GVC journeys when national and territorial comparative advantage differ

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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 patters of industrialisation and deindustrialisation—namely the "GVC journey's" of advanced and emerging economies. We also provide a simple model that highlight the interactions among trade costs, and the knowledge transfers that accompany offshoring of parts production and assembly.

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

JEL

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 tends to produce relatively symmetric outcomes since freer trade lets every nation do what they do best and trade for the rest. As long as the cross-sector competitiveness profiles of nations differ, wages and prices adjust so that each nation is the low-cost producers in at least something (Ricardo, 1817). From a welfare perspective, globalisation in this paradigm is like two football clubs exchanging players; both clubs gain if an exchange actually takes place.

In this tradition, the post-1990 radical reductions in communication costs are modelled as lowering frictional trade barriers (Grossman and Rossi-Hansberg 2008, Hsieh et al 2016, etc). But does this conceptualisation fully capture what happened in the 1990s and 2000s? Was it only a matter of easier trade allowing nations to better exploit existing national comparative advantages? Or did the radically easier communication and coordination capabilities that

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came with Information and Communication Technologies (ICT) also make it easier to move the sources of comparative advantage?

Maybe it really matters that ICT is directly facilitating the flow of ideas across borders and only lowering trade costs indirectly? Maybe we should consider a conceptualisation a newly important form of globalisation (global value chains) as knowledge-led, not just trade-led?

Knowledge-led globalisation tends to produce asymmetric outcomes for two very good reasons. First, knowledge tends to be non-rival, so cross-border flows of knowhow are more like spreading 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. To follow on the football analogy, knowledge-led globalisation is like the coach of the better football club training the worse-teams' players on the weekends. The impact of this knowledge crossing team boundaries will be asymmetric in many ways (and gains from trade are not guaranteed at the team level).

1.1. National Comparative Advantage versus Territorial Comparative Advantage

As noted by Baldwin (2016), and many others, such as Jones (2000), this type of globalisation involves a 'denationalisation' of comparative advantage. That is to say, the companies cost advantage is not organised around solely according to national boundaries. GVC boundaries also matter. That is, the Northern company retains control of its technology as it applies it to Southern labour, and the result cost reduction boosts the Northern firm's competitiveness. But now, the South's pattern of trade – its EMA in particular – is no longer solely a national trait. It is a combination of national wages and firm-specific knowhow.

To distinguish this shift in trade patterns from a more traditional change in national comparative advantage, we call this 'territorial comparative advantage', or TCA for short. The traditional comparative advantage is thus NCA, short for national comparative advantage. The issues involved are identical to those addressed in trade theory with respect to capital mobility in the Heckscher-Ohlin model, and the distinction between GNP and GDP.

1.2. Literature Review

In terms of globalisation and trade, Baldwin (2006) suggests the second unbundling and task trade. Baldwin and Lopez-Gonzalez(2015) shows current global supply chain.

FDI is currently complex and beyond vertical vs horizontal FDI. Ekholm et al. (2003) proposes export platform and Yeaple (2003) does complex FDI. Baldwin and Okubo (2014) proposes networked FDI. The current FDI sees local sales and sourcing as well as sales to and sourcing from the third country.[2] Current complex FDI boosts trade of final products as well as intermediate inputs.

Turning to Asian trade, Ng and Yeat (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.[3] More in details, Kimura and Obashi (2010) report some more statistical

[2] Baltagi et al.(2005) show empirical evidences how important the third-country effect is.

[3] 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.

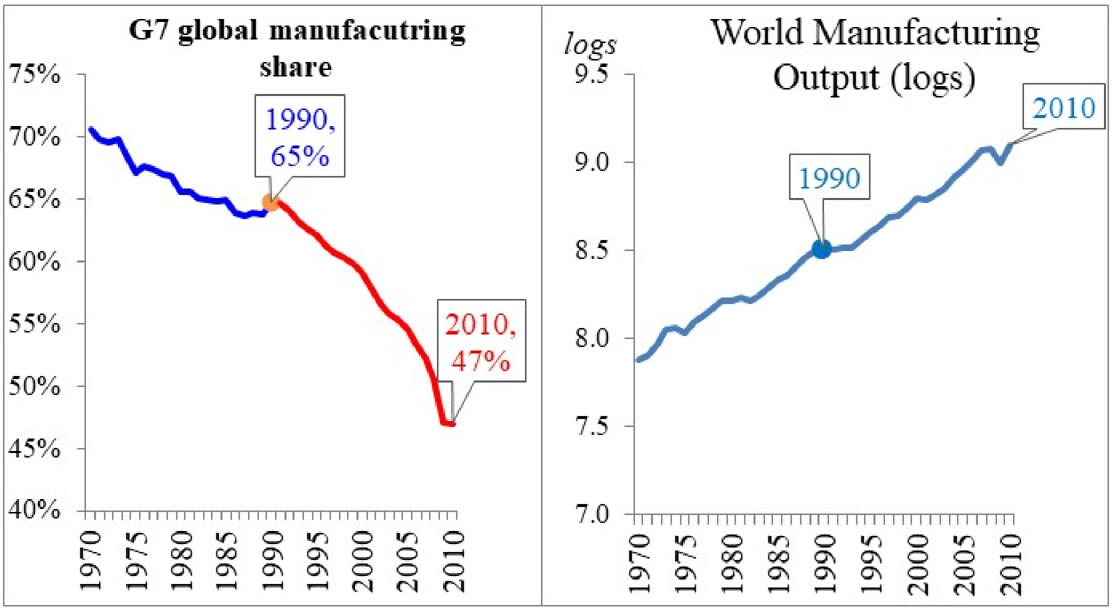
evidences.[4] Asia is high specialisation in exports and imports of machinery industries, in particular their parts and components. East Asian countries increased proportion of machinery trade within Asia and with other regions. Many Asian countries increased parts and components trade within Asia while they increased final machinery products with other regions. Furthermore, some current 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).[5]

2. 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 wasn't sudden. From the 1970s, a handful of developing countries known as the 'Newly Industrialising Nations' (Hong Kong, Taiwan, Singapore and 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.

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



Source: Authors' elaboration of UNSTAT.org data.

This deindustrialisation of the 'North' and the industrialisation a handful of developing nations that 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

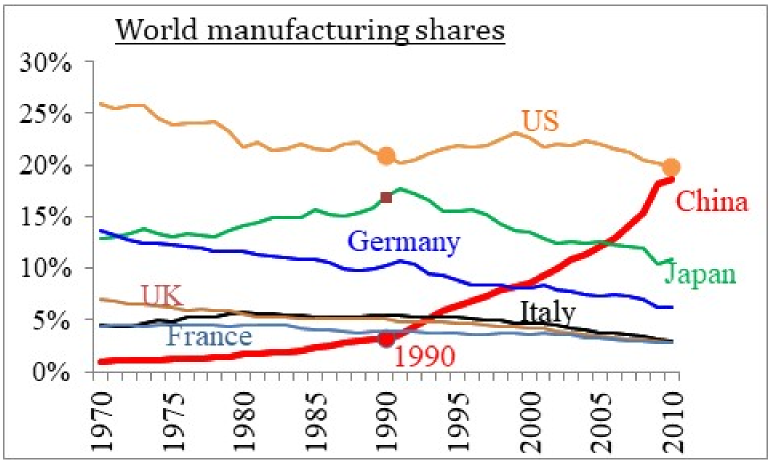
[4] Kimura and Obashi (2010) measure specilization indices of machinery trade by Balassa (1965) and Aminian et al. (2009)

[5] See Kimura and Obashi (2016) for overview on Asian fragmentation.

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 (left panel) 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.

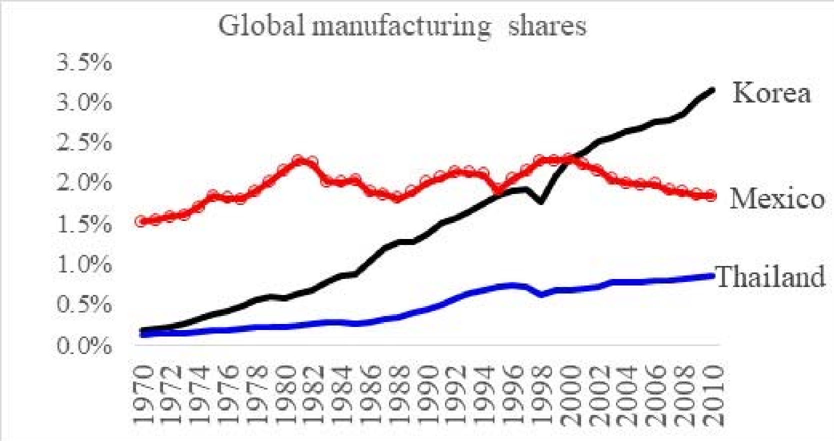
The Japanese experience in the period was very different. During two 'miracle decades', Japan's manufacturing output swelled rapidly and this in turn was associated with a tremendous overall income growth take-off. This rapid rise eventually caused a great deal of conflict with the US as Japanese autos, electronics, and machinery threated the postwar dominance of American goods; up to 1990 or so, Japan's rising share is the mirror image of the falling US share. This changed with the 2^{nd} unbundling. Since 1990, Japan has joined the general G7 downward trend.

Interestingly, US manufacturing output enjoyed 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.

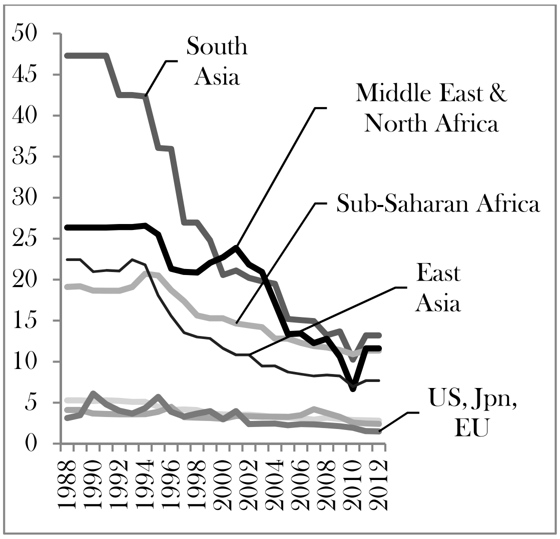
In the knowledge-led view of globalisation, revolutionary advances in ICT mattered since they made it possible to coordinate complex production arrangements internationally. This fostered offshoring, but the change was asymmetric. It was a revolutionary boost in developing nations' abilities to export parts, but less so for G7 parts exporters.

The point is that until the ICT revolution, the export of parts was lopsided. 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, reliability and 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.

Figure 4: Asymmetric tariff cutting since 1988.



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

2.1. 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 the North versus South, and to what happened to parts versus final goods. To this end, we introduce diagram that helps collated 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) and 'parts' (all the bits and pieces that go into the assembled cars). We also presume that countries fall neatly into one of two categories. The North (think of 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, or Poland) which has lower wages and worse technology in both parts and final goods.

2.1.1. 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 intraindustry trade. This allows for two-way trade allowing us to deal with the existence of intraindustry 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', or ECA for short:

$$ECAX_{cik} = \frac{X_{cik} - M_{cik}}{X_{cik} + M_{cik}} \qquad \textbf{(1)}$$

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).

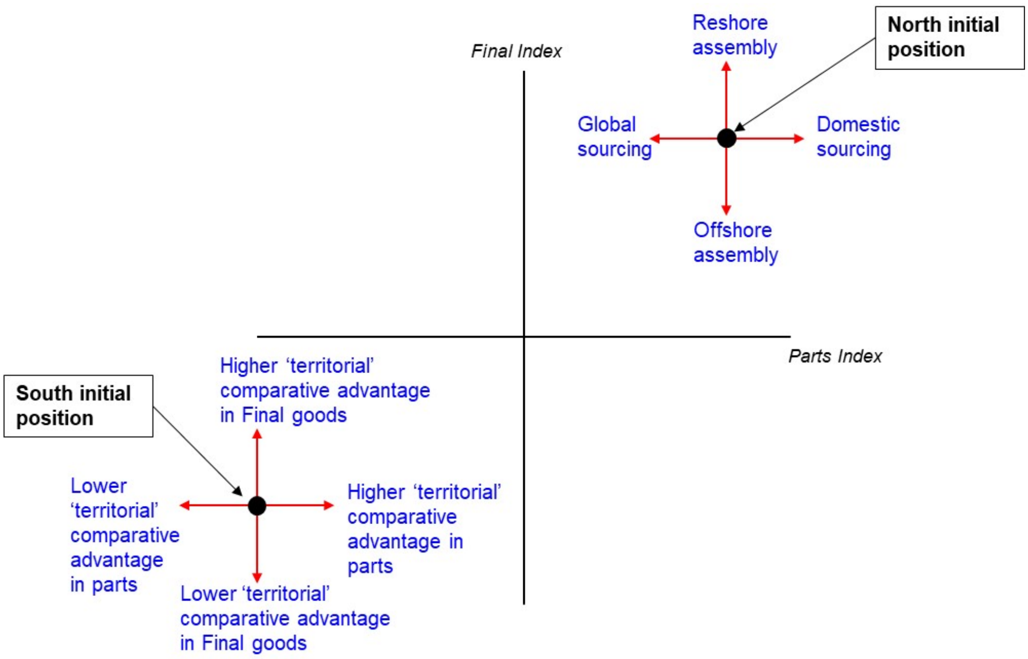
This is related to the well-known Revealed Comparative Advantage but uses only data for a single country. It is also akin to country c's index Grubel-Lloyd index but without the absolute value.

To think about this, note that a multi-sector Krugman model which allows a distribution of sectoral comparative advantage across nations would see the ECA being positive where the nation had a comparative advantage (net exporter) and negative in sectors where it had a comparative disadvantage (and thus a net importer). It 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.

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 only one possible pathway for the North.

Starting from the North's initial condition, shown in Figure 5, 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' it 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; 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

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 national comparative advantage, 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 has a national comparative disadvantage in both final goods and parts. From this starting point, the South's position can more to the North, which is an improved TCA in final goods. This would typical come when Northern firms decide to shift assembly plants to the South; in the classic example, the South would increase its net imports of parts for assembly but increase its net exports of final goods, to the motion would be to the Northwest. A motion to the South would implies a reduced TCA in final goods.

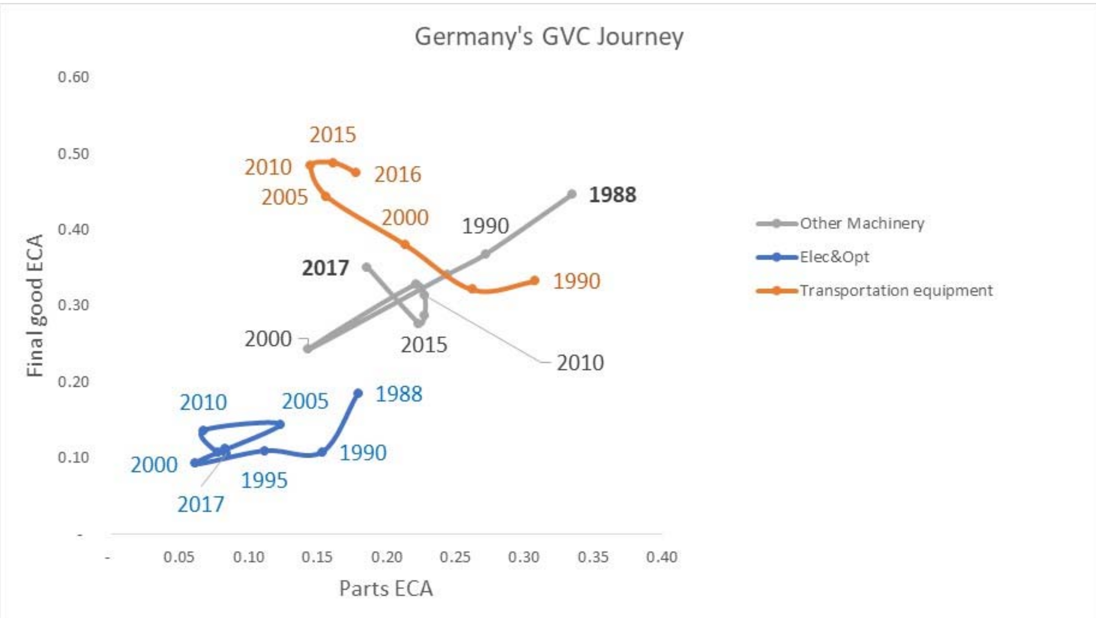
A move to the east, would be the result of a Northern firm shifting technology to the South to make more parts. The result would be an improvement in the South's TCA. A shift to the west is the opposite. A classic example would be if a Northern manufacturer decides to source more parts from the South 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 Sothern-made final goods.

2.2. Experience of Northern nations

To get an empirical handle on this approach requires us 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 aggregate the 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)

Figure 6: Germany's GVC Journey diagram



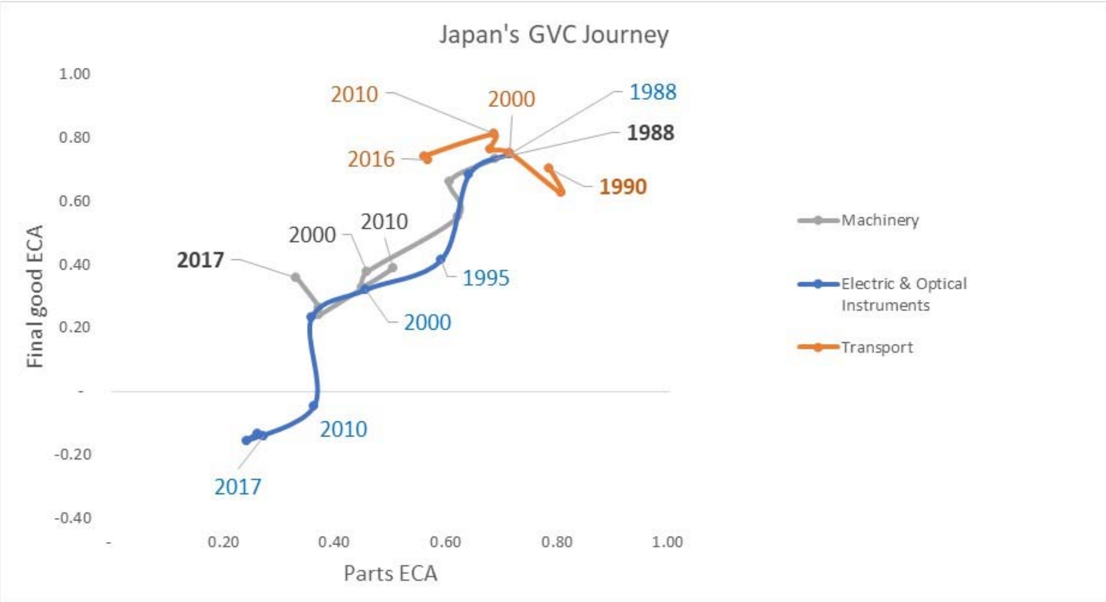
The idealised North in this deindustrialisation narrative would experience some combination of global sourcing of parts, which would tend to move the ECA for parts to the west, and some offshoring of assembly which would result in a decrease in the ECA for final goods. The result would be an initial 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.

Note that in all three sectors, there is evidence of the offshore overshooting produced by the Baldwin and Venables (2013) analysis.

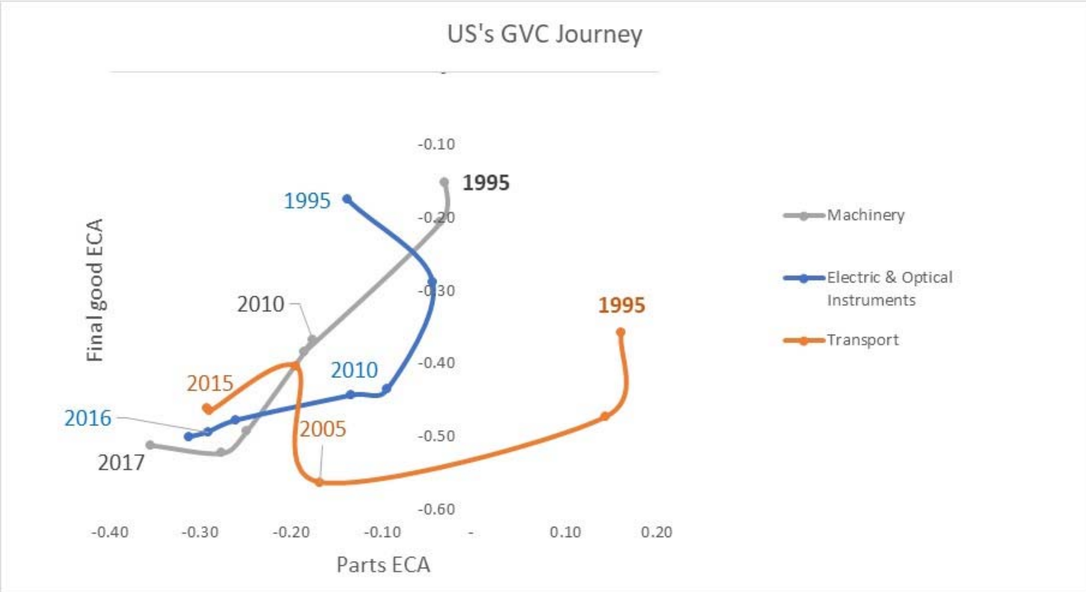
The case of Japan is similar but differs in important ways. First, there is little or no evidence of offshore overshooting at this level of aggregation. Second, the GVA development has gone much further in electrical and optical instruments (think cameras); Japan has lost sufficient TCA to turn it from 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). It's 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.

Figure 8: US's GVC Journey diagram



2.3. 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 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.

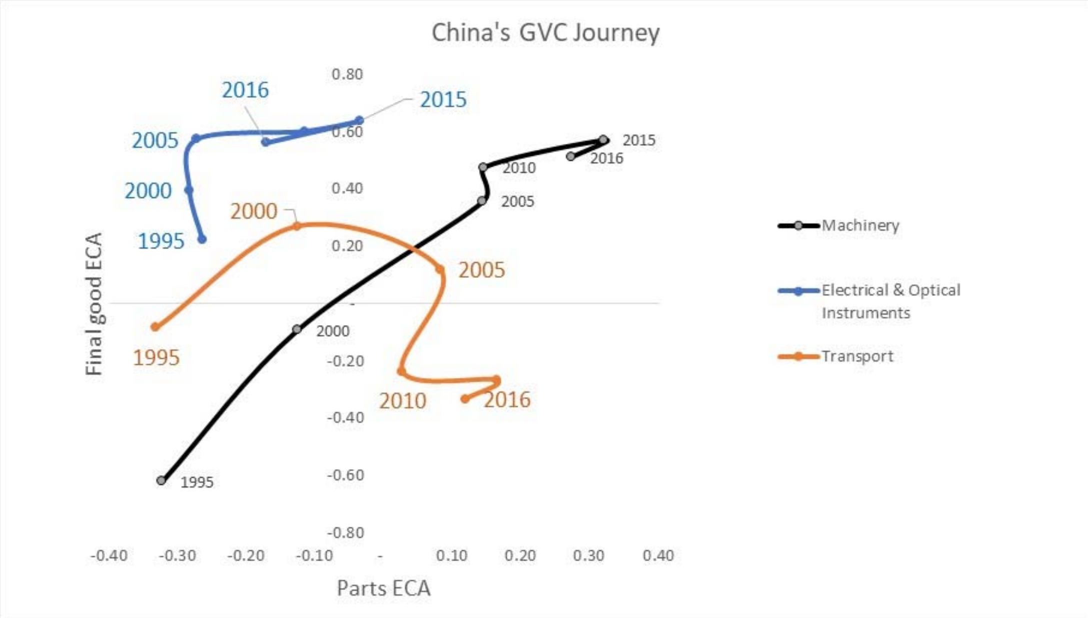
Table 1: Biggest global share gainers and losers, 1990 to 2010, manufacturing GDP

	1990	2010		1990	2010
China	3.12%	18.62%	Canada	2.18%	1.48%
Korea	1.38%	3.15%	Spain	2.36%	1.60%
India	1.00%	2.06%	US	20.94%	19.85%
Poland	0.24%	0.90%	France	3.87%	2.75%
Indonesia	0.65%	1.07%	UK	5.11%	2.78%
Thailand	0.45%	0.86%	Italy	5.42%	2.93%
Ireland	0.28%	0.56%	Germany	10.30%	6.26%
Malaysia	0.26%	0.52%	Japan	16.91%	10.92%
Singapore	0.26%	0.51%			
Turkey	0.89%	1.13%			
Iran	0.14%	0.31%			
Viet Nam	0.04%	0.19%			

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, it belonged to firms located in the nation, but 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 national comparative advantage (i.e. the comparative advantage of a nation's firms) and territorial comparative advantage (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.

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 not time-sensitive parts. 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

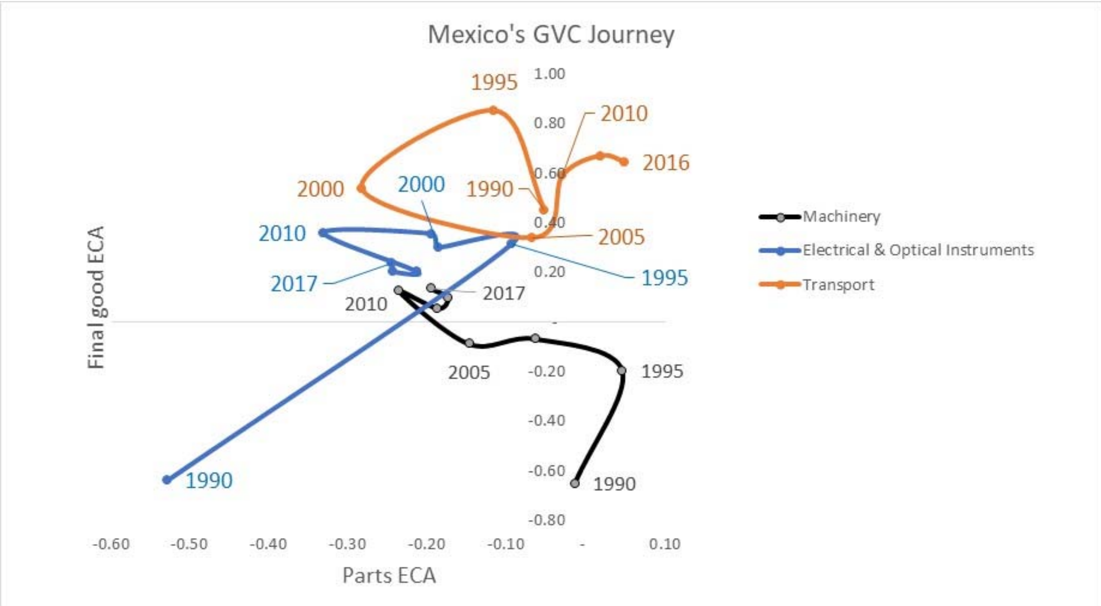
Source: International Organization of Motor Vehicle Manufacturers
http://www.oica.net/category/production-statistics/2016-statistics/

China's GVC journey in transport 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 national comparative advantage 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. Korea's GVC journey in transportation shares some of these two-phase features.

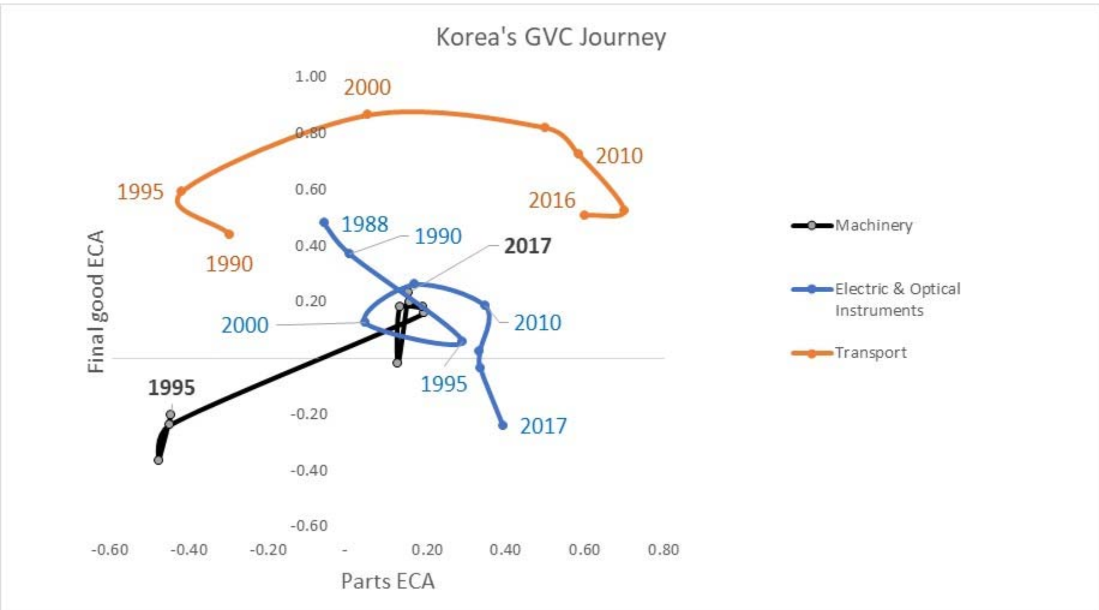
Korea's car industry is one of world's most impressive industrial development stories. From a small assembler of complete knockdown kits in the 1970s, Korea has risen to a major player—now the 6th largest producer globally. In the first phase, Korea's ECA in both parts and final goods rose, peaking around 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.

Figure 10: Mexico's GVC Journey diagram



In machinery, the GVC journey resembles the Chinese model of rising territorial comparative advantage 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 territorial comparative advantage in final instruments—due largely to the offshoring of assembly activities to lower wage nations, especially China.

Figure 11: Korea's GVC Journey diagram



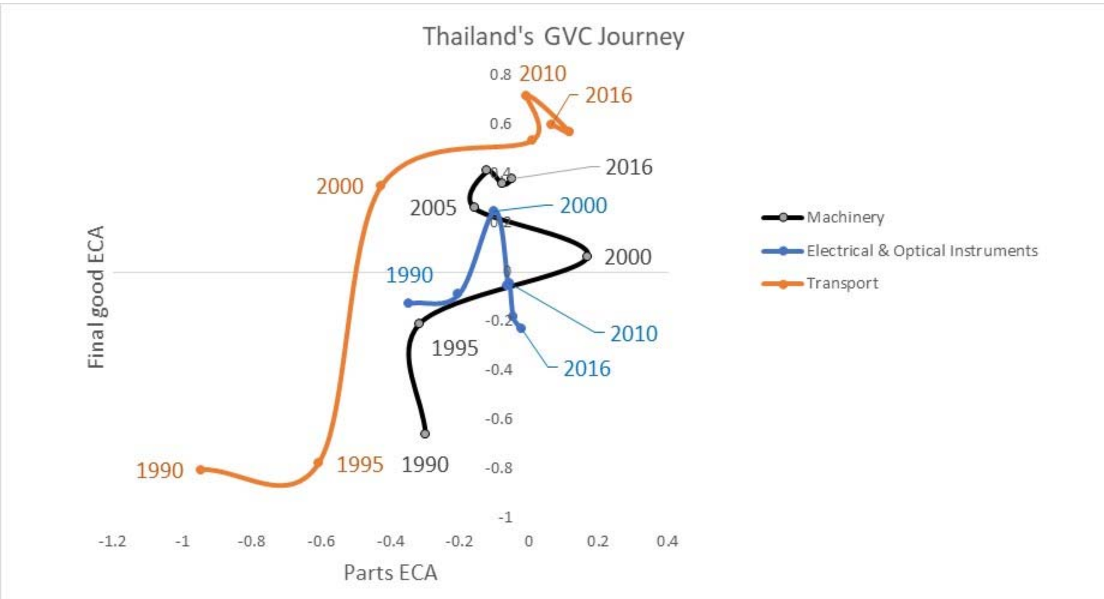
Korea, in this sense, is quite unique in that its import substation strategy had brought to a situation before the ICT revolution that allowed its industrial development to resemble a blend of a ‘headquarter economy’, like the US or Japan, and a ‘factory economy’ like China.

Mexico’s industrialisation pathway 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 move 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 sector—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.

The experience of Thailand in the GVC revolution is another of the most notable industrial success stories the world has ever seen.

Figure 12: Thailand’s GVC Journey diagram



The development is most marked in transportation equipment. Thailand started out in 1990 with a classic developing country auto sector. That meant 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.

3. THE BASIC MODEL

The basic set up 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, so all parts are produced from labour without any intermediate input 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 S wage, w_S, times the S unit labour input coefficient, 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 so, $a_S > a_N$ 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 national comparative advantage 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. As in the BV model, we assume that goods are only consumed in N. This avoids issues of market-seeking investment and simplifies the formulas.

If a part need 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. Wages are taken as parameters.

3.1. 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

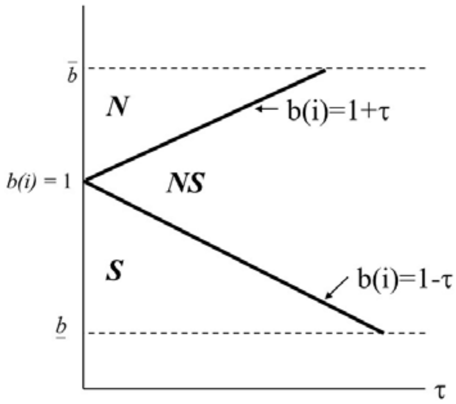
North's b's equal 1.

To be concrete, we assume that the technology is such that b's are distributed uniformly, i.e. $\underline{b} < b(i) < \overline{b}$ and $\underline{b} < 1 < \overline{b}$. 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 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 the S is b(i)+τ. When assembly is in S, the cost of sourcing part 'i' from S is b(i) and 1+τ from N.

The cost-minimising sourcing pattern for parts can be calculated with the help of Figure 14, 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-τ 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 of parts are in the set NS. These are 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:

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

and the cost of assembly in S is:

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

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:

$$C_N > C_S + T \qquad \textbf{(5)}$$

and in S is the chosen location when this holds with the inequality reversed. For simplicity, following BV model, we assume T=τ.

With this basic model, we study trade-lead globalisation, namely were the driver is a reduction trade costs without any offshoring of knowledge or change in quality control costs.

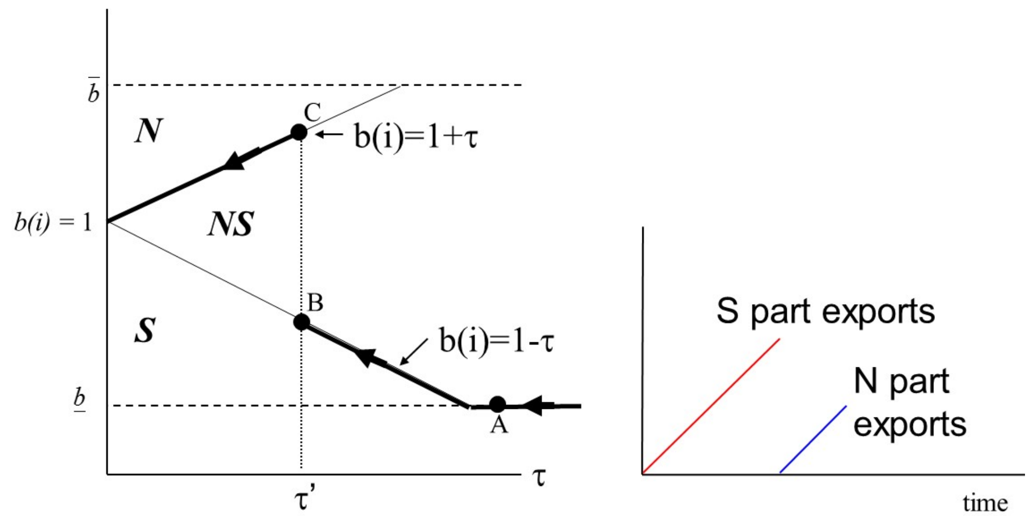
4. TRADE- DRIVEN GLOBALISATION

Consider first the pattern of trade and offshoring when globalisation is driven by falling trade costs only when some goods are initially assembled in N and others are assembled in S.

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. 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. Over all, 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.

This initial phase of trade-led globalisation corresponds 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.

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 assemble. 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 14), 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.

4.1. 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 shift 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, 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. This is associated with rising parts exports from S and rising foreign value-added content in N goods production.

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:

$$\tau' = \frac{(\bar{b}-\underline{b})(1-w_S A_S)}{2(\bar{b}-1)}$$

See Appendix for the derivation of the critical value. 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 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 assuming τ falls over time. At first S parts exports rise, then they drop to zero and N's parts exports begins to grow. The key point is that falling trade costs lead 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:

$$\int_{\underline{b}}^{1-\tau} bf(b)db = \frac{1}{\bar{b}-\underline{b}}\left(\frac{(1-\tau)^2}{2} - \frac{\underline{b}^2}{2}\right) \text{ when } \tau > \tau'$$

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

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

Note that trade in parts and trade in goods are both one-way for any given final good, but reproducing the widely observed intraindustry trade arises directly in a model with heterogenous goods where some assemble is in S and some is 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 combination 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 2.

5. KNOWLEDGE-DRIVEN GLOBALISATION

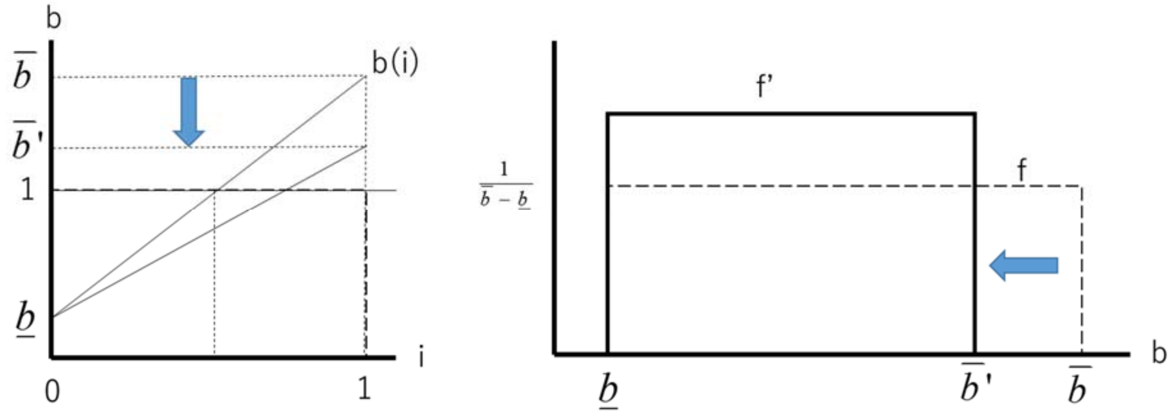
There are two types of knowledge in our model; one is linked to quality control, and the other is linked to production technology, namely a's.

The first type is associated with costly quality control of parts (see Figure 15). N-based firms, who 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 affect quality between the two nations. As communication costs fall, the ideas move more cheaply and the cost of quality control fall. This is the first aspect of knowledge driven 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).

The second 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 S labour to produce parts as in Baldwin and Robert-Nicoud (2014) (see Figure 16). Given the definition of b(i), it is clear that knowledge-driven globalisation of this type 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-driven 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 $\theta(i)=\chi\Theta i$, 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. 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.

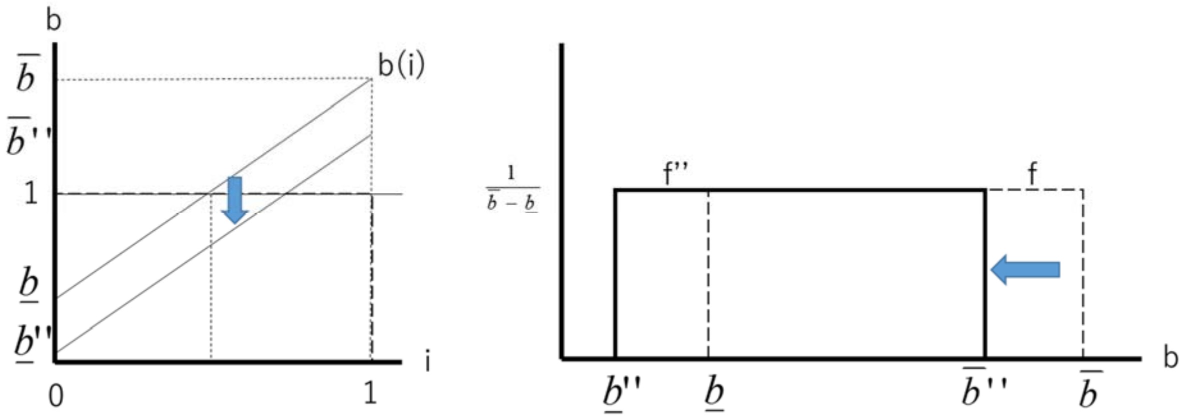
One way to think of this outcome is that knowledge-led globalisation is not allowing nations to better exploit their comparative advantage, it is shifting comparative advantages. Observe that this shift in comparative advantage is in the background. The solutions to the lowest-cost sourcing problem is 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.

Figure 15: Production technology and distribution of comparative advantage.



The other type of knowledge-led globalisation is shown in Figure 16, namely the lowering of θ_S. The distribution changes from f to f", and thus upper and lower b's both shifts down. The distribution just shifts leftward and thus its frequency is invariant.

Figure 16: Production technology and distribution of comparative advantage.



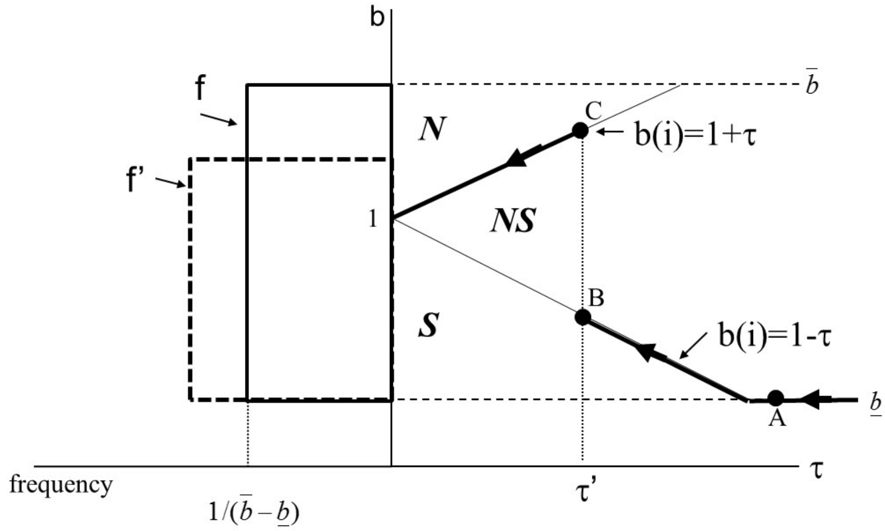
Given that S has a comparative advantage (under free trade) in any part where b < 1, the leftwards shift of probability mass shown in the will mean that falling τ will tend to have a more asymmetric impact on S's exports. For goods where assembly is still in N, the falling trade costs will lead to a faster rise in parts exports from S. The point is that S's part exports will rise due both to lower trade costs and the shifting comparative advantage. Of put 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 is more likely to shifts vertical and horizontal ways.

Figure 17: Asymmetric parts production and exports with knowledge-led globalisation



6. Concluding Remarks

This preliminary draft illustrates how "GVC Journey" diagrams can be used to organise thinking about the various industrialisation and deindustrialization experiences witnessed in recent decades. In future drafts, we plan to conduct more extensive analysis of the GVC journeys (for more nations and less aggregated sectors), and generally the model to more tightly explain the various outcomes.

Appendix

$$C_N = w_N A_N + \int_{\underline{b}}^{1-\tau} \left(b(i)+\tau\right) dF(i) + \int_{1-\tau}^{\bar{b}} 1 dF(i)$$

$$= 1 + \left[\frac{(1-\tau)^2}{2} + \tau(1-\tau) - \frac{\underline{b}^2}{2} - \tau\underline{b}\right]\frac{1}{\bar{b}-\underline{b}} + (\bar{b}-(1-\tau))\frac{1}{\bar{b}-\underline{b}}$$

$$C_S = w_S A_S + \int_{\underline{b}}^{1+\tau} b(i) dF(i) + \int_{1+\tau}^{\bar{b}} \left(1+\tau\right) dF(i)$$

$$= w_S A_S + \left[\frac{(1+\tau)^2}{2} - \frac{\underline{b}^2}{2}\right]\frac{1}{\bar{b}-\underline{b}} + (\bar{b}(1+\tau)-(1+\tau)^2)\frac{1}{\bar{b}-\underline{b}}$$

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

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