GVC journeys: Industrialisation and Deindustrialisation in the Age of the Second Unbundling

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Abstract

Offshoring and participation in Global Value Chains (GVCs) are critical to understanding the rapid deindustrialisation of G7 nations and the rapid industrialisation of a handful of developing nations. This paper distinguishes between trade in final goods and trade in parts to track the shifting pattern of the location of manufacturing. We introduce a simple empirical measure of comparative advantage in parts on one hand and in final goods on the other. We illustrate how this distinction can help organise thinking on the patterns of industrialisation and deindustrialisation—namely the "GVC journeys" of advanced and emerging economies. We also provide one simple model. The model highlights the interactions of trade costs and the knowledge transfers to accompany offshoring of parts production and assembly, which we call trade-led versus knowledge-led globalisation.

Keywords: globalisation, knowledge-led globalisation, parts and components trade, fragmentation

JEL F10, F20, F60

1. Introduction

Globalisation's advance is typically conceptualised as having been driven by falling trade costs. This could be called the trade-led conceptualisation of globalisation. This form of globalisation, which started in the early 1800s, was associated with the industrialisation of today's rich nations (say the G7 to be concrete) and the de-industrialisation, or non-industrialisation of all other nations. In tandem with this asymmetric industrialisation, income growth took off sooner and faster in the G7. The result was a massive increase in per-capita G7 incomes but a much less impressive increase in rest-of-world incomes. The result has been called the Great Divergence (Pomeranz, 2000). During this phase of trade-led globalisation, or what Baldwin (2006) calls globalisation's 'first unbundling' (unbundling of production and consumption), comparative advantage was conceptualised as being defined at the national level (Ricardo, 1817). This made perfect sense. The 19th century wave of

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globalisation and industrialisation boosted the industrial competitiveness of some nations, but not others. Lower trade costs in goods fostered manufacturing innovation and productivity advances in today's rich nations, and the new technologies stayed inside the nations, developing them. The best way to characterise the resulting rapid shift in industrial competitiveness was at the national level since technological capabilities tended to stay national. Some nations became, what we would today call, high-tech nations, while most did not and the resulting shift in competitiveness undermined industry in non-G7 nations. Quite simply, the stock of innovations that stayed in the G7 nations made it difficult for the G7 firms that owned the technology to apply it abroad.

A second phase of globalisation was launched by the ICT revolution that radically lowered the cost of moving knowhow across international borders. This made it much easier, safer and more profitable for G7 firms that owned large amounts of manufacturing knowhow to combine some of their knowhow with low-cost labour in nearby developing nations. This new type of globalisation, which Baldwin (2006) called the second unbundling (unbundling of factories), dramatically changed the nature of comparative advantage. This rise of international production – call it global value chains (GVCs for short) – fundamentally changed the nature of international competition. Before, globalisation meant nations exchanging the fruits of their nationally-defined comparative advantage. After, G7 firms could spread their technical knowledge across borders. In essence, the knowhow was always owned by firms rather than nations, but since communication was so difficult, it was an innocent assumption to conceive of technology differences being defined at the nation level. However, the ICT revolution undermined the innocent of this assumption. To put it differently, the new type of globalisation 'denationalised' comparative advantage, as noted by Baldwin (2016), Jones (2000) and many others. The firms' cost advantages are no longer organised around solely according to national boundaries; GVC boundaries also matter. That is, the G7 firms retain control of its technology as they apply it to labour in non-G7 nations, and the resulting cost reduction boosts the G7 firm's competitiveness. Nowadays, the non-G7 nation's pattern of trade is no longer solely a national trait. It is a combination of national wages and firm-specific knowhow.

This new type of knowledge-led globalisation produced quite different outcomes for two very good reasons. First, knowledge tends to be non-rival, and thus cross-border flows of knowhow are more likely to spread something rather than exchanging something. Second, the flows tend to be asymmetric given that knowhow is abundant in a handful of advanced economies and scarce everywhere else. The result was a rapid deindustrialisation of the G7 nations (but not the G7 firms) and a rapid industrialisation of a handful of formally poor nations that benefitted from the massive new knowledge flows. Firms from high-tech nations move the managerial, marketing, technical, organisation, and logistic knowhow within production networks that cross borders. For example, a US company can move some of its knowhow to a plant in Mexico, and thus comparative advantage is defined by the territory on which the US company is applying its knowhow. Now this phenomenon allows us to reconsider comparative advantage, which means the distinction between national and territorial comparative advantage. When ICT enables firms to move sources of comparative advantage across borders, the boundaries of comparative are no longer purely national. To distinguish this shift from a more traditional change, we call this 'territorial comparative advantage' (TCA for short), while the traditional comparative advantage is called national comparative advantage (NCA for short).

1.1. Literature Review

First, this paper is related to national comparative advantage in dynamic aspects. Tracking back the old literature, which remains the notion of NCA, the flying geese model (Akamatsu, 1962) explains dynamic change of industrial structure with varying comparative advantage.[2] The model describes catch-up process of industrialization in backward countries, in which a country first starts from imports of a product, domestic production, exports, and then declines its production over time. Subsequently, the country switches to a new sector. Similarly, the leapfrogging cycle model characterises dynamic NCA (Brezis, Krugman and Tsiddon, 1993). Once advanced technology is introduced, the country has comparative advantage but lock-in the technology. Since technology deteriorates over time, the country gradually loses comparative advantage and the backward country introducing new technology gets comparative advantage. Turning to formal theories, Krugman (1987) and Grossman and Helpman (1991) model over-time endogenous comparative advantage in endogenous growth and trade theory. Yi (2003) builds the dynamic Ricardian model to characterise a rise of intermediate and final output trade by fragmentation.

To deeply understand NCA as well as TCA in the context of the current globalization, foreign direct investment (FDI) is a key factor. Traditionally, FDI is categorized by horizontal and vertical types. Horizontal FDI tends to seek local market demands while vertical FDI is aimed at saving costs (see e.g. Navaretti and Venables, 2004). More importantly, physical technology as well as human capital are transferred through FDI (Findley, 1978; Glass and Saggi, 2002).[3] Later, the knowledge capital model is proposed by Carr et al. (2001) and Markusen and Maskus (2002). Knowledge capital is critical in understanding the linkage of multinational operations and thus it arises horizontal and vertical FDI simultaneously.[4] Beyond the horizontal or vertical FDI, the recent literature finds more complex types of FDI such as complex FDI (Yeaple, 2003; Baltagi, et al. 2007; Grossman, et al. 2006), platform FDI (Ekholm et al. 2007), and networked FDI (Baldwin and Okubo, 2014). Other than FDI, various types of oversea productions emerge such as foreign outsourcing (Antras and Helpman 2004). Overall, firms are internationalised and their production process is segmented and diversified over the world in the ICT revolution. The production process in FDI networks is tightly connected by human capital, knowhow, and technology, while final products as well as intermediate inputs (parts and components) are actively traded across countries.

The ICT revolution in the current globalisation substantially grew fragmentation and offshoring. Thus this paper also contributes to the growing literature on offshoring or "fragmentation", as it was originally referred to by Jones and Kierzkowski (1990). Prominent contributions to the theoretical framework of offshoring include the works of Feenstra and Hanson (1996), Arndt (1997), Jones and Kierzkowski (2001), Deardorff (2011), Kohler (2004), Egger and Egger (2005), Baldwin and Robert-Nicoud (2007), and Grossman and Rossi-Hansberg (2008), among others. Spencer (2005) and Helpman (2006) review another strand of the theoretical literature on fragmentation focusing on the organisational choices of firms and their boundaries. The empirical literature related to offshoring proposes a variety of measures and data sources to quantify the extent of fragmentation and supply chain (Baldwin

[2] There are some extensions and applications. See e.g. Kojima (2000).

[3] There are several aspects in the literature. Saggi (2000) studies the patent transaction by multi-national enterprise (MNE). Braconier et al. (2001) and Coe and Helpman (1995) study R&D spillovers to local economies through FDI. Turning to the Japanese case, Branstetter (2000) investigates the relationship between patenting activities of Japanese firms and their operation in the US, while Fukao et al. (2003) and Okubo (2007) study the impact of technology transfer by the Japanese FDI on vertical intra-industry trade.

[4] See Bloningen et al. (2003) and Braconier et al. (2005) for empirical analysis on the knowledge capital model.

and Lopez Gonzalez, 2015). At the sectoral level, three key sources of data typically used in the literature to measure fragmentation are customs statistics on processing trade (Egger and Egger, 2001; Clark, 2006), international trade statistics on parts and components (Yeats, 1998), and Input-Output (I-O) tables (Feenstra and Hanson, 1996; Hummels et al, 2001). Furthermore, using customs statistics on product-level trade, Ng and Yeats (1999) and Athukorala and Yamashita (2006) see active trade of intermediate inputs in Asia. According to Ando and Kimura (2005) and Ando (2006), intermediate input trade, in particular parts and components, has been active in Asian machinery trade.[5] More in detail, Kimura and Obashi (2010) reports some evidences in support of the formation of East Asian production networks, in terms of the expansion of exports and imports of machinery industries, in particular their parts and components. East Asian countries increased proportion of machinery trade within Asia and with other regions. Many Asian countries increased parts and components trade within Asia while they increased final machinery products with other regions. Furthermore, some recent studies see a resilience of fragmentation. Even if crisis and negative shock hit the economy, trade of parts and components tend to survive and thus fragmentation is robust (Obashi, 2010; Ando and Kimura, 2012; Okubo et al.2014).[6]

2. STYLISED FACTS

2.1. Industrialisation and deindustrialisation pathways

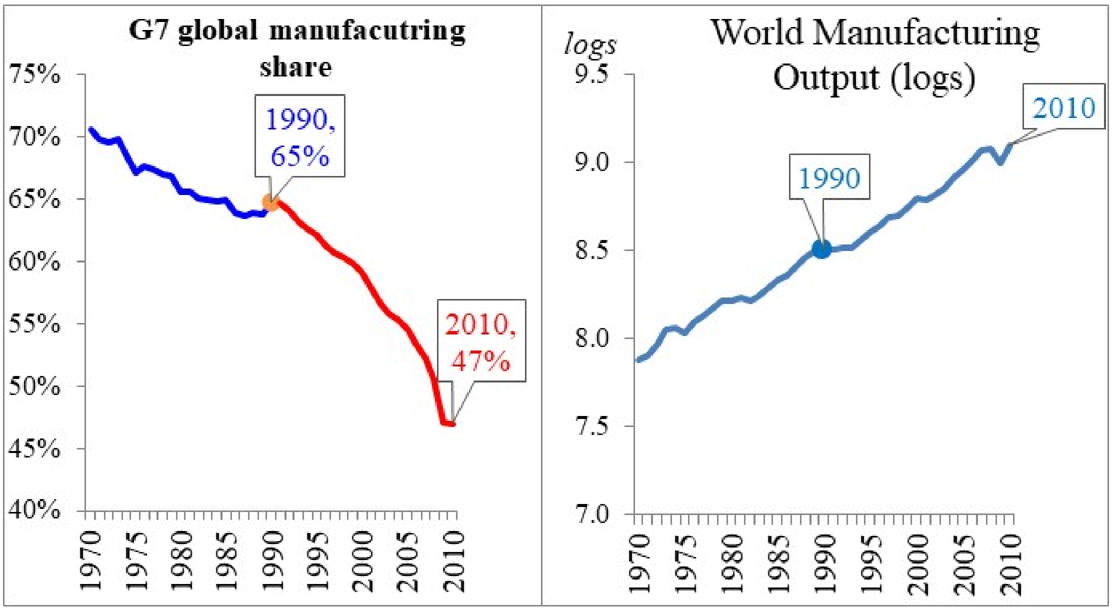
Before the ICT revolution, the G7 nations dominated global manufacturing in a truly impressive way, accounting for over 70% of world value added in manufactured goods (see Figure 1). The ICT possibilities changed this by making it organisationally feasible for G7 firms to take their firm-specific knowhow and combine it with low-cost labour abroad. The result was a rapid fall in the number of jobs and value added in the manufacturing sector in the nations formerly known as the ‘industrialised nations’.

Of course, the shift in manufacturing shares was not sudden. From the 1970s, a handful of developing countries known as the ‘Newly Industrialising Nations’ (Hong Kong, Taiwan, Singapore and South Korea) industrialised from the 1970s. The real sea change, however, came later. From 1990 to 2010, the G7’s manufacturing share fell from two-thirds to just under a half. Note that the general trend in global manufacturing growth did not change.

[5] Kimura and Ando (2005) and Athukorala and Yamashita (2006) use product-level trade data and estimate the determinants of trade in parts and components in machinery sectors in the gravity equation. They find evidence of substantial fragmentation and production networks in Asia. Using the gravity equation, Okubo(2003) and Fukao and Okubo(2011) find a substantial decline of the Japanese national border effect due to a surge of trades of intermediate inputs and parts and components with Asia.

[6] See Kimura and Obashi (2016) for overview on Asian fragmentation. See also Aminian et al. (2006) for Asian trade with respect to economic integration.

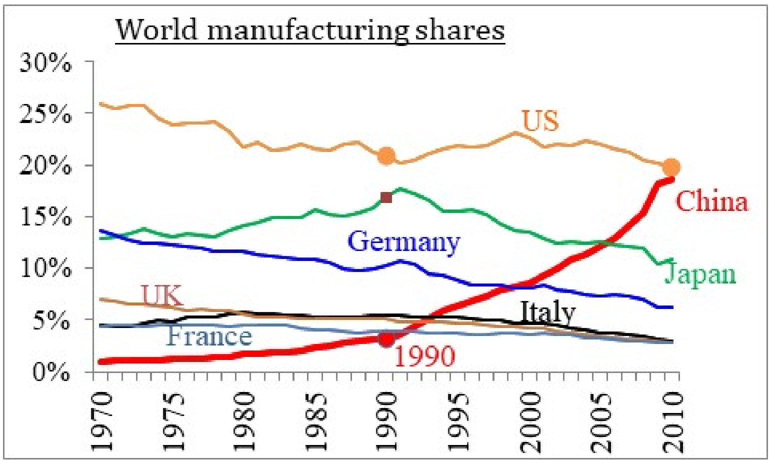
Figure 1: G7 share of world manufacturing, 1970-2010.



Source: Authors' elaboration of UNSTAT.org data.

This deindustrialisation of the 'North' and the industrialisation of a handful of developing nations, which came to be called the 'emerging markets', had dramatic effects on the world – both inside and outside nations. But how did this happen? Was the process the same for Northern nations and all Emerging Markets? At an aggregate level Figure 2 shows the shares for the G7 countries and China. While the downturn for the G7 as a whole is very sharply defined, shares of the three Big G7 manufacturers show a more varied pattern. The UK and Germany experienced straight-line losses of manufacturing shares since the data began in 1970.

Figure 2: G7 global manufacturing shared, 1970 to 2010.



Source: Authors' elaboration of UNSTAT.org data.

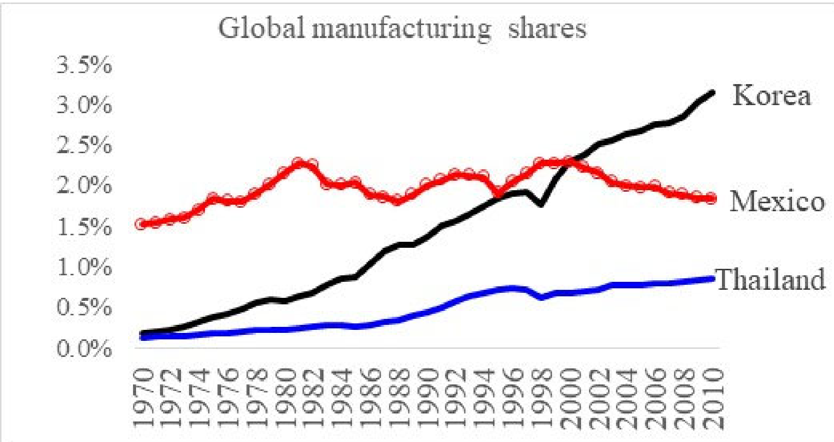
The Japanese experience in the period was very different. During two 'miracle decades' (1970s and 1980s), Japan's manufacturing output swelled rapidly and this in turn was associated with a tremendous overall income growth take-off. This rapid rise eventually caused a great deal of conflict with the US as Japanese autos, electronics, and machinery threated the post-war dominance of American goods. Until 1990, Japan's rising share is the mirror image of the falling US share. However, the Japanese economy dramatically changed with the 2nd unbundling. Since 1990, Japan has joined the general G7 downward trend.

Interestingly, US manufacturing output enjoyed a positive growth for the first decade after the second-unbundling started – perhaps because it gained international competition from outsourcing to Mexico. Regardless of the cause, the share growth has vanished and now US manufacturing output has joined the general G7 movement since about 2000.

The figure also shows China's amazing industrialisation that took off around 1990. In just two decades, a sixth of world manufacturing moved from outside China to inside China. In the beginning, this was very much a process of foreign firms bringing factories and jobs to China along with everything else necessary to produce world-class products including marketing, managerial, and technical knowhow.

Three other emerging markets are particularly interesting cases of industrialisation: Korea, Mexico, and Thailand. Their shares are shown in Figure 3 (note the change in scale from the previous figure – these nations are much smaller players).

Figure 3: World manufacturing shares of the 'Industrialising 6', 1970 to 2010.



Source: Author's elaboration of UNSTAT.org data.

This paper focuses on one aspect of this industrialisation/deindustrialisation story, namely the role of final goods versus parts – what could be called the GVC journeys.

2.2. Parts and components versus final goods

In the knowledge-led view of globalisation, revolutionary advances in ICT mattered since they made it possible to coordinate complex production arrangements internationally. This fostered offshoring, but the change was asymmetric. It was a revolutionary boost in developing nations' abilities to export parts, but less so for G7 parts exporters. The point is that the export of parts was lopsided until the ICT revolution. G7 firms sold parts and components to manufacturers in other G7 nations and to manufacturers in developing countries, but relatively few parts were exported from developing nations to G7 nations. To put it differently, there is nothing surprising about Japanese firms selling transport equipment parts to Vietnam. Developing-nation manufacturers have always had to deal with or work around the standards of G7 manufactures when importing parts. There really was no other option as two-thirds of all manufacturing was done in G7 nations and the G7 share of sophisticated parts and components was even higher. This is why it was always relatively easy for G7 firms to export parts to developing nations, at least from a technical point of view.

Developing-nation manufactures, by contrast, found few foreign buyers for their parts since it was costly or even impossible for G7 firms to verify the parts' quality and reliability and to fit into the rest of the production process. All this changed when the G7 firms could monitor developing-nation factories in real time and at a very low cost. The ability to observe and control what went on in developing nations' factories in real time gave G7 firms the confidence to unbundle their production processes and shift labour-intensive stages in low wage nations. Moreover, since the internationalised factory had to work as a symphony, the G7 firms tended to offshore their managerial, technical and market knowhow along with the offshored production stages. It was, in essence, the increased cross-border flows of knowledge that drove this offshoring, not just the lower cost of moving goods.

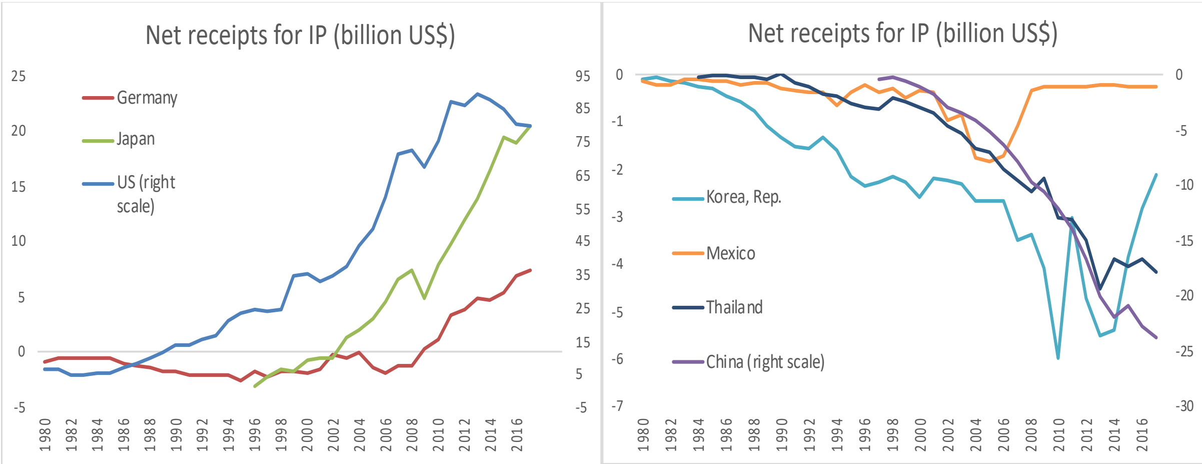
We note that this rapid shift on industry from G7 to non-G7 countries took place in an environment where the non-G7 was lowering its tariffs much faster than the G7 was lower its. From a trade-led globalisation perspective, this should have boosted G7 exports to non-G7 more than it boosted non-G7 exports to G7 especially in parts and components (the developing country liberalisation focused on intermediate goods rather than final goods).

2.3. Knowledge flows

Measuring knowledge flows is notoriously difficult since knowledge is hard to define in quantity space and difficult to price. One rather imperfect measure is the balance of payments data on payments for intellectual property rights (IPR), specifically, the IMF data series "Charges for the use of intellectual property, payments, BoP, current US$". The data exists for payments to a nation, which are something like the export of knowledge, and the payments from a nation, which are something like import of knowledge. These data are precisely what we want since it aggregates everything from copyright payments on Hollywood movie to payments for the use of industrial process designs. Be that as it may, the data do suggest some confirmation of notion that the G7 is 'lending' technology to rapidly industrialising nations in the second unbundling.

The data are shown in Figure 4 for the three G7 industrial giants, the US, Germany and Japan, and four rapidly industrialising nations, China, Korea, Mexico and Thailand. The lines show the balance of payments for the use of intellectual property, namely the receipts (exports) minus payments (imports). The lines should thus be thought of as a proxy for the net export of knowhow. The pattern of the US is very clear in the left panel. Since about 1990, the US has been a big net exporter of knowhow. It is so large that we have to plot the figures on the right-scale to avoid losing details of the other two nations. The net flow has risen from about $15 billion to over $85 billion in the course of 25 years. The net-flow statistics for German and Japan are positive at the end of the period, but negative to start with. The Japanese numbers go positive in the early 2000s. Those of Germany turn positive only in the 2010s. On the other side of the knowhow-shifting, we see that China, Korea, Mexico and Thailand have been substantial net importers of knowhow as measured by this proxy. China has been a massive net importer since the late 1990s (it is so large that we plot it on the right scale separately). The trend is very clearly towards an ever-increasing net import of knowhow. The trends for the other developing nations are more mixed. Thailand continues to widen its net imports, but Korea's net import grew only until about 2010 and has since flattened or even reverse. For Mexico, the net imports grew (so the net exports turned more negative) up to the mid-2000s and have gone to near balance.

Figure 4: Payments for intellectual property, 1980-2017



3. The GVC Journey Diagram

One way to organise thinking about this transformative 'reversal of fortunes' in the location of manufacturing is to think about what happened in North versus South, and to what happened to parts versus final goods. To this end, we introduce diagram that helps us collate the various industrialisation and deindustrialisation experiences. The idea is to capture the evolution of trade in parts, on one hand, and of final goods, on the other, using indices that reflect net trade by type of good (parts or final), by sector, and by country.

For the moment, we skip over the detailed data issues and presume there is a clear-cut distinction between 'final goods' (think of assembled cars, trucks, buses and the like) and 'parts' (all the bits and pieces that go into the assembled vehicles). We also presume that countries fall neatly into two categories: The North (think of the US, Japan, and Germany) that has a dominate comparative advantage in the production of both parts and final goods since its technological superiority more than offsets the wage gap with the South, and the South (think of Thailand, Mexico, and China) which has lower wages and worse technology in both parts and final goods.

3.1. The Empirical Comparative Advantage (ECA) index

The index that we use to capture the relative cost edge of North and South are akin to the standard Grubel-Lloyd index of intra-industry trade (Grubel and Lloyd, 1975). This allows us to deal with the existence of intra-industry trade in all directions. The North's overall edge, however, meant that it was a net exporter to the South of both parts and components in almost all industrial sectors. A rough empirical measure of this comparative advantage is what might be called the 'Empirical Comparative Advantage', (ECA for short):

$$ECA_{cik} = \frac{X_{cik} - M_{cik}}{X_{cik} + M_{cik}} \quad \textbf{(1)}$$

This is defined for a particular country 'c' in sector 'i' and for type of product 'k' ('f' for final goods and 'p' for parts). [7]This is related to the well-known Revealed Comparative Advantage

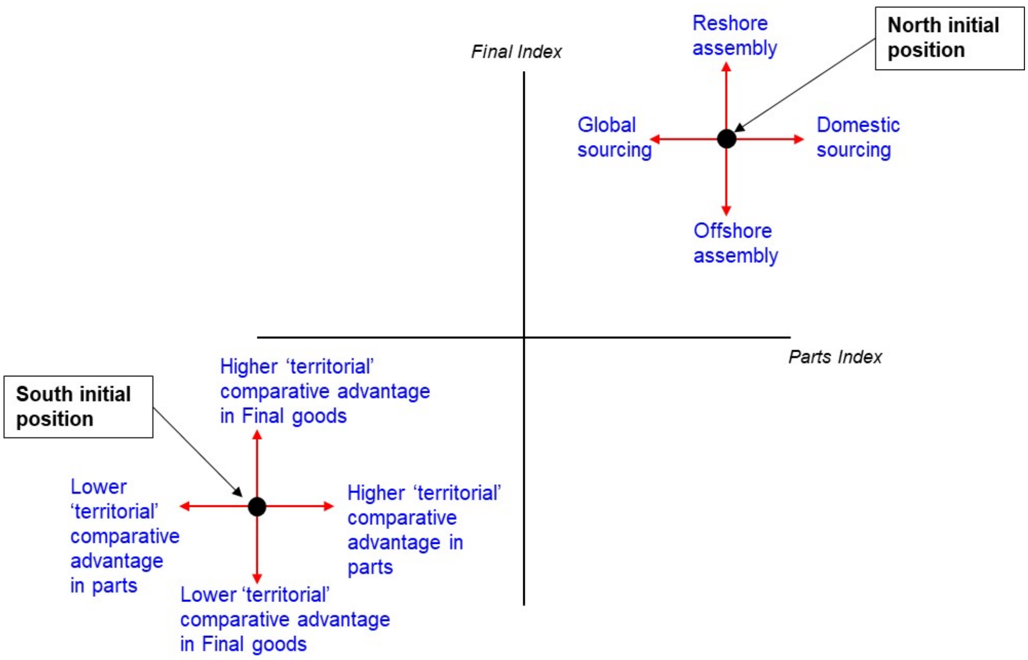
[7] METI (2005) proposes a similar diagram, so-called "international competition index chart (Kokusai Kyousouryoku Shisuu Cha-to in Japanese)", and uses the same formulation as our ECA. While our focus is trade of parts and components in detail machinery sectors to investigate NCA as well as TCA, his focus is total intermediate inputs in all sectors using the RIETI TID 2005 data. His aim is to investigate NCA. The questions are addressed which sectors and which production stages are net-exporters in Japan in the NCA context of the

(Balassa,1965) but uses only data for a single country. It is also akin to country c's index Grubel-Lloyd index but without the absolute value.

To think about this, we note that a multi-sector Krugman model (Krugman, 1987) which allows a distribution of sectoral comparative advantage across nations would see the ECA being positive in sectors where the nation had a comparative advantage (net exporter) and negative in sectors where it had a comparative disadvantage (and thus a net importer). If country c is a one-way exporter, the ECA is 1; if it is a one-way importer, it is -1, so the ECA is bound between 1 and -1.

Before the second-unbundling really got going, we would expect that the ECA would be positive for Northern nations and negative for Southern nations for both parts and final goods in all heavy-industry sectors. This can be illustrated in a diagram that has ECA_f on the vertical axis and ECA_p on the horizontal axis; the initial North point is in the positive quadrant as shown in Figure 5. As the GVC revolution begins, there will be some 'global sourcing' of parts, i.e. offshoring of the production of parts from the North to the South, and some offshoring of assembly from the North to the South. But this is just one possible pathway for the North. As shown in Figure 5, starting from the North's initial condition, the production changes can shift the ECA in four basic directions. A move to the west indicates an increase in global sourcing of parts, i.e. shifting the production of more parts production to the South – presumably with the help of knowhow that the G7 firm brings to the South to make sure the parts are of the right quality and well jive with other parts. Note that this is not 'technology transfer' as traditionally conceived since the Northern firm does not 'transfer' that technology to the South, it merely 'lends' technology since it keeps ownership of the knowhow. A move to the east is the opposite, i.e. a further nationalisation of the parts supply chain. A move to the south is associated with the offshoring of some assembly activities while a move to the north is the opposite.

Figure 5: The GVC Journey diagram



Things in the South are less clear-cut since the globalisation may allow the South to better exploit whatever comparative advantage it had in manufacturing, but it is also changing the

flying geese type of economic growth patterns.

South's comparative advantage due to the knowledge-lending that is coming from the North. In short, changes in the South's net export pattern may reflect the exploitation of its NCA, or a GVC-induced change in its TCA. In the diagrams we are plotting ECA indices which may move due to changes in TCA, NCA, or both.

In the diagram, the initial point of the South is in the lower-left quadrant reflecting our assumption that the South does not have NCA in both final goods and parts. From this starting point, the South's position can move to the North, which is an improved TCA in final goods. This would typically come when Northern firms decide to shift assembly plants to the South. In a classic example, the South would increase its net imports of parts for assembly but increase its net exports of final goods, in which the motion would be to the Northwest. A motion to the South would implies a reduced TCA in final goods.

A move to the east would be the result of a Northern firm shifting technology to the South to make more parts. The result would be an improvement in the South's TCA. A shift to the west is the opposite. A classic example would be if a Northern manufacturer decides to source more parts from the South while keeping assembly in the North. In this case the movement would be to east, and probably northeast, since the lower cost parts would boost the competitiveness of Northern final goods versus the Southern-made final goods.

3.2. Trade-led globalisation versus knowledge-led globalisation

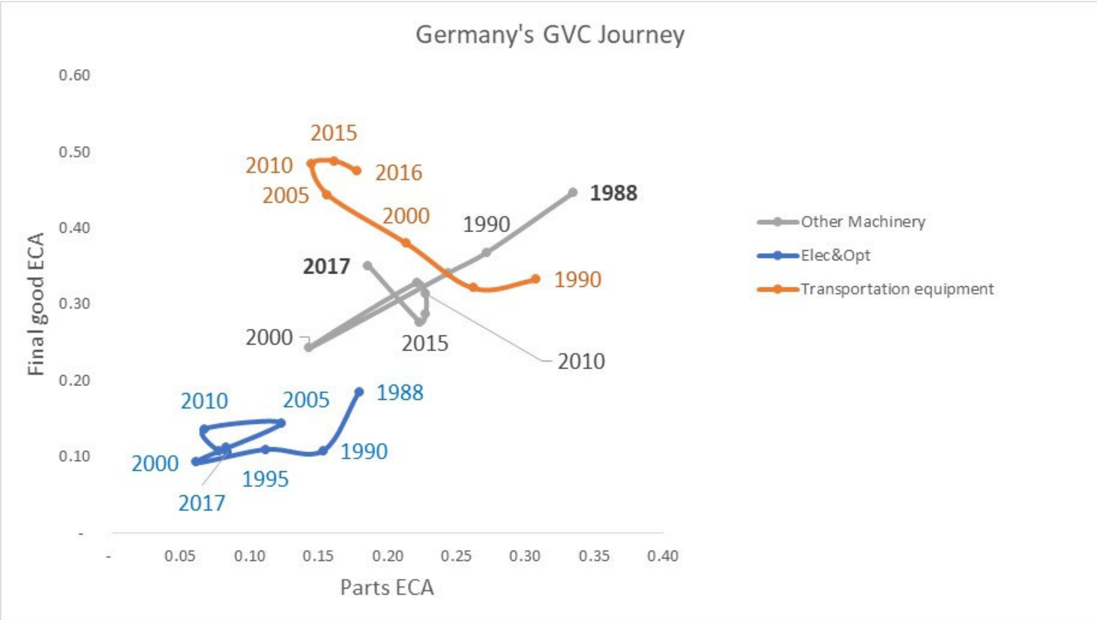
Roughly speaking, we think of trade-led globalisation as a situation where manufacturing of both parts and final goods tends to get offshored from advanced economies—moreover less in the same proportion. If, by contrast, the globalisation is driven not just by lower trade costs but also by the application by G7 firms of their knowhow in low-wage nations, then the impact on parts trade should be much more marked. This implicitly assumes that the technology embedded in parts production is more important than that embedded in the assembly of parts. For example, a very large number of developing nations has assembly operations for automobiles that are kept competitive for local sales by very high tariffs on final autos but much lower tariffs on parts. To put it differently, it might be much easier to master the assembly of cars than it is to master the production of the high-value added parts that go into them. We will thus be making the rather bold claim that a big asymmetry in the evolution of the trade pattern for parts and final goods will suggest that knowledge-led globalisation is important, while a more balanced evolution will suggest that trade-led globalisation is dominant. Admittedly, this is a strong assumption and we discuss it in the concluding remarks.

3.3. Experience of Northern nations

To get an empirical handle on this approach, we need to distinguish between final goods and parts. To this end, we employ the lists developed by Kimura and Obashi (2010) to classify the HS trade categories as final or parts. As for sectors, we work with rather aggregated industry classification, namely machinery and equipment (HS code 84), electrical machinery and optical instruments (HS codes 85, 90, 91), and transport equipment (HS codes 86, 87, 88). The period we look at is 1988, or 1990 (depending upon data) to the latest year available, which is 2016 or 2017.

We start with Germany's experience in the three sectors.

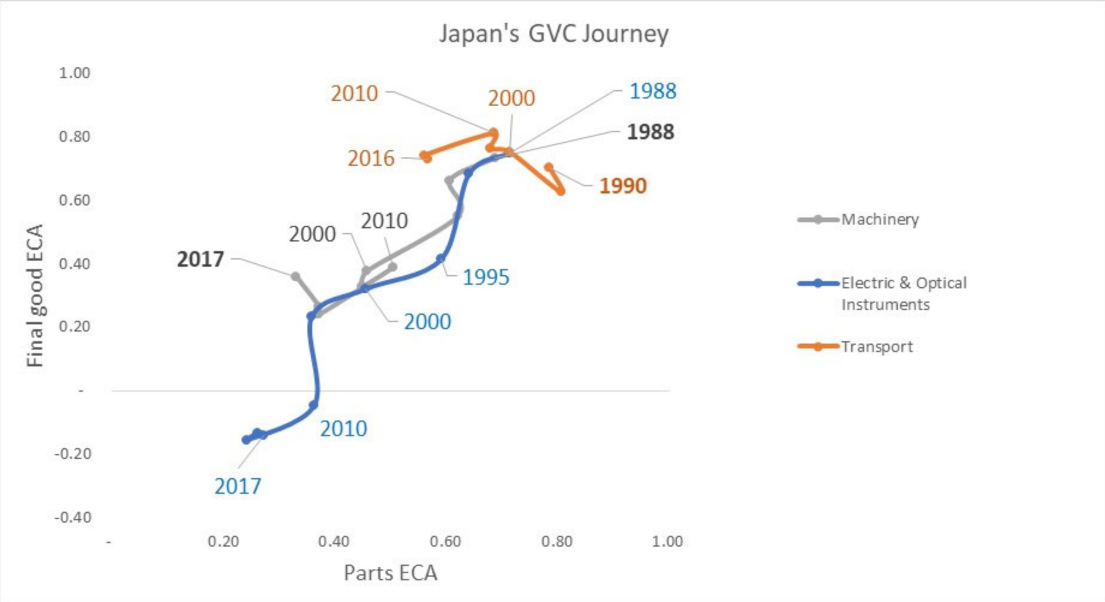
Figure 6: Germany's GVC Journey diagram



The idealised North in this deindustrialisation narrative would experience some combinations of global sourcing of parts, which would tend to move the ECA for parts to the west, and some offshoring of assembly, which would result in a decrease in the ECA for final goods. The result would be an initial position that starts in the northeast corner of the northeast quadrant and a movement towards the southwest. The German experience matches the idealised journey in machinery, and optical and electrical instruments sectors, but not in transportation equipment. In the latter, we see that Germany has turned to global sources for its parts, and thus a fall in its ECA for parts, but a rise in its ECA for final goods. This suggests that the global sourcing of parts boosted its advantage in final transport products. We note that all three machinery sectors see the offshore overshooting proposed by Baldwin and Venables (2013).

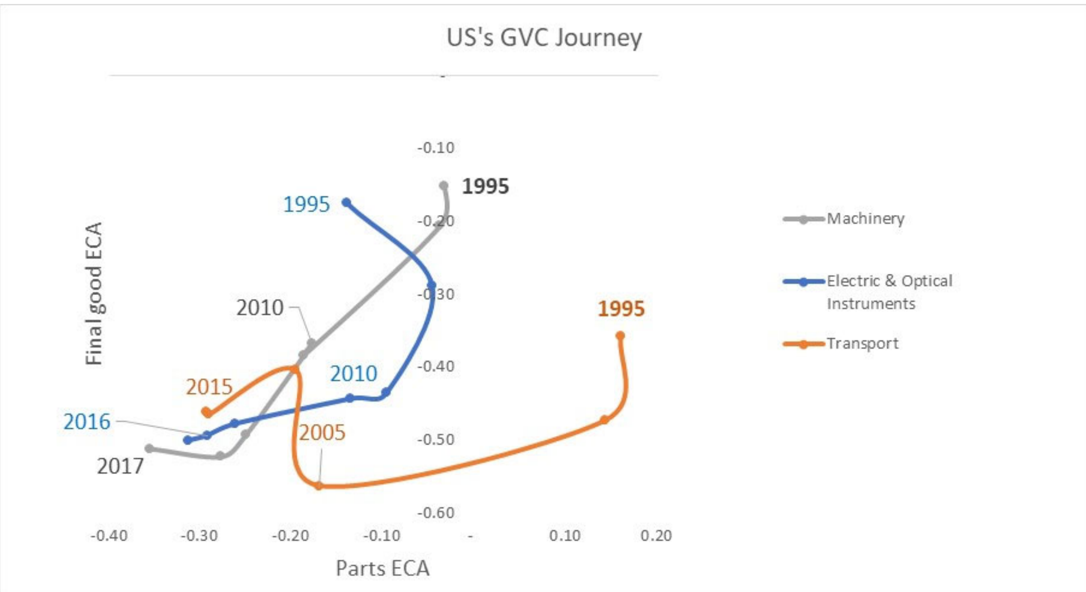
The case of Japan is similar but differs in important ways (Figure 7). First, there is little or no evidence of offshore overshooting at this level of aggregation. Second, the GVA development has gone much further in electrical and optical instruments (think cameras); Japan has lost sufficient TCA to turn it from a net exporter of final goods in this sector to a net importer. Note that the very near position of China, which offers excellent low-wage opportunities, may help explain the difference between the two cases (most of Germany's offshoring and global sourcing takes place within Europe).

Figure 7: Japan's GVC Journey diagram



The US experience is quite different from the other two Northern manufacturing giants (Figure 8). Unlike Germany and Japan, the US starts in negative territory for all three industries for final goods, and then proceeds to move into negative territory for parts as well. By the mid-2010s, the US had negative ECA for parts and goods for all three sectors. Its initial position in the 1990s indicates a territorial comparative disadvantage in all three sectors in that it is a net importer of both parts and final goods. The evolution of its GVC situation involved an increase in global source of parts in all three sectors – especially the transport sector, as well as some increased offshoring of final goods with the trend especially marked in machinery, and electric and optical Instruments.

Figure 8: US's GVC Journey diagram



3.4. Experience of Southern nations

The lower global shares of manufacturing GDP experienced by the G7 nations showed up as share gains in a handful of nations—with China being the standout gainer with an increase of about 15 percentage points of world manufacturing value added. Table 1 shows the biggest share winners (left column) and the biggest share losers (right column). The listed losers account for a total drop of about 19 percentage points; the gainers for about 21 percentage points. Most other nations in the world lost shares. In particular, Japan is the biggest loser in the world.

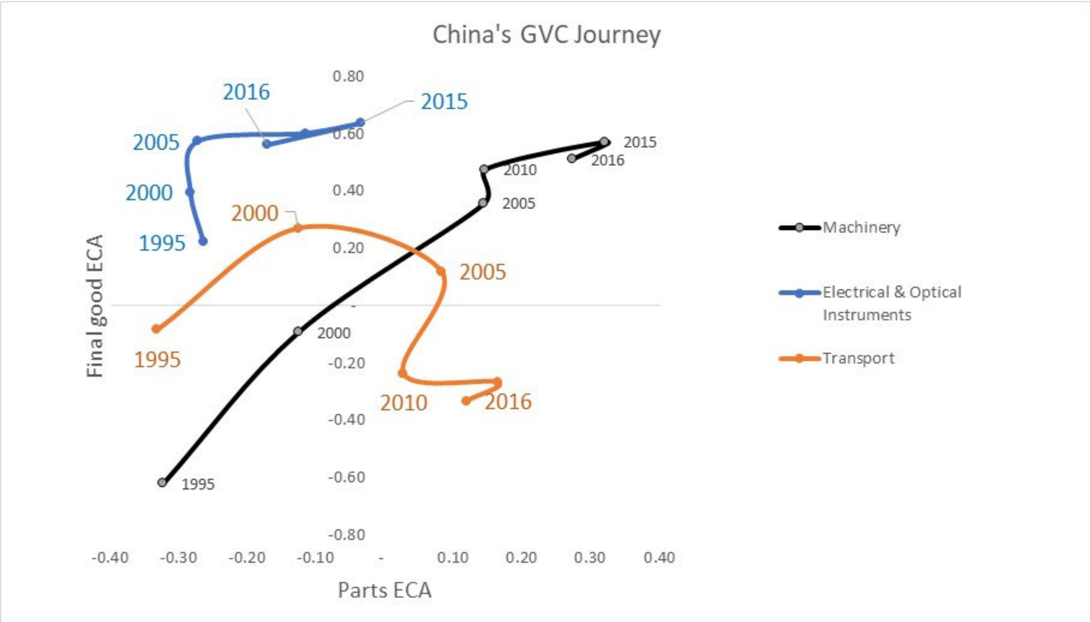
Table 1: Biggest global share gainers and losers, 1990 to 2010, manufacturing GDP

	1990	2010	growth		1990	2010	growth
China	3.12%	18.62%	15.50%	Japan	16.91%	10.92%	-5.99%
Korea	1.38%	3.15%	1.77%	Germany	10.30%	6.26%	-4.04%
India	1.00%	2.06%	1.06%	Italy	5.42%	2.93%	-2.49%
Poland	0.24%	0.90%	0.66%	UK	5.11%	2.78%	-2.33%
Indonesia	0.65%	1.07%	0.42%	France	3.87%	2.75%	-1.12%
Thailand	0.45%	0.86%	0.41%	Canada	2.18%	1.48%	-0.70%
Ireland	0.28%	0.56%	0.28%	Spain	2.36%	1.60%	-0.76%
Malaysia	0.26%	0.52%	0.26%	US	20.94%	19.85%	-1.09%
Singapore	0.26%	0.51%	0.25%				
Turkey	0.89%	1.13%	0.24%				
Iran	0.14%	0.31%	0.17%				
Viet Nam	0.04%	0.19%	0.15%				

Source: UNSTAT.org, GDP breakdown at constant 2005 prices in US Dollars.

To illustrate the very different ‘GVC journeys’ that brought the rapid industrialisers to where they are today, we focus on China, Korea, Mexico, and Thailand.

Figure 9: China's GVC Journey diagram



China's rapid industrialisation was truly an epoch-changing event. Starting as poor, economy with a very weak industrial sector and inferior manufacturing technology, China is now the largest or second largest manufacturer in the world. This booming success, however, was not achieved in the same way the G7 industrialised in the 19th and 20th centuries. The G7 developed manufacturing knowhow at home that gave them an edge abroad. Of course, the knowledge did not belong to the nations and belonged to firms located in the nation, although the blurring of the distinction between firm-specific technology and nation-specific technology was an innocent convenience before the ICT revolution. The point is that practical difficulties forced Japanese firms, to take an example, to combine their technology with Japanese labour in Japan. After the ICT revolution made offshoring practical, the vast wage differences between the G7 and nearby developing nations induced G7 firms to spread the use of their firm-specific knowhow to low-wage labour in emerging markets. In other words, the ICT revolution made it important and useful to distinguish between NCA (i.e. the comparative advantage of a nation's firms) and TCA (i.e. the comparative advantage of production facilities located inside the nation).

The point here is that the rapid industrialisation of the nations listed in Table 1 was—in a large part—due to the decision of G7 firms to change these nations' comparative advantage by moving a key source of comparative advantage across borders. This rapid industrialisation was not just lower trade costs allowing nations like China to better exploit their pre-existing comparative advantage; this was knowledge-led globalisation changing China's comparative advantage. In essence, G7 firms taught Chinese workers to make world-class parts and final goods that they could never have made using only Chinese technology. As shown in Figure 9, the GVC pathway taken by the Chinese machinery trade shows a strong and sustained improvement in both final goods and parts. China became a favourite location for assembly activities, so the ECA in final goods shifted from negative to positive. China was also a choice location for the production of many types of parts—generally the most labour intensive, modular, and parts that were not time-sensitive. This meant that despite a doubling of the import of parts between 1995 and 2015, China's ECA swung from -0.3 to +0.3. The GVC journey in the Chinese trade in electrical and optical instruments was less dramatic.

Since assembly was already booming in China before our data starts in 1995, the initial position involves a positive ECA in final goods, but a negative ECA in parts. The pathway has generally been an increase in both between 1995 and 2016. The Chinese transport sector's pathway is particularly interesting as China is now the world's largest producer of cars. Indeed, China produces almost three times more vehicles than the runner-up, the US, as Table 2 shows.

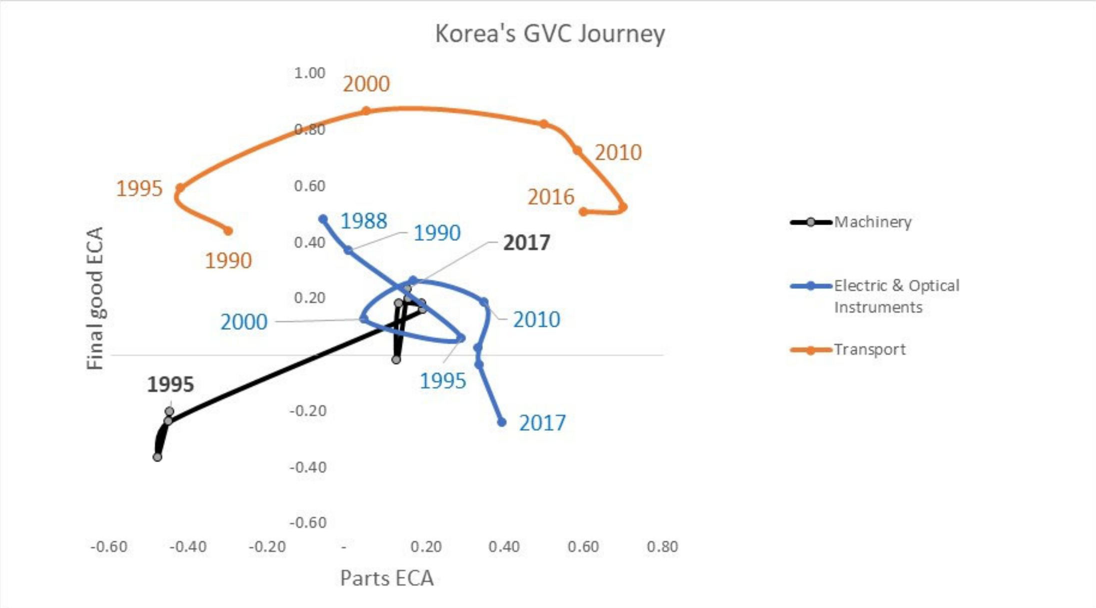
Table 2: Vehicle production by nation, 2016.

Rank	Country	Motor vehicle production (units)
1	China	29,015,434
2	United States	11,189,985
3	Japan	9,693,746
4	Germany	5,645,581
5	India	4,782,896
6	South Korea	4,114,913
7	Mexico	4,068,415
8	Spain	2,848,335
9	Brazil	2,699,672
10	France	2,227,000

Source: International Organization of Motor Vehicle Manufacturers
http://www.oica.net/category/production-statistics/2016-statistics/

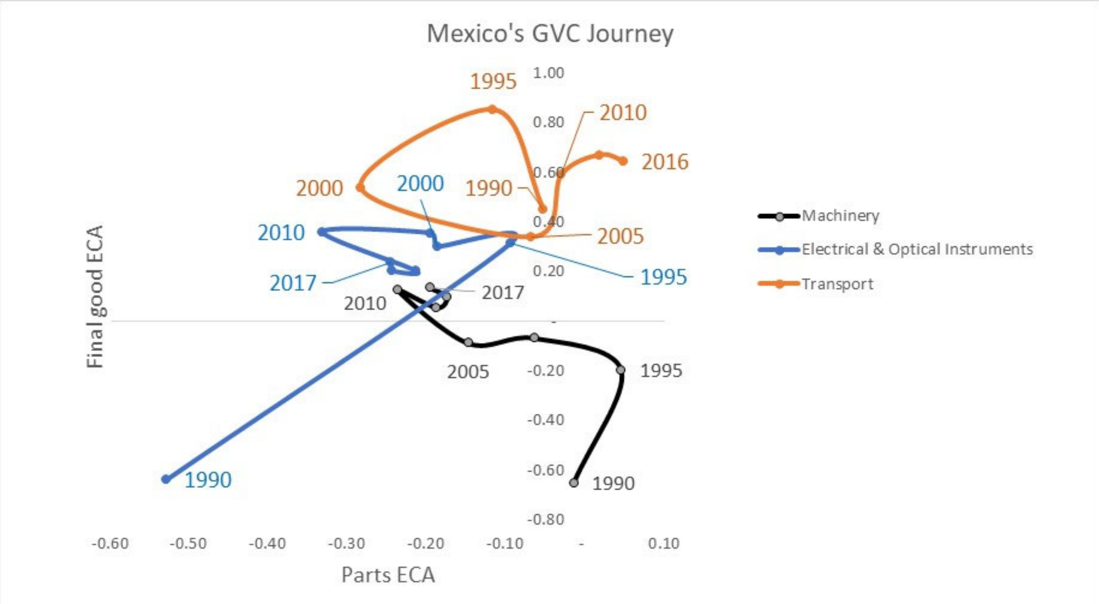
China's GVC journey in transport machinery is particularly interesting as it comes in two distinct phases. It starts as expected in the negative quadrant for both parts and final goods, but moves sharply northeast up to 2000, breaking into positive ranges for ECA is final goods in the late 1990s. This reflects a shift in assembling activities to China and the use of China as an export platform by some US, German, Japanese, and Korean producers. Given the booming Chinese domestic market for cars, however, the net exports of final vehicles switched to a net import by 2010. China is now far and away the largest consumer of new automobiles. In 2017, China's new car registrations exceed that of the entire EU28 by 60%. The Chinese market is six times larger than Japan's and 40% larger than the US market. In recent years, four large Chinese firms have emerged: SAIC Motor, Dongfeng, FAW and Chang'an. These use a combination of Chinese and foreign technology. This is one industry where the GVC story is transforming into one of rapidly developing NCA as Chinese firms innovate autonomously or imitate foreign technology. The net effect of the two phases is a movement to the southeast, namely a lower territorial ECA in final goods, but a sharply improved ECA in parts.

Figure 10: Korea's GVC Journey diagram



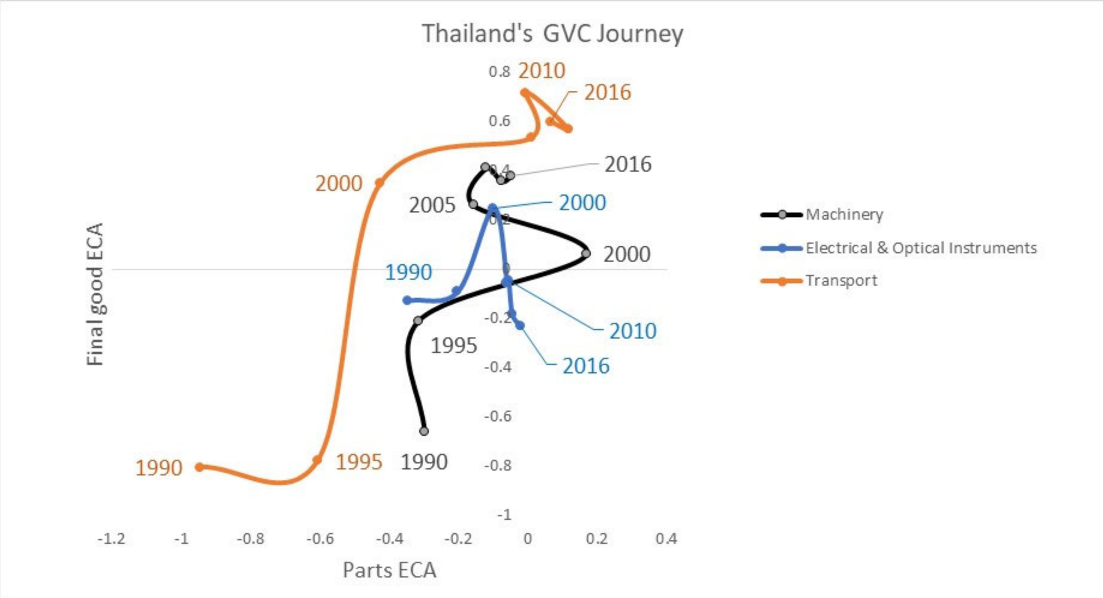
Next, Korea's GVC journey in transportation shares some of these two-phase features (Figure 10). Korea's car industry is one of world's most impressive industrial development stories. From a small assembler of complete knockdown kits in the 1970s, Korea has risen to a major player—now the 6th largest producer globally. In the first phase, Korea's ECA in both parts and final goods rose, peaking around 2000. After a massive change in industrial strategy—from hard-line import substitution to an embrace of foreign firms and global sourcing (triggered in part by the Asian Financial Crisis)—Korean-based manufacturing shifted in relative terms from exporting final goods to exporting parts. However, since the whole journey started in the northwest quadrant, the net effect of the two phases was to bring it to a position where Japan and Germany were in 1990. In machinery, the GVC journey resembles the Chinese model of rising TCA in both final goods and parts. By contrast, the journey in electrical and optical instruments was quite different. From a positive ECA in both types of goods, it shifted to a substantial rise in the its ECA for parts, but a deterioration in its TCA in final instruments—due largely to the offshoring of assembly activities to lower wage nations, especially China. Korea, in this sense, is quite unique in that its import substation strategy had brought to a situation before the ICT revolution that allowed its industrial development to resemble a blend of a 'headquarter economy', like the US and Japan, and a 'factory economy' like China.

Figure 11: Mexico's GVC Journey diagram



Mexico's industrialisation pathway (Figure 11) has been massively influenced by its proximity with the US, and the signing of NAFTA in 1994 (which greatly facilitated the development of North American value chains). More recently, Chinese producers and China-based foreign firms have started to use Mexico as an export platform for the North American market. The machinery industry journey starts with a positive ECA in parts but negative ECA in final goods, and switches progressively to the reverse signs as Mexico's assembly functions outstripped the growth in attractiveness as a location for parts manufacturing. In electrical and optical instruments, the massively negative ECA in both categories moves dramatically to positive ground in final goods and near-zero in parts along with the signing of NAFTA and all the GVC guarantees that came along with it. From there, a second phase of the journey started that involved a loss of territorial comparative advantage in parts—driven at least in part by the movement of assembly activities to Mexico and the resulting surge in imported parts. The transport machinery —the really big one in terms of the country's industrialisation—has also had a two-phase development. The country has been a base for export oriented assembly so Mexico's ECA in final goods is positive throughout its GVC journey. The first phase, from 1990 to 2000, saw a deterioration in its ECA in parts, followed by a sharp improvement.

Figure 12: Thailand's GVC Journey diagram



The experience of Thailand in the GVC revolution is another of the most notable industrial success stories the world has ever seen (Figure 12). The development is marked in transportation equipment. Thailand started out in 1990 with a classic developing country auto sector. This means local assemblers pretending to make cars by putting together complete knock down kits (CKDs). Specifically, this was where advanced-nation car producers helped make it look like Thailand had a car industry by sending kits and explaining how to reassemble the kits into complete cars. This situation was marked by massively negative net trade in cars and car parts, which is why both ECA are in the negative quadrant. Following a strongly pro-GVC industrialisation strategy, Thailand has become the "Detroit of Southeast Asia". It is a major exporter of final vehicles and parts—thanks to an absolutely massive amount of knowhow brought to Thailand by Japanese car companies. This is knowhow-led globalisation par excellence. A similar but less dramatic and smaller scale success has been witnessed along the GVC journey in machinery. In electrical and optical instruments, the evolution has been more modest, with the focus on net exports of parts for instruments assembled elsewhere.

With this rich gallery of examples in hand, it is worth laying out a simple yet flexible model to help organise our thinking on the key factors governing these GVC journeys.

4. THE BASIC MODEL

The basic setup can be thought of as a generalisation of the 'Snakes and Spiders' framework (Baldwin and Venables (2013); call it the BV model). Here we work only with the 'spider' version where there is no sequentiality in the production of parts, and thus all parts are produced from labour without any intermediate inputs and final goods are assembled directly from these parts using labour (there are no intermediate stages or assembly of parts into components that then feed into goods).

As in the BV model, we work with two-countries, North (N) and South (S), and assume perfect competition and constant returns to scale in all productive activities. Production of each final "good", which we refer to as goods without ambiguity, involves the assembly of many "parts"; specifically, each good is produced from a continuum of parts that are indexed by $i \in [0,1]$. The per unit cost of producing part 'i'' in S is the Southern wage, w_S, times units of labour input coefficient in South, a_S. The unit cost in N is isomorphic but denoted with the subscript N. To reflect the developed versus developing nation features of offshoring, we assume that N has an absolute advantage in all parts, $a_S > a_N$ for all i, although this plays no role until we consider knowledge-based globalisation.

Our first extension of the BV model allows improved communication technology to affect NCA without changes in production technologies (i.e. the a's). Specifically, in addition to production costs, we assume that each part needs to be inspected for quality compliance; the per part quality-control cost is θ_N in N and θ_S in S; we normalise θ_N to be zero. Turning to the production technology for goods, we assume that the assembly of parts into goods uses one unit of every part together some labour which costs A_N and A_S in N and S, respectively. Unlike the BV model, we assume that goods are consumed in N and S with the share of goods consumed in N given by 's'. If a part needs to be shipped between nations, the per unit cost of importing parts into N and S are τ_N and τ_S respectively. The cost of shipping a final good is T in either direction.

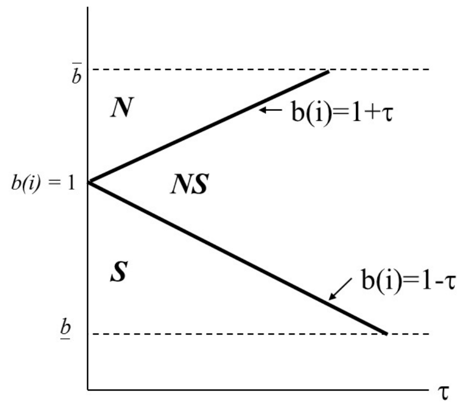
4.1. Cost minimization allocation of parts and final good production

Unit production cost is denoted as 'b' and it consists of labour inputs and inspection costs. It proves convenient to choose units of each part such that N's production and inspection cost, $w_N a_N(i)+\theta_N$, equals unity for all i, i.e. $w_N=1$, $a_N(i)=1$ and $\theta_N=0$, and to introduce the notation b(i) for S's production and inspection costs, namely:

$$b(i) = w_S a_S(i) + \theta_S(i) \qquad \textbf{(2)}$$

where $w_S<1$, $a_S(i)>1$ and $\theta_S>0$. We can drop the country index on the b's since all the North's b's equal 1. To be concrete, we assume that the technology is such that b's are distributed uniformly, i.e. $\underline{b} < b(i) < \bar{b}$ and $\underline{b} < 1 < \bar{b}$. The lack of sequentiality allows us to reorder the parts such that we can use the b's as the index rather than the underlying a(i) to gauge comparative advantage. Thus, we define b(i) as N's comparative advantage/disadvantage in part i, since N is the low-cost producer for all parts where b(i)>1 and S is the low-cost producer when b(i)<1. Due to trade costs, the cost minimising sourcing of parts depends upon the local of assembly. When assembly is in N, the cost of sourcing part i from N is 1, while the cost of sourcing it in S is $b(i)+\tau$. When assembly is in S, the cost of sourcing part 'i' from S is b(i) and $1+\tau$ from N. The cost-minimising sourcing pattern for parts can be calculated with the help of **Figure 13**, taking the two τ's as identical for the moment. While the choice is along the i-dimension, we can characterise the solution in terms of the b's. Specifically, only for parts whose b's are below $1-\tau$ is sourcing from S is cheaper regardless of the location of assembly. The set of such parts thus depends upon only on τ as show by the set ***S*** in the diagram.

Figure 13: Cost-minimising sourcing of parts



There is a similar set for N. Regardless of where assembly takes place, it is cheaper to source from N all parts where b(i)>1+τ; this set is shown as ***N***. The most interesting set is in the set NS. These are the cheapest to source from S when assembly is in S, but from N when assemble takes place in N.

To summarise, the solution to the cost-minimisation in parts-sourcing is characterised by three sets: ***S*** and ***N*** for parts that are always cheaper when bought from S and N (respectively), and ***NS***, which is the set of goods whose sourcing co-locates with assembly. When assembly is in S, it is cheaper to source the parts in ***NS*** from S and the reverse is true when assembly is in N.

Given this optimal sourcing of parts, the cost of assembly in N is:

$$C_N = w_N A_N + \int_{\underline{b}}^{1-\tau} (b(i) + \tau) dF(i) + \int_{1-\tau}^{\overline{b}} 1\, dF(i) \qquad \textbf{(3)}$$

and the cost of assembly in S is:

$$C_S = w_S A_S + \int_{\underline{b}}^{1+\tau} b(i) dF(i) + \int_{1+\tau}^{\overline{b}} (1 + \tau)\, dF(i) \qquad \textbf{(4)}$$

The choice of assembly location turns on the comparison of the two C's and final good transport costs, T. Specifically, N is the location of production for goods where:

$$C_N - C_S < 2T(s - \frac{1}{2}) \qquad \textbf{(5)}$$

As defined above, s and 1-s are market shares of N and S, respectively (s>1/2) [8]. As Northern market is bigger and trade costs from S is higher, assembly is more likely to locate in N, and vice versa. To put it differently, we suppose that C_N-C_S is positive. Production only takes

[8] Both N and S have consumers in our model. Thus we assume that assembly needs to ship to the other market in proportional to market size. If assembly locates in S, it has to ship "s" units to N involving transport costs T, and vice versa. The cost gap is given by $(1 - s)T + C_N - (sT + C_S) < 0$. This results in (1-2s)T+C_N-C_S<0.

place in N if N's share of consumption, s, is large enough. S is the chosen location when this holds with the inequality reversed. With this basic model, next section studies trade-led globalisation, namely were the driver is a reduction trade costs without any offshoring of knowledge or change in quality control costs.

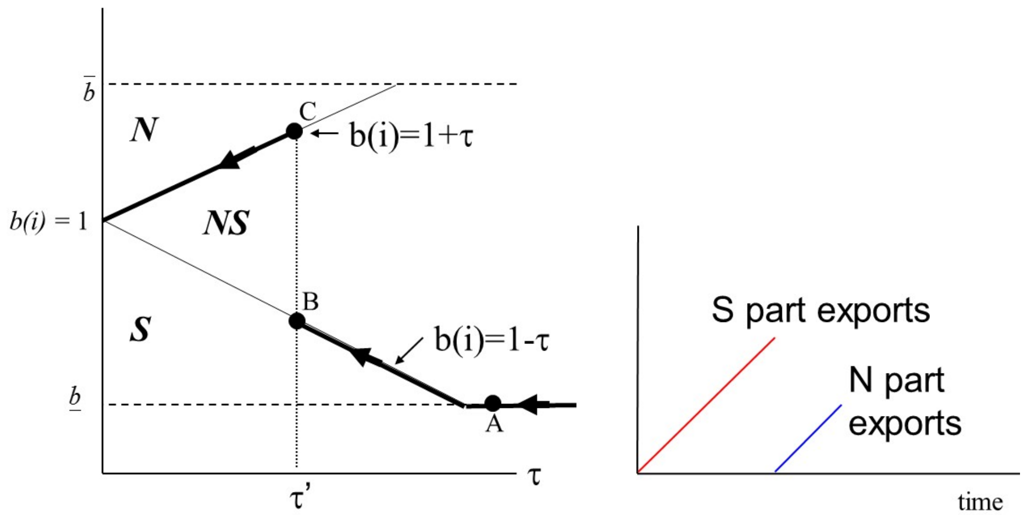
5. TRADE- LED GLOBALISATION

Consider first the pattern of trade and offshoring when globalisation is driven by falling trade costs for a good that is initially assembled in N.

As τ falls, the production of parts is progressively offshored from N to S as can be seen in Figure 14 (the range of parts in set ***S*** increases and τ falls). This would be associated with a rise in parts N's imports of parts from S for goods where assembly is in N, i.e. the N producer would engage in more global sourcing of parts. In the GVC journey diagrams, this would correspond to a move towards the west starting from a point in the positive quadrant in the GVC journey diagram. Since the location of assembly is unchanged, there would be no change in the ECA for final goods. Thus, N's ECA horizontally shifts toward west and S's ECA horizontally shifts toward East.

For final goods that are assembled in S to start with, the lower trade costs would lead to more export of parts from N to S. Overall, N's net export of parts could rise or fall, but if parameters such that most goods initially assembled in N, then the trade-led globalisation would lower the N's ECA in parts, since the increase in S-parts imports would swamp the increase in N-parts exports.

Figure 14: Typical trade-driven globalisation evolution.



This horizontal shift in ECA in parts, but no change in the ECA for final goods, will potentially result in a shift in the location of assembly. For some parts, assembly will be cheaper in S, so sufficiently free trade would lead to an offshoring of assembly. Specifically, as the range of parts production has been offshored to S rises (as per Figure 144), it may become cheaper to assemble in S and ship the good back to N rather than ship to parts for assembly in N. To be specific, this happens when τ is low enough such that the inequality in (5) reverses. We define τ' as the threshold level of τ where assembly shifts to S.

Now the ECA for final goods shifts by the assembly shifts to S. N's ECA shifts toward East-South and S's ECA shifts toward North-West.

5.1. Focus on a single good

To illustrate the basic trade-driven globalisation process, consider an individual good for (5) holds initially. The thought experiment is that τ falls gradually and we are looking for the τ' where the inequality reverses and assembly shifts to S.

At high levels of τ (e.g. point A in Figure 14), all parts are made in N and so assembly in N is also cheaper than assembly in S. To build intuition, we note that from this initial situation, τ dampens S's comparative advantage in parts, so falling τ tends to encourage production and export of S parts. That is, as τ falls, S's cost advantage can be better exploited, so an increasing range of parts are sourced from S, as the system moves towards point B in Figure 14. This is associated with rising parts exports from S and rising foreign value-added content in N goods production. Without loss of generality, we assume that trade costs for final product and parts and components are identical, T= τ , for simplicity's sake. For τ below the threshold level τ', it becomes cheaper to assemble the good in S instead of N, thus at τ', assembly is offshored to S. This critical level, call it the offshoring point, is given by:

$$\tau' = \frac{(\overline{b}-\underline{b})(1-w_S A_S)}{2\left(s\overline{b}+(1-s)\underline{b}-1\right)} \qquad \textbf{(6)}$$

See Appendix for the derivation of the critical value. We note that the offshoring of assembly happens 'sooner', i.e. at a higher τ, when A_S and w_S are lower and S has more comparative advantage in parts (lower $\underline{b}$).

From this point onwards, the burden of trade costs for parts shifts from S to N. That is, from point C onwards (i.e. moving to the left), the falling trade costs allow N to better exploit its comparative advantage in parts, so further reductions in τ result in more parts being exported from N and a rise in the foreign value-added in S production. This is what the BV models calls "offshore overshooting". In particular, when the jump from B to C occurs (i.e. when assembly is offshored), a wider range of parts are produced in S than is justified on pure production cost terms (remember N has a native comparative advantage in all parts with b>1). As trade costs fall further, some parts production is reshored to N.

The implied pattern of parts trade is shown in the right panel of Figure 14, assuming τ falls over time. At first S's parts exports rise, then they drop to zero and N's parts exports begin to grow. The key point is that falling trade costs leads to a fairly symmetric outcome in the sense that it does not generally tend to favour parts exports from S.

Exports of parts and components are simple to derive. Export volumes from South to North (excluding trade cost payments) are:

$$\int_{\underline{b}}^{1-\tau} b f(b)\,db = \frac{1}{\overline{b}-\underline{b}}\left(\frac{(1-\tau)^2}{2} - \frac{\underline{b}^2}{2}\right) \quad \text{when } \tau > \tau'$$

Export volumes from North to South (excluding trade cost payments) are

$$\int_{1+\tau}^{\overline{b}} f(b)\,db = \frac{1}{\overline{b}-\underline{b}}\left(\overline{b} - (1+\tau)\right) \quad \text{when } \tau < \tau'.$$

We note that trade in parts and trade in a final good are both one-way for any given good, but reproducing the widely observed intra-industry trade arises directly in a model with heterogeneous goods where some assemblies are in S and some are in N. The reverse shift in location of assembly, from S to N, is possible for final goods with different parameter configurations. For instance, if S has a large cost-edge in assembly, but N has a large cost edge in parts, we can see situations where assembly starts in S but switches to N when trade gets free enough.

Once we allow T and τ to be distinct, and to allow them to differ for N to S and S to N trade, we can get any combinations of changes in ECA for parts and goods as trade-led globalisation proceeds. The model is thus flexible enough to account for the variety of GVA journeys documented in Section 3.

6. KNOWLEDGE-LED GLOBALISATION

There are two types of knowledge-led globalisation in our model; one is linked to quality control, and the other is linked to production technology.

The first type is associated with costly quality control of parts. Figure 15 illustrates the change by this type of globalisation. For simplicity, we assume that b(i) proportionally decreases in terms of i, given no change of $\underline{b}$. (the left panel of Figure 15). The right panel of Figure 15 shows how globalisation changes the density of b(i), where f represents the probability density distribution of b(i). The change by this type of globalisation can reflect from f to f'. N-based firms, which control all the production processes, find it more expensive to check quality of parts made in S due to the cost of moving ideas across borders. That is to say, it is expensive to get knowledge about quality and processes that affects quality between the two nations. As communication costs fall, the ideas move more cheaply and the cost of quality control falls. This is the first aspect of knowledge-led globalisation and it involves the asymmetric lowering of θ_S since N-based firms already know the quality of the parts they are producing in N (θ_N is normalised to zero). One way to think of this outcome is that knowledge-led globalisation is not allowing nations to better exploit their comparative advantage, it is shifting comparative advantages. Observe that this shift in comparative advantage is in the background. The solutions to the lowest-cost sourcing problem is the same in terms of b's, but the mass of N parts with a particular b changes. Thus, the analysis of sourcing is unaffected, but the mass of parts sourced in S increases at every level of τ. In terms of offshoring overshooting point, as shown in Figure 16, B and C will move to B' and C', respectively and thus overshooting point, τ ', will go down (τ '').

Figure 15: Production technology and distribution of comparative advantage.

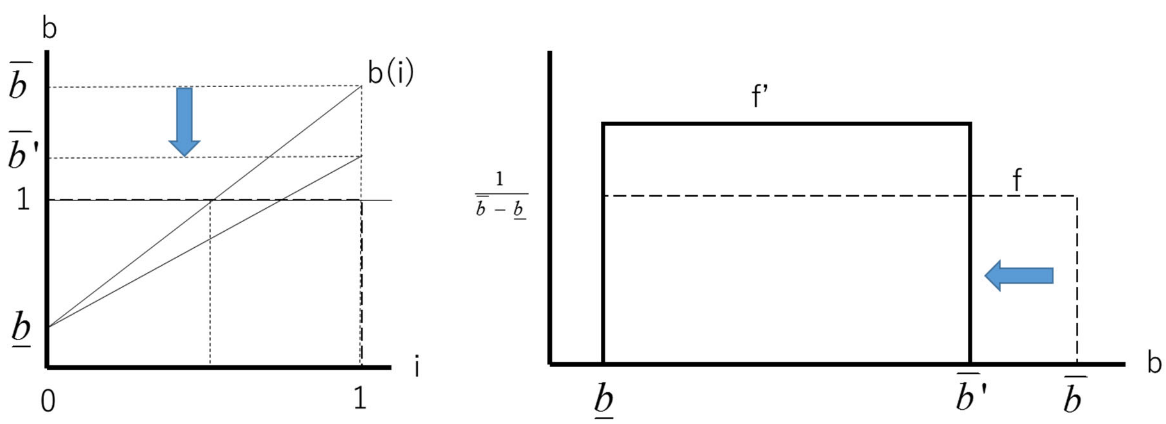
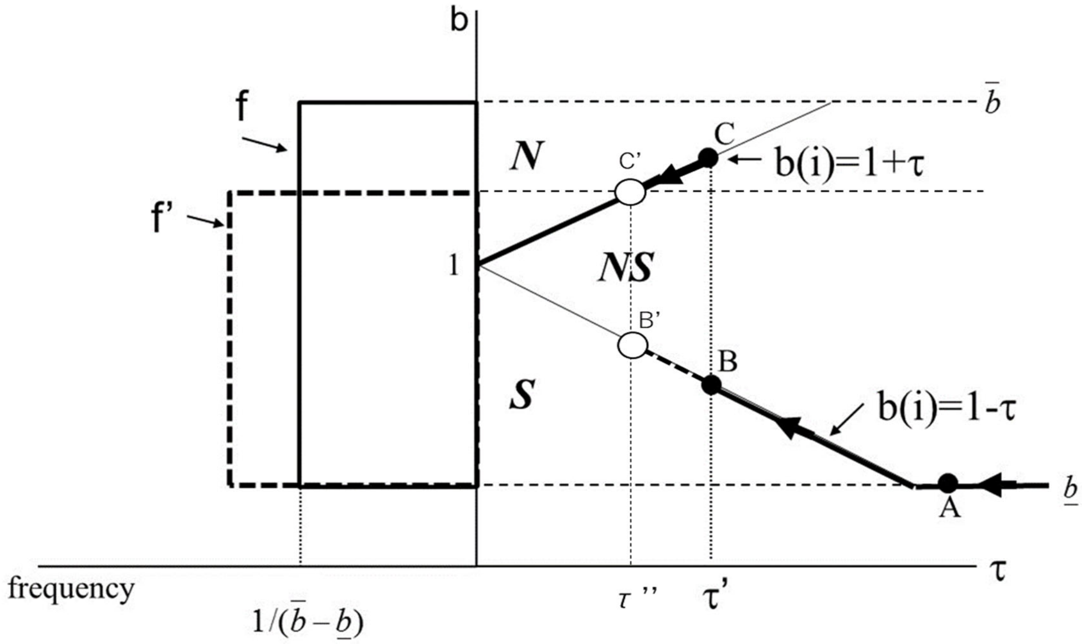
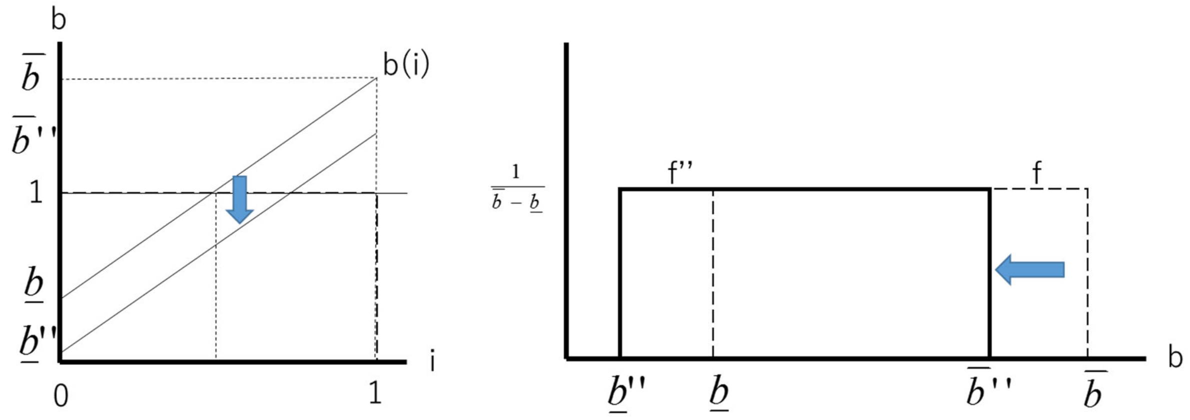


Figure 16: Asymmetric parts production and exports with knowledge-led globalisation



The second type of knowledge-led globalisation can be thought of as firm-specific technology 'lending' whereby an N-based firm combines its superior technology (i.e. $a_N < a_S$) with lower cost in S's labour to produce parts as in Baldwin and Robert-Nicoud (2014) (see Figure 17). Given the definition of b(i), it is clear that knowledge-led globalisation will shift comparative advantage in S's favour. Both types of knowledge crossing borders lower the cost of producing parts in S without change the production cost in N. To be concrete, we introduce a functional relationship, namely $a_S(i)= a_N(i)+\chi i$, where χ (a mnemonic for communications costs) is a parameter governing the distribution of comparative advantage. This implies that N has better production technology than S in all parts except i=0 where the two technologies are equal, i.e. $a_N(0) = a_S(0)$. Knowledge-led globalisation of this second type is modelled as a fall in communication costs that facilitates the application of N technology to S workers, namely a fall in χ. Again, for simplicity's sake, we assume that $\theta(i)=\chi$, so that falling χ lowers the cost of quality control in S relative to the cost in N. The technology lending reduces "a_S" for all i. This can be illustrated as Figure 17. The right panel shows the parallel downward shift of b(i). In the left panel, the impact of firm-specific technology lending can be seen as a shift in the distribution of b from f to f''. This implies an unambiguous increase in the mass of parts where S is more competitive than N for any given level of trade costs.

Figure 17: Production technology and distribution of comparative advantage.



Given that S has a comparative advantage (under free trade) in any part where b < 1, the leftwards shift of probability mass shown in the will mean that falling τ will tend to have a more asymmetric impact on S's exports. For goods where assembly is still in N, the falling trade costs will lead to a faster rise in parts exports from S. The point is that S's parts exports will rise due both to lower trade costs and shifting comparative advantage. To put it differently, we would see rising parts exports from S if only τ fell, or only χ fell. Likewise, for goods where assembly has moved to S, the rise in N parts exports from falling τ (moves from point C) will be less marked than before the shift in comparative advantage since N firms are losing comparative advantage even as lower τ is allowing others to exploit their comparative advantage. In either case, the value-added originating from S embedded in all goods will rise as χ falls.

In summary, knowledge-led globalisation favours production of parts in S and disfavours parts production in N. Consequently, it should tend to be associated with S exports of parts growing faster N's. This implies that ECA shifts vertical and horizontal ways in the GVC diagram.

7. CONCLUDING REMARKS

This paper investigates the deindustrialisation of G7 nations that has occurred since the 1980s and the industrialisation of a handful of developing nations by focusing on the difference between parts and final goods. The key innovation is to introduce the notion of "GVC Journeys" that describes how nations' territorial comparative advantage evolves in parts, on one hand, and final goods on the other hand. This is measured by following the "Empirical Comparative Advantage" (ECA) index for parts and final goods separately. This index, which is a minor modification of a Grubel-Lloyd-like measure, looks at the trade balance in, for example, parts in a particular industry as a share of total trade in parts in the industry. This measure, which is naturally bound between 1 and -1, is a proxy for revealed competitiveness. That is, if a nation is very good compared to the rest of the world at making parts in, say, the transport machinery sector, then the nation should have a positive ECA.

By tracing out the evolution of the ECA for parts versus final goods, we suggest that the deindustrialisation of the US has been very different than that of Germany and Japan. In all cases, there is a clear movement for the rich nation to source more parts abroad, but the impact on sourcing final goods is more mixed. Germany in transport machinery, for example, started with a positive balance in parts and goods, and lost ECA in parts, but gained it in final goods. The US, by contrast, lost ECA in both parts and goods, and in fact started with a negative balance in both.

We believe that this "GVC Journey" diagrams can be used to organise thinking about the various industrialisation and deindustrialization experiences witnessed in recent decades. This paper also presented a simple partial equilibrium model that clarified the difference between trade-led and knowledge-led globalisation. Of course, our simple theory based on Baldwin and Venables (2013) cannot perfectly explain the locus of the GVC Journey diagram, because there are several important missing aspects in the simple partial equilibrium theory, e.g. economic growth in South and multiple stage productions in multiple countries (e.g. snake type in Baldwin and Venables (2013)). The future research will be extension of our simple theory.

APPENDIX

$$
\begin{aligned}
C_N &= w_N A_N + \int_{\underline{b}}^{1-\tau} (b(i)+\tau)dF(i) + \int_{1-\tau}^{\overline{b}} 1\, dF(i) \\
&= 1 + \left[\frac{(1-\tau)^2}{2} + \tau(1-\tau) - \frac{\underline{b}^2}{2} - \tau\underline{b}\right]\frac{1}{\overline{b}-\underline{b}} + (\overline{b}-(1-\tau))\frac{1}{\overline{b}-\underline{b}}
\end{aligned}
$$

$$
\begin{aligned}
C_S &= w_S A_S + \int_{\underline{b}}^{1+\tau} b(i)dF(i) + \int_{1+\tau}^{\overline{b}} (1+\tau)\, dF(i) \\
&= w_S A_S + \left[\frac{(1+\tau)^2}{2} - \frac{\underline{b}^2}{2}\right]\frac{1}{\overline{b}-\underline{b}} + (\overline{b}(1+\tau)-(1+\tau)^2)\frac{1}{\overline{b}-\underline{b}}
\end{aligned}
$$

By solving $C_N - C_S - T(2s-1) = 0$ with T= τ , we can derive τ ', which is offshoring point.

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