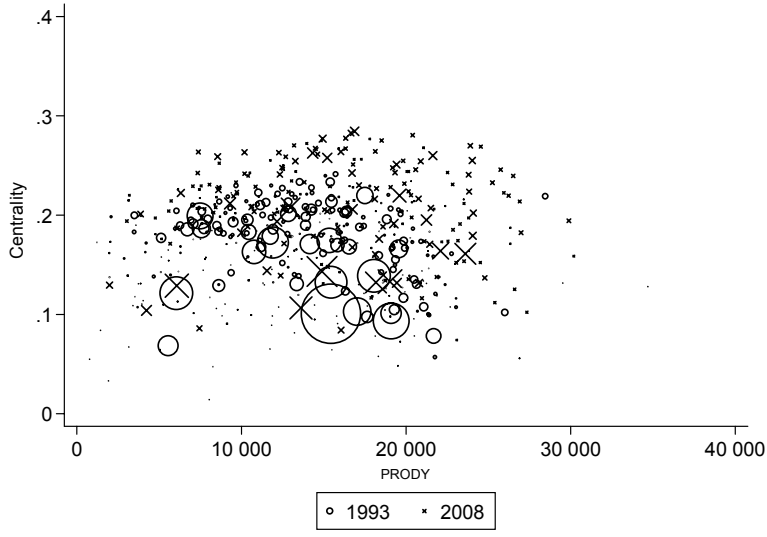
Source: Author's computations based on COMTRADE data.

Figure 18. Product space (1993 versus 2008): China



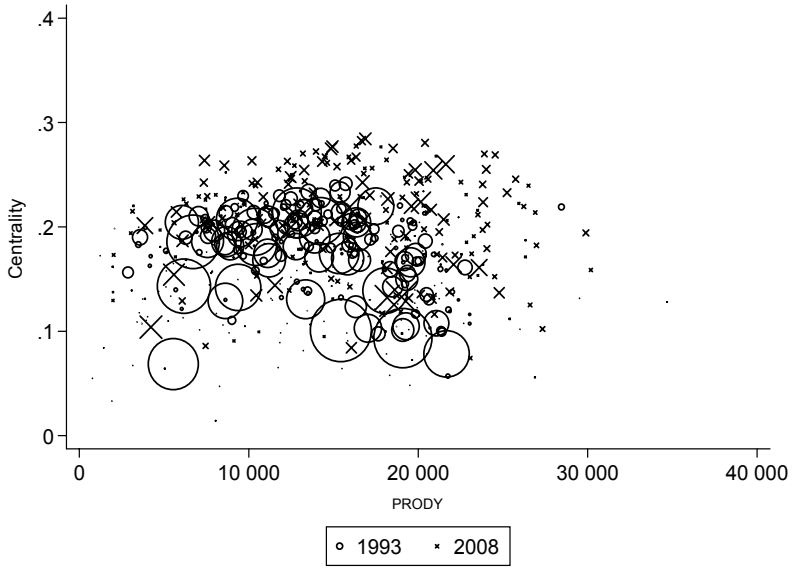
Source: Author's computations based on COMTRADE data.

Figure 19. Product space (1993 versus 2008): Malaysia



Source: Author's computations based on COMTRADE data.

Figure 20. Product space (1993 versus 2008): Thailand



Source: Author's computations based on COMTRADE data.

The share of the service sector has been increasing at a high rate in many of the South Asian economies to the extent that some authors suggest that these countries could achieve sustainable growth by skipping the industrialization phase. However, this is unlikely since there is a positive association between the level of sophistication of the production structure and economic growth and it is less likely that the service sectors are proximate to many high-value products. Moreover, there are limitations on generating employment in the high-skilled sectors, such as information technology, when the vast majority of the labour force is unskilled.

IV. CONCLUDING REMARKS

This study describes the structural transformation process in South Asian economies. The fact that per capita GDP has been high in recent years in most of these countries is due to impressive growth in the industry and service sectors. In terms of stability, the service sector growth has been most stable and agricultural growth the most unstable. For most South Asian countries the share of services in GDP exceeds the shares of manufacturing and agriculture sectors. However, agriculture constitutes the main source of employment in South Asia, absorbing the highest proportion of the labour force, namely between 40 and 60

per cent. Despite the rising share of services in India, only 25 per cent of total employment is provided by this sector.

Apart from analysing the sectoral shares of output and employment, the structure of exports of these economies is examined making use of a methodology developed in the recent literature on trade and growth. Based on this methodology a measure or index of export sophistication for each of the countries' export baskets is derived. As shown in the literature, a country's initial level of export sophistication is a significant factor in an economy's future growth. In this paper, it is found that in general, the level of sophistication is low for exports from South Asian economies compared to some of the East Asian ones, such as China, Malaysia and Thailand. However, export sophistication has been rising over the years in all the countries and the rise is remarkable particularly in the case of India and the rate is comparable to the East Asian countries. The low level of diversification of exports is one of the reasons for the slow structural transformation of these economies in terms of export sophistication.

The potential for future export sophistication for each of the countries depends on how close the current export basket is to currently unexported products, in particular, to high-value products. The proximity of a country's current exports to high-productivity products is determined by the ease with which factors of production used in the production of the former can be adapted for production of the latter. It is found that for all the countries the proximities or the density of the current export basket around high-value products is lower compared to the same around low-value products.

The average of the density of the export basket around the set of all unexploited products is obtained by a summary measure called open forest. Growth in export sophistication is found to be positively related to the initial level of open forest, controlling for the initial level of income. Among the South Asian countries, open forest is highest for India and lowest for Bhutan followed by Bangladesh.

Over time in most countries, exports moved towards products of high values and high degrees of centrality as measured by the proximities to other products in the product space. In general, government policy can play an important role in developing countries in accelerating the process of diversification into sophisticated products. Governments, in collaboration with the private sector, can identify strategic areas where innovations can be encouraged by adopting conducive infrastructure and trade policies. However, attempting to upgrade to sophisticated production structure through distortional policies may not be advisable as it may not be sustainable. What is important is to help develop capabilities and comparative advantage for sustainable growth.

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