Electronics Production Upgrading: Is China Exceptional?

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Abstract

In this paper, we make use of a unique world electronics production data set to assess China's upgrading trajectory in the global electronics industry. Contrary to existing studies, we find no evidence that China's electronics production activities are more sophisticated than one would expect from its level of development. We also find little evidence that China is rapidly upgrading into more sophisticated production activities.

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1 Introduction

China's economy seems to be upgrading rapidly. Where fifteen years ago China was primarily an exporter of low-tech products such as apparel, toys and footwear, today it has become the world's largest exporter of electronics products (OECD, 2005). This has caused concern in the West that China is rapidly moving up the technology ladder and becoming increasingly competitive in areas of comparative advantage for Western economies.

A number of recent studies have used trade data to show that China indeed has become more sophisticated than one would expect given its level of development. Rodrik (2006) and Hausmann *et al.* (2007) develop a methodology to assess a country's position on the technology ladder by analyzing the composition of its export bundle.[1] They posit that an export good is more sophisticated the higher the weighted average income of its exporting countries. This permits a ranking of export products according to their "implied productivity." They then use each country's export composition to estimate the degree of sophistication of its export bundle vis-à-vis the rest of the world. Rodrik (2006) and Hausmann *et al.* (2007) find that the bundle of goods that China exports is similar in sophistication to exports of countries with income levels three times higher than that of China, thus leading Rodrik (2006) to conclude that "China has somehow managed to latch on to advanced, high productivity products that one would not normally expect a poor, labor abundant country like China to produce, let alone export."

Using a similar logic, Schott (2006) has recently used Finger and Kreinin's (1979) export similarity index to demonstrate that China's exports are surprisingly similar to the export structure of OECD countries. This has led Schott (2006) to conclude that "China's export bundle increasingly overlaps with that of more developed countries, rendering it more sophisticated than countries with similar endowments."

The main shortcoming of these studies is that trade patterns can be a poor indicator of a country's set of comparative advantage goods (Baldone *et al.*, 2006; Van Assche, 2006). International trade data are generally collected and reported as gross flows rather than as foreign value added, making it difficult to attribute the type of production activities that have taken place in an exporting country (Grossman and Rossi-Hansberg, 2006). Indeed, in a world with international production fragmentation and intermediate good trade, a country's exports do not necessarily reflect the embodied technology and relative endowments that have gone into the country's domestic

[1] Lall *et al.* (2006) have developed a similar approach, but did not focus on China.

production activities, but may simply reflect the technology and factors of the countries from which it imports intermediate goods. To illustrate this, consider an export good z that is produced through the assembly of inputs x and y. In Figure 1, we depict two scenarios. In Scenario 1, the production of the inputs x and y and the assembly of product z all occur at home. In Scenario 2, the inputs x and y are imported from abroad, while only the assembly occurs at home. Although the amount and type of production activities differ in the two scenarios, the export pattern is identical. This implies that export data will overestimate a country's production activities in industries with a large share of processing trade.[2]

Two features of China's export system suggest that its estimated sophistication level is likely to be biased upward more than other countries. First, China's foreign trade expansion in the last few decades is mainly due to a rise in processing exports. In 1986, processing exports accounted for only 18 percent of China's total exports, while by 2005 they had risen to more than 55 percent (Naughton, 2007). Second, the share of processing exports in total exports has consistently been higher in high-tech industries such as electronics than more traditional industries such as textiles, leather and shoes (Gaulier *et al.*, 2005). These two characteristics suggest that the existing literature's result that China's export bundle is relatively more sophisticated than one would expect from the country's level of economic development might be a statistical mirage.

In this paper, we provide an alternative estimate of China's position on the global technology ladder by making use of a unique data set of world electronics production compiled by Reed Electronics Research.[3] Contrary to existing studies, we find no evidence that China's electronics production activities are more sophisticated than one would expect from its level of development. We also find little evidence that China is rapidly upgrading into more sophisticated production activities.

[2]Processing trade encompasses imports of goods to be assembled or transformed in China and re-exported, within international assembly and subcontracting operations. These imported inputs are exempted from tariffs.

[3]Production data could be subject to the same difficulty in identifying value added as opposed to the value of gross sales, which could in some cases, "amount to little more than assembly of imported piece-parts and sub-assemblies." The problem is likely smaller than for export values, however, since goods are counted in production only when "value is added in the assembly process and the finished article can be classified under a different SIC (Standard Industrial Classification) from those of its components." (Reed Electronics Research, 2007.)

2 Data and Methods

The Reed Electronics Production Data Set (REP) measures a country's domestic production by electronics subcategories for 51 countries. The coverage and degree of disaggregation in the REP varies between countries, but we have been able to extract a consistent panel for 13 electronics subcategories from 1992 to 2005 (See Table 1 for the list of product subcategories). The subcategories range from computers and peripherals to medical equipment, audio and video equipment, semiconductor parts, and even electronic clocks and watches.

[Table 1 about here]

In Table 2, we present summary statistics from the REP data set. The table clearly identifies the emergence of China (and the rest of developing East Asia) as a dominant player in the global electronics industry. China's electronics production has grown at a remarkable rate of 24.8 percent between 1992 and 2005. As a result, China's share of world electronics production has risen from 1.9 percent in 1992 to 18.4 percent in 2005. With a value of production of 260.1 billion U.S. dollars, it has surpassed that of the European Union and Japan, just lagging behind the U.S. electronics production value.

[Table 2 about here]

The rapid rise in China's share of global electronics production, however, does not necessarily mean that China is upgrading technologically. The electronics sector is a highly heterogeneous industry that consists of production activities that vary greatly in their sophistication levels. If China is primarily specialized in production activities with low sophistication levels, then China's rise in the global electronics industry does not necessarily go hand-in-hand with technological upgrading. To analyze China's position on the global technological ladder, it is therefore necessary to take into account the composition of production activities that take place within its electronics industry.

Revealed comparative advantage (RCA) indices are often used to measure patterns of specialization in trade.[4] We can compute a similar index to measure patterns of production specialization. Let $x_{i,c}$ denote the production value of electronics subcategory i in country c, then $X_c = \sum_i x_{i,c}$ equals country c's total electronics production value. Then the *production intensity index* (PII) is given by:

$$PII_{i,c} = (\frac{x_{i,c}}{X_c})/(\frac{\sum_c x_{i,c}}{\sum_c X_c}). \quad (1)$$

Values greater than one indicate that the country has a greater share of its electronics production in the product subcategory than world producers as a whole.

Table 3 presents the production intensity indices based on production data for each electronics subcategory for China, the ASEAN-4 (Indonesia, Malaysia, the Philippines and Thailand), the Newly Industrialized Economies (NIEs: Hong Kong, Singapore, South Korea and Taiwan), Japan, the United States and the EU-15. Average indices are reported for both the 1992–1994 and 2003–2005 periods. The production specialization patterns vary greatly across countries. In 2003–2005, for example, China was particularly specialized in the electronics sub-categories *audio equipment*, *electronic data processing (EDP)*, *other components* and *video equipment*. The United States, on the other hand, was specialized in the production of very different subcategories including *x-ray & medical equipment*, *control and instrumentation*, *office equipment* and *radio communications & radar*.

[Table 3 about here]

Even if China begins at a lower echelon of the global technological ladder, it can upgrade by gradually specializing in more sophisticated production activities. And in fact, a comparison of China's production intensity indices for 1992–1994 and 2003–2005 shows that China's specialization pattern has changed over the past two decades. Specifically, its electronics industry has

[4]The revealed comparative advantage (RCA) index (Balassa 1965), a measure of trade specialization, is generally calculated as a country c's share of world exports of a good i divided by its share of total world exports: $RCA = (\frac{ex_{i,c}}{EX_c})/(\frac{\sum_c ex_{i,c}}{\sum_c EX_c})$. Values greater than one indicate that the country has a greater share of its exports in the product category than world exporters as a whole. In this paper, we use the same methodology, but use production data instead of export data.

become more specialized in sub-categories *electronic data processing* and *radio communications & radar*, while becoming less specialized in *personal consumer electronics* and *audio equipment* among others (see Table 3).

To estimate China's position on the technology ladder as well as its upgrading trajectory in the electronics industry, we use a methodology similar to Rodrik (2006) and Hausmann *et al.* (2006). In a first step, we estimate the level of technological sophistication of a product as the weighted-average income of its producers. The rationale behind this is that, in the absence of trade interventions, richer countries generally will have characteristics that provide a comparative advantage in more-advanced industries. These characteristics may include high capital abundance, the embodiment of higher-level technology and better institutions. Let Y_c represent country c's per-capita GDP in current prices, with the other symbols as defined above. Then the level of product sophistication S for good i is given by

$$S_i = \sum_c \frac{x_{i,c}/X_c}{\sum_c (x_{i,c}/X_c)} Y_c. \tag{2}$$

The numerator of the weighting expression is the share of product i in overall production for a country. The denominator gives the sum of these shares across all countries. Therefore, the index is a weighted average of national incomes, where the weights reflect patterns of relative specialization in that good. It is straightforward to rearrange equation (2) so that a country's weight is a function of all countries' production intensity indices:

$$S_i = \sum_c \omega_{i,c} Y_c \tag{3}$$

where

$$\omega_{i,c} = \frac{\mathrm{PII}_{i,c}}{\sum_c \mathrm{PII}_{i,c}}.$$

The value of sophistication index, S_i, summarizes the average income of countries specialized in the production of good i. Note that there are two reasons why a good's sophistication index may increase. First, it may increase because rich countries increase their specialization in the production of good i. Second, it may increase because the countries that are specialized in good i get relatively richer than the rest of the world.

Once the sophistication index has been estimated for all goods i, one can calculate a country's technology index CTI as the weighted average of the sophistication levels of the products that it produces:

$$CTI_c = \sum_i \theta_{i,c} S_i. \tag{4}$$

where a product's weight $\theta_{i,c}$ equals the share of good i in country c's total electronics output:

$$\theta_{i,c} = \frac{x_{i,c}}{X_c}.$$

3 Results

In this Section, we present the results in three parts. In subsection 3.1, we discuss how electronics subcategories are ranked in terms of their degree of sophistication and how this has changed over time. In subsection 3.2, we then analyze how China's estimated technology index compares to other countries. Finally, in subsection 3.3, we compare China's technology index to its level of development.

3.1 Product Sophistication Index

In Table 4 we present the average sophistication indices for the various electronics subcategories in 1992–1994 and 2003–2005 respectively. We can make a couple of observations concerning the sophistication rankings. First, it might seem surprising that *personal consumer electronics* is ranked as the most sophisticated electronics subcategory, since it primarily accounts for items such as electronics clocks and watches. This can be explained by the fact that the world's richest country—Switzerland—produces almost a third of the total value of *personal consumer electronics.*

Second, the ranking of electronics subcategories has remained fairly stable across time. The three most sophisticated subcategories are consistently *personal consumer electronics*, *x-ray & medical equipment* and *control & instrumentation*, while the four least sophisticated products are *video equipment*, *audio equipment*, *office equipment* and *industrial equipment.*

Third, there is one electronics subcategory that has seen a dramatic change in ranking: *electronic data processing (EDP).* In 1992–1994 it was ranked as the 4th most sophisticated product, while in 2003–2005 it had dropped to 9th place. This drop in ranking is because developed countries in the last two decades have significantly reduced their specialization in *EDP*, while developing countries have increased their specialization. Indeed, the PII index for *EDP* of developing countries including China, the ASEAN-4 countries, Mexico and a number of Eastern European countries all increased significantly between 1992 and 2005. At the same time, many EU-15 countries, Japan, the United States and Canada have reduced their specialization in *EDP*. This trend can be attributed to the large-scale offshoring of *EDP* assembly plants by multinational firms to developing countries primarily in East Asia, made possible by changes in technology and the economic environment that facilitated the vertical fragmentation of computer production (Dedrick and Kraemer, 1998; Bonham *et al.*, 2006).

[Table 4 about here]

3.2 Country Technology Index

In Table 5, we present the Country Technology Index (CTI) in the global electronics industry. A number of observations stand out. First, Switzerland and the Scandinavian countries Denmark, Norway, Finland and Sweden have the highest technology indices in 2003–2005 due to their high specialization in the most sophisticated subcategories *personal consumer electronics*, *x-ray & medical equipment*, *control & instrumentation* and *radio & radar communications*. In Switzerland, for example, almost a third of its electronics production in 2005 was in *personal consumer electronics* and a quarter of its electronics production was in *control & instrumentation*. Two thirds of Finland's electronics production in 2005 was in *radio & radar communications*, chiefly cellular phones.

[Table 5 about here]

The very high ranking of Saudi Arabia and Puerto Rico may be surprising. For Saudi Arabia, this is due to their high specialization in *radio & radar communications* and *x-ray & medical equipment*.[5] For Puerto Rico, this is due to the fact that 44.1 percent of its electronics production value in 2005 was *x-ray & medical equipment*.

There are several countries that have made large moves up or down the rankings since the 1992–1994 period. Finland's move up from 15th place to 4th place in the rankings reflects a doubling of its degree of specialization in *radio communications* with the cellular phone boom. Austria's jump from 44th to 20th place reflects a shift from low-sophistication *audio and video*

[5] The fact that Saudi Arabia's overall trade is dominated by oil exports does not affect the present analysis, which focuses only on the country's pattern of specialization within the electronics sector.

equipment to higher-sophistication areas including *control and instrumentation*, *x-ray and medical equipment* and *active components* and *passive components*. Hong Kong's (surprising?) drop from 9th to 26th place reflects a rise in relative production shares for *office equipment*, *industrial equipment* and *audio equipment*. In the case of Ireland, it appears that the marked decline in ranking is associated with the drop in the estimated product sophistication of *electronic data processing*, in which Ireland is particularly heavily specialized.

Notably, our analysis provides little evidence that China has rapidly moved up the global technological ladder. While China was ranked 42nd in 1992–1994, it has only moved up to the 39th position in 2003–2005.

3.3 CTI vs. Level of Development

The primary question we want to address is whether the sophistication of China's electronics production is unusually high given its level of economic development. As we discussed above, several authors have argued that this is the case for overall Chinese production based on an analysis of export data. Does this result hold up when electronics production data are considered? The answer is a resounding "no".

In Figure 2, we show the scatter plot of CTI against per-capita GDP in 2003–2005. Similar to the export analysis of Rodrik (2006) and Hausmann *et al.* (2007), we find that there is a positive correlation (the correlation coefficient is 0.64). Richer countries tend to have higher country technology index values.[6] However, unlike these authors, we do not find that China is a positive outlier. Rather, we find that China lies dead on the regression line, implying that we find no empirical evidence that China's level of technological sophistication in electronics is higher than one would expect for its level of development.[7]

[Figure 2 about here]

[6] As noted by Hausmann *et al.* (2007), the positive relationship between CTI and per-capita GDP is partly by construction, since a commodity's sophistication is determined by the per-capita income of countries that are important producers of the good. However, this accounts for only a limited part of the positive correlation.

[7]

4 Conclusion

In this paper, we have made use of a unique world electronics production data set to assess whether China's electronics industry is more sophisticated than one would expect from its level of development. Contrary to existing studies, we find no evidence of this, nor do we find evidence that China is rapidly upgrading into more sophisticated electronics production activities.

There are admittedly some strong assumptions embedded in this analysis—assumptions common to this literature. While it is plausible that income levels of producing countries may proxy for technology level, this is clearly imperfect. The mapping from production location to product sophistication is also potentially problematic. For example, whether a part is produced locally or imported from a lower-wage country may have as much to do with whether a final good can be easily modularized as it does with the technological sophistication of the underlying production process (Van Assche, forthcoming). It would be useful to have more sophisticated measures of product sophistication based on factor endowments and measurable productivity.

The idea of using income levels and specialization patterns to evaluate productivity levels is an appealing one. But if one wants to take this seriously, one must acknowledge the fundamental shortcoming of gross international trade data, which may tell us little about actual value added. Our results based on production data for electronics provide a striking contrast to the earlier broad trade-based results and challenge the common assertion that China is a positive outlier in the sophistication of its production.

References

[1] Balassa, B. (1965) "Trade Liberalisation and Revealed Comparative Advantage", The Manchester School of Economic and Social Studies, 33, pp. 99-123.

[2] Baldone, S.; Sdogati, F.; Tajoli, L. (2006) "On Some Effects of International Fragmentation of Production on Comparative Advantages, Trade Flows, and the Income of Countries," CESPRI Working Paper No. 187.

[3] Bonham, C.; Gangnes, B.; Van Assche, A. (2007) "Fragmentation and East Asia's Information Technology Trade," Applied Economics, 39:2, pp. 215-228.

[4] Dedrick, J.; Kraemer, K., 1998. Asia's Computer Challenge: Threat or Opportunity for the United States and the World? Oxford: Oxford University Press.

[5] Finger, J.; Kreinin, M. (1979). "A Measure of Export Similarity and Its Possible Uses." Economic Journal 89, pp. 905-912.

[6] Gaulier, G.; Lemoine, F.; Unal-Kesenci, D. (2005). "China's Integration in East Asia: Production Sharing, FDI and High-Tech Trade," CEPII Working Paper No. 2005-09.

[7] Grossman, G.; Rossi-Hansberg, E. (2006). "Trading Tasks: A Simple Theory of Offshoring." National Bureau of Economic Research Working Paper No. 12721.

[8] Hausmann, R; Hwang, J.; Rodrik, D. (2007). "What You Export Matters." Journal of Economic Growth, 12:1, pp. 1-25.

[9] Lall, S.; Weiss, J.; Zhang, J. (2006). "The Sophistication of Exports: A New Trade Measure," World Development 34:2, pp. 222-237.

[10] Naughton, B. (2007). The Chinese Economy: Transitions and Growth. Cambridge, MIT Press.

[11] OECD (2005). "OECD finds that China is biggest exporter of Information Technology Goods in 2004, surpassing US and EU," www.oecd.org/document/8/0,2340,en_2825_495656_35833096_1_1_1_1,00.html.

[12] Reed Electronics Research (2007). "Guide to the Interpretation of the Statistics." Mimeo.

[13] Rodrik, D. (2006). “What’s So Special about China’s Exports?” China and the World Economy 14:5, pp. 1-19.

[14] Schott, P. (2006). “The Relative Sophistication of Chinese Exports.” NBER Working Paper 12173.

[15] Van Assche, A. (2006). “China’s Electronics Exports: Just A Standard Trade Theory Case”, Policy Options 27:6. 79-82.

[16] Van Assche, A. (forthcoming). “Modularity and the Organization of International Production” Japan and the World Economy.

Table 1: Product categories

Mnemonic	**Category**	**Type of Products**
EDP	Electronic data processing	*Computers, peripherals*
OFF	Office equipment	*Photocopiers, electronic calculators*
CON	Control and instrumentation	*Measuring instruments, control systems*
XME	X-ray and medical equipment	*X-ray equipment, electromedical equipment*
IND	Industrial equipment	*Traffic signaling, security and fire alarms*
COM	Radio communications and radar	*Mobile radio telephones, pagers*
TEL	Telecommunications	*Telephones, fax, answering machines*
VID	Video equipment	*Television, video camera, DVD player*
AUD	Audio equipment	*Portable audio, car audio, CD player*
PCE	Personal consumer equipment	*Electronic clocks, electronic watches*
ACT	Active components	*Integrated circuits, diodes, transistors*
PAS	Passive components	*printed circuit boards, relays, switches*
OTH	Other components	*Microphones, loudspeakers, amplifiers*

Source: Reed Yearbook of World Electronics Data

Table 2: Developments in Electronics Production

	Electronics Production ($ Mill)			Share of world electronics production (%)		Electronics production /GDP (%)
Country	**1992**	**2005**	**CAGR (%) 1992–2005**	**1992**	**2005**	**2005**
China	14,626	260,161	24.8	1.9	18.4	11.7
United States	212,757	282,697	2.2	28.3	20.0	2.3
EU 15	173,679	225,689	2.0	23.1	15.9	1.8
Japan	193,417	192,878	-0.0	25.7	13.6	4.2
NIEs	73,684	200,139	8.0	9.8	14.1	14.0
Hong Kong	*8,499*	*3,874*	*-5.9*	*1.1*	*0.3*	*2.2*
South Korea	*25,970*	*106,561*	*11.5*	*3.5*	*7.5*	*13.5*
Singapore	*20,244*	*48,373*	*6.9*	*2.7*	*3.4*	*41.4*
Taiwan	*18,980*	*41,331*	*6.2*	*2.5*	*2.9*	*12.0*
ASEAN-4	22,591	97,584	11.9	3.0	6.9	14.2
Indonesia	*2,169*	*11,352*	*13.6*	*0.3*	*0.8*	*4.0*
Malaysia	*12,361*	*48,968*	*11.2*	*1.6*	*3.5*	*37.4*
Philippines	*1,949*	*13,915*	*16.3*	*0.3*	*1.0*	*14.1*
Thailand	*6,112*	*23,349*	*10.9*	*0.8*	*1.6*	*13.5*
Total Market	752,961	1,415,222	5.0	100	100	3.2

Source: *Yearbook of World Electronics Data*. GDP from IMF

Table 3: Production intensity index

	PII													
	China		ASEAN-4		NIEs		Japan		United States		EU-15		ROW	
	1992-1994	2003-2005	1992-1994	2003-2005	1992-1994	2003-2005	1992-1994	2003-2005	1992-1994	2003-2005	1992-1994	2003-2005	1992-1994	2003-2005
PCE	4.39	1.52	0.74	0.80	1.99	0.63	0.93	0.58	0.33	0.42	0.30	0.32	1.13	1.60
XME	0.25	0.13	0.14	0.10	0.11	0.13	0.85	0.70	1.53	2.07	1.15	1.54	1.12	1.52
CON	0.26	0.18	0.14	0.21	0.11	0.10	0.44	0.57	1.48	1.80	1.70	2.16	1.53	1.76
COM	0.51	0.71	0.42	0.29	0.32	1.09	0.50	0.91	1.84	1.40	1.09	1.18	1.01	1.05
PAS	1.38	0.82	0.73	1.05	1.02	0.90	1.21	1.63	0.81	0.69	1.05	1.15	0.99	1.05
TEL	0.80	0.88	0.62	0.49	0.50	0.33	0.82	0.58	0.88	1.29	1.59	1.46	1.53	1.53
OTH	1.77	1.66	0.95	1.45	1.58	0.93	1.14	0.88	0.76	0.55	0.84	1.00	0.84	0.93
ACT	0.55	0.25	1.83	1.84	1.56	1.94	1.42	1.73	0.90	0.87	0.45	0.61	0.44	0.47
EDP	0.59	1.75	0.81	1.15	1.33	0.99	1.04	0.67	0.94	0.80	0.95	0.78	0.95	0.85
IND	1.15	0.61	0.39	0.24	0.44	1.11	0.61	0.63	0.91	1.22	1.62	1.47	1.71	1.40
OFF	1.53	1.14	0.70	0.46	0.59	0.48	1.24	1.02	1.02	1.44	1.00	1.03	0.91	0.97
AUD	4.99	2.12	3.41	2.10	1.68	0.72	1.39	0.73	0.02	0.13	0.45	0.70	0.73	1.00
VID	2.18	1.58	2.42	1.35	1.11	0.57	1.30	1.35	0.33	0.22	0.81	0.43	1.06	1.19

Source: Authors' calculations using Reed Yearbook of World Electronics Data

Table 4: Product sophistication index

	1992–1994		2003–2005	
	Index	**Ranking**	**Index**	**Ranking**
PCE	17482	**1**	26722	**1**
XME	15133	**2**	25704	**2**
CON	15025	**3**	25388	**3**
COM	12791	**5**	21578	**4**
PAS	11992	**8**	18616	**5**
TEL	12343	**7**	18578	**6**
OTH	12690	**6**	18278	**7**
ACT	10740	**9**	17751	**8**
EDP	12897	**4**	17306	**9**
IND	9814	**11**	17046	**10**
OFF	10478	**10**	16007	**11**
AUD	7294	**12**	11150	**12**
VID	6952	**13**	8315	**13**

Source: Authors' calculations using Reed Yearbook of World Electronics Data

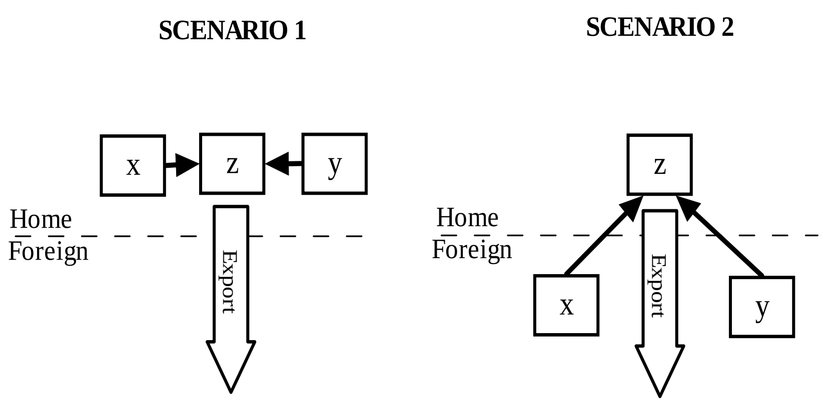

Figure 1: Ordinary versus processing trade.

Table 5: Country technology index (rankings)

Rank in 2003-2005	1992-1994	1998-2000	2003-2005
Switzerland	1	1	1
Denmark	5	6	2
Norway	4	4	3
Finland	15	3	4
Sweden	7	2	8
Saudi Arabia	3	17	6
Puerto Rico	8	25	7
Netherlands	6	15	8
Germany	17	7	9
Croatia	12	11	10
Canada	11	14	11
New Zealand	2	5	12
United States	13	8	13
Ukraine	47	13	14
Australia	16	9	15
Italy	14	18	16
France	20	12	17
Israel	18	10	18
Bulgaria	28	32	19
Austria	44	36	20
United Kingdom	19	20	21
Greece	36	29	22
Slovenia	21	24	23
Venezuela	22	21	24
Romania	34	19	25
Hong Kong	9	16	26
Ireland	10	22	27
Belgium	26	37	28
South Korea	43	23	29
South Africa	33	34	30
Japan	29	28	31
Philippines	38	26	32
Taiwan	24	30	33
Singapore	27	31	34
Czech Rep.	25	33	35
Russia	41	35	36
Brazil	32	38	37
Hungary	23	46	38
China	**42**	**40**	**39**
Malaysia	49	41	40
Thailand	37	39	41
Slovakia	40	27	42
Spain	31	43	43
India	35	45	44
Portugal	39	49	45
Vietnam	51	48	46
Indonesia	48	44	47
Poland	30	42	48
Egypt	45	50	49
Mexico	46	47	50
Turkey	50	51	51

Source: Authors' calculations using Reed Yearbook of World Electronics Data

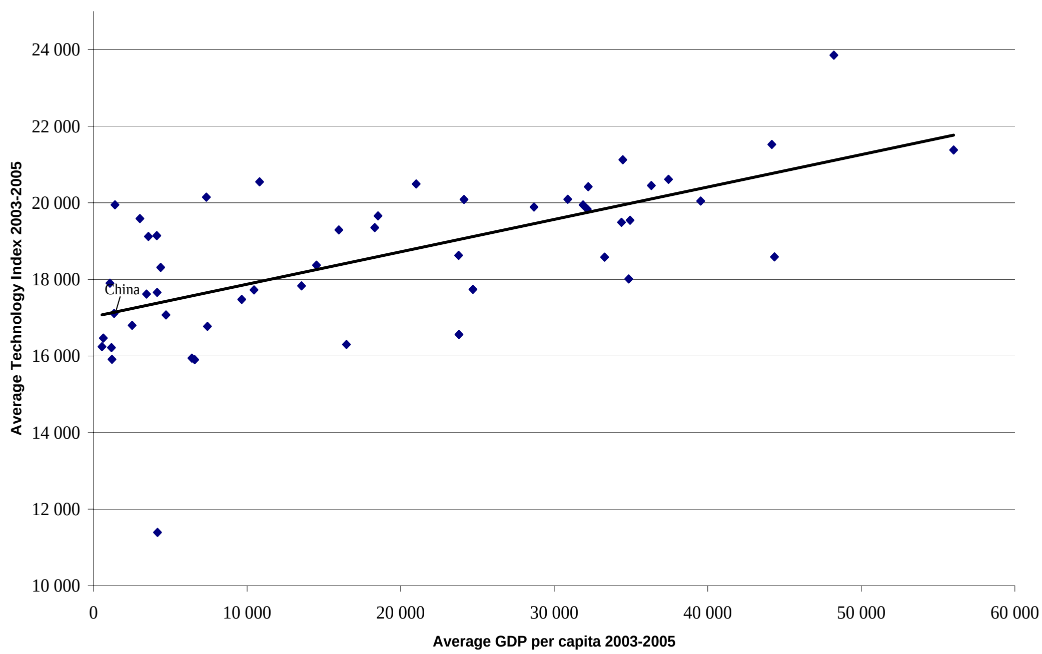

Figure 2: CTI versus GDP per capita.