The smile curve: Evolving sources of value added in manufacturing

Richard Baldwin, Tadashi Ito and Hitoshi Sato

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1. INTRODUCTION

Globalisation's 2nd unbundling – the geographical unbundling of production processes – is transforming the global economy. This is especially true in the manufacturing sector. A key element of this shift is the displacement of value added from high-technology-high-wage nations to low-technology-low-wage nations. This shift, however, is accompanied by a seemingly paradoxical pair of concerns.

- Rich nations worry about the loss of manufacturing jobs to a handful of low-technology-low-wage nations.
- The receiving nations, however, are increasing worried that they are getting the wrong sorts of jobs.

The first concern has been well documented (UNIDO 2013). As Figure 1 shows, the shift of manufacturing from developed to developing nations has been remarkable since 1990, especially to China.
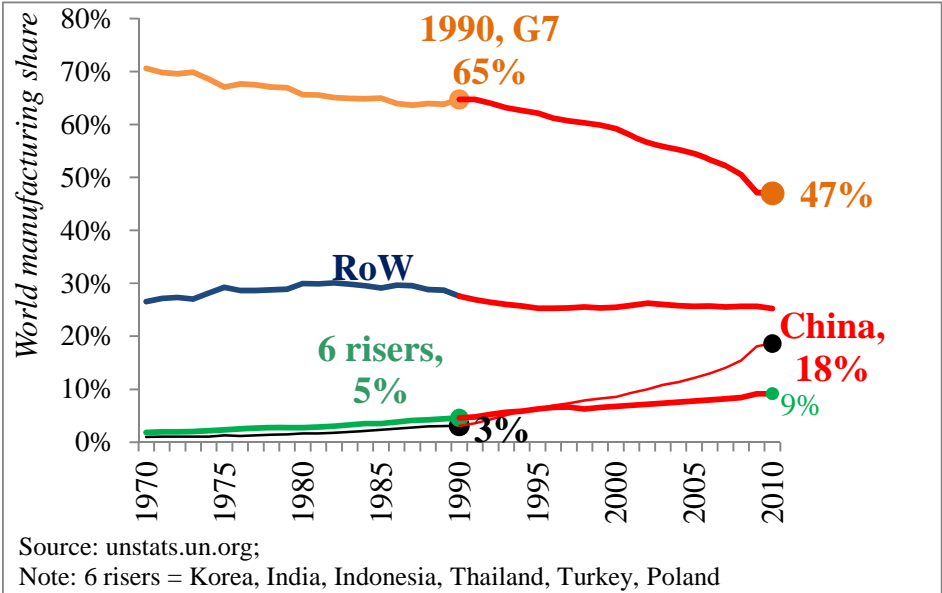

Figure 1: Global shift in manufacturing value added, 1970 – 2010.

On the first concern, advanced technology nations with high wages – such as Japan, UK, and the US – worry about a hallowing out of their economies as manufacturing jobs are offshored to low-technology-low-wage nations. Advanced economies around the world are rethinking their 'competitiveness strategies' and revisiting industrial policy debates, which have not been given credence since the late 1980s.

On the second concern, the 2nd unbundling has meant that developing nations can now industrialise by joining supply chains rather than building them, but only certain types of jobs are being offshored to developing nations. There is a fear that the 'good jobs' are staying in advanced economy cities while the 'bad jobs' are being shuffled off to developing economy factories.

The second concern is less well founded empirically but no less influential. It is often organised around a keynote intellectual construction – the so-called 'smile curve'. Introduced by Acer founder and CEO Stan Shih in the early 1990s, the smile-curve logic asserts that the share of value added in manufactured products is shifting from the fabrication stages to pre- and post-fabrication services. The general assertion – widely held among developing nation policy makers – is that this distribution is moving against fabrication stages, i.e. the smile is deepening as shown schematically in the left panel of Figure 2. As a result, the emerging markets that are industrialising at historically unprecedented rates are now worrying that they are getting the 'bad' jobs, i.e. jobs associated with low value added per worker, while the 'good' jobs stay in the North.

The economics literature on the smile curve is surprisingly underdeveloped (although see Mudambi 2008) even though the concept is widely discussed in the International Business literature (e.g. Yan and Islam 2011).
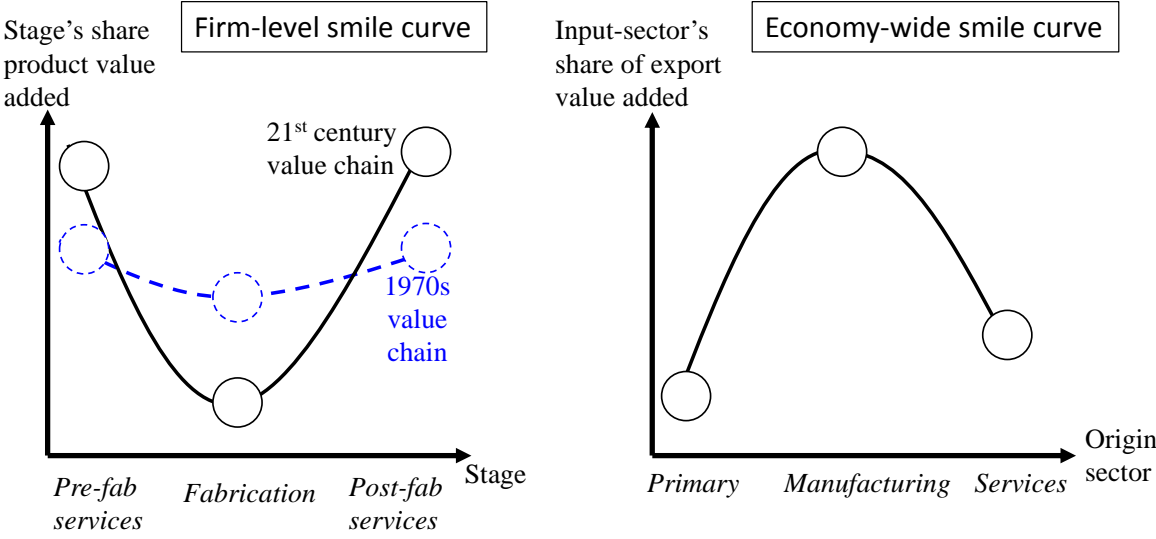

Figure 2: The smile curve: Firm-level versus economy-wide conceptualisation.

The goal of this paper is to shed light on how important the smile-curve notion is at an aggregate level. In particular, we focus on how value added has shifted along the value chain when it comes to Asian exports. To this end, we use the newly released 2005 version of JETRO-IDE's Asian Input-Output (AIO) table. This data is compiled and the AIO constructed by the Institute of Developing Economies, Japan External Trade Organization (IDE-JETRO) and has been constructing every 5 years since 1985. The table covers 76 sectors and is focused on Asian nations (Indonesia, Malaysia, Philippines, Singapore, Thailand, China, Taiwan, Korea, Japan and the US). It includes the US since the US is the major trading partner for almost all Asian countries. Partner countries other than the Asian countries and the US are aggregated as the Rest of the World (ROW).

2. ECONOMY-WIDE SMILE CURVE AND PRIMA FACIE EVIDENCE

The smile curve is based mostly on causal empiricism (although see REITI 2004). There may be many reasons for this lack of evidence, but one clear problem is that the concept is defined at the firm-level and product level where the notion of a value chain makes sense. Most systemic data sets, however, are at the economy-wide level where the value chain concept is more obscure. The point is that firms' value chains intersect and overlap. Thus at the economy-wide level, concepts such as upstream and downstream lose much of their relevance. What is an upstream service input for one firm will be the final output for another firm, so it is hard to know whether value is being shifted upstream or downstream when the service input garners greater value added.

To overcome the firm-level to economy-level gap, we re-jig of the smile-curve concept by focusing on the sectoral origin of value-added in nation's exports. As a first pass, we work with a very high level of origin-sector aggregation, namely primary, secondary and tertiary sectors. In this reformulated version of the smile. The economy-wide versions of the smile curve is shown in the right panel of Figure 2.

The economy-wide concept surely misses some of the subtle aspects of the firm-level concept. But for policy purposes, the economy-wide concept is perhaps more pertinent. The basic fear that offshoring involves sending low-value-added jobs to developing nations and keeping high-value-added jobs in rich nations is, after all, an economy-wide concern. Moreover, the 'good jobs' are loosely associated with high-wage service jobs such as research and development, marketing, product design, etc while the 'bad jobs' are loosely associated with low-wage jobs in fabrication stages. The well-known iPhone example is a good illustration. The good jobs – and most of the profits – are in California while the low-wage assembly jobs are in China.

2.1. TRACING BACK THE SOURCE OF VALUE ADDED IN EXPORTS

It is important to note that one cannot simply read off the numbers we are after. From the AIO table, we can decompose a nation's exports of, say, transport equipment into direct value added in the nation's transport equipment sector and the sector's intermediate-input purchases. The purchased inputs may be from primary, secondary or tertiary sectors, but each of these inputs themselves use purchased inputs. Thus we have to iteratively trace all the value added to its origin. To start with, we ignore the nationality of the value added and focus on the origin-sector.

By recursive use of information in an international IO table, we can determine the source of value added in every dollar of exports. The key is that simple accounting identity that states the sale-value of a product equals the cost of intermediate inputs and the direct value-added of the industry producing the good. Here value-added refers the cost of primary inputs such as capital, labour, etc. The same identity applies to the intermediate goods used as inputs, so a recursive application can generate a full map of where all a product's value was added.

For example, Thai auto exports of worth $10,000 can be decomposed into the value-added of countries involved in the car production supply chain, which sources its inputs from chemical industry, or metal industry, which themselves sources their inputs from other industries. In each production stage, the value-added (essentially, labour and capital contribution) is put on. By tracking down the whole process until the production values reaches to the sum of value-added, we can decompose the production values into the value-added by industry/country. By doing this computation, we can find which country/industry contributes to Thailand's car exports. In this first paper – where we hope to stick to a level of analysis that is amenable to graphical presentation – we often aggregate across all of a nation's exports. See Figure 3 for a

schematic illustration of how we get the three-way decomposition for a nation's aggregate exports.

To get a feel for the result of such calculations, consider the case of the exports of textile and leather products. Here our decomposition of the origin-sector of the value added shows that in 1985, 21% of the value added came from primary sectors, 70% came from manufacturing sectors (including the textile and leather sector itself) and only 9% came from service sectors. By 2005, the corresponding figures were 15%, 57% and 28% for primary, secondary and tertiary sectors.

Figure 3: Value-added origin sector.

2.2. PRIMA FACIE EVIDENCE: ECONOMY-WIDE SMILE CURVE

We illustrate concepts with the example of Japan before turning to other Asian nations in our dataset. Table 1 shows the results of our decomposition of value-added source sectors for Japan's aggregate exports. In 1985, 6.8% of the value of Japanese exports stemmed from value that was added in the primary sector (in Japan or elsewhere). By 2005, this share had fallen to 2.1%. The big variation, however, is seen in the manufacturing sector's contribution. In 1985 the manufacturing sector was the source of 80.1% of all the value added in Japan's exports.

Table 1: Distribution of value-added by broad input sector, 1985 and 2005: Japan

Source sector	1985	2005	Change
Primary	6.8%	2.1%	-4.7%
Manufacturing	80.1%	69.3%	-10.8%
Service	13.1%	28.6%	15.6%

Source: Authors calculations on AIO database

The fact that this number is high is not a surprise. Japan's exports are heavily skewed towards manufacturing and most of value added of manufactured goods is added in the manufacturing

sector itself (the rest being added in the service and primary sectors that provide inputs into manufacturing). The share in 2005 fell to 69.3%, which, while still high, is a big drop. As the shares must add to 100%, the service sector saw a corresponding rise in its share of value added in Japanese exports.

The figures in the table – and corresponding numbers for Korea and Taiwan can be graphically displayed by plotting the changes as in Figure 4. For all three nations, the result is a smile curve of sorts (although perhaps it would be better dubbed the 'smirk curve').

The primary sector falls in importance as a source of value added by 5 to 10 percentage points in all three nations. The service contribution also rises by double digits in all three. When it comes to the fall in manufacturing's contribution, Korea stands out in that its share fell by less than primary's contribution, while it fell by more in the other two.
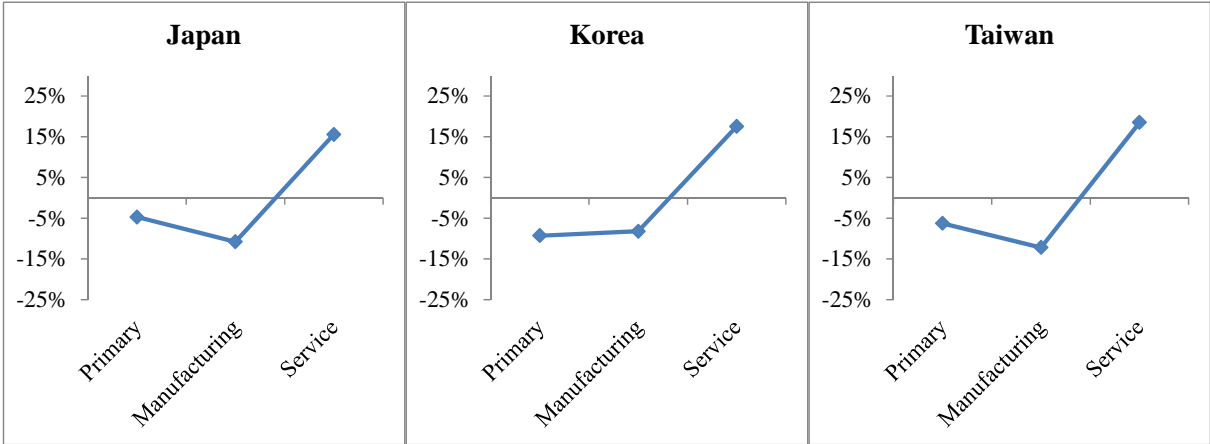
Figure 4: Aggregate smile curve, Japan, Korea and Taiwan

Interpreting these aggregate changes is not straightforward. The changes could be driven by many different factors. Before turning to interpretation, we present the aggregate smile curves for the other Asian nations in our sample in Figure 5. This charts show that most of the countries follow the classic smile, or 'smirk' pattern. The Philippines and Indonesia are notable exceptions. These nations see the usual drop in primary and rise in services, but the drop in manufactured value input is much less marked.

Figure 5: Aggregate smile curve, Thailand, China, Philippines, Indonesia, and Malaysia

3. ECONOMICS OF THE SMILE CURVE

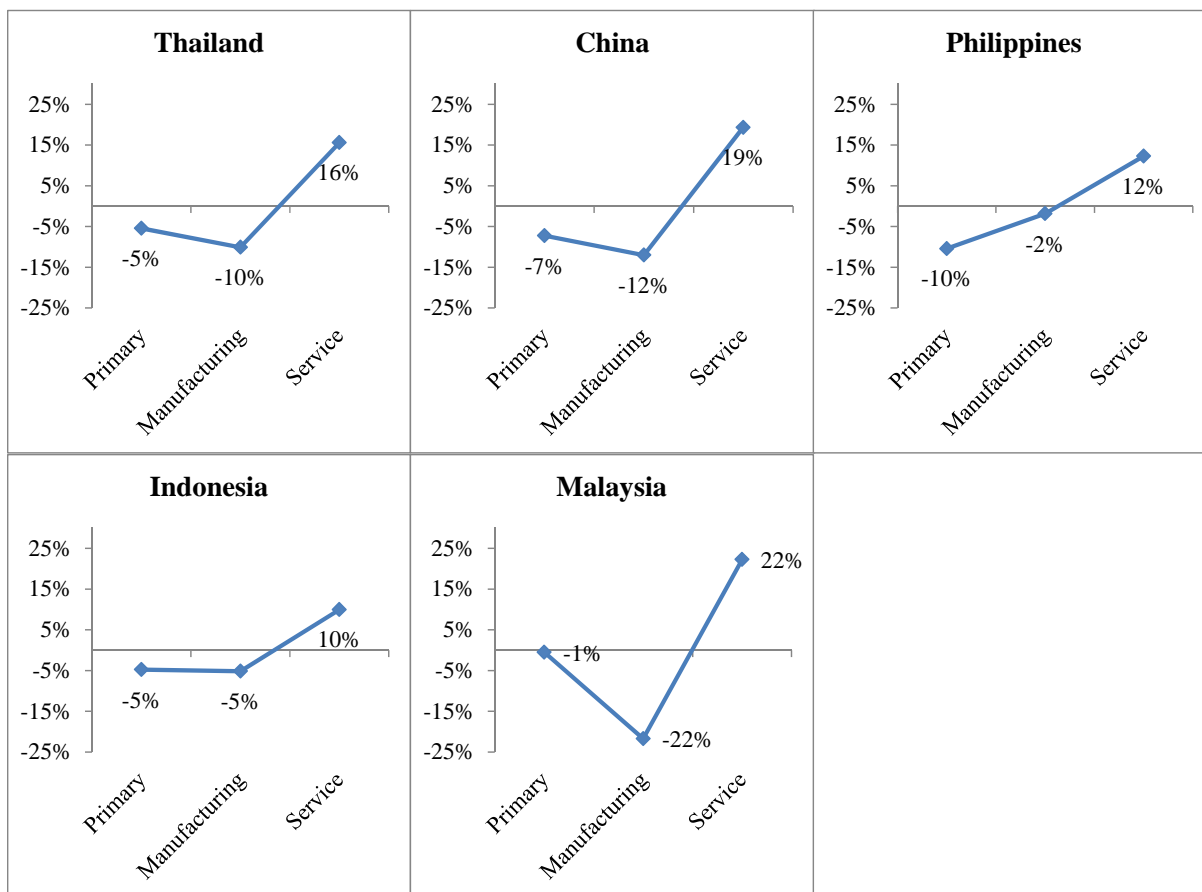The forces behind the smile curve have not been thoroughly investigated theoretically or empirically. The goal of this section is to present an analytic framework that can help explain why the smile deepened and how policy makers should think about value-chain issues.[1]

Simple economics suggest two explanations for the economy-wide shifts: compositional changes across industries, and changes within industries/firms. First, the smile may be down to the change composition of nation's exports. That is, even if there were no change in the production process at the product level, the shift that is evident in Figure 4 and Figure 5could be due to shift towards exporting goods that happen to be intensive in their use of inputs from service sectors.

While the composition of these nation's exports clearly shifted from 1985 to 2005, a look at the industry aggregates suggest that this cannot be the whole story. The value-added shifts by industry are shown in

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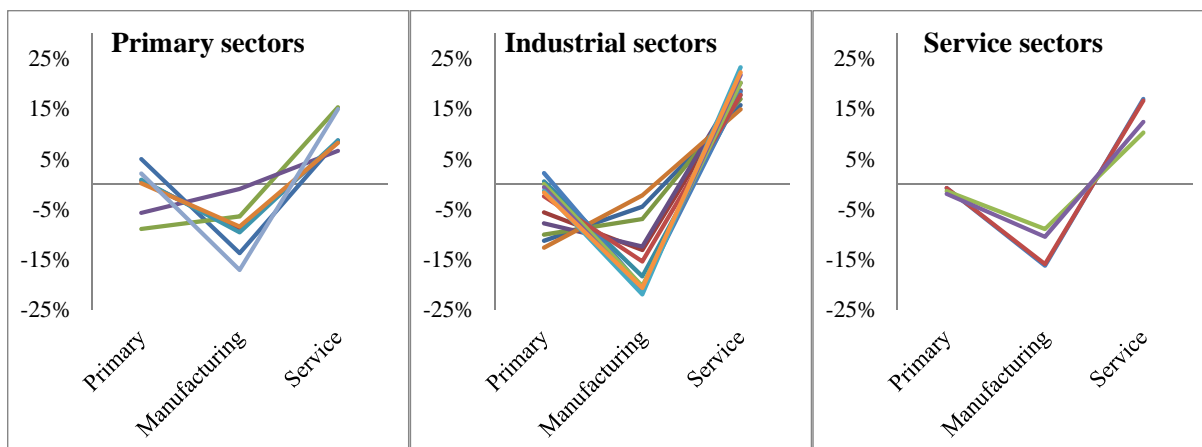
Figure **6** for all of our sectors that are consistently represented in the AIO back to 1985. Here we see that the smile phenomenon is observed across all industries.
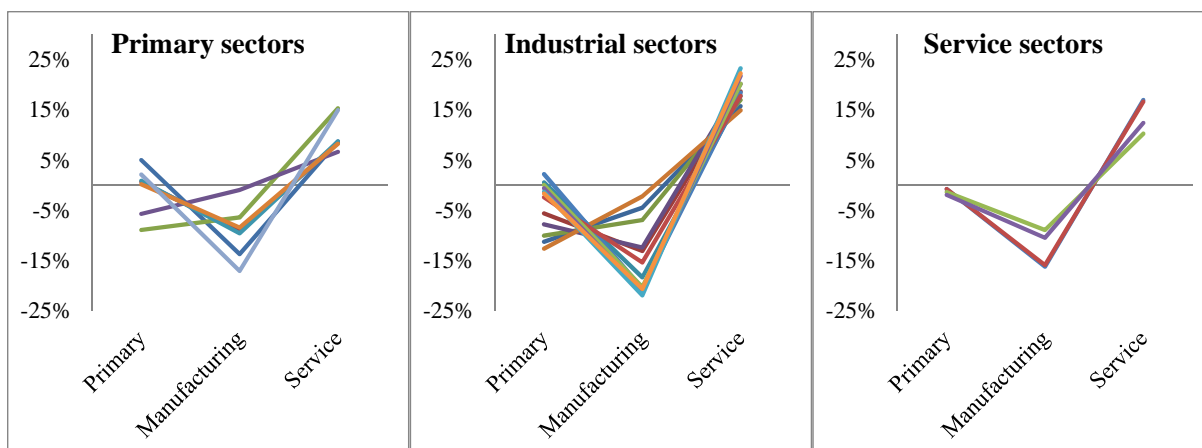
Figure 6: Smile curves by industry, 1985 to 2005.

The underlying data for these charts are shown in

Table 2 (aggregating across all Asian nations in the AIO). One of the striking points from the table is the consistency across industries of the shift to sourcing value added in exports from service sectors. In all industrial sectors, the shift to services has been from 15 to 23 percentage points. In service sectors, the figures varies from 10 to 17. Only in primary sectors do we see a less important shift – with the range being approximately half that of manufacturers, namely from 8 to 15 percentage points. See the Appendix for industry by industry charts.

Table 2: Change in sector-origin by industry, Data for smile curves.

Primary sectors

	Primary	Manufacturing	Service
Paddy	5%	-14%	9%
Other agricultural products	1%	-9%	8%
Livestock	-9%	-6%	15%

	Primary	Manufacturing	Service
Forestry	-6%	-1%	7%
Fishery	1%	-10%	9%
Crude petroleum and natural gas	0%	-8%	8%
Other mining	2%	-17%	15%

Industrial sectors

	Primary	Manufacturing	Service
Food, beverage and tobacco	-11%	-4%	16%
Textile, leather, and the products thereof	-6%	-13%	19%
Timber and wooden products	-10%	-7%	17%
Pulp, paper and printing	-8%	-12%	20%
Chemical products	1%	-18%	18%
Petroleum and petrol products	-13%	-2%	15%
Rubber products	2%	-21%	18%
Non-metallic mineral products	-2%	-15%	18%
Metal products	0%	-20%	20%
Machinery	-1%	-21%	22%
Transport equipment	-1%	-22%	23%
Other manufacturing products	-2%	-21%	22%

Service sectors

	Primary	Manufacturing	Service
Electricity, gas, and water supply	-1%	-16%	17%
Construction	-1%	-16%	17%
Trade and transport	-1%	-9%	10%

This conclusion continues to hold when we look at a particular sector for each nation. The smile curve by nation by industry for the case of Machinery is shown in Figure 7. Even if we look at the same industry across countries, the 'smirk curve' remains although it is deeper for some nations. Figures for the other industries are in the appendix.
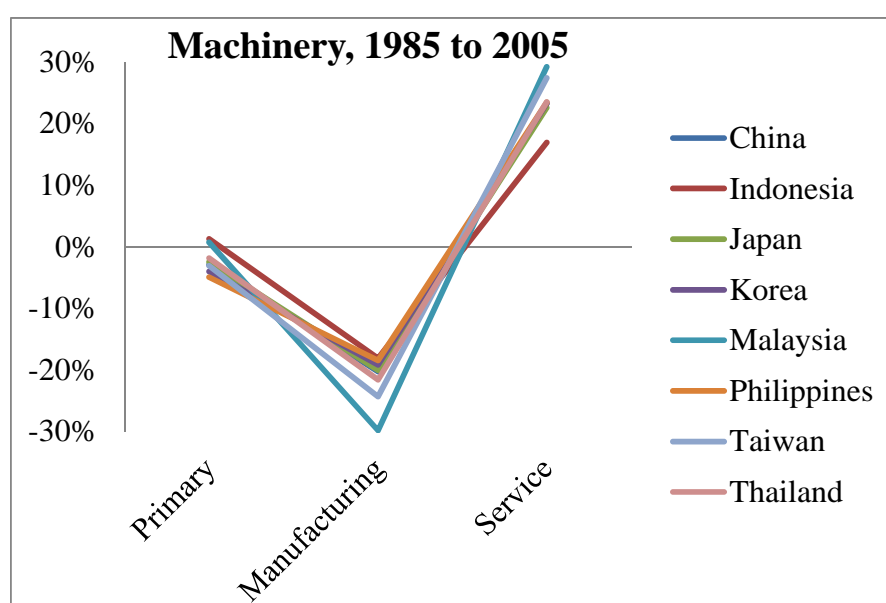

Figure 7: Machinery smile, by nation, 1985-2005

The second explanation for the value-added shift concerns industry, or firm level changes. The redistribution of value added by origin-sector could be forced by changes in technology, competition, relative prices, or corporate restructuring. For example, technological changes could rise or lower the amount of primary inputs necessary to produce a given product. Primary share could also fall if the price of primary goods rose by less than the price of the goods produced by the sectors using them.

3.1. ORGANISING FRAMEWORK: FIRM-LEVEL SMILE CURVE

We start with the definition. Value added of a stage is the difference between the value of the stage's output and the cost of its intermediate inputs, namely

- Value Added = Price×Output – (Per-unit cost of intermediates)×Output

To connect it to things that might be subject to policies, the first step is to relate the price to the costs of capital, labour and other primary factors, intermediate costs, and the mark-up, namely:

- Price = Per-unit factor payments + Per-unit cost of intermediate inputs + mark-up

where factor payments represents wages, return to capital, technology, etc, and the mark-up is the premium of price over average cost. Using the price relationship, we get:

- Value Added = (Per-unit factor payments + mark-up)×Output

Observe that the cost of intermediates is netted out. To compare value-added across links in the value chain, we normalise to get value-added per unit of output, namely:

- Value Added/Output = Per-unit factor payments + mark-up

This is a workable starting point. It tells us that value-added at each stage in a firm-level value chain consists of factor payments and profits. From this it follows immediately that the only way to change the distribution of value-added per stage is to change relative factor payments or relative profit margins.

One clear source of such changes is offshoring. Imagine that firms in high-tech-high-wage nations offshore labour intensive stages to low-tech-low-wage nations. The implied cost savings will mechanically reduce the offshored stage's share of total value assuming that the profit margin doesn't change much. The reason is that a stage's value added is based on its costs.

This basic cost-accounting effect can be amplified by two additional effects. The first is relative market power. Offshored tasks tend to be things that can be done in many emerging nations – most of them eager to attract such stages. The non-offshored stages, by contrast, tend to involve things where firms naturally have market power due to product differentiation, branding, etc. In short, offshored tasks become commoditized; the onshore tasks do not. The second is the combination of high-technology from the lead firm with low-wage labour in the offshoring recipient. Even if such firms pay local workers more than average (as is often the case), the combination of high labour productivity and low wages can massively reduce the unit cost of the offshored stage.

This provides one simple story for the smile curve. Some production stages are more readily offshored than others and North-South offshoring is typically driven by cost-lowering

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motives. Thus the value added in the offshored stages could be expected to fall. If the most offshore-able stages involve fabrication, the firm-level smile curve would be a natural outcome.

At the economy-wide level, the story is slightly different. Here the key point is that if it is easier to offshore manufacturing activities than service activities, offshoring should be expected to produce an economy-wide smile curve.

3.2. 'SERVICIFICATION' OF MANUFACTURING

A very different sort of explanation could come from the 'servicification' of manufacturing. That is, even if there were no change in technology, costs or prices, shifting jobs and tasks from manufacturing firms to service firms would make it look like less of a product's total value added was coming from fabrication. The basic idea here is that manufacturing firms have outsourced many tasks such as marketing, accounting and cleaning. In most national accounting systems, such outsourcing would shift value added from a manufacturing firm to service sector firm and thus this would appear to be an increase in value that is added by the nation's service sectors. This would be true even if there were no changes at all in the production process.

The servicification of manufacturing has long been commented upon by economist tracking employment data. More recent work documents the trend more carefully (Falk and Peng 2011, Lodefalk 2010). An important recent paper by Bernard and Fort (2013) document what they call 'factoryless manufactures' as having reached the polar extreme of service separation from fabrication.

4. DECONSTRUCTING THE VALUE SHIFT TO SERVICES

This section takes a closer look at the prima facie evidence presented in Figure 4, Figure 5, and Figure 6. We start with the time dimension.

4.1. SMILE CURVES 1985-1995 AND 1995-2005

Unlike other multiregional IO tables that are available (notably WIOD and TiVa), the Asian IO table exists in electronic form back to 1985. This allows us to investigate whether the smile curve is a recent phenomenon or whether it also was present in the 1980s.To start with, we take the first 10 years (1985-1995) and contrast it with the second 10 years (1995-2005) – each time focusing on the changes rather than the levels. Specifically, we calculate the value added in each nation's exports fully tracing back service, manufacturing and primary inputs.

The smile curve comes from plotting these changes. Figure 8 shows the facts for Japan and the Philippines. The figure plots on the vertical axis the change in value that was added in the three sectors (primary, manufacturing and services) to the nation's exports. The figure shows that between 1985 and 1995, the value added in these nation's exports stemming from primary sectors fell for both Japan and the Philippines. The value added originating in manufactured sectors rose in both nations over the same period, while value added to these nations exports in service sectors rose for Japan (slightly) but was unchanged for the Philippines. In summary, there was no smile-curve phenomenon in either of these nations in the decade running up to 1995.
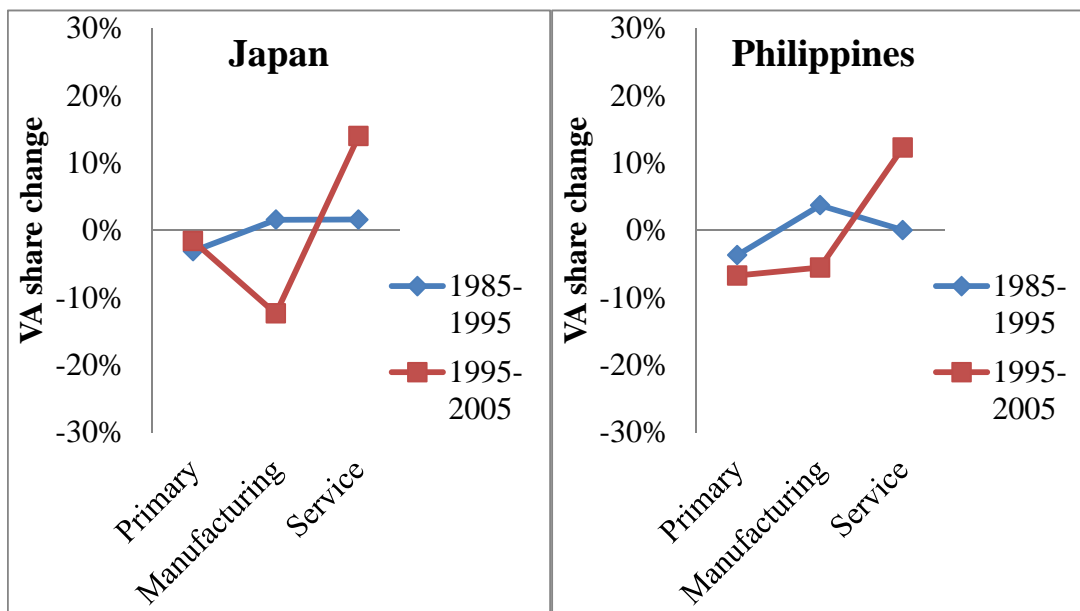
Figure 8: Smile curves for Japan and Philippines, 1985-95, 1995-05.

The smile appears clearly, however, during the decade following 1995. The value added in primary sectors fell for both nations as did the value added in manufacturing sectors. The value added in service sectors rose sharply. As the 'corner of the mouth' rises only for the left side, this might be called a smirk curve rather than a smile curve. The pattern for the Philippines is broadly similar when it comes to the magnified importance of service sector inputs, but the drop in manufacturing is less marked while the drop in primary inputs in more marked.

Having fixed ideas by looking at these two nations, we turn to the remaining Asian nations in the AIO. The results are striking (Figure 9). There was:

- Little or no shift of the value-added in the 1985-1995 period;
- A massive shift between 1995 and 2005.

This pattern holds for all the countries as Figure 9 shows.

We can do this same temporal decomposition aggregating across the Asian nations in the AIO database but separately by industry. Figure 10 displays the result for exports in selected industries.[2] Again we see quite a bit of commonality in the patterns.

While this set of facts is striking, it does not immediately help us identify the drivers of the shift to services. Factory Asia started to develop rapidly from about 1985 but it accelerated substantially between 1990 and 2000 as China opened up, joined the WTO and Asian nations unilaterally reformed post-Asian Crisis in ways that were attractive to offshored factories. Other things equal, this might point to the second unbundling as a key driver. Unfortunately, the servicification of manufacturing was also booming post 1995 (Lodefalk2010). The main point here is that the ICT revolution fostered outsourcing and offshoring by making it easier and safer to organise complex interactions at distance.

At the very least, the change over time alerts us to the fact that something has changed in recent decades to produce this evolution in the service-inputs into Asian exports. It is not a universal trend. This is helpful in that it rules out many of the standard 'structural change'

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[2] The cases of the other industries are in the appendix.

explanations in the growth literature. Studies such as Ngai and Pissarides (2007), Acemoglu and Guerrieri (2008), and Foellmi.and Zweimuller (2008) stress the secular rise in services share of GDP and employment. What we see with the contrast between the 1980s and 2000s is that this cannot be the whole story.
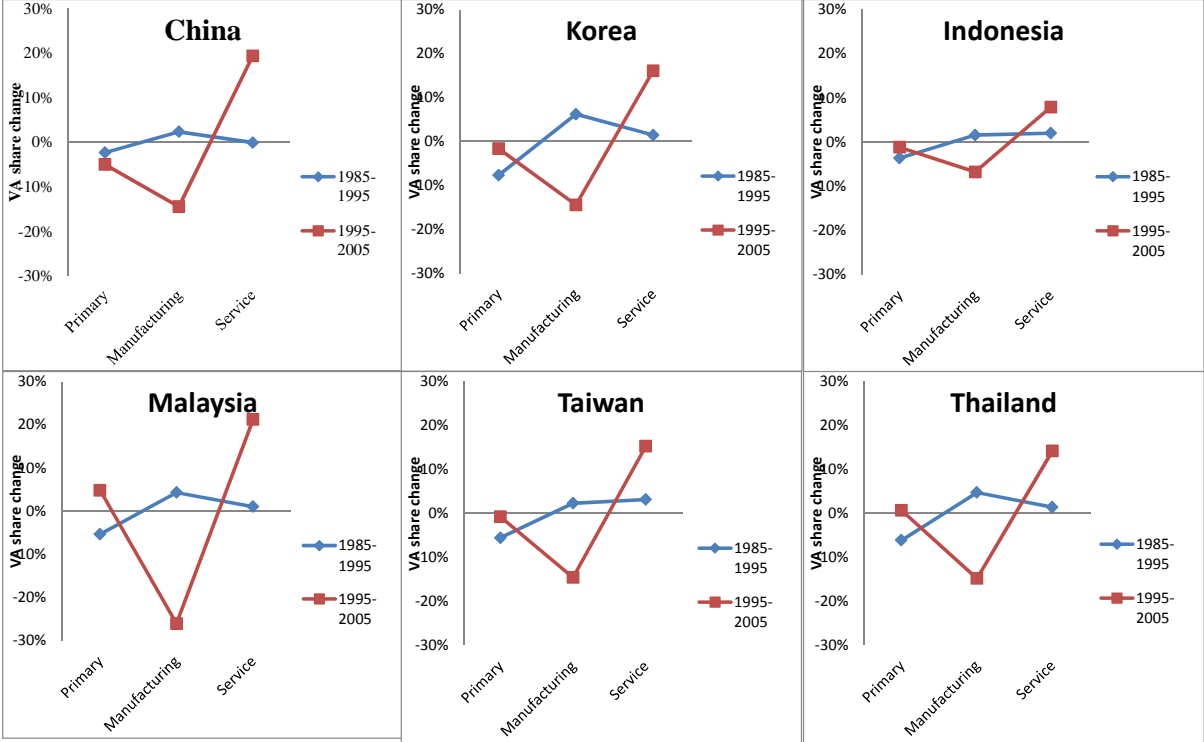

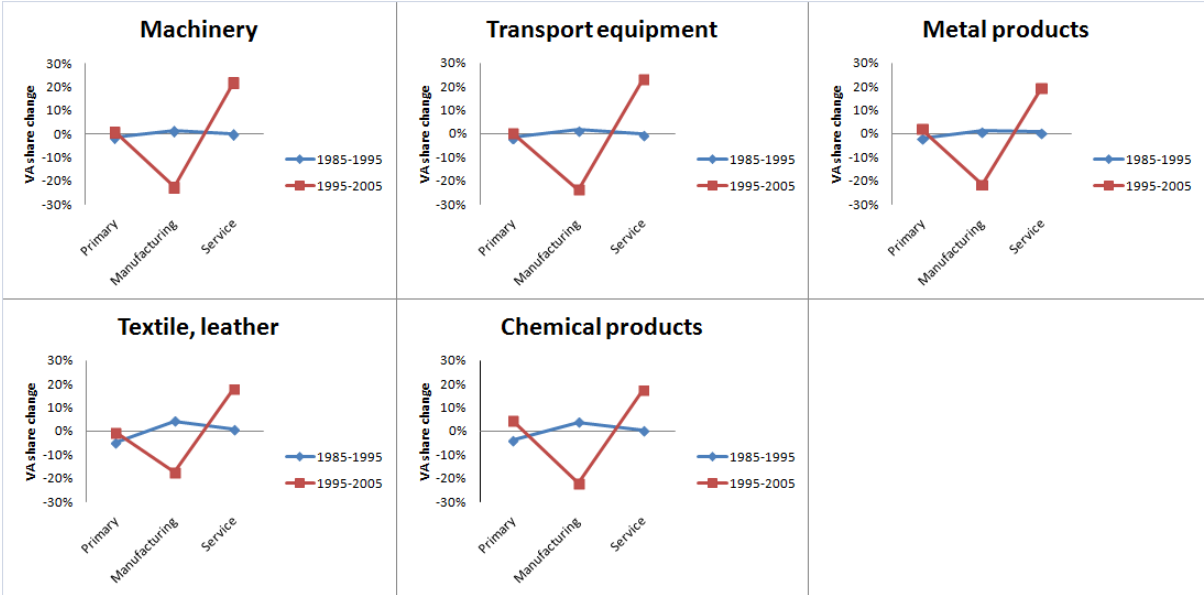Figure 9: Aggregate smile curve by nation, 1985-1995 versus 1995-2005

Figure 10: Aggregate smile curve by industry, 1985-1995 versus 1995-2005

The next slice at this aggregate level is to consider the change in the input value-added distribution by sector and nation. Figure 11 displays the facts for four key export industries:

transport equipment, machinery, metal products, and chemical products for the 1985 to 2005. The most salient point is the fact that while there is some variation by country by sector, most show a strong smile curve pattern.
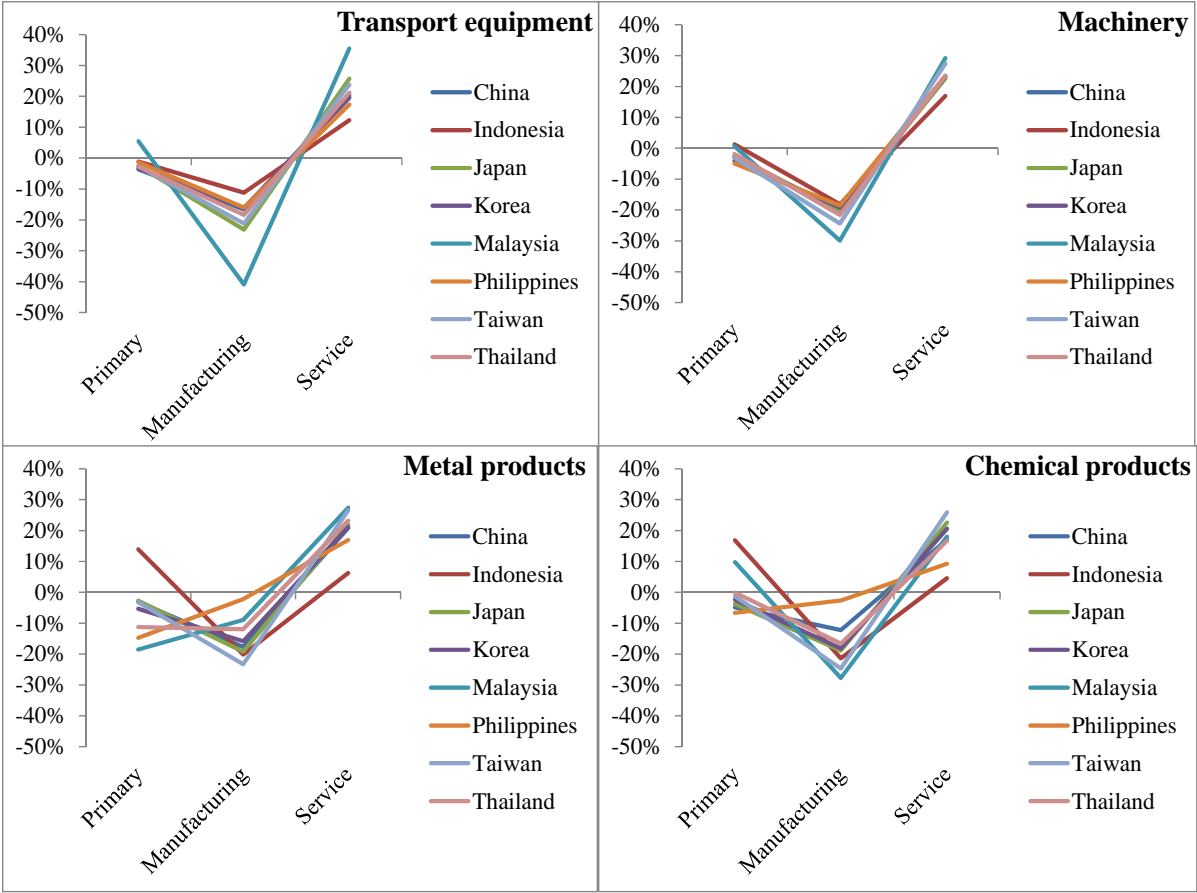
Figure 11: Smile curve by nation and industry: Selected export sectors, 1985 – 2005.

4.2. THE GEOGRAPHY OF THE SHIFT TO SERVICES VALUE ADDED

The large shift of the value-added source from the manufacturing sector to the service sector ignored the issue of national sources. Hereto we have ignored the geographical dimension, i.e. which countries supplied the extra sector-sector value-added. This misses a key part of the concern raised by the smile curve – that offshoring is sending the 'bad jobs' to emerging markets while the 'good jobs' stay in the lead firms' home nations. The smile-curve fear is that high-productivity service sector jobs are stay in, or even moving to advanced nations while low-productivity fabrication jobs – especially assemble – are moving to developing nations.

Given the aggregation in our dataset, we cannot really address this good-versus-bad job dichotomy. We can, however, track the nations that provide the higher service-sector inputs. Namely, we look at the increase in service VA, by *source* nation for each exporting nation/industry. Loosely speaking, we associate the service-sector inputs into nation's exports as 'good jobs'.

To fix ideas and introduce concepts, we start with a single export sector (machinery) and look at the nation-of-origin of service-sector inputs for Thailand and Japan. For example, the top panel of Table 3 shows the case of the machinery exports of Thailand. We see that Thailand's own-share of service-sector inputs decreased from 94% in 1985 to 40% in 2005. The

corresponding rise in foreign service sector inputs came mainly from Japan, the US and China – although it increased for every nation in our database. The increase in the share of value added in Thailand's machinery that was added by Japanese service sectors is quite remarkable. From just 3% in 1985, it jumped to 40% in 2005. The US's and China's increases were also large, but not where near as dominate as Japan's.

This result is consistent with the firm-level smile curve drivers discussed above, although it is far from conclusive. That is, if Japanese lead firms in the machinery sector are offshoring fabrication jobs to lower costs, but keeping pre- and post-fabrication service-sector jobs at home, we should expect the pattern in the top panel of Table 3. The large increase of Thai export sourcing from US service sectors (the US share of service inputs rises from 2% to 12%) is also in line with the canonical smile curve thinking at the firm-level.

An interesting twist, however, is that Thai exports are seeing more of the value added by the service sectors in other Asian developing nations such as China, Taiwan, Korea and Singapore. Of course, it is possible that the service-sector inputs from, say, the Philippines involves low-productivity service inputs into intermediate goods, while the service-sector inputs from, say, the US involves high-productivity market, design and innovation services.

Exporter	Industry	Source Country	Sector	Country share 1985	Country share 2005
Thailand	Machinery	Thailand	Service	94.14%	40.26%
Thailand	Machinery	Japan	Service	3.04%	21.54%
Thailand	Machinery	USA	Service	2.12%	11.59%
Thailand	Machinery	China	Service	0.00%	10.24%
Thailand	Machinery	Taiwan	Service	0.19%	4.29%
Thailand	Machinery	Malaysia	Service	0.06%	3.71%
Thailand	Machinery	Korea	Service	0.12%	3.56%
Thailand	Machinery	Singapore	Service	0.05%	1.99%
Thailand	Machinery	Indonesia	Service	0.02%	1.58%
Thailand	Machinery	Philippines	Service	0.26%	1.24%
Exporter	Industry	Source Country	Sector	Country share 1985	Country share 2005
Japan	Machinery	Japan	Service	99.04%	89.20%
Japan	Machinery	USA	Service	0.74%	4.05%
Japan	Machinery	China	Service	0.04%	2.47%
Japan	Machinery	Taiwan	Service	0.05%	1.13%
Japan	Machinery	Korea	Service	0.05%	1.12%
Japan	Machinery	Malaysia	Service	0.04%	0.52%
Japan	Machinery	Thailand	Service	0.01%	0.40%
Japan	Machinery	Philippines	Service	0.01%	0.39%
Japan	Machinery	Singapore	Service	0.02%	0.38%
Japan	Machinery	Indonesia	Service	0.02%	0.35%

Table 3: Value shift to services-sectors: Machinery exports from Thailand and Japan

The bottom panel of Table 3 shows the same breakdown for Japanese machinery exports. The decrease in domestic service-sector sourcing is far less marked than it was for Thailand, with Japan's share fall only 10 percentage points. This fall was accompanied by modest rises in service-sector value added in the US (an extra 3 percent points) and China (an extra 2.5 percent points).

4.3.   DATA FOR 5 EXPORT SECTORS AND 8 NATIONS

With the basic idea in hand, we turn to a more systematic exploration of the geographical dimension of the shift to services. To keep the figures manageable we focus on 5 key export

sectors and 8 of the Asian exports in the AIO database. For each of these 40 cases, we look at the change in service source shares for 10 supplies, namely Japan, USA, China, Singapore, Korea, Taiwan, Malaysia, Indonesia, Thailand, and the Philippines.

The basic data is displayed in a rather concentrated manner in Figure 12. For each of the 40 cases (5 export sectors for 8 Asian nations) we plot the change in the sourcing share for the main actors – Japan, the US and China. For comparison, the Japanese figure for Thai machinery exports (Table 3) is 18.5 percentage points (21.54% minus 3.04%). For Japan itself in machinery, the number plotted is -9.8% (89.20% minus 99.04%).

Note that the negative numbers in the chart are primarily reflecting a decrease in the own-nation share of service-sector inputs. Table 4 shows the numbers for the five sectors we focus on. There is a clear pattern whereby large and more developed nations see a lower drop in own-sourcing.

	Japan	China	Korea	Taiwan	Indonesia	Thailand	Philippines
Textile & leather	-8%	-16%	-14%	-22%	-19%	-23%	-33%
Chemical products	-8%	-22%	-24%	-34%	-24%	-30%	-44%
Machinery	-10%	-22%	-25%	-34%	-19%	-54%	-47%
Transport equip	-6%	-16%	-23%	-27%	-36%	-45%	-82%
Metal products	-6%	-14%	-28%	-24%	-24%	-40%	-45%

Table 4: Reduction in own-nation service-sector sourcing shares (percentage points, 1985 to 2005).

What the chart shows is that a great deal of the value-added shift towards services has involved international outsourcing – not just domestic outsourcing. Given the well-known tight production network links between Japanese companies and the listed Asian nations, this is a clear indication that the 2nd unbundling is closely linked to the shift in services. For instance in transportation equipment, where regional production networks are tightly controlled by lead firms, the service value added shift has been massive away from local service sectors and towards Japan's. In the case of Thailand, the share shift away from domestic sources and towards Japanese sources was a massive 28 percentage points. The idea here is that the fact that Thai production facilities have access to worldclass business services via their associated Japanese lead firms may well be a key to the boom in Thai transport equipment exports.

The US and Chinese service sectors have also become much more important adders of value to Asian nation's exports, with the gain in share typically lying in the 5 to 10 percentage point range. Notice that we cannot tell what is causing what from the data. In principle, this could be rich nation firms offshoring manufacturing tasks to developing nations and keeping the service tasks at home, or it could be emerging market firms buying in worldclass services in order to make their products more competitive.
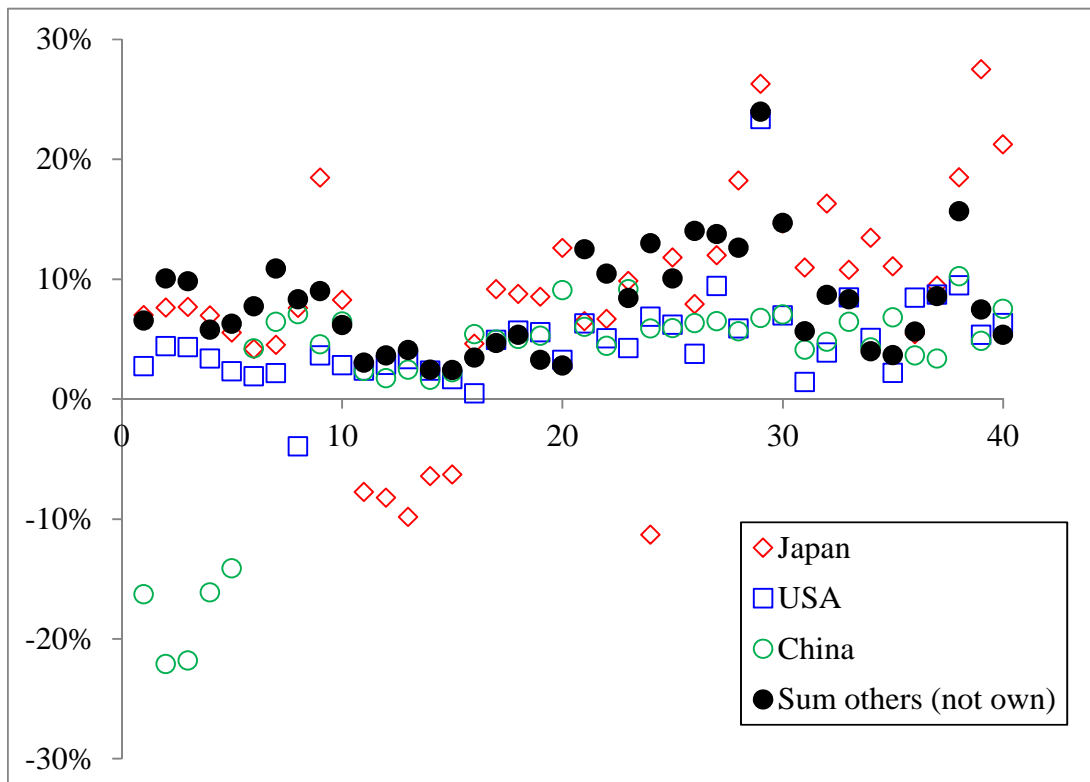
Figure 12: Service-input share changes: By national origin 1985 – 2005.

Up to this point, the 'good/bad jobs' notion discussed in the introduction seems to pass the first look at the date. The exports of Asian developing nations are deriving much more value added from service-sector inputs, but a great deal of this is coming from advanced technology nations. But the numbers tell a more nuanced story. All the other nations in our sample saw an increase in their shares of each other's service-sector sourcing, but the percentage point increases were typically small. Taken together, however, the shifts are very important – typically more important than that of the US or China.

5. CONCLUDING REMARKS AND TESTABLE HYPOTHESES

This is, to our best knowledge, the first attempt to show what economy-wide smile curves look like for Asian nations. Our use of the AIO allows us to show that the smile curve is more than just an international implication of the shift to services that has been stressed in the structural change literature. We find that in fact inputs from manufacturing sectors provided rising shares of nations' export value added from 1985 to 1995, but sharply falling shares from 1995 to 2005. This pattern of little change in value added via inputs from primary sectors teamed with large shifts in value added from inputs stemming from manufactured sectors to inputs coming from service sectors. We find this outcome for almost all sectors and almost all nations.

One informal explanation for this shift is that fabrication has become commoditised. That is, the vast range of nations eager to welcome low-productivity manufacturing jobs has reduced the markups and labour costs in such stages. In this view, lead firms from high-technology-high-wage nations offshore labour-intensive manufacturing task while keeping high-skill service tasks at home. We find some very indirect evidence in support of this since the overall

rise in service-sectors importance has been accompanied by an important shift in sourcing from domestic service-sector providers to service-providers located in Japan and the US. More study is necessary to track down the outcome more precisely. For instance, the simple notion of fabrication jobs moving to developing nations while service jobs move to developed nations is contradicted by the fact that developing nation exporters are also sourcing more service inputs from each other.

We view our paper as the first step in a long research effort. As a first step we shall seek to identify the role of offshoring, or GVC participation in the observed shift to services. To this end, we can use proxies for GVC-intensity as interaction terms in a Rajan-Zingales-like regression on the service sector shifts by sector, by country and over time.

We shall also delve more deeply into the types of service inputs that account for the shift. We suspect that we'll find the types of service value added from advanced nations differs substantially from that developing nations such as China.
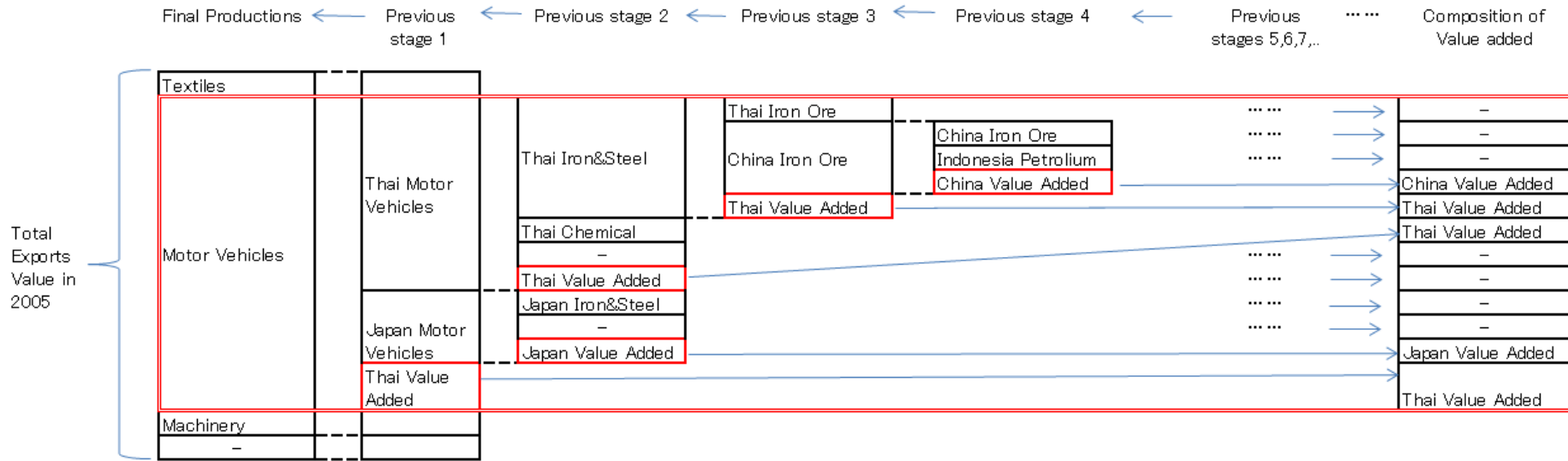
As an ultimate goal of this work, we would like to better understand the role that service-sector imports – especially from advanced technology nations – plays in the rapid industrial development observed in Asia since around 1990.

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Appendix

A sketch of the concept of the value-added computation

Final Productions ← Previous stage 1 ← Previous stage 2 ← Previous stage 3 ← Previous stage 4 ← Previous stages 5,6,7,... ····· Composition of Value added

Textiles

Motor Vehicles

Total Exports Value in 2005

Thai Motor Vehicles

Thai Iron&Steel — Thai Iron Ore / China Iron Ore / Thai Value Added

China Iron Ore — China Iron Ore / Indonesia Petrolium / China Value Added

Thai Value Added

Thai Chemical — –

Thai Value Added

Japan Motor Vehicles

Japan Iron&Steel — –

Japan Value Added

Thai Value Added

Machinery — –

Composition of Value added: –, –, –, China Value Added, Thai Value Added, Thai Value Added, –, –, –, –, Japan Value Added, Thai Value Added

Motor Vehicle exports in Thailand, are made from input values from Motor Vehicle industry of Thailand and of Japan, and Value added within Thailand. Japan Motor Vehicles, in turn, are made from Japan's Iron and Steel industry and others combined with Value added within Japan. And so on.

Export sector		Value-added by source country		Value-added by source country / sector		Value-added aggregated into sectors
Textiles		Thai Value Added(80%)		Manufacturing		Manufacturing
				Service		
				Primary		
		Foreign Countries Value Added(20%)		Manufacturing		
				Service		
				Primary		
Motor Vehicles		Thai Value Added(65%)		Manufacturing		
				Service		Service
				Primary		
		Foreign Countries Value Added(35%)		Manufacturing		
				Service		
				Primary		
Machinery		Thai Value Added(70%)		Manufacturing		
				Service		Primary
				Primary		
		Foreign Countries Value Added(30%)		Manufacturing		
				Service		
				Primary		

The computed value-added are aggregated into the three sectors (Primary sector, Manufacturing sector, and Service sector) as is defined in the industry list above.

List of industries

Industry code	Industry name	Sector classification
001	Paddy	
002	Other agricultural products	
003	Livestock	
004	Forestry	Primary
005	Fishery	
006	Crude petroleum and natural gas	
007	Other mining	
008	Food, beverage and tobacco	
009	Textile, leather, and the products thereof	
010	Timber and wooden products	
011	Pulp, paper and printing	
012	Chemical products	
013	Petroleum and petrol products	Manufacturing
014	Rubber products	
015	Non-metallic mineral products	
016	Metal products	
017	Machinery	
018	Transport equipment	
019	Other manufacturing products	
020	Electricity, gas, and water supply	
021	Construction	
022	Trade and transport	Service
023	Services	
024	Public administration	

Appendix Figures for 4.1.: Aggregate smile curve by industry (the other industries), 1985-1995 and 1995-2005

Paddy

Other agricultural products

Livestock

Forestry

Fishery

Crude petroleum and natural gas

Other mining

Food, beverage and tobacco

Timber and wooden products

Pulp, paper and printing

Petroleum and petrol products

Rubber products

Non-metallic mineral products

Other manufacturing products

Electricity, gas, and water supply

Construction

Trade and transport

Services