Export Sophistication and Export-Led Growth: An Analysis of the Export Basket of Selected East Asian Economies

Bayudan-Dacuycuy, Connie and Lim, Joseph Anthony

Economics Department, Ateneo de Manila University, Economics Department, Ateneo de Manila University

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This research aims to examine the sophistication of export portfolios of selected ASEAN and developed Asian economies. It aims to provide evidence on where exactly the ASEAN economies are in the context of exports sophistication and structural transformation. Results from the product space analysis indicate that although limited in product scope, there are prospects for ASEAN economies to converge to the level of the export sophistication of the developed Asian countries.

Keywords: product space; export diversification; economic development; Asian economies; ASEAN exports
JEL Code: F1, F14

1. Introduction

Based on the experience of the newly industrialized Asian economies, the ability of a country to move from the agriculture to the high-technology manufacturing exports is one manifestation of successful structural transformation and economic development. In the words of Hausmann and Klinger [8], structural transformation is a development process that involves the movement of production from simple poor-country goods to more complex rich-country products. This is consistent with a successful export-led growth strategy where trade in high-technology and scale products takes an active role.

ASEAN economies have benefited from trade and they can further reap benefits from it. The Philippines, tagged as the "sick man of Asia", can explore improvements in export sophistication as a potential avenue towards the path to higher economic development instead of relying mainly on remittances of overseas workers**.** While trade in goods or services are both vulnerable on the political turmoil and social unrest in the host countries, growth derived from trade in goods is more self-sustaining once the right mix of infrastructure, skills and knowledge-based structures are developed.

Asian economies have significantly improved their export composition, moving from agricultural and primary commodities and low-skilled type of goods to more sophisticated products such as electronic and high-technology manufactured goods. Evaluating the performance of the export basket of these countries is one important objective of this paper.

While a number of studies on export-led growth have been done using econometric techniques [1,5,6,7,13,19], recent literature introduces new methods of assessing the performance of a country's exports through their location in the product space. The product space analysis has started in Hausmann and Rodrik [12] which explores the cost discovery process of firms or their ability to venture into new products and technological innovation. The cost discovery generates positive externalities when other firms learn from the successful innovator and produce goods that push the economy to its technological and production frontier. Later, Hausmann, Hwang and Rodrik [9] have quantified the process of cost discovery by constructing an index that measures an export product's sophistication (*PRODY*) and an index that measures the overall sophistication of a country's export basket (*EXPY*).

Building on these, Hausmann and Klinger [10] have investigated deeper the sophistication of export products by working on the fact that while vertical specialization through improved productivity is necessary, horizontal specialization is indispensable so that firms will upgrade technology and manpower skills. Based on this idea, Hausmann and Klinger [10] have developed a measure called proximity or the revealed distance between products and demonstrated that a country's speed of structural transformation depends on whether its existing exports have many nearby high-value added goods in the product space. This has significant implication on the portfolios that countries can diversify into overtime.

Later, Hidalgo, Klinger, Barabasi and Hausmann [14] have visually illustrated that there are regions of the product space where goods are densely connected to many products while other regions have goods that are sparsely connected with each other. The former region is the core while the latter is the periphery. Hausmann and Klinger [10] have shown that labor intensive goods such as garments, cereals and tropical agriculture have low *PRODY* and are mostly found in the periphery while machinery and high-technology manufactured products are found in the core. The export basket of wealthier countries also tends to be in the denser regions of the product space.

Since the existing exports of the lagging developing countries are in the less-connected region of the product space, they have fewer options for horizontal diversification.

Within the context of product space, the location of current exports has implications on a country's economic growth. If the country's export portfolio is in the sparse parts or in the periphery, then the country has limited option for diversification and an even limited opportunity to penetrate the denser or richer part of the product space. To converge to industrialized economies, the country needs significant adjustment in its production structure.

Using the product space, this research work aims to assess the performance of the export portfolio of selected ASEAN countries by analyzing the trends in the sophistication of their export basket. This will be done alongside Korea and the People's Republic of China to provide a sense on how far the ASEAN countries have gone in export upscaling and how much further they should go compared to their more successful neighbors. This will reveal the kind of structural transformation that will have to be undertaken by the less developed ASEAN economies. This research is the first to use the product space to analyze the export baskets of ASEAN economies. While relatively simpler than Hausmann and Klinger [11] analysis of Colombia's opportunities for economic growth, the paper performs simulation exercises that determine whether the ASEAN economies can reach the core of the product space given their existing exports. Based on these, the paper identifies some viable options for diversification in the short-run and offers some insights for future policy. Herein lies the contribution of our study.

The study uses the United Nations Commodity Trade Statistics (UN-COMTRADE) Standard Industrial Trade Classification (SITC) Revision 2 at the four digit disaggregation. The research is organized as follows: Section II discusses the history of the product space and how it is related with the earlier works on product similarity and horizontal specialization. Section III uses the product space to analyze the export portfolios of the seven Asian countries namely, China, Korea, Indonesia, Malaysia, the Philippines, Singapore and Thailand. It then uses the proximity and productivity indices to discuss the current capacity of these countries to diversify into more sophisticated goods. Section IV provides the summary and conclusions.

2. Export sophistication and proximity: A product space analysis

History and Related Literature

The product space is a relatively new approach to analyzing a country's existing exports and its implication on economic growth. Its brief history dates back Hausmann and Rodrik [12] cost discovery process that is related to the literature on cost heterogeneity and uncertainty. Building on this, Hausmann, Hwang and Rodrik [9] explored the role of positive externalities and information costs on economic growth. Central to their argument is that the positive externalities generated by a successful firm in producing a good should drive other firms to replicate this success. The bigger the number of firms producing goods with higher productivity, the more likely the economy will reach and expand its technological and production frontier. In this context, Hausmann, Hwang and Rodrik [9] have developed indices that differentiate goods based on their implied productivity: the *PRODY* score to measure the sophistication at the product level and the *EXPY* score to measure the sophistication of a country's export basket.

Briefly, let the subscripts *j* and *k* represent country and product respectively. The *PRODY* of product *k* is the sum of the *GDP* per capita of each exporting country weighted by the country's comparative advantage for product *k*, $PRODY_k = \sum_j \frac{x_{j,k} / X_j}{\sum (x_{j,k} / X_j)} * GDP\ per\ capita_j$ where $X_j = \sum_k x_{j,k}$ and $x_{j,k}$ is the export value of product *k* in country *j*. Each exported good will have a corresponding PRODY that reflects its productivity level in terms of its contribution to the country's income. The country's *EXPY* is then constructed by summing all the *PRODY* weighted by the good's share to the country's total exports, $EXPY_j = \sum_j (x_{j,k} / X_j) * PRODY_k$. Higher *EXPY* score indicates that the country's export portfolio comprises of sophisticated commodities. Hausmann, Hwang and Rodrik [9] have shown that primary commodities have low *PRODY* and that countries with high initial *EXPY* also experience higher subsequent economic growth.

Hausmann and Klinger [10] have investigated further the productivity/sophistication of products by emphasizing the importance of horizontal specialization. They then developed a measure called proximity or the revealed distance between products. The idea behind the proximity measure is that products close to each other will share similar level of input, technological infrastructure and institutional requirements. Therefore, horizontal specialization between products sharing similar production structure will not be as costly as between products that are farther apart in production requisites. For example, fewer modifications are needed to the production structure of footwear when moving to textiles than when moving to electronics. Formally, proximity is defined as $\phi_{ij} = \min\{P(RCAx_i \mid RCAx_j), P(RCAx_j \mid RCAx_i)\}$.[1] The proximity between products *i* and *j* is the minimum of the pairwise conditional probabilities of a country exporting a good given that it exports another or formally where *RCA* is the revealed comparative advantage [14]. Proximity measures had been computed by Hidalgo, Klinger, Barabasi and Hausmann [14] for each pair of products using the four-digit UN-COMTRADE SITC Revision 2. Products close to each other in the product space have high ϕ_{ij}.

Later, Hidalgo, Klinger, Barabasi and Hausmann [14] have visually illustrated the relatedness of goods in what is now known as the product space. The product space has dense and sparse parts, the latter being less connected to the rest of the products and the former being close to many products that countries can upgrade to in the future. Hidalgo, Klinger, Barabasi and Hausmann [14] have shown that wealthier countries are in the denser regions of the product space. Their simulation results indicate that the exports of lagging developing

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[1] Following Balassa [2], RCA is computed as $RCA_{jk} = \frac{c_{jk}}{c_k}$ where $c_{jk} = \frac{X_{jk}}{\sum_k X_{jk}}$ is the ratio between the country *j*'s export of good *k* and its total export and $c_k = \frac{\sum_j X_{jk}}{\sum_{jk} X_{jk}}$ is the ratio between the world's export of good *k* and the total world export. Values greater than one indicate that the country is exporting more of that product (as a share of its export basket) compared to other countries in the world.

countries will not be as sophisticated as the exports of industrialized economies since these economies have export portfolios that are located in the periphery. This implies that there are few sophisticated products available for these economies to branch out into and suggests that diversification into sophisticated products requires significant transformation in technology, infrastructure, institutions and human capital. Within this framework, policies related to the upgrade of production structure can substantially shape what countries can be in the future.

Summary

It is clear from the literature discussed above that the product space is just a visual representation of how close the goods are to each other, the closeness of which is defined by the proximity measure. The proximity index, in turn, is a formal representation of the idea that the closeness of goods is defined by their production requisites[2]. The product space also incorporates the *PRODY* index or the implied sophistication level of each good.

The visual representation is done by mapping all the products in a space such that the network connections among goods are dictated by the proximity measure. The higher the proximity values, the closer the goods are to each other. The product space has outer and inner regions. In the outer periphery and sparse sections of the product space are the products with low *PRODY* or those with low level of implied contribution to income, such as oil, fishing, tropical agriculture, animal agriculture, garments and forest and petroleum products. At the core and the denser section of the product space are the more sophisticated products with higher *PRODY* such as metallurgy, machinery, capital-intensive products and motor vehicles. In this region, there are many products that can lead to even more sophisticated products.

[2] The idea behind the proximity measure is related to the clusters earlier proposed by Hirschman [15] and by Jaffe, Trajtenberg and Henderson [16] where existing industries can make way for other industries with similar level of input requirements to flourish. Leamer [17] has also provided a widely-used classification of goods based on factor intensity.

The standard measure of similarity of goods in the traditional literature of international trade is based on factor endowments such as the Leamer [17] clusters of products. While Hausmann and Klinger [10] have provided evidence for the striking similarity between the product space and the Leamer classification, their key difference is that the former is an outcomes-based approach that introduces a new measure of similarity of products without making a priori assumptions on how goods are going to be related. The product space also provides a large number of detailed information with ease. It provides information such as what goods can be produced, whether these goods lead to other goods with higher value-added and whether the existing export portfolio can take a country to the export baskets of developed economies. The product space is therefore more helpful in providing a more specific guideline on structural transformation. This is the major innovation and contribution of the product space analysis.

3. Results and Implications

The *PRODY* and *EXPY* indices discussed above are computed for the selected Asian countries using the UN-COMTRADE SITC Revision 2 at the four digit disaggregation. The contributions to *EXPY* of exports whose *PRODY* is more than half of the highest *PRODY* score are summarized in Table 1. It can be seen that the Philippines' export basket has the lowest contribution with an average of 6.5% between the years 2000 to 2006. This indicates that its export portfolio consists of less sophisticated products. The other countries, such as Indonesia and Thailand, have a more diversified export basket consisting of more highly sophisticated products on the average. China, Korea and Singapore have more than 25% of their *EXPY*s coming from highly sophisticated commodities.

Given the current export performance of the less developed countries, this research aims to ascertain their trade potentials of and future challenges. To do this, the proximity matrix is borrowed from Hidalgo, Klinger, Barabasi and Hausmann [14] which is then merged with the export data of selected Asian countries using the four-digit UN-COMTRADE SITC Revision 2. To facilitate the exercises that follow, the following notation

will be adopted: exports in 2006 will be products *i* while the products close to them will be products *j*. Products *j* should have $PRODY_j > PRODY_i$. In addition, products *j* should have no significant portion in the 2006 export share, $share_j < .09\%$, implying that the country is yet to produce the products in full scale. Products *i* should have $RCA_i \geq 1$.

It should be noted that the boundaries on the relevant parameters are set such that the current research can provide directions towards high value-added products given the countries' existing export portfolios. To attain this objective, the most feasible starting point would be the current exports for which the country has a comparative advantage on (RCA_i restriction). To identify plausible products for future diversification, the product that countries should branch out to should be more sophisticated (*PRODY* restrictions) and are not yet significantly produced ($share_j$ restrictions).

Using the restrictions discussed above, table 2 attempts to look at the potential of the countries' existing exports to evolve into highly sophisticated goods. It shows the summary statistics of the products *j* close to the existing exports with $RCA \geq 1$ at different rounds. The first round contains the products *j* close to the current exports at $\phi_{ij} \geq 0.55$. Products *j* must satisfy the criteria set above. The second round contains the products close to the first round products. This search process is repeated for several rounds at $\phi_{ij} \geq 0.55$ for each round until the search no longer produces any result. Following this procedures, figures in table 2 also shows the length it takes for countries to reach the products with high *PRODY*. It can be seen that the Philippines has the lowest average *PRODY* in the first round. By round two, the number of potential products with that the Philippines can choose to branch out into has increased to 36% from 9% in round one. By round three, the average sophistication index of the potential products that the Philippines can expand into is already close to that of the developed Asian economies. The same trends can be observed for Indonesia. These imply that both countries have the possibilities to move from their current location to the denser part of the product space. Korea, China and Singapore need lower rounds to reach the highly

sophisticated products. This is because their existing exports are already in the denser parts of the product space and their production set-up needs little modifications to produce goods that are more sophisticated than their existing export basket.

To identify directions for export diversification in the short run, table 3 lists the products that have significant export shares in 2006 and that have goods which require much less alteration in the production structure. Data in this table show the potential of the countries' existing exports to evolve into highly sophisticated goods given that they opted for less modification in their production structures. The 2006 exports that can lead to higher value-added goods and the paths leading to them are also identified. This is done by choosing products *i* with at least 3% share to the 2006 exports that have products *j* proximate to it at $\phi_{ij} \geq 0.60$ for all rounds. Results show that the exports of Korea, China and Singapore are varied and the products close to these exports have very high *PRODY*. This indicates that these economies have more opportunities to diversify their future export basket into an even more sophisticated export portfolio. The Philippines and Indonesia, on the other hand, have few exports and the average *PRODY* of the close products is the lowest. Thailand currently exports a commodity that has a proximate product with high *PRODY* at $\phi_{ij} = 0.75$. This shows that Thailand can penetrate the core region of the product space easier than Indonesia and the Philippines. It currently has a comparative advantage on an export that has a production structure requiring lesser modification to be able to expand into a more sophisticated product. While Indonesia has an export that has a proximate product at $\phi_{ij} = 0.70$, the product close to it is not as sophisticated. Like the Philippines, the rest of Thailand's exports have proximate products at $\phi_{ij} = 0.6$. However, the proximate products to Thailand's exports are more sophisticated compared to that of the Philippines and Indonesia's.

Results indicate that using the existing export baskets as the starting point, the less developed Asian economies may, with proper policies or incentives, produce high value-added goods. However, the diversification portfolios of these economies are limited when

they institute lesser modifications in their production structure. This can happen when the state fails to provide enabling environment for adaptation and innovation so that firms are limited in its vertical and horizontal integration efforts. This hampers the ability of the country to push itself into the development frontier. Korea and Singapore, owing to its efforts to translate the opportunities for backward and forward linkages presented by the production networks that proliferated in the region in the1960s, have currently bigger export base that are close to many sophisticated products. China, despite its dual trade approach to industrialization, also has wider array of existing exports that can lead to sophisticated goods.

While the gains from the production networks in the region have been realized by Korea, Singapore and China, the less developed economies have yet to reap its benefits in terms of technological adaptation and innovation. Outsourcing firms from the developed economies are aware that the technological resources within Asia are heterogeneous so that high-value added production will be typically fielded out to high-skilled economies such as Malaysia, Korea and Singapore. In the semiconductor chain, jobs outsourced to the Philippines and Indonesia are low-end portions of the value chain that need no new technology such as testing and assembly. This is a reflection of the countries' weak technological capabilities [3] and may limit the potential diversification and backward linkaging in electronics to more sophisticated chips and circuits.

4. The Role of the Government

How the countries technologically upgrade to nearby products is a controversial matter. Some would suggest that comparative advantage theory is enough to allow the markets and the private sector to effect the structural transformation while Schumpeterians would emphasize the role of innovators and entrepreneurs in the specific country. Hausmann and his friends view the process as a combination of the Schumpeterian process and market failures.

Hausmann, Hwang and Rodrik [**9**] tackle two types of market failures that entail government intervention. One type would be the first-mover or 'cost discovery' problem

where high technology and economies-of-scale industries are not entered to because the first-mover (the Schumpeterian innovator) takes up the entire risk of the innovation but shares profits with other firms if it succeeds since the other firms will just 'imitate' or replicate the first mover's innovation, and dissipate his reward or profits. Another type of market failure would be coordination failure problems where upscale products with high value-added are not produced because the required adjustments on the technology, input requirements, infrastructure and legal and social institutions are not in place, and the simultaneous attainment of these adjustments are not attempted at by anybody. Both market failures require government interventions. Hausmann and Rodrik [1**2**] join the endogenous growth models where positive externalities pose market failure problems for developing economies. The government has a role on the adjustments required to move from the production of a more sophisticated product and we quote from Hausmann and Klinger [10]:

> "We argue that producing new things is quite different from producing more of the same. Each product involves highly specific inputs such as knowledge, physical assets, intermediate inputs, labor training requirements, infrastructure needs, property rights, regulatory requirements or other public goods. Established industries somehow have sorted out the many potential failures involved in assuring the presence of all of these inputs, which are then available to subsequent entrants in the industry. But firms that venture into new products will find it much harder to secure the requisite inputs. For example, they will not find workers with experience in the product in question or suppliers who regularly furnish that industry. Specific infrastructure needs such as cold storage transportation systems may be non-existent, regulatory services such as product approval and phytosanitary permits may be underprovided, research and development capabilities related to that industry may not be there, and so on. In short, changing products is problematic and the difficulties it involves may adversely affect the process of development. We argue that the assets and capabilities needed to produce one good are imperfect substitutes for those needed to produce another good, but this degree of asset specificity will vary. For example, it sounds plausible to

suggest that the human, physical and institutional capabilities needed to produce cotton trousers are closer to those needed to produce cotton shirts than those needed to produce computer monitors. Correspondingly, the probability that a country will develop the capability to be good at producing one good is related to its installed capability in the production of other similar, or nearby goods for which the currently existing productive capabilities can be easily adapted."

Our view would be sympathetic to that of Hausmann and his colleagues. This is one of the most plausible explanations why the Philippines remain underdeveloped even though it has actual paths to product upgrade as the other countries. It failed to provide incentives for the Schumpeterian innovators. This is reflected on the Philippines' low rating in the Global Competitiveness Report 2010 [8] as a result of bad governance.

The role of the government in the context of regional production networks has been discussed in Borrus, Ernst and Haggard [4]. Murphy, Shleifer and Vishny [18] have also recognized the government's role for the small and less-developed economy to make a big push towards industrialization.

Based on the results above and given our sentiment on the role of the government, we cite some areas that may call for government's action. One, the government should attract the right investments by providing the correct investment climate. Stemming corruption, elimination of excessive bureaucracy and the development of physical infrastructures are three such examples. Two, the government should strengthen its human capital by strengthening the link between the academe and industry. Once the correct investments are in place, a big number of local firms should be able to replicate the production of goods and then innovate into a wider range of high value-added products. This will push the economy's development frontier. This has been done by Korea and Singapore through backward and forward integration early on.

The results clearly show that while relatively limited, there are paths towards structural and industrial transformation for the less developed Asian economies. However,

diversification to sophisticated goods does not naturally happen. It can only occur when the production requisites are satisfied emphasizing the role of the government to provide enabling environments so that the positive externalities and opportunities brought about by trade, production networks and economic cooperation within the region can be exploited by local firms. Possible enabling environment would be institutional changes, development of human and physical infrastructures and investment in the research and development. Improvement in these areas come at a cost and may take some time but will prove to be beneficial when done. As the results have shown, there are opportunities for Indonesia, the Philippines and Thailand, to produce sophisticated exports in the future, provided they have the correct policies to make a bigger push towards product upgrades.

5. Summary and conclusions

Using the product space and the metrics for export sophistication, results indicate that while the current export basket of the less developed Asian countries is still in the less-connected parts of the product space, opportunities for diversification exist. There are paths from its existing export portfolio that leads the countries to the richer region of the product space. For moderately close products, the countries can branch out – assuming the right ingredients of technology, productivity enhancement, infrastructure and institutions – into quite sophisticated products. The possibilities of diversification into more sophisticated products in the long-run are limited if these economies choose to branch out to goods that do not require as much modification in their production structure. This emphasizes the need for a more active role of the government in promoting the more appropriate industrial and economic policies for the country.

The research has identified some existing exports that can lead to the richer part of the product space. This should not be misconstrued, on the other hand, as recommending that the countries focus only on these commodities. Rather, this research work is geared towards the assessment of where the countries are in terms of their achievements in their structural transformation efforts and to evaluate the opportunities available to them for economic

growth. It is a good news that although limited in product scope, there are prospects for Asian countries to converge to the export sophistication level of the developed Asian economies. The government and the private sectors can therefore work together on how to achieve this goal. It is the objective of this research work to provide information by narrowing down the search for viable options in the immediate future. In the end, collective efforts within each country and among Asian countries will most likely be needed to achieve the goal of export upgrading and structural transformation.

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Table 1: Contribution to the *EXPY* of products with more than half of the $PRODY_{world}$, selected ASEAN countries, Korea and China

		Total contribution to *EXPY* of products with more than half of the highest *PRODY world*	*EXPY*	% of the contribution
China	2000	2108	8860	23.80
	2001	2450	9126	26.85
	2002	2628	9386	28.00
	2003	2672	9612	27.80
	2004	2786	9881	28.19
	2005	2817	10059	28.00
	2006	2897	10157	28.52
Korea	2000	2599	11184	23.24
	2001	3027	11637	26.01
	2002	3017	11741	25.69
	2003	3148	11878	26.50
	2004	3338	12028	27.75
	2005	3578	12294	29.10
	2006	3571	12300	29.03
Indonesia	2000	1162	7598	15.29
	2001	1017	7431	13.69
	2002	1094	7488	14.61
	2003	1053	7377	14.27
	2004	1182	7362	16.06
	2005	1044	7290	14.33
	2006	999	7082	14.11
Malaysia	2000	1070	10249	10.44
	2001	1339	10269	13.04
	2002	1276	10371	12.30
	2003	1269	10208	12.44
	2004	1342	10153	13.21
	2005	1394	10238	13.61
	2006	1499	10233	14.65
Philippines	2000	639	10792	5.92
	2001	685	10620	6.45
	2002	667	10779	6.19
	2003	666	10710	6.22
	2004	649	10693	6.07
	2005	587	10245	5.73
	2006	572	9943	5.75
Singapore	2000	2988	12413	24.07
	2001	3137	12415	25.27
	2002	3202	12508	25.60
	2003	3805	12776	29.78
	2004	3921	12813	30.60
	2005	3688	12696	29.05
	2006	3803	12727	29.88

Thailand	2000	990	9297	10.65
	2001	1036	9274	11.17
	2002	1092	9280	11.77
	2003	1082	9299	11.64
	2004	1207	9421	12.82
	2005	1268	9655	13.14
	2006	1310	9663	13.56

Note: Highest $PRODY_{world}$ =28571 is computed using all the exports of all countries based on the UN-COMTRADE SITC Revision 2, 4-digit Disaggregation. *PRODY* is the sophistication index of each good while *EXPY* is the sophistication index of the country's export portfolio. These indices are computed as follows:

$$PRODY_k = \sum_j \frac{x_{j,k} / X_j}{\sum (x_{j,k} / X_j)} * GDP\ per\ capita_j \text{ while } \quad EXPY_j = \sum_j (x_{j,k} / X_j) * PRODY_k$$

This table summarizes the contributions to *EXPY* of exports whose *PRODY* is more than half of the highest *PRODY*world.

Table 2: Summary statistics of the products *j* with $\phi_{ij} \geq 0.55$ per round given the country's 2006 export basket

	China	**Korea**	**Indonesia**	**Malaysia**	**Philippines**	**Singapore**	**Thailand**
Round 1							
AVE. *PRODY*	12765	14020	8016	12126	7656	17108	9475
# of products	116	41	48	44	77	16	95
# of products with 17000>=*PRODY*<20000	14	6	3	5	3	4	5
# of products with 20000>=*PRODY*<23000	12	8	0	10	4	5	9
# of products with *PRODY*>=23000	0	0	0	0	0	1	0
Round 2							
AVE. *PRODY*	16989	16232	12213	12368	13410	17647	15909
# of products	36	29	10	41	28	10	32
# of products with 17000>=*PRODY*<20000	9	6	1	7	6	4	7
# of products with 20000>=*PRODY*<23000	7	7	1	5	4	2	8
# of products with *PRODY*>=23000	2	1	0	1	0	1	2
Round 3							
AVE. *PRODY*	18051	16941	14505	13471	16300	15875	16720
# of products	25	26	11	51	32	13	30
# of products with 17000>=*PRODY*<20000	7	3	2	4	10	3	6
# of products with 20000>=*PRODY*<23000	7	6	2	7	6	2	6
# of products with *PRODY*>=23000	3	3	0	3	1	1	3
Round 4							
AVE. *PRODY*	18012	16965	18286	13639	17338	16135	16936
# of products	20	27	15	43	25	14	33
# of products with 17000>=*PRODY*<20000	6	4	9	8	9	3	10
# of products with 20000>=*PRODY*<23000	6	7	3	5	7	2	7
# of products with *PRODY*>=23000	1	1	0	2	1	1	2
Round 5							
AVE. *PRODY*	18690	16477	19331	15116	19238	15173	17441
# of products	21	25	17	36	21	24	32
# of products with 17000>=*PRODY*<20000	6	2	10	7	10	2	7
# of products with 20000>=*PRODY*<23000	6	5	4	6	6	3	7
# of products with *PRODY*>=23000	2	2	1	2	2	1	3
Round 6							
AVE. *PRODY*	18545	17244	19489	15934	19772	17358	18442
# of products	24	23	18	40	19	21	27

# of products with 17000>=*PRODY*<20000	6	6	10	11	9	5	8
# of products with 20000>=*PRODY*<23000	7	6	5	7	7	5	8
# of products with *PRODY*>=23000	2	0	1	2	1	1	2
Round 7							
AVE. *PRODY*	20541	19423	20427	17390	20471	18473	19323
# of products	13	17	16	31	16	11	24
# of products with 17000>=*PRODY*<20000	2	5	9	9	9	2	7
# of products with 20000>=*PRODY*<23000	7	6	5	7	5	4	7
# of products with *PRODY*>=23000	2	2	2	3	2	1	3
Round 8							
AVE. *PRODY*	21324	20941	20865	17094	21157	18975	19521
# of products	7	11	11	32	11	3	18
# of products with 17000>=*PRODY*<20000	1	3	5	11	4	0	8
# of products with 20000>=*PRODY*<23000	4	6	5	7	6	2	6
# of products with *PRODY*>=23000	1	1	1	2	1	0	1
Round 9							
AVE. *PRODY*	21478	22767	21870	18386	21983	18022	20252
# of products	3	5	9	24	8	4	16
# of products with 17000>=*PRODY*<20000	0	0	3	7	3	2	7
# of products with 20000>=*PRODY*<23000	3	4	4	7	3	1	5
# of products with *PRODY*>=23000	0	1	2	3	2	0	2
Round 10							
AVE. *PRODY*	24196	24196	21235	18028	21577	21349	19718
# of products	3	3	8	20	7	2	16
# of products with 17000>=i<20000	0	0	4	8	3	0	8
# of products with 20000>=*PRODY*<23000	2	2	3	6	3	2	5
# of products with *PRODY*>=23000	1	1	1	1	1	0	1
Round 11							
AVE. *PRODY*			22448	19338	22818		21362
# of products			5	17	4		12
# of products with 17000>=*PRODY*<20000			0	7	0		5
# of products with 20000>=*PRODY*<23000			4	5	3		5
# of products with *PRODY*>=23000			1	2	1		2
Round 12							
AVE. PRODY			21957	19718	21957		21519
# of products			1	16	1		9
# of products with 17000>=*PRODY*<20000			0	8	0		3
# of products with 20000>=*PRODY*<23000			1	5	1		5
# of products with *PRODY*>=23000			0	1	0		1
Round 13							
AVE. *PRODY*				21362			22818
# of products				12			4
# of products with 17000>=*PRODY*<20000				5			0
# of products with 20000>=*PRODY*<23000				5			3
# of products with *PRODY*>=23000				2			1

Note: This table shows the summary statistics of the potential products that the countries can produce (product *j*). These are close to the existing exports (products *i*) with $RCA \geq 1$ at different rounds. Products *j* should have $PRODY_j > PRODY_i$ and $share_j < .09\%$. ϕ_{ij} is the proximity measure between products *i* and *j*. *PRODY* is the product level sophistication index and *EXPY* is the export portfolio sophistication index. The table contains the number of products *j* that satisfy the criteria above. The number of products *j* that has high sophistication index (*PRODY*) is also shown and is further disaggregated into various *PRODY* intervals so that the readers will see how many sophisticated products *j* are available for diversification. The first interval can be interpreted as the least sophisticated among the sophisticated products, the second interval as the mid-sophisticated and the third as the most sophisticated.

Table 3: Products close to 2006 exports for the selected East Asian economies at $\phi_{ij} \geq 0.60$ for all rounds

2006 Exports (product *i*) with at least 3% Share	Round 1			Round 2			Round 3			Round 4		
	ϕ_{ij}	*PRODY*	Products *j*	*PRODY*	ϕ_{ij}	Products *j*	ϕ_{ij}	*PRODY*	Products *j*	*PRODY*	ϕ_{ij}	Products *j*
KOREA												
Abrasive power or grain, on a base of woven fabrics	0.64	21401	Printing paper and writing paper, in rolls or sheets									
Machinery for specialized industries and parts thereof, nes	0.63	20965	Machine for making cellulosic pulp									
Silicones	0.75	20644	Printing ink									
Other machines-tools for working metal or metal carbides, nes	0.63	20625	Machine for extruding man-made textiles and parts									
Construction and mining machinery, nes	0.65	17332	Natural or artificial abrasive powder grain									
CHINA												
Power hand tools, pneumatic or non-electric, and parts thereof, nes	0.60	22730	Cellulose acetates									
Inorganic esters, their salts and derivatives	0.62	22611	Organo-sulphur compounds									
Cocks, valves and similar appliances, for pipes boiler shells, etc	0.63	21957	Ind. and lab. Furnaces and ovens and parts									
Aldehyde, ketone and quinone-function compounds	0.66	17691	Phenols and phenol-alcohol and their halogenated derivatives	22611	0.62	Organo-sulphur compounds						
Cocks, valves and similar appliances, for pipes boiler shells, etc	0.65	17332	Natural or artificial abrasive powder or grain									
Lifting, handling, loading machinery, telphers and conveyors	0.62	17332	Natural or artificial abrasive powder or grain									
Locksmiths wares, safes, etc, and hardware, nes, of base metal	0.65	17332	Natural or artificial abrasive powder or grain									
Articles of electric lighting of plastic	0.65	15128	Glass mirrors									

Table 3 continued…

SINGAPORE

Parts, nes of pumps and liquids elevators falling in heading 742	0.67	28571	Furnace burners for liquid fuel and parts										
Power hand tools, pneumatic or non-electric, and parts thereof, nes	0.60	22730	Cellulose acetates										
Welding, brazing, cutting, etc machines and appliances, parts, nes	0.60	22036	Parts of the mach. Of 725-										
Parts, nes of and accessories for machine-tools of heading 736	0.67	20740	Workholders, self-opening dieheads and tool holders										
Parts, nes of pumps and liquids elevators falling in heading 742	0.60	20740	Workholders, self-opening dieheads and tool holders	21957	0.61	Industrial and laboratory furnaces and ovens, etc, parts, nes							
Other condensation, polycodensation or polyaddition products	0.61	20547	Epoxide resins										
Parts, nes of pumps and liquids elevators falling in heading 742	0.71	19005	Parts of the mach. Of 726.31,726.4-,726.7-	28571	0.62	Furnace burners; mechanical stokers, etc, and parts thereof, nes							
Parts, nes of pumps and liquids elevators falling in heading 742	0.66	18630	Other printing machine for uses ancillary to printing	19005	0.74	Parts, nes of machines falling within headings 72631, 7264, 7267							
Parts, nes of pumps and liquids elevators falling in heading 742	0.66	18630	Other printing machine for uses ancillary to printing	19170	0.61	Parts, nes of the machines falling within headings 7435 and 7436	0.60	21957	Industrial and laboratory furnaces and ovens, etc, parts, nes				
Parts, nes of pumps and liquids elevators falling in heading 742	0.66	18630	Other printing machine for uses ancillary to printing	19170	0.61	Parts, nes of the machines falling within headings 7435 and 7436	0.61	20740	Work holders, dividing heads for machine-tools, etc; tool holders	21957	0.61	Industrial and laboratory furnaces and ovens, etc, parts, nes	
Aldehyde, ketone and quinone-function compounds	0.66	17691	Phenols and phenol-alcohol and their halogenated derivatives										

Table 3 continued…

INDONESIA									
Kraft paper and paperboard, in rolls or sheets	0.70	17070	Chemical wood pulp, sulphite						
Paper and paperboard, in rolls or sheets, nes	0.65	17070	Chemical wood pulp, sulphite						
MALAYSIA									
Sound recording tape, discs	0.63	22343	Instr. And App. For physical or chemical analysis						
Off-line data processing equipment, nes	0.64	17568	Complete digital central processing units						
PHILIPPINES									
Other parts and accessories, for vehicles of headings 722, 781-783	0.60	17121	Taps, cocks, valves for pipes, tanks etc						
Other parts and accessories, for vehicles of headings 722, 781-783	0.61	16285	Transmission shafts, cranks, bearing housing						
Other parts and accessories, for vehicles of headings 722, 781-783	0.63	14840	Bodies for the motor vehicles of 722/781/782/783						
Other parts and accessories, for vehicles of headings 722, 781-783	0.60	14661	Lifting, handling loading machine conveyors	17121	0.63	Cocks, valves and similar appliances, for pipes boiler shells, etc	0.65	17332	Abrasive power or grain, on a base of woven fabrics

Table 3 continued…

THAILAND						
Silicones	0.75	20644	Printing ink			
Other condensation, polycodensation or polyaddition products	0.61	20547	Epoxide resins			
Piston engines parts, nes, falling in headings: 7132, 7133 and 7138	0.61	17332	Natural or artifical abrasive powder or grain			
Paper and paperboard, in rolls or sheets, nes	0.65	17070	Chemical wood pulp, sulphite	17693	0.65	Newsprint
Automotive electrical equipment; and parts thereof, nes	0.61	16285	Transmission shafts, cranks, bearing housing			

Note: This table identifies directions for export diversification and contains the 2006 exports (product *i*) that have significant export shares (at least 3%) and the sophisticated products *j* close to it at $\phi_{ij} \geq 0.60$. The products *j* under the columns in various rounds are goods with $PRODY_j > PRODY_i$ and require less alteration in the production structure compared to products *j* at $\phi_{ij} \geq 0.55$ in table 2. This essentially shows the potential of the countries' existing and major exports to evolve into highly sophisticated goods given that the countries opted for less modification in their production structure.