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Changing Trade Structure and Its Implications for China

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I. Abstract

Based on the insight that the type of product an economy exports can have important implications for its economic performance and that goods exported predominantly by rich countries will have different characteristics from those exported by poor countries, Lall et al (2006) put forward a novel means of classifying commodities based on the income levels of a product's main exporters. At around the same time Hausmann et al (2006) following a similar approach put forward a slightly different form of product classification and Rodrik (2006) applied this specifically to an analysis of China. This paper highlights the difference between the approaches and its implications for the analysis of China, which appears less 'special' using the approach of Lall et al.

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II. Introduction

The argument that what it exports has strong implications for a country's growth prospects has a long tradition in development studies. Initially in the Prebisch-Singer version this focused on differences between manufactured and primary products. However following the shift of developing economies into manufactured exports a new version of this argument has emerged based on a difference between exports of manufactures in which developed countries dominate and those manufactures produced in developing economies. The difference is seen principally as due to technology, so that a higher skill-higher technology content, gives developed economy producers a stronger market position protecting profit margins and ensuring a higher value added content (see for example, Kaplinsky 2006). Not only is it argued that for technologically more sophisticated manufactures terms of trade shifts will be less unfavourable than for simpler manufactures, but prospects for demand growth are also seen as more favourable. These arguments have a particular relevance to China for several reasons. China's vast exports of manufactures now span a wide range of products and its competition has been seen as simultaneously depressing world market prices for labour-intensive manufactures (like clothing) whilst also taking world market share in more technologically advanced products (like electronics). In this latter context China's move into a number of relatively sophisticated and dynamic product lines is seen as a major threat to economies in S.E Asia and Latin America, particularly in the large North American market (Lall and Albadejo 2004, Lall and Weiss 2005, Jenkins et al 2008). In addition it has been argued that China's own economic growth has been strongly aided by its 'premature' shift of export structure, so that China’s export basket has moved much closer to that of developed economies than would be expected given its income level.

These are important arguments that as yet are difficult to resolve empirically. This paper examines two recently proposed ways of assessing trade structure and how they relate to China’s recent performance. Further empirical work is needed to assess fully the impact of export structure on growth prospects and this paper should be seen as preliminary contribution.

III. World market trends in the 1990’s

Data on the terms of trade case of a strong decline in the prices of developing country manufactures relative to developed country manufactures are at least suggestive if not conclusive. In a recent survey Kaplinsky (2006) cites the detailed work of Maizels looking at the import prices in the US, EU and Japanese markets, which in general show developing country manufactured export prices falling, but significantly with the prices of goods from the East Asian newly industrialised economies (with a more technologically sophisticated export structure) falling more slowly than the average. Kaplinsky and Santos-Paulino (2005) looked in detail at manufactured import prices into the EU at a highly disaggregate level finding that in about one third of case prices of goods from China fell. In general for other countries price falls were less likely the higher the income level of the exporting economy. They authors draw the conclusion that over the period the greater China’s participation in a global market the more likely it was for prices to fall and that this price competition was felt more strongly for low income exporters.

On the issue of demand growth UNCTAD analysed trends over the 1990’s and identified the fastest growing manufactured exports. Table 1 summarises the position of the 20 fastest growing products using a weighted comprehensive index explained in Mayer et al (2002).

Table 1: Ranking of twenty most dynamic products in world trade 1980-1998

Ranking	SITC code	Product group	Developing country share %[a]	Factor classification
1	776	Transistors and semi-conductors	46	High skill-high technology
2	752	Computers	36	High skill-high technology
3	871	Optical instruments	30	High skill-high technology
4	759	Parts of computers/office machines	38	High skill-high technology
5	764	Telecom equipment	24	High skill-high technology
6	714	Non-electrical engines/motors	4	Medium skill-medium technology-capital intensive
7	541	Medicinal and pharmaceutical products	8	High skill-high technology
8	781	Passenger motor vehicles	9	Medium skill-medium technology-capital intensive
9	792	Aircraft and equipment	6	High skill-high technology
10	846	Knitted undergarments	57	Labour-intensive-low technology
11	893	Plastic materials	23	Medium skill-medium technology-capital intensive
12	514	Nitrogen compounds	11	High skill-high technology
13	771	Electric power machinery	37	Medium skill-medium technology-capital intensive
14	553	Perfumery and cosmetics	10	High skill-high technology
15	772	Electrical apparatus	24	Medium skill-medium

				technology-capital intensive
16	872	Medical instruments	12	High skill-high technology
17	778	Electrical machinery	23	Medium skill-medium technology-capital intensive
18	515	Organo-inorganic/heterocyclic compounds	9	High skill-high technology
19	821	Furniture	21	Labour-intensive-low technology
20	773	Electricity distributing equipment	34	Medium skill-medium technology-capital intensive

Source : Mayer et al (2002) table 2 and 1

Note a) share refers to 1998 1

Using UNCTAD's own classification most dynamic products tend to be either in relatively high skill- high technology lines (although there is ambiguity in this classification that we return to below) in electronics and related products (for example computers and their component parts, precision equipment and pharmaceuticals) or in medium technology relatively capital intensive products where scale economies are important (like passenger vehicles and electrical machinery). The dynamic labour intensive product lines are in clothing and furniture. Different rankings are obtained using different measures of dynamism but the ranking by simple annual growth has four products out the top five in table 1 in its top five.

The developing country share is slightly misleading as it includes the first tier NIEs (Hong Kong, Korea, Taiwan and Singapore) and arguably this is a misleading classification for these economies. None the less as expected developing countries take relatively small shares world exports in several capital intensive product lines (for example passenger motor vehicles), often below 10%. However they take a majority share in the only clothing product shown (knitted under-garments) and a significant (that is over 30%) share in some very fast growing high technology products (transistors and semi-conductors, computers and their parts). The standard interpretation of this phenomenon (that is developing countries exporting high technology goods) is that the classification high technology refers to the overall product not to all of the processes used to produce it and that due to the process of international division of labour (*vertical specialisation*) production of the labour-intensive stages of the production of these goods has shifted to developing countries.

IV. Classification of export products: sophistication

Path-breaking work by Lall created a taxonomy of products based on their R and D intensity (that is R and D costs as a proportion of sales value) and this has been used widely to classify export structure (Lall 2000). This groups exports into nine technology categories by this R and D measure. Table 2 illustrates the approach using China's export structure in 2000. Broadly speaking by this classification, low technology products still dominate exports, although the share of high technology products is rising rapidly. A formal test of the similarity in export structure for 2000 found China to be closer to Korea and Taiwan in 1990 than to most of ASEAN in 2000. It was still very dissimilar from Japan (Lall and Albaladejo 2004).

Table 2: China's manufactured export structure 2000

Technology category	% of manufactured exports	Growth 1990-2000 % pa
Resource-based	9.5	12.3
Low technology	44.9	15.2
Of which		
Fashion cluster	27.9	13.3
Others	17.0	19.4
Medium technology	21.2	14.1

Of which		
Automotive	1.9	1.3
Process	6.2	15.7
Engineering	13.1	17.7
High technology	24.4	32.7
Of which		
Electronics	21.7	36.1
Others	2.7	19.8

Source: Lall and Albaladejo (2004: table 1)

A limitation of this analysis is that it does not allow for a distinction between production processes and products, since even relatively technologically advanced goods can still have simple labour-intensive stages in their production. In response to this Lall et al (2006) attempted to differentiate between products at the disaggregate level and to create an index (calculated at the 4 digit level) to capture their sophistication. This was done for 766 individual product categories by taking a weighted average of the incomes of all exporters of the good concerned with the weights given by their share in total world trade in the good. Hence we have

$$SIi = \sum(Xik/Xiw)*Yk \quad (1)$$

where SIi is the sophistication index for good i, Xik is exports of i from country k, Xiw is world exports of i , Yk is income per capita in k and summation is for all k.

Lall et al (2006) use SI in various ways including ranking between countries at the aggregate level (where SI is aggregated over all products in total trade), for comparing technology classifications and for establishing patterns within broad categories like textiles and electronics. The rationale is that within individual product categories the average income of exporting countries can be a useful proxy of the technological depth of a product; hence an electrical good from Japan may be deemed to have higher technology content than the same good from the Philippines. Similarly within apparel products exported by rich countries –or processes undertaken by them – are taken to be more skill, technology or marketing intensive and to yield higher profit margins and wages than the more standardized goods exported by poorer countries.

A comparison of the index scores with the technology classification of Lall (2000) is given in table 3.

Table 3: Average SI by technology category 4-digit level for world trade in 2000

Category	Score	
	Developed country	Developing country
Resource-based 1 (agro-based)	70.41	54.93
Resource-based 2 (mineral-based)	67.00	58.00
Low technology 1 (fashion)	44.26	38.74
Low technology 2 (others)	67.32	62.06
Medium technology 1 (automotive)	78.34	76.25
Medium technology 2 (process industry)	72.74	62.86
Medium technology 3 (engineering)	77.72	67.94
High technology 1 (electronics and electricals	68.74	65.68
High technology 2 (other)	84.88	78.80

Source Lall et al (2006) table 6 1

The links between the technology classification and the index are very limited no doubt reflecting the fact that the technology categories cover a range of products and processes. There is an association at the top and the bottom of the technology range. Hence high technology 2 products (the non-electronics) have the highest SI score and there is a clear distinction between all high technology goods and the fashion cluster (textile and clothing) in the low technology category. However the other low technology category has score that is not very different from the electronic high technology group, no doubt reflecting product fragmentation with the shift of assembly and simple operations in electronics to low wage locations.

In this analysis China appears only a modest outlier in 2000 (although more recent work will be needed to check the current situation). In terms of its overall SI China ranks 20th out of 30 countries for which a detailed analysis was undertaken. However more significantly when the SI is regressed on income per capita China appears above the regression line with a score about 1% above that predicted. However for the positive deviation from the predicted score for China is in fact lower than that for most of the NIE and middle income economies including Taiwan, Argentina, Thailand, South Africa, Malaysia, Brazil, the Philippines and Mexico (Lall et al 2006, Figure 1). Within the important sector of electronics China's sophistication score is almost exactly that predicted by its income level. In automotive products however its score is 11% above that predicted (Lall et al 2006: 234).

V. Classification of export products: productivity

Independently Hausmann et al (2007) applied the same approach, but using a different weighting system. Here PROD represents the income level of a particular good (calculated at the 6 digit level) but unlike the SI the weights used are the revealed comparative advantage of each country in the good concerned. Hence we have

$$PRODi = \sum ((Xik / Xtk)/(Xiw/Xtw))*Yk \qquad (2)$$

where PRODi is the income level for good i, as before Xik is exports of i from country k, Xiw is world exports of i, Yk is income per capita in k and summation is for all k. In addition Xtk is total exports of country k and Xtw is total world exports.

Rearranging we have

$$PROD_i = \sum ((X_{ik} / X_{iw})^* (X_{tw} / X_{tk}))^* Y_k \qquad (3)$$

The weights that result from the expression in brackets in (3) are then normalized to sum to unity. The difference from the procedure in (1) is that now the share of country k in world trade in product i is multiplied by the inverse of k's share in total world trade. This has the effect, which is intentional, of giving a higher weight to goods exported from small countries. Hence in this view even if the US exports more shirts say than Bangladesh if shirts are a product in which Bangladesh has specialized, but the US has not, they should be seen as a low productivity product.

Hausmann et al (2007) apply their PROD indicator to total trade of individual countries to calculate an overall measure akin to the sophistication index. What they term the 'productivity level of an economy's export basket' EXPY is a weighted average of PROD for all commodities with the weights given by their share in a country's trade. Their focus is on long term trends and they relate EXPY to performance growth over time and contrast actual EXPY with that expected for an economy's income level. As Lall et al (2006) point out because equation (1) uses trade shares as weights and because middle income economies have been gaining world market share in many products, there is a tendency for the SI for individual products to fall in nominal terms over time. This means that using SI it is more meaningful to compare country and product ranking at a point of time rather than analysing trends in its absolute value. An advantage of the weighting scheme of Hausmann et al is that as one would not expect revealed comparative advantage weights to shift systematically towards middle income economies there is no reason why PROD should decline for individual products. Hence at the product level dynamic comparisons over time are meaningful. However at the country level, EXPY as the weighted average of PROD for individual products can fall due to a change in the composition of export basket. This in fact is the case overall as the mean of EXPY across the country sample declines between 1992 and 2003 (Hausmann et al 2007 table 4). However whilst equation (2) may have an advantage at the product level the weighting scheme used to construct the PROD scores on which it is based is questionable. The idea behind SI is that good exported by predominantly high income countries have characteristics (partly reflecting technology but other features as well) that differ from those of goods exported by predominantly low or middle income economies. The rationale for using an indicator deliberately skewed towards goods exported by small exporting economies at any income level is not clear. Table 4 gives a simple illustration for two economies (one larger than the other in trading terms) and a third economy taken as the rest of the world. It shows how the country weights differ for SI and for PROD and how the absolute values of the indicators change as a result. Further when two products are compared, depending upon the trade shares and income levels involved, it is possible for one to have a higher SI but a lower PROD as compared with the other product. In this case the two indicators will give conflicting comparisons between the two products.

Table 4: Illustrations: products a and b

Product a	Country 1	Country 2	ROW	World
Exports a	4000	4000	8,000	16,000
Total exports	20,000	40,000	100,000	160,000
Income per capita	1300	2500	3000	
Weights (1)	0.25	0.25	0.5	
SIa	2137.5			
Weights (3)	0.526	0.263	0.210	
PRODa	1644.7			
Exports b	2000	8000	10000	20,000
Total exports	20,000	40,000	100,000	160,000
Income per	1300	2500	3000	

capita				
Weights (1)	0.10	0.40	0.50	
SIb	2130			
PRODb	1700			

Table 4 shows two countries 1 and 2 and a third the rest of the world (ROW) and two products a and b. For a countries 1 and 2 have the same export value and hence the same share in world trade and thus using (1) the weights on their income per capita are equal. Their incomes per capita are close at $1300 and $1250 respectively and well below the ROW average of $3000. The SI using these income figures and weights is $2137.5. However applying (3) we must allow for the different size of a and b in world trade. The total exports of 1 are half those of 2 and as in (3) trade share must be multiplied by the inverse of the country's share in world trade ((Xtw / Xtk), this means that when the weights from (3) are normalized relative to unity that on 1 is twice the weight on 2 and more than twice that on the rest of the world. In other words despite their exporting similar values, country 1 is twice as specialised in a as is country 2. The resulting PROD for a is $1644.7

Comparison between the absolute values of SI and PROD is not meaningful as they are specified in different ways but a comparison across products using both indicators as alternatives should cast light on the nature of the products. Table 4 also shows similar data for product b. Here country 2 exports four times as much of b as country 1 and hence the share of 2 in world trade is four times as high. The relevant SI is $2130, which is slightly below that of a. However the share of b in total exports is twice as high in 1 as in 2 and thus using (3) the weight on country 1 is twice that on 2. The resulting value of PROD is $1700. Thus in a comparison between a and b, SI suggests b is the more 'sophisticated', whilst PROD suggests that b has the 'higher productivity.'

Which judgement is correct depends on interpretation. Are technologically sophisticated high productivity goods those where high income economies dominate the world market in sales or are they the goods in which such countries specialise? The analysis in Lall et al implies the answer is the former and that of Hausmann et al that the latter is correct. Part of the difficulty is in product disaggregation. Returning to the shirts example even if they are within the same 4 or 6 digit classification the US shirts may be non-competing with those from Bangladesh due to brand or quality differences. If this is the case, using trade shares as weights the error will be smaller than using revealed comparative advantage.

VI. The Chinese case

Rodrik (2006) uses the EXPY indicator to analyse China's exports arguing that its export structure is skewed considerably more than expected for its income level towards high productivity goods and that this has been an important feature of its economic performance and high export growth. As he puts it ' had China only exported those goods that countries at China's level of income tend to export, its growth rate would have been significantly lower' (Rodrik 206: 13).

Lall et al (2006) agree with the general thrust of the argument that what a country exports clearly matters. As noted above earlier work has shown that China's technology composition of exports has shifted towards the medium and high technology end of the spectrum although its structure still does not match that of the original Tiger economies and even newer arrivals like Thailand and Malaysia. When SI per country is related to income per capita in 2000 China is found to be an outlier (as it is in Rodrik 2006) but not dramatically so. Its SI score is higher than predicted based on a simple regression against income and is higher than that of India and Indonesia, however the positive deviation from the predicted score for China is in fact lower than that for most of the NIE and middle income economies including Taiwan, Argentina, Thailand, South Africa, Malaysia, Brazil the Philippines and Mexico. In Rodrik's results for 2003 not all of these countries are included, but China has a much larger deviation than Brazil and a slightly larger one than for Mexico. Hence using the SI index, at least for 2000, China appears much less special than in the analysis of Rodrik (2006).

The growth analysis of Hausmann et al (2007) considers whether initial levels of export productivity as measured by EXPY can explain subsequent growth controlling for initial income levels. The results show a positive and significant relation between EXPY in 1992 and subsequent growth 1992-2003. The estimated coefficient on EXPY implies that 'a doubling of the productivity level of a country's exports results in an increase in its overall per capita GDP growth of around 6%' (Rodrik 2006: 13). When we test for a similar double-log relation between initial SI in 2000 and subsequent growth 2000- 2005 controlling for income per capita, however unlike the results in Hausmann et al (2007) where export productivity has a significant positive relation with subsequent growth, we find SI to be very weakly significant, but with a negative sign. Further in this simple regression model China is a major positive outlier with nearly seven percentage points of its average annual growth unexplained. The analysis is very simple and clearly other factors need to be brought into the model, but at first sight SI seems a much less powerful explanatory factor for China's growth than EXPY.

VII. Conclusions and future research

Even accepting the basic argument of Hausmann et al (2007) and of Rodrik (2006) that the structure of export products matters for growth, at the macro level it is not possible to replicate their results using the Sensitivity Index. There can be a number of reasons for differences in results. One is the different periods chosen. More likely to be significant however are differences of level of disaggregation and weighting. Hausmann et al (2007) work at the six digit level, whilst Lall et al (2006) work at four digits. It is clearly preferable in this form of analysis to disaggregate as far as possible and the Sensitivity Index could usefully be extended to the six digit level. Slightly paradoxically we argue that although it is difficult to say one weighting scheme is unambiguously superior to the other, the more disaggregate the analysis the more likely it is that weighting by trade value, as in Lall et al (2006), will be more accurate than weighting by revealed comparative advantage. However Lall et al do not stress the macro economic dimension of the SI preferring to focus on what it may reveal on differences within and between product categories. This differs from the focus in Hausmann et al and Rodrik which is principally on trends in macro performance, so that it is mainly the aggregate measure EXPY covering all exports rather than the product level estimates PROD, which matter.

On the specific analysis of China the shift in its export structure has been highlighted a number of times. However use of the Sensitivity Index to reflect export structure shows China to be rather less special than the analysis of Rodrik (2006). This is also true for the important sector of electronics. This may partly be due to the fact that China's export structure is shifting rapidly and Rodrik's analysis focuses on 2003, whilst the Sensitivity Index for China is calculated for 2000. The difference in weighting scheme may also be important here. However in our results much less of China's outlier status seems due to the type of goods it was exporting (at least in 2000).

Future research can helpfully clarify these aspects. Both sophistication and productivity product measures can be updated and compared and used in further analyses of trade structure. China's outlier status can be reassessed in a more detailed model and Rodrik's growth analysis for China can be revised and extended with the addition of further explanatory variables. An important test will be of the basic hypothesis that 'rich country manufactures' face better price or demand prospects that those manufactures in which poor countries are major exporters on the world market or in which they specialise. Either one or both of the indicators examined here can be applied in this test.

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