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PRODUCTION FRAGMENTATION, UPSTREAMNESS, AND VALUE ADDED

EVIDENCE FROM FACTORY ASIA 1990-2005

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Abstract: We exploit the recent release of the 2005 Asian Input-Output Matrix to dress a picture of the geographic fragmentation of value added in Factory Asia from 1990 to 2005. We document 3 stylized facts. The first is that the average share of foreign value added embedded in production rose by about 7 percentage points between 1990 and 2005, from 9% to 16%. The second is that, contrary to popular belief, China has emerged as a major source of value added to other Factory Asia countries' production. Third, we find empirical support for the smile-curve hypothesis. Country-industries at the upstream and downstream extremities of the supply chain embed a larger share of value added than those with intermediate levels of upstreamness.

JEL Codes: F15, F13.

Keywords: Factory Asia, supply chains, upstreamness

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1. Introduction

"A Barbie doll costs $20, but China only gets about 35 cents of that."– New York Times 2006

Two questions may come to mind when reading the above quote. First, is Chinese production really only about adding cents of value to intermediate inputs? Or, more generally, within the labyrinth of Factory Asia's value chains, where is value added? Second, is China adding so little value to Barbie dolls because its assembly stage is at the downstream end of the production chain? Or, broadly speaking, do we observe a relationship between value addition and the position of a production stage along a global value chain?

While economists have been studying production fragmentation since the 1990s (e.g. Jones and Kierzkowski 1990), answering the above questions has been difficult due to lack of appropriate data. The recent release of international input-output tables has opened up new research avenues by making it possible to dissect ever-expanding global value chains. Yet, despite a recent spurt of interest in the economics of global value chains, or the second unbundling (Baldwin 2011), economists have not yet scrutinized the geographic distribution of Factory Asia's production value added.

When it comes to China, the conventional wisdom is that it is not using Chinese factors of production for most of Chinese exports (Baldwin 2011). Ma and Van Assche (2010) suggest that the Chinese content of its 'processing exports' is less than 20%, and processing exports accounted for more than 50% of the nation's boom in manufactured trade. These numbers are often translated in the policy sphere as China having to solve the value-added problem. When it comes to global value chains in general, economists have suggested that the relationship between value added and production stages may be u-shaped, i.e. a smile curve with upstream and downstream stages adding more value than intermediate stages (Baldwin, Ito and Sato 2014, Mudambi 2008). Is this the case in Factory Asia?

In this paper we use newly-released Input-Output data from the Institute of Developing Economies, part of the Japan External Trade Organization (IDE-JETRO), to dress a picture of value-added fragmentation in Factory Asia (China, Indonesia, Japan, Korea, Malaysia, the Philippines, Singapore, Taiwan, and Thailand) from 1990 to 2005 and in doing so shed new light on the questions above.

Our methodology is novel. Firstly, we do not only decompose the value-added content of exports but dissect all of Factory Asia's final production, whether exported or not. While Johnson and Noguera's (2012) estimate the value-added of exports using the GTAP Input-Output matrices, we trace out the origin of the value added embedded in all of a country's production of final goods. If we take Boeing' Dreamliner as an example. Let's assume it is made in the US and sold to American Airlines, and hence not exported. This does not mean that the aircraft is not part of an elaborate global value chain with parts and components imported from many countries. Our decomposition aims to capture the geographic extent of these value chains, even when the final product is not exported. This allows us to go beyond the analysis of trade economists, who were mostly concerned about measuring trade flows accurately, and get a clear depiction of how value added is split along global value chains.

Our decomposition allows us to establish two stylized facts. The first is that the share of foreign value added embedded in Factory Asia's final production rose by about 7 percentage points between 1990 and 2005, from 9% to 16%. The second is that, contrary to popular belief, China's production of final goods embeds a smaller share of foreign value added than that of other Factory Asia countries. The anecdotal evidence on Barbie dolls as an example of low-value-added exports from China may not be a good indicator of China's overall production. The data suggests otherwise across all industries. Between 1990 and 2005 among factory Asia countries China grew most as a source of value added to other countries' production.

Our second methodological contribution is the estimation of smile curves at the country-sector level. To do so we measure the upstreamness of each sector in each country in Factory Asia, using the index suggested by Antras et al. (2012) and plot it against the industry's average value-added contribution to final demand. What we find is that, on average, country-industries at the upstream and downstream extremities of the supply chain do indeed embed a larger share of value added than those with intermediate levels of upstreamness. In doing so we provide the first confirmation of the smile-curve conjecture at the multi-sector international level[3].

Our paper fits in the literature on production fragmentation pioneered by, among others, Jones and Kierzkowski (1990), Hummels, Ishii, and Yi (2001), and in the context of Asia, Ando and Kimura (2005). Our contribution is to trace out the geographic and sectoral distribution of the value-added embedded in the production of final goods, whereas many previous studies focused instead on trade flows of intermediate goods. Our paper is similar to Baldwin and Lopez-Gonzalez (2013) who present a portrait of global supply-chain trade and its evolution since 1995 using the recent World Input-Output Database. While they introduce import-to-produce and import-to-export measures of supply-chains taken directly from Input-Output tables, we trace out the origin of value-added through Input-Output structures through recursive computation. The relevance of our approach is also linked to the trade-and-growth debate, as highlighted

[3] In concurrent work Ye, Meng and Wei (2015) also estimated smile curves at the country-industry level yet they focus on exports, use a different methodology to compute value added, and a different data source. Previous empirical studies of the smile curve focused on electronics (Shin et al. 2012) or on Japanese firms only (Kimura 2003).

by Baldwin and Lopez-Gonzalez (2013) who argue that value-added is directly related to national income, especially wage, and Low (2014), who writes that knowing where the value is created by trade is absolutely crucial when jobs are at stake.

Finally, one unique contribution of our paper is to cover the period 1990-2005, hence starting earlier than previous studies and before the information and communication technology (ICT) revolution, which is considered to be the kick-starter of production fragmentation (Baldwin 2011). This allows us to observe the rise of international production fragmentation in the Input-Output matrices.

The rest of our paper is structured as follows. In the next section we describe the data and our methodology to decompose value added. Section 3 presents descriptive statistics for production fragmentation patterns. Section 4 examines the relationship between upstreamness and value added and presents theoretical arguments behind the smile curve. The last section concludes.

2. Data

The data come from the Asian International Input-Output (AIO) Table. This international IO table has been constructed by IDE-JETRO every 5 years from 1985 to 2005. The 2005 table covers nine Asian nations (Indonesia, Malaysia, the Philippines, Singapore, Thailand, China, Taiwan, Korea, and Japan) plus the US and 76 sectors (the 1985 table covered 24 sectors). We focus on 42 manufacturing industries and thus on the period from 1990 to 2005.[4] It includes the US since it is a major trade partner of almost all Asian countries. Other countries are aggregated as the Rest of the World (ROW). While other datasets are now available for many nations, e.g. the OECD-WTO Trade in Value-Added (TiVA) initiative and the World Input-Output Database (WIOD), the AIO has the advantage of starting before the ICT revolution, i.e. in 1990 rather than in 1999, covering more Asian countries, and it also provides a higher disaggregation of industries.

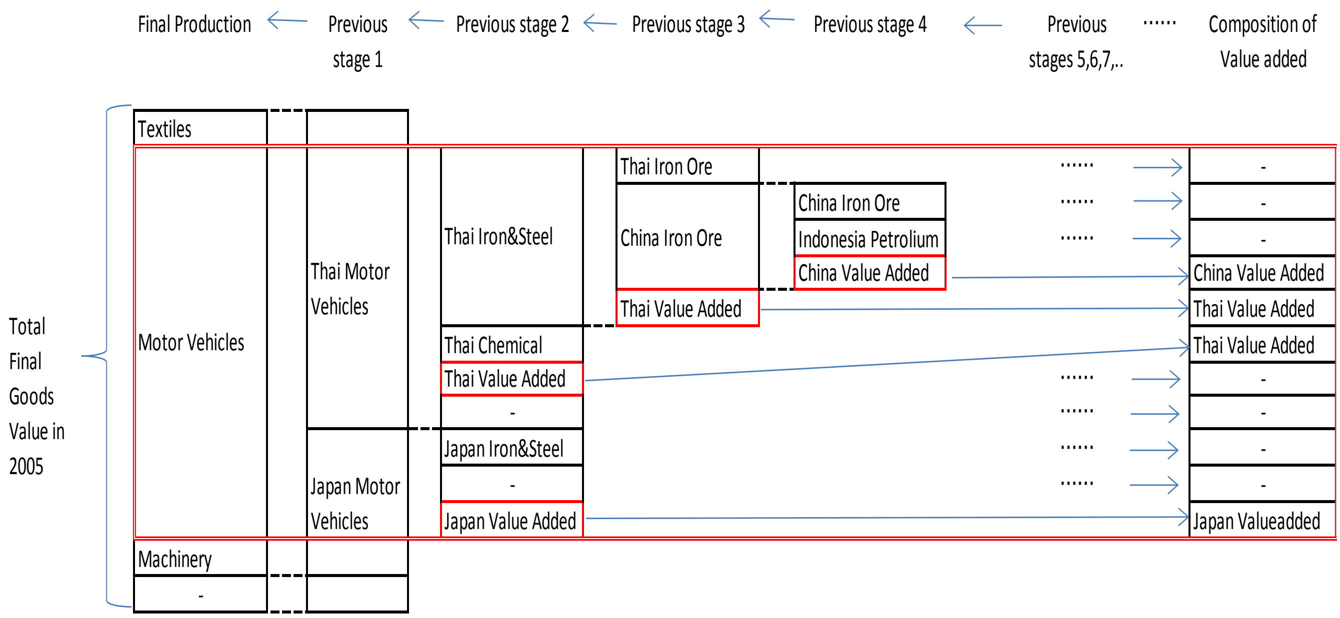
By recursive use of information in the AIO table, we can determine the source of value added in every dollar of production of final goods. The key is the simple accounting identity that states that the sale value of a product equals to the cost of intermediate inputs plus value added. Here value added refers to payments to factors of production, i.e. wages as well as profits. The same identity applies to the intermediate goods used as inputs, so a recursive application can generate a full map of where the value

[4] Our analysis focuses on the value-added sources of manufacturing industries. The Asian Input-Output table (AIO) of 1985, which covers 24 industries, includes only 12 manufacturing industries, whereas the AIO tables from 1990 onwards include 42 manufacturing industries. The use of more disaggregated data allows us to avoid some aggregation bias and gives us a larger number of observations in our regression analysis. The covered industries are listed in Table A1 in the appendix.

was added. For example, if labor were the only productive factor, we could identify where all the workers behind a given final product were employed (by sector and by nation).

For example, the value added embedded in Thai auto production can be decomposed into countries involved in the international supply chain which sources motors from Japan and petrol from Indonesia, as well as other inputs from the chemical and metal industries, which themselves source their inputs from other industries in other countries. By tracking down the whole process until the output value equals the sum of value added, we can decompose the total value added by industry and country. To ease understanding of the calculation process, Figure 1 provides a sketch of the scheme of the computation.

Figure 1. Tracing the value added of production of final goods



Decomposing value-added across input-output structures is straightforward using matrix algebra (see Johnson and Noguera 2012):

$$VA = F[I - B]^{-1}X$$

where VA is value-added embodied in the final goods production of a given country (N countries and J sectors), F is a (NJ;NJ) diagonal matrix with the ratio of direct value-added to gross output for each country and sector on the diagonal, $(I\text{-}B)^{-1}$ is the (NJ;NJ) Leontief inverse - it estimates the amount of intermediates per US$ of final output after all rounds intermediate shipments across sectors and countries. X is the (NJ; 1) vector of final goods production. We describe the results of this decomposition in the next section.

3. A portrait of production fragmentation in Factory Asia

Our first step is to decompose geographically the value added embedded in each country's final production. Figure 2 summarizes the results. It breaks down the value added of each country's by source country in 1990 and 2005. A column nation's production of final goods is composed of value added in row nations. For example, the first column gives the value-added shares of China's final demand. The extent of production fragmentation is first observed in the pseudo diagonal (without the USA row)[5], which represents value added at home. China's home-value-added share of exports fell from 97% in 1990 to 94% in 2005. The numbers below 0.01 (1%) are represented as zeros. The number of zeros in the matrix decreased from 49 to 29 (out of 90 possible spots), indicating the international expansion of value chains.

One of the most striking changes is the rise of China as a source of value added. In 1990 it accounted for 4% of the value added embedded in other countries' production. In 2005 that number had increased to 24%. While the US and Japan were and still are important sources of value added in all of these countries' production, in 2005 China's value added accounted for around 6% of production in Malaysia, 3% in Korea and Thailand, and 5% of Taiwan. The other noticeable feature is the foreign origin of value added embedded in Malaysia's production which is the highest among the countries studied despite the fact that it has not increased since 1990. Contrary to anecdotal evidence, China is surprisingly not number one in terms of foreign sourcing, quite to the contrary China's final manufactured goods are the ones that embed the least foreign value added among the 9 countries we cover. The anecdotal evidence on the little value added in China on products like the Barbie doll may not be representative of China's production.

Figure 3 summarizes the share of foreign value added embedded in the most fragmented manufacturing sectors in 1990 and 2005. In 2005, more than 20% of the value of electronics was embedded in imported inputs. In 1990 that number was below 10%. Across all sectors we notice a substantial increase in international sourcing from 1990 to 2005. Perhaps surprisingly, we find the most internationally-fragmented industry in 2005 to be "other basic industrial chemicals".

[5] The US does not appear as a column as the Asian IO Table does not provide the value-added origin of US production outside of Asia.

Figure 2. The geography of value added

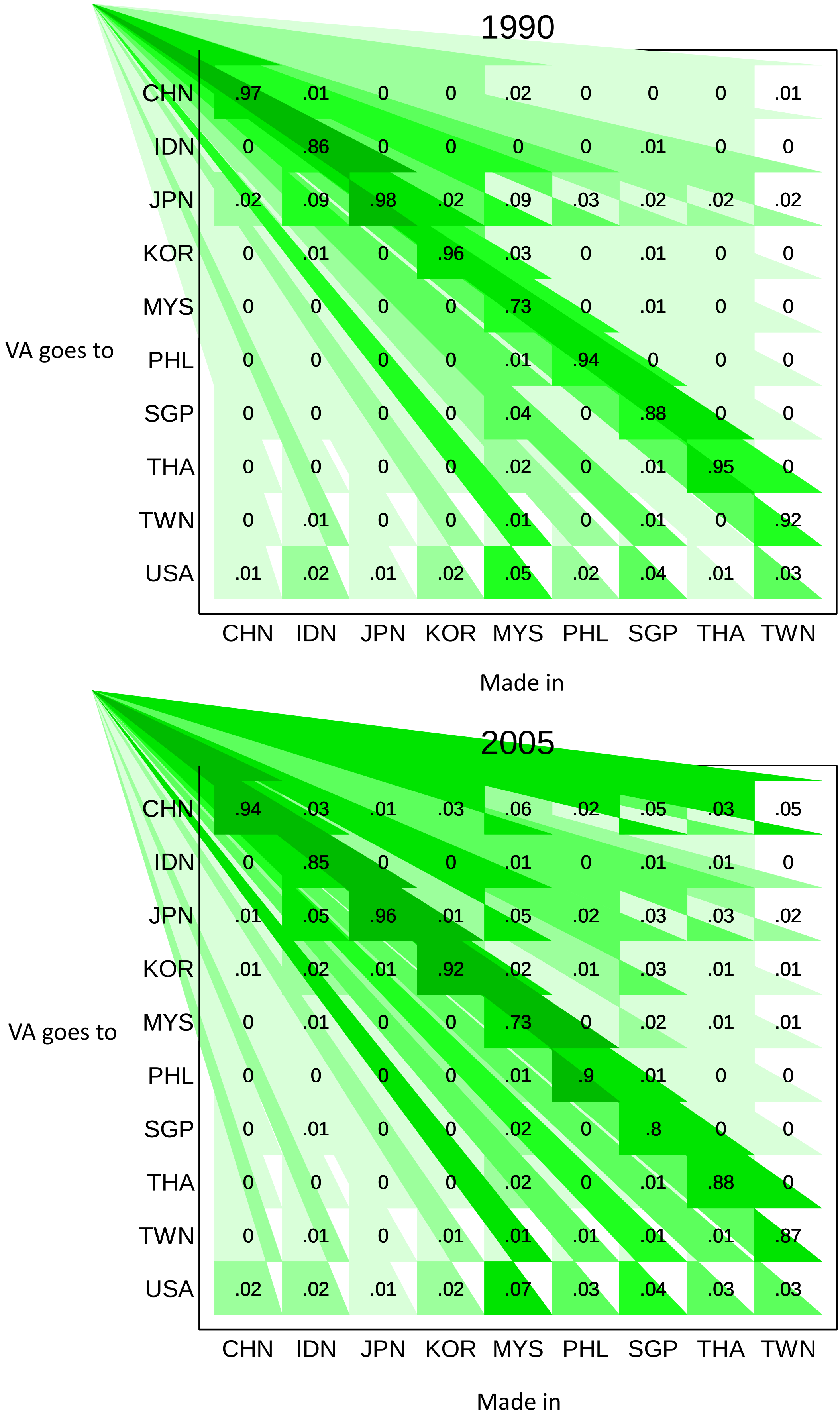
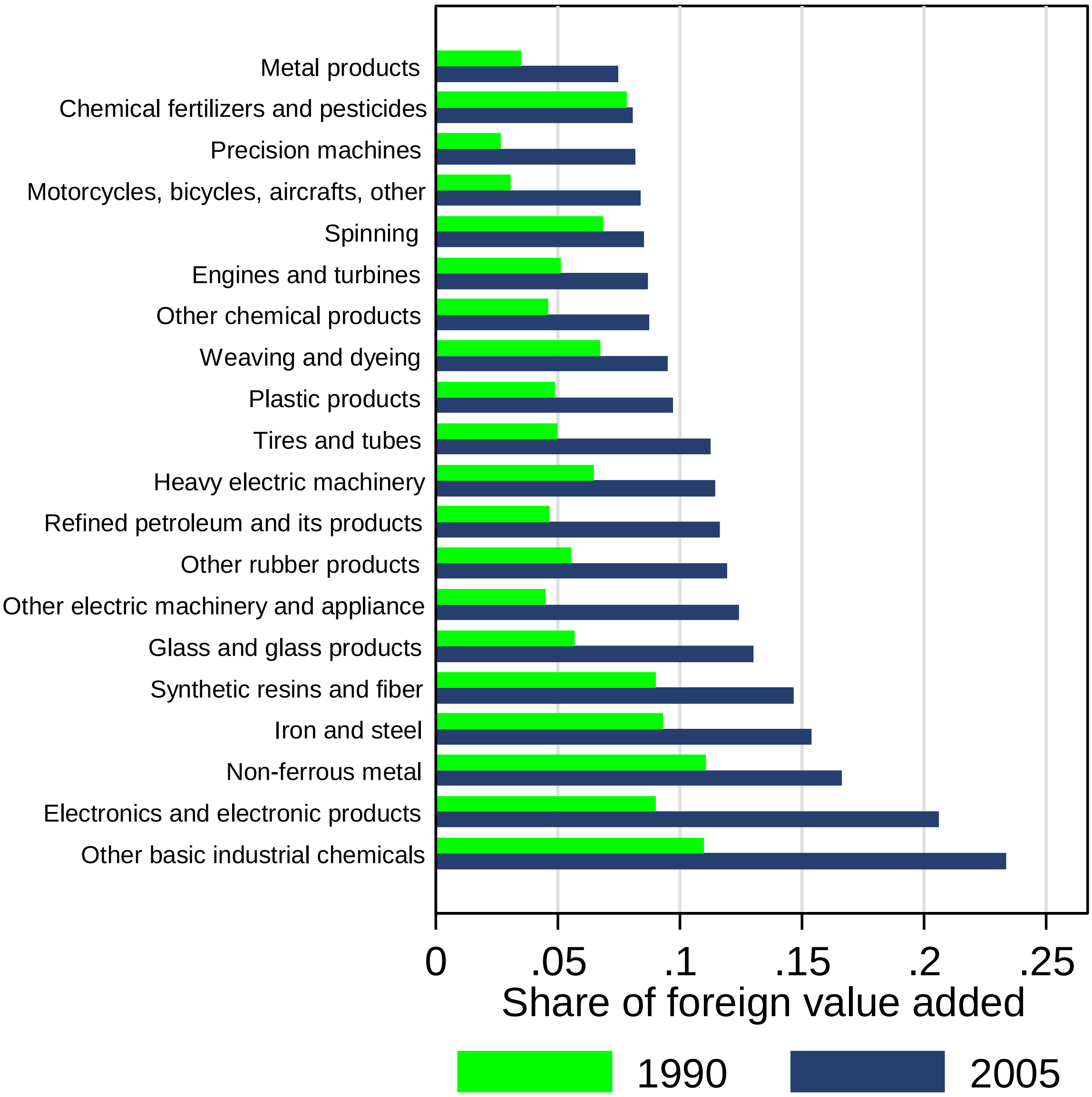


Figure 3. Share of foreign value added across sectors

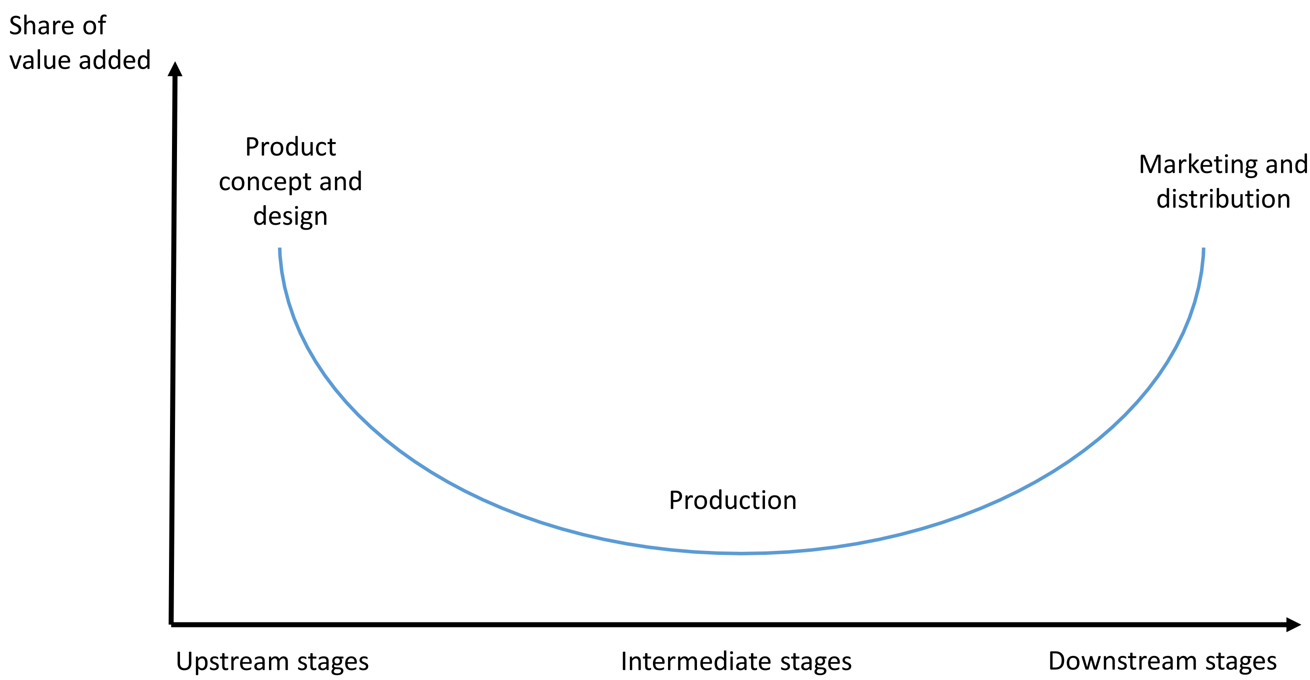


4. Upstreamness, value added and the smile curve[6]

While our decomposition of production fragmentation in Factory Asia makes it clear that Factory Asia's production is not only about adding cents to products embedding foreign value added, the second question of our introduction is still left unanswered. Does the position of a production stage along a value chain predict the share of value added to the final product?

The contribution of production stages to a product's value added has been a hot topic in the management literature since the beginning of 1990s. In 1992 Stan Shih, the founder of Taiwanese computer company Acer, famously suggested that in the personal computer industry, initial and final stages of production contributed more to a product' value added than the intermediate stages. This concept became known as the smile curve, due to the u-shaped relationship between production stages and value addition, as shown in Figure 4.

Figure 4. The smile curve along a value chain



To explain the smile curve, the management literature, most notably Mudambi (2008), suggested that the stages prone to automation and increased modularity, typically the fabrication or assembly stages, would have a lower value-added share because their cost, mainly labor compensation, was subject to downward

[6] The argument in this section draws on Baldwin, Ito and Sato (2014), Baldwin, Ito and Forslid (2015), Mudambi (2007) and Mudambi (2008).

pressure as they could be offshored to developing countries. More generally, the intermediate stages may involve more manual routine tasks and such processes do not allow for the differentiation that supports value creation. On the other hand, tasks in the initial and final stages, such as product design and marketing are knowledge intensive and require non-replaceable skilled workers that command high wages and allow for market power, another source of value creation via profits.

The concept of smile curve has been defined at the firm-product level, such as for Apple's iPads, where the notion of a value chain makes sense. It was tested empirically notably by Shin et al. (2012) who examined data on the world's top 300 electronics firms during the period 2000-2005. What they found was that component suppliers earn higher margins than contract manufacturers that focus on fabrication operations, which was consistent with the smile-curve hypothesis. In a similar exercise, Kimura (2003) looked at Japanese assembly-type manufacturing in six key industries including electronics and motor vehicles. He found a smile-curve relationship between profit rates and production stages in household electronic appliances, electronic computing equipment and accessory devices, and trucks, buses and other vehicles. Yet the challenge when introducing this concept to the economy-wide level is that the analysis can only be done using Input-Output tables where numbers are aggregated by industries, not by stages. Thus the challenge is to find a way to order the countries and industries on the value chain, i.e. on the horizontal axis of the smile curve. Is Japan's automobile industry located in the initial stage or the middle stage, or the final stage? How about Thailand's automobile industry? For this purpose, we borrow a newly proposed concept of "upstreamness" from Antras et al. (2012).

The Antras et al. (2012) measure is simply the ratio of final use to input use of a country-industry's output. The intuition is straightforward. An industry whose output is used mostly as intermediate input for other industries should be relatively upstream. Consider a particular industry *i*. Its output can be divided into final uses, i.e. consumption, and intermediate uses, i.e. sales to other industries down the production stream. Let's denote the total output of the industry Y and the value of this output that goes to final uses F. We can express each industry's output as:

$$Y_i = F_i + \sum_{j=1}^{N} d_{ij} Y_j$$

where d_{ij} is the value of inputs from industry *i* that are required by industry *j* to produce $1 of output and *N* is the number of industries. If we replace repeatedly the output terms on the right-hand side we get:

$$Y_i = F_i + \sum_{j=1}^{N} d_{ij} F_j + \sum_{j=1}^{N}\sum_{k=1}^{N} d_{ik} d_{kj} F_j + \sum_{j=1}^{N}\sum_{k=1}^{N}\sum_{l=1}^{N} d_{il} d_{lk} d_{kj} F_j + \cdots$$

The output of an industry is thus equal to the sum of its final sales and sales of input to all other industries before final use. If we assume that the distance between each sector is 1, upstreamness can be expressed as

$$U_i = 1 \cdot \frac{F_i}{Y_i} + 2 \cdot \frac{\sum_{j=1}^{N} d_{ij} F_j}{Y_i} + 3 \cdot \frac{\sum_{j=1}^{N} \sum_{k=1}^{N} d_{ik} d_{kj} F_j}{Y_i} + 4 \cdot \frac{\sum_{j=1}^{N} \sum_{k=1}^{N} \sum_{l=1}^{N} d_{il} d_{lk} d_{kj} F_j}{Y_i} + \cdots$$

In other words, industry *i*'s upstreamness is akin to a weighted average of its sales along the production process, where the weights are the production distances to industry *i*. The intuition is that the more sales are used as inputs in faraway industries, the more upstream the industry, i.e. the longer the distance to final consumers. Upstreamness thus increases in the number of non-zero input-output coefficients.

Antras et al. (2012) show that, in matrix form:

$$U_i = [I - \Delta]^{-1} 1$$

where 1 is a column vector of ones and Δ is a matrix with $\frac{d_{ij} Y_j}{Y_i}$ in entry (*i,j*). Their measure is thus easily computable using the IO matrix.[7]

We compute upstreamness for each country-industry in all years (we treat Factory Asia as one economy). The same industry's upstreamness differs across countries. Namely, the same industry can be more "upstream" in one country than another. The 2005 upstreamness indices averaged by industries are shown inTable 1. Non-ferrous metal, spinning, iron and steel, other basic industrial chemicals appear among the most upstream industries, selling their output mostly as input to other industries. The most downstream industries are beverages, apparel and other manufacturing, which sell most of their output to final consumers.

Table 1. Upstreamness by industry, 2005

[7] The Stata code for computing the upstreamness measure is available from the authors at http://www.aeaweb.org/aer/data/may2012/2012_1467_app.zip

Industry	Upstreamness	Industry	Upstreamness
Non-ferrous metal	5.90	Other chemical products	1.74
Other electric machinery and appliance	3.59	Leather and leather products	1.71
Other basic industrial chemicals	3.30	Other wooden products	1.71
Spinning	3.29	Other machinery	1.63
Synthetic resins and fiber	3.26	**Motor vehicles**	1.57
Heavy electric machinery	3.07	Other non-metallic mineral products	1.56
Iron and steel	2.70	Oil and fats, Sugar, Other food products	1.41
Weaving and dyeing	2.47	Furniture	1.39
Pulp and paper	2.30	**Motorcycles, bicycles, aircrafts, etc…**	1.35
Plastic products	2.24	Printing and publishing	1.33
Other rubber products	2.21	Milled rice, Other milled grain and flour	1.33
Glass and glass products	2.17	Shipbuilding	1.29
Tires and tubes	2.12	Tobacco	1.29
Refined petroleum and its products	1.97	Cement and cement products	1.26
Electronics and electronic products	1.93	Slaughtering, meat and dairy products	1.24
Timber	1.87	Chemical fertilizers and pesticides	1.20
Metal products	1.82	Fish products	1.18
Knitting	1.81	Drugs and medicine	1.17
Precision machines	1.80	Beverage	1.15
Engines and turbines	1.77	Wearing apparel	1.14
Other made-up textile products	1.75	Other manufacturing products	0.87

We then plot upstreamness against the average of the country-industry's value-added shares of final demand (Figure 5). Each dot represents a particular industry in a particular country, e.g. Japan's Motor vehicles industry. The horizontal axis measures its upstreamness. It is worth noting again that an industry such as Motor vehicles may be more upstream in Japan than in Thailand, for example. The vertical axis measures the average of the industry's value-added shares in each country-industry's final demand. For example, if $100 of Chinese metal products account for 0.3% of Thai Motor vehicles and $300 account for 0.1% of Japan Engines and turbines, Chinese metal products average value-added share would be 0.75 x 0.1% + 0.25 x 0.3%, i.e. 0.15%.

The data reveals a u-shaped relationship where country-industries in the middle of the supply chain add least value to final demand. This suggests the presence of a smile curve across the industries of Factory Asia.[8]

[8] A similar relationship has been documented with more aggregated data by Baldwin, Ito and Sato (2014). Instead of using an upstreamness index to define production stages along the horizontal axis, they use the standard economy classification of primary, manufacturing and services sectors and focus on the increasing value-added share of service industries.

Figure 5. Upstreamness and value added share

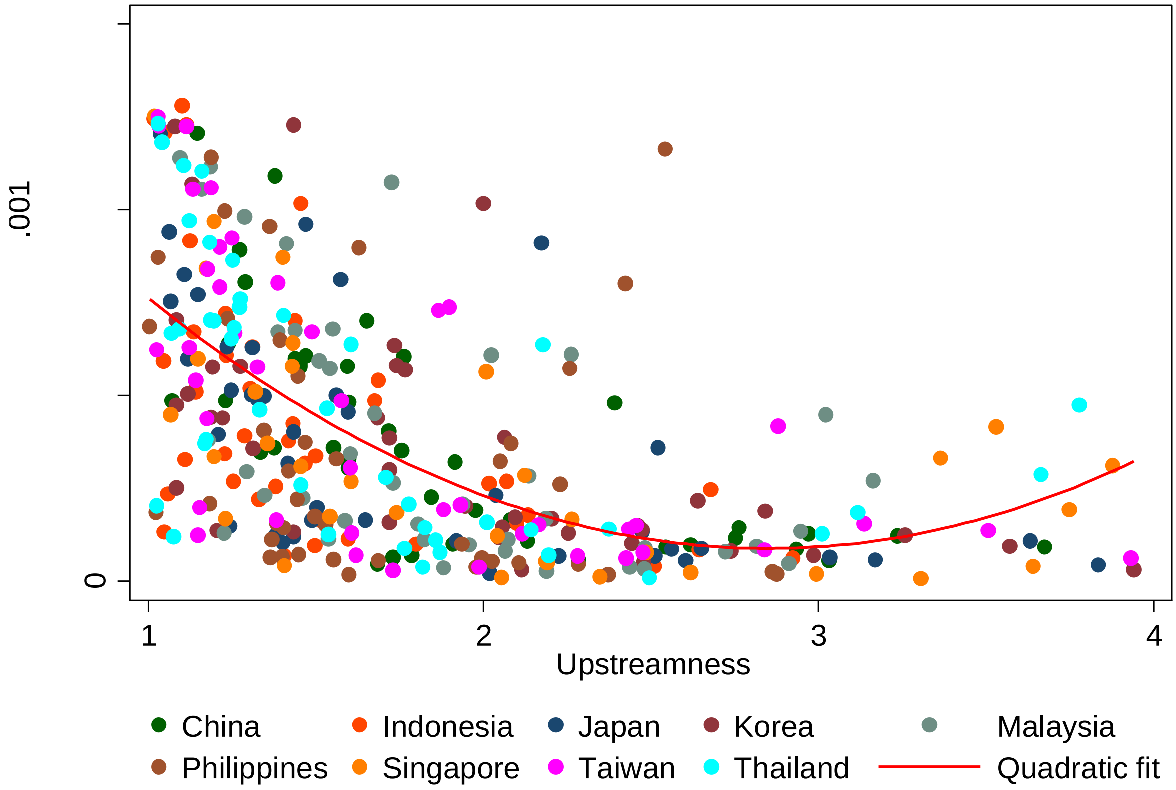
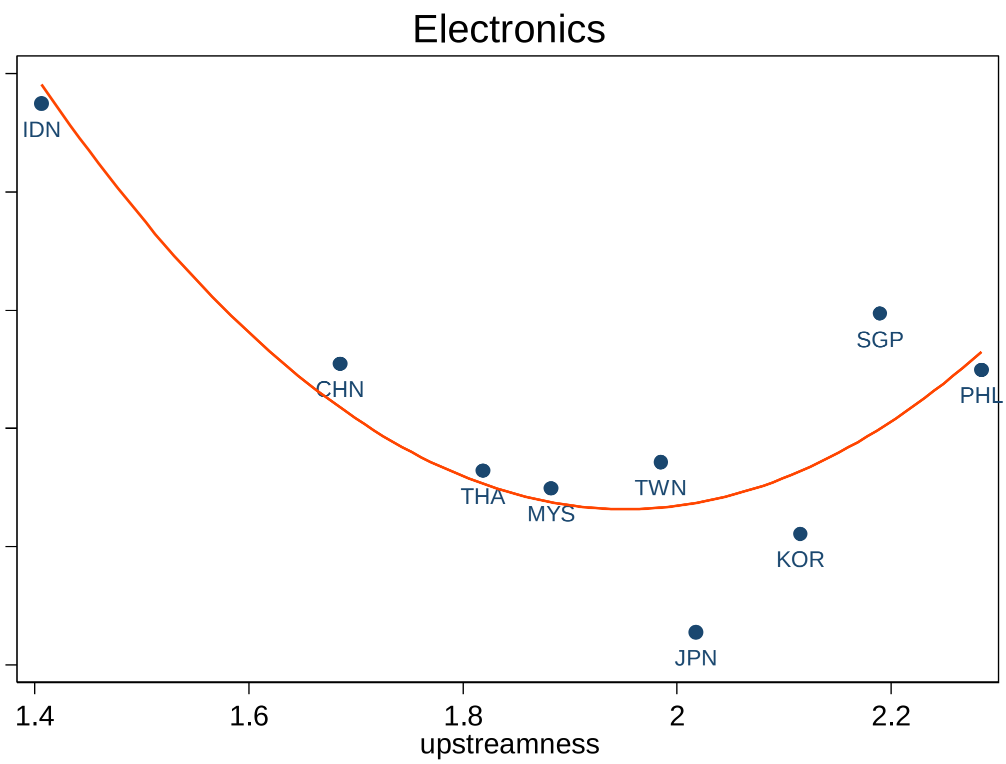


Figure 6 suggests that this pattern also holds across countries in electronics and motor vehicles, industries known for their international fragmentation. This suggests that countries at the upstream end of the supply chain in cars, i.e. Japan, add a larger share of value to final demand in all industries, than countries at mid-stream such as China and Malaysia. Countries at the downstream end, such as Taiwan, also contribute more value added to final demand than mid-stream country-industries. In electronics, countries as the downstream end of the supply chain, e.g. Indonesia and China, add more value than Korea and Japan which are more upstream.

Figure 7 plots the smile curves by country for the 6 developing, or emerging, countries in our data. We observe a smile curve in all countries in 2005. This suggests that within countries, industries that concentrate on upstream and downstream processes contribute more value to final demand than industries that focus on intermediate stages of production. This suggests that both within and across countries less value is added in the middle of the stream, maybe as it involves the highest degree of modularity and international competition, as suggested by the smile-curve hypothesis.

Figure 6. The smile curve across industries and across countries



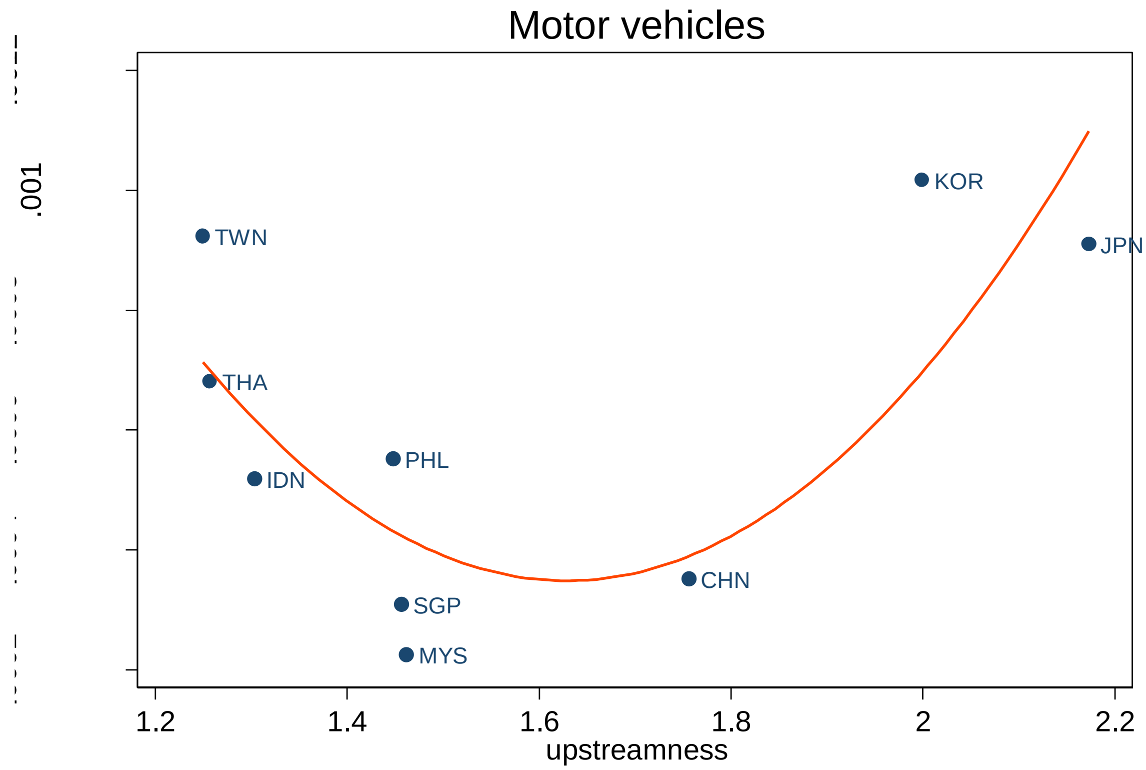
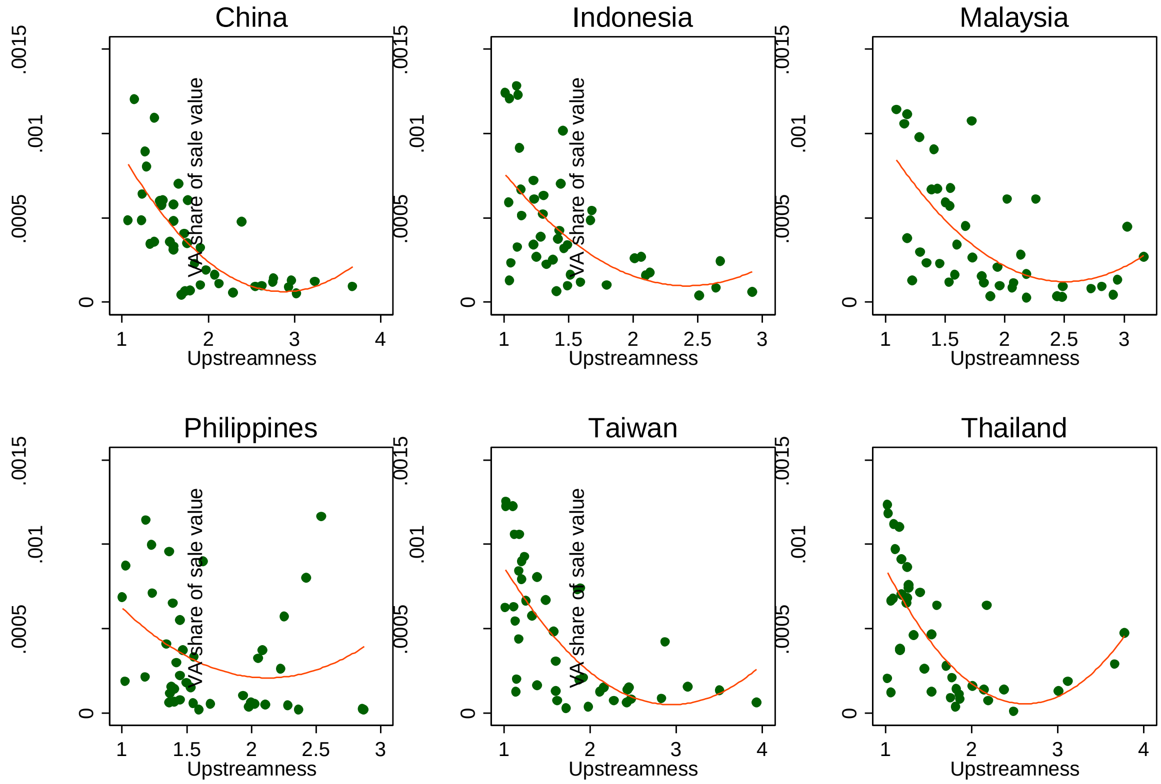

Motor vehicles
.001
TWN
THA
IDN
PHL
SGP
MYS
CHN
KOR
JPN
1.2
1.4
1.6
1.8
2
2.2
upstreamness

Figure 7. The smile curve across countries



We then test the smile curve significance with a quadratic term regression:

$$VA\ share_{ik} = \alpha_i + \delta_k + \beta_1 U_{ik} + \beta_2 U_{ik}^2 + \epsilon_{ik}$$

where $VA\ share_{ik}$ is country *k*'s sector *i* average share of value added embedded in the final goods industries it contributes to, α_i and δ_k are sector and country fixed effects, U_{ik} is the upstreamness of country *k*'s sector *i* and ϵ_{ik} is an error term. We focus on a 2005 cross section. Results are inTable 2. Across alternate specifications where we use different sets of fixed effects we observe a u-shape pattern as the coefficient on upstreamness is negative and significant while the coefficient on upstreamness squared is positive and statistically significant. This result is robust to including country and industry fixed effects and thus indicates that the "smile curve" is present both within and across countries and industries.

Table 2. Testing the smile curve across countries and industries in 2005

	(1) VA share	(2) VA share	(3) VA share	(4) VA share
upstreamness	-0.186***	-0.183***	-0.0568***	-0.0376**
	(0.0341)	(0.0353)	(0.0213)	(0.0183)
upstreamness^2	0.00640***	0.00634***	0.00239***	0.00193***
	(0.00114)	(0.00115)	(0.000708)	(0.000584)
Country FE		X		X
Industry FE			X	X
Observations	378	378	378	378
R-squared	0.185	0.199	0.673	0.699

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. (VA share is multiplied by 1000).

5. Conclusion

The second unbundling, or the fragmentation of production across countries, is probably the most important aspect of contemporary globalization (Baldwin 2011). It implies, for example, that products "Made in China" may have little Chinese value added embedded in them. In this paper we dressed a portrait of the geographic fragmentation of the value added embedded in Factory Asia's output of final goods from 1990 to 2005. We showed that the share of foreign value added embedded in production rose significantly from 1990 to 2005 and that contrary to popular belief, China's final production embeds a smaller share of foreign value added than other Factory Asia countries. The anecdotal evidence on Barbie dolls as examples of low-value-added exports for China may not be good indicators of China's overall production. While concerns that Factory Asia's exports may not embed much domestic value added resonate in the policy world, our estimates suggest that the domestic share of value added in production of final goods was above 80% in all countries except Malaysia (73%) in 2005.

We then tested for the presence of a smile-curve relationship between value addition and production stages along industries of Factory Asia. We found that country-industries at the upstream and downstream extremities of the supply chain do account for a larger share of value added than those with intermediate levels of upstreamness. This does not necessarily mean that developing countries should avoid joining international supply chains, or should focus on upstream and downstream stages. Often the intermediate stages are the only entry door to global value chains and may lay down the path towards the upstream and downstream stages which provide more scope for differentiation and value creation. Identifying the development implications of joining global value chains makes for promising future research.

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Appendix

Table A1. Industry code list: Asian Input-Output Table 1990, 1995, 2000, 2005

Industry code	Industry description	Sector
001	Paddy	Primary sector
007A	Other grain	
002X	Cassava, Sugar cane and beet, Oil palm and coconuts, Other food crops	
003X	Natural rubber, Fiber crops, Other commercial crops	
009	Livestock and poultry	
010	Forestry	
011	Fishery	
012	Crude petroleum and natural gas	
015A	Iron ore	
010X	Copper ore, Tin ore, Other metallic ore	
016	Non-metallic ore and quarrying	
018X	Milled rice, Other milled grain and flour	Manufacturing sector
021A	Fish products	
021B	Slaughtering, meat and dairy products	
017X	Oil and fats, Sugar, Other food products	
022A	Beverage	
022B	Tobacco	
023	Spinning	
024	Weaving and dyeing	
025	Knitting	
026	Wearing apparel	
027	Other made-up textile products	
028	Leather and leather products	
029	Timber	
030A	Furniture	
030B	Other wooden products	
031	Pulp and paper	
032	Printing and publishing	
033A	Synthetic resins and fiber	
033B	Other basic industrial chemicals	
034	Chemical fertilizers and pesticides	
035A	Drugs and medicine	
035B	Other chemical products	
036	Refined petroleum and its products	
037	Tires and tubes	
038	Other rubber products	
039	Cement and cement products	
040	Glass and glass products	
041	Other non-metallic mineral products	
042	Iron and steel	
043	Non-ferrous metal	
044	Metal products	
045D	Heavy electric machinery	
045E	Engines and turbines	
045X	Ordinary industrial machinery, Specialized industrial machinery, Agricultural machinery	
046A	Electronics and electronic products	
046B	Other electric machinery and appliance	
047A	Motor vehicles	
048B	Shipbuilding	
048X	Motor cycles and bicycles (Motor cycles), Motor cycles and bicycles (Bicycles), Aircrafts, Other transport equipment	
049	Precision machines	
050A	Plastic products	
050B	Other manufacturing products	
051	Electricity, gas and water supply	Service sector
052A	Building construction	
052B	Other construction	
053A	Wholesale and retail trade	
053B	Transportation	
054A	Telephone and telecommunication	
054B	Finance and insurance	
054C	Education and research	
054D	Other service including Real estate, Medical and health service, Restaurants, Hotel	
056	Unclassified	
055	Public administration	

Note: Whereas AIO tables 1990, 1995 include 78 industries (out of which, 49 manufacturing sector industries), AIO tables 2000, 2005 contain 76 industries (out of which, 53 manufacturing sector industries). This table shows harmonized industry codes throughout 1990, 1995, 2000, 2005.