
4 Value Creation and Trade in 21st Century Manufacturing: What Policies for UK Manufacturing?¹

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1 Introduction: motivation and stylised facts

With the financial sector in the doldrums—losing jobs and deleveraging—not surprisingly government leaders and analysts have turned their attention to other sources of employment and value creation, such as manufacturing. Since the beginning of 2012 there has been a remarkable level of interest in the plight of manufacturing on both sides of the Atlantic, with some calling for more active industrial policies (Sperling 2012, Bruegel 2012.)

Advocates of state intervention often point to innovations in the technology and organisation employed in manufacturing as altering the cost-benefit analysis towards intervention. Translating this into concrete policy measures would imply a marked departure from the relatively arms-length approach adopted by successive UK governments and could alter UK positions towards industrial policy in the European Union and in other international fora.

Some of the recent arguments for intervention amount to ‘old wine in new bottles’; for example, the suggestion that backward linkages matter in innovation and productivity growth (Sperling 2012). Still, enough has changed to merit considering whether 21st century manufacturing requires a fundamentally different approach to government support. The principal purpose of this paper is to tackle this question, drawing out specific implications for UK government policy.

Since policymaking benefits from a coherent framework for thinking through the form, merits, and circumstances associated with successful intervention, this paper goes beyond characterising recent developments to provide a systematic understanding of the causes and consequences of spatial reorganisation of

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manufacturing, the ever-finer slicing up of value chains, the greater use of robotics and so on. The right way to frame policies for UK manufacturing is to take account of all of these developments and not focus on any one dimension, such as international outsourcing and job losses.

In fact, our assessment of where matters stand for UK manufacturing points to important opposing forces associated with innovation and globalisation. On the one hand, fewer barriers to international commerce allow for greater production relocation and technology transfer, which can be seen in negative terms of losses jobs and intellectual property. To the extent that this chase for lower cost production locations and the like can be pursued effectively by many firms, relocation cannot provide the basis for value creation over the longer term.

However, the entrenched productivity and specialisation advantages associated with agglomeration of skills and stages of production—of which the UK and its nearby trading partners in the EU have aplenty—should counter fears that every chunk of value creation is at risk of migrating across open borders. Steps to capitalise on those viscid advantages both within the UK and the EU should influence how the next generation of UK policies are framed.

So as to avoid misunderstanding, it is important to state what this paper is not about. The fact that it focuses on manufacturing does not imply any hidden assumptions about the relative merits of producing ‘things’ over delivering services. Moreover, while the focus here is on technological and organisational choices that are fundamentally affecting contemporary manufacturing, this is not to say that sudden changes in oil prices, other commodity prices, and macroeconomic shocks are irrelevant to the plight of manufacturing in the UK and elsewhere.

There is, for example, growing evidence that the current high levels of oil prices—which in nominal terms are four to five times larger than in the early 1990s when international outsourcing took off—are encouraging some firms to repatriate certain stages of production or to shorten supply chains (Simchi-Levi 2008). Moreover, disappointment with the returns from international outsourcing has grown for a number of reasons and this will no doubt continue to colour the ways in which firms exploit global markets (Economist 2011).

So-called reshoring, however, may have its limits. A recent discussion of reshoring to the United States implied that its relevance was greatest in sectors where transport cost savings were highest and where shortages of first class suppliers and talent were less of a concern (*Financial Times*, 2012). Our findings, then, should be seen in the light of other developments in the global economy.

1.1 Globalisation's two unbundlings

Globalisation is often viewed as driven by the gradual lowering of natural and man-made trade costs. This is a serious misunderstanding. Globalisation leaped forward on the back of two 'connective' technological breakthroughs: transportation and transmission (Baldwin 2006, 2011a).

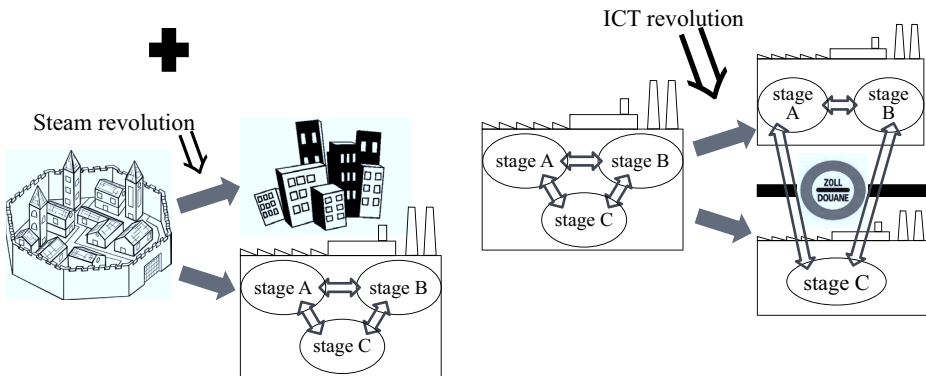
1.1.1 The 1st unbundling: Steam made it possible, scale economies made it profitable

When sailing ships and stage coaches were high-tech, few items could be profitably shipped over anything but the shortest distance. Production and consumption were forcibly bundled geographically so each village made most of what it consumed. The steam revolution changed this.

- Railroads and steamships radically lowered transport costs and made it feasible to spatially separate production and consumption;
- Scale economies and comparative advantage made it profitable to do so.

Nations specialised along comparative advantage lines and international trade boomed. This was globalisation's 1st unbundling (Figure 1 left panel).

Figure 1 Schematic illustration globalisation's two unbundlings



Most economists and policymakers continue to view globalisation through the prism of trade theory that was designed to understand the effects of lower trade costs, i.e. the first unbundling. As a result, many of today's policies towards the business environment are informed by this view – everything from social policy, education policy, and trade policy to global trade rules and practices. One goal of our paper is to push beyond this tendency.

1.1.2 The 2nd unbundling: ICT made it possible, wage differences made it profitable

The 1st unbundling did not make the world flat. Indeed, as production dispersed internationally, it clustered locally (factories). To think through the implications of coordination costs, consider a stylised factory with three production stages (Figure 1). Coordinating the stages requires continuous, two-way flows among the stages of activity, technology, people, training, investment, and information (double-headed arrows). Productivity-enhancing changes keep the process in flux, so the flows never die down.

In this light, the ‘disperse globally but cluster locally’ paradox is easily resolved: i) cheap transport favoured large-scale production, ii) such production is complex, and iii) proximity (factories) lowers the cost of coordinating the complexity. In short, by removing the transport constraint on dispersion, the 1st unbundling brought forward another – the transmission/coordination constraint.

Some coordination costs are related to communications. As telecommunications became cheaper, more reliable, and more widespread from the mid-1980s, the ‘coordination glue’ began to loosen. Telecom advances united soaring computing and transmission capacities with organisational software and the ICT revolution was launched.

The ICT revolution made it technically possible to coordinate complexity at distance. The vast wage differences between advanced and developing nations made separation profitable. This was globalisation’s 2nd unbundling – production stages previously performed in close proximity were dispersed geographically.

But note the phrase “technically possible”. For sure, some coordination costs fell, but difficulties in contracting – which might be called contracting costs – were still important. In fact, many of the concerns that have been articulated with greater force in the past 12 months concerning the profitability of international outsourcing relate to difficulties in enforcing contracts and being unable to prevent malfeasance by counterparties (Economist 2011). Such malfeasance relates to quality of products (defective rates), treatment of staff and sub-contractors, and deliberate under-bidding for contracts. More generally, one needs to take a broader view of ‘distance’ (more on this in Section 5).

Beyond trade: Heightened international mobility of firm-specific technology

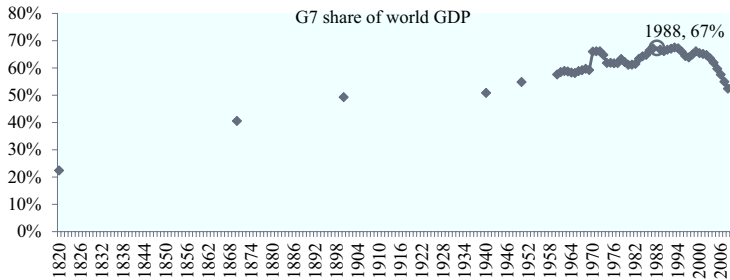
The 2nd unbundling also greatly heightened the cross-border mobility of technology. By allowing better control at distance, the information revolution helped firms from advanced-technology nations combine firm-specific know-how with low-wage labour abroad.

This easing of cross-border technology flows and internationalisation of supply chains opened an ‘industrialisation fast-track’ for poor nations (Baldwin 2011b). In this way, globalisation’s 2nd unbundling produced spectacular growth in

emerging markets, reversing many decades of growing income gaps between developed and developing nations.

After rising for a century and a half, the G7's share of world income peaked in 1988 (Figure 2). The 2nd unbundling reversed remarkably quickly. By 2010, the G7's share is down to half and falling quickly.

Figure 2 G7's global income and output share declined after the 2nd unbundling



Source: World Databank from 1960; Maddison pre-1960; pre-1960, G7=W. Europe, US, Canada, Australia and New Zealand.

While growth is not a zero sum game, Figure 2 reminds us that policies that encouraged industrial activity in high-wage nations had the winds of global change at their back before the 2nd unbundling; now they face headwinds.

Trade in technology is not like trade in goods

Importantly, cross-border technology flows cannot be thought of in the same way as trade in goods. The basic approaches of comparative advantage and its handmaiden – gains from trade – do not necessary work when technology can cross borders.

The contrast between free trade in goods and free trade in technology can be illustrated with an analogy. Allowing trade in goods is like allowing cricket teams to exchange players – a reform that will almost surely make both teams better if each freely agrees to the deal. Transferring technology, however, is like the better team training their opponents’ batsman. The resulting game will surely be at a higher level, but it is not clear that both teams benefit.

As will become clear later, these observations are not just of theoretical importance—for they raise questions as to whether governments should be encouraging (directly or indirectly) the development of appropriable technologies that can be transferred across borders. Or put another way, should government support for innovation be confined to initiatives that are viscid or sticky, that is, the benefits of which cannot be transferred abroad or for which the parties concerned have no incentive to effect such transfers?

1.2 Organisation of the remainder of this study

The rest of the chapter is organised into two broad parts and a conclusion. Part 1 draws out a first round of implications concerning the transformation in manufacturing for the location and extent of value added and employment. In doing so, the elements of the second unbundling are described. Part 2 seeks to reorient thinking about manufacturing and associated policymaking in the light of the second unbundling, principally by arguing that some commonly held post-war insights need to be modified. The concluding section draws together the policy implications of this study.

PART 1: THE TRANSFORMATION OF MANUFACTURING VALUE ADDED AND JOBS

2 Value chains and valued jobs

Until the 1990s one rarely heard of value chains outside of business schools and consultancies. Value-chain discussions seemed irrelevant to national-level policy making. Government policy might have a sectoral dimension but not a value-chain dimension. This has changed.

Globalisation's 2nd unbundling made globalisation's impact more granular – shifting it from sectors to stages of production. This change requires an analytic focus on value chains. Before turning to an overview of value-chain economics, we present basic facts on value-chain trade.

2.1 A snapshot of supply-chain trade

Directly measuring trade within value chains is difficult since existing statistical categories were designed to quantify the 1st unbundling. One proxy for supply-chain trade has been developed by Amador and Cabral (2006); its evolution by region and by sector is shown in Figure 3 and Figure 4.

These charts show that supply-chain trade did not start with the 2nd unbundling. However, before the ICT revolution, most of the international sourcing was done among mature economies, e.g. US and Canada in the auto industry, or intra-EU trade in machinery. Figure 3 shows that starting in the late 1970s, Asia's participation started to boom, with a sudden take-off timed with the ICT revolution around 1990. By the late 1990s, Asia's supply-chain trade surpassed that of the north Atlantic economies combined.

Figure 4 shows that this '21st century trade' is concentrated in relatively few sectors. Electrical machinery and electronics take the lion's share of the level and the growth in the 1990s.

Figure 3 Regional measures of supply-chain trade, 1967-2004

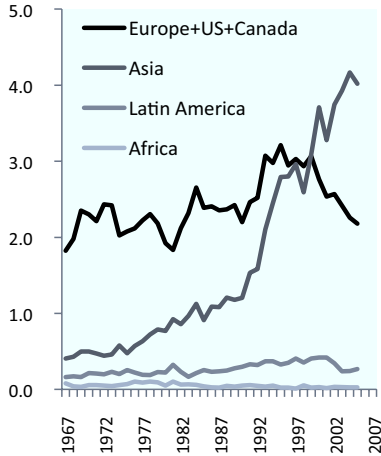
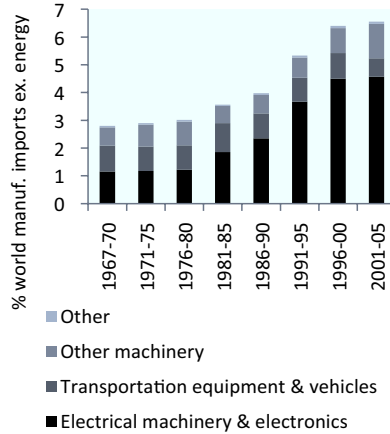


Figure 4 Sector measures of supply-chain trade, 1967-2004



Notes: This measure identifies products where nations are exporting and importing extraordinarily much – say the UK imports and exports lots of chemical products compared to world trade patterns. First-unbundling thinking would lead to the contradictory conclusion that the UK has a comparative advantage in chemical (extraordinarily large exports relative to other nations) and a comparative disadvantage in chemicals (extraordinarily large imports relative to other nations). Such overlap, however, is a standard implication of trade flows across an international supply chain. Thus measuring such trade flows provides an indirect measure of supply-chain trade by country for all products, and by product for all countries.

Another proxy for supply-chain trade uses input-output matrices to identify which goods are inputs in a particular supply chain and then uses standard trade data to measure the supply chain trade.² Gonzales (2012) uses this method to estimate the share of a nation’s exports made up of value added from intermediate inputs from its trade partners. For example, about 0.6% of the gross value of UK exports consists of intermediate inputs from Japan, while only 0.1% of Japanese exports consist of British intermediate inputs.

Figure 5 shows the matrix of these ‘backward linkages’ – backward in this sense that the nation is importing in order to export. The numbers reveals stark asymmetries in the global supply-chain trade.

- There are ‘headquarter’ economies (whose exports contain relatively little imported intermediates) and ‘factory economies’ (whose exports contain a large share of imported intermediates).

The bottom row of the table shows the column sums and thus each nation’s overall dependence on intermediates from the listed nations. Japan and Germany have quite low shares, but all the advanced technology nations have shares under 20%; the figures for Indonesian and Brazil are low since they are important exporters of natural resources that use few intermediates.

² See Hummels, Ishii and Yi (1999), Johnson and Noguera (2011), Koopman, Wang, and Wei (2008), and González (2012).

- The global supply chain is really not very global – it's regional.

Most of the large numbers – which indicate a strong supply-chain relationship – are in the regional blocks.

- There is a hub-and-spoke asymmetry in the dependence of factory economies on headquarter economy's intermediate exports.

For example the US column shows small dependency on imports from Canada and Mexico, but the Mexican and Canadian columns show strong dependence on the US and very little dependency on each other. The same can be seen in Factory Asia where Japan is the technology leader, although the asymmetries are far less stark than they are in NAFTA. Germany is the hub in Factory Europe, but the asymmetry is not nearly as marked as it is in Asian and North America.

Figure 5 Backward linkage matrix for major supply-chain traders, 2007

	US	Canada	Mexico	Japan	China	India	Indonesia	Korea	Germany	UK	Italy	France	Spain	Poland	Portugal	Brazil
US		18%	37%	1%	2%	2%	3%	3%	1%	2%	1%	2%	2%	1%	1%	5%
Canada	4%		2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mexico	2%	1%		0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	1%
Japan	1%	1%	5%		5%	1%	5%	6%	1%	1%	0%	1%	1%	1%	1%	1%
China	3%	3%	9%	2%		5%	6%	7%	2%	2%	2%	2%	3%	3%	1%	3%
India	0%	0%	0%	0%	1%		1%	1%	0%	0%	0%	0%	0%	0%	0%	1%
Indonesia	0%	0%	0%	2%	1%	1%		1%	0%	0%	0%	0%	0%	0%	0%	0%
Korea	1%	0%	4%	1%	4%	1%	2%		0%	0%	0%	0%	1%	1%	0%	1%
Germany	1%	1%	3%	0%	1%	2%	2%	1%		4%	5%	5%	7%	12%	7%	2%
UK	1%	1%	1%	0%	0%	1%	0%	0%	2%		1%	2%	2%	1%	2%	1%
Italy	0%	0%	1%	0%	0%	1%	1%	0%	1%	1%		3%	4%	3%	3%	1%
France	0%	0%	1%	0%	0%	0%	1%	0%	2%	2%	3%		5%	2%	4%	1%
Spain	0%	0%	1%	0%	0%	0%	0%	0%	1%	1%	1%	2%		1%	15%	0%
Poland	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%		0%	0%
Portugal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%		0%
Brazil	0%	0%	1%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%
Total	15%	27%	65%	8%	16%	16%	20%	21%	11%	13%	16%	17%	29%	26%	35%	16%

Source: Authors computations based on data in Gonzales (2012).

Notes: The columns show the intermediate inputs intensity from each row nation, e.g. 5% of the gross value of China's exports consist of intermediates bought from Japan, while 2% of Japan's gross exports consist of intermediates bought from China.

2.1.1 UK manufacturing trade and value chains: Where do matters stand?

Additional evidence comes from two recent competitiveness studies.³ What is useful for our purposes is that one looks at manufacturing performance through

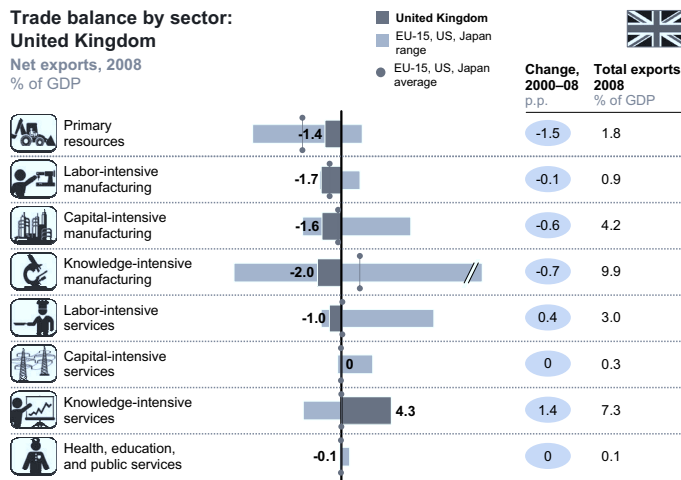
³ While these studies discuss UK performance, both have wider country coverage. McKinsey (2012) focuses on the first 15 members of the European Union, Japan, and the United States. Timmer et al (2012) considers both the largest industrialised countries—often taking the EU as a separate unit—and several large emerging markets.

the lens of the 1st unbundling (McKinsey 2012) and the second focuses on value creation within production processes that are dispersed internationally, thereby taking account of the fact that a nation's manufacturers and service sector firms can add value at different stages (Timmer et al 2012). The second study, therefore, sees the world through the prism of the 2nd unbundling.

Traditional analyses of the relative performance of national manufacturing tend to emphasise this sector's share of world markets, the growth of total export revenues, national and sector trade balances, and measures of revealed comparative advantage. Of course, industrialised countries sell resources, agricultural products, and services, so an overall view of a nation's trading position examines developments in these sectors too. One such analysis has recently been conducted by McKinsey (2012).

Unlike most of its industrial country trading partners, the UK has a smaller deficit on primary resources, thanks to North Sea oil (Figure 6). This is important as McKinsey show that in recent years the expansion of trade deficits of many industrialised countries is in primary goods (reflecting higher commodity prices since 2000) and not manufacturing. In contrast, the UK runs a deficit in knowledge intensive manufacturing while on average its industrial country trading partners run a surplus.⁴ Knowledge intensive services are a source of trade surplus in, although not large enough to offset the combined trade deficit in manufacturing.

Figure 6 UK's trade balance, services primary resources & manufacturing

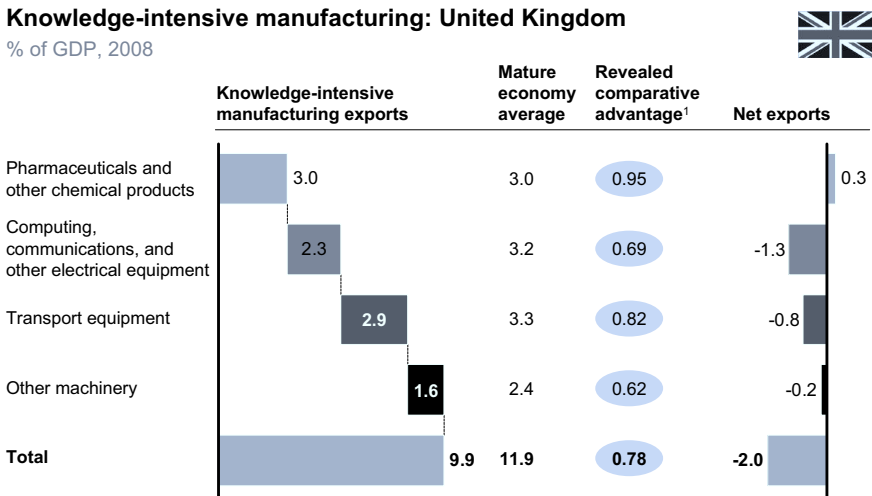


Source: McKinsey (2012), page 44.

⁴ Note, however, the substantial variation in the trade surpluses and deficits of industrialised countries in knowledge-intensive manufacturing. The UK is joined by the US and Southern Europe in this regard. Japan and 'continental Europe' are found to have run large surpluses on knowledge intensive manufacturing (McKinsey 2012, page 11 Exhibit 5).

Narrowing the focus to knowledge-intensive manufacturing, with the exception of pharmaceuticals and other chemicals the UK underperforms on a number of metrics (see Figure 7). In no subsector of UK knowledge-intensive manufacturing is its size larger than the average of industrial country peers. Nor does any UK subsector have a revealed comparative advantage above one. Only in pharmaceuticals and other chemicals subsector does the UK run a trade surplus.

Figure 7 Focus on knowledge intensive manufacturing



Notes: 1 Defined as the share of a country’s exports in a certain sector compared with the share that sector has in our 17-country sample. Numbers may not sum due to rounding.

Source: McKinsey (2012), page 44.

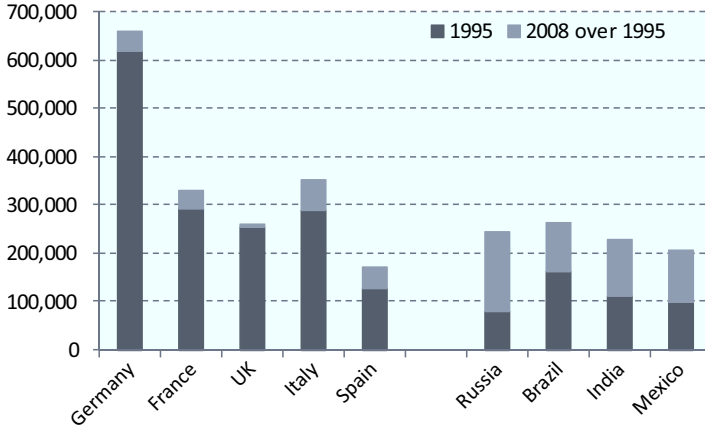
From gross sales to value added

Moving from a sectoral perspective (whereby gross value added, revenues, trade, and employment are assessed without taking account of purchases to and from other sectors in the economy) to a value chain perspective (where the focus is on the value created at each stage of commercial process within a nation) provides a slightly different view. For sure, there is still some bad news. Figure 8 shows that the value added created in the UK in 2008 was barely above that of 1995, once inflation is stripped away. Meanwhile, Germany, France, Italy, and Spain created more value over time, so much so that by 2008 Italy and France have opened up substantial leads over the UK. Moreover, by 2008 Brazil, India, and Russia had almost caught up in terms of total income generated in value chains.

The UK also stands out in terms of the different sources of income generated in international value chains. Increases in the value created can come from scaling up employment, improved labour productivity, or exchange rate revaluation effects. Figure 9 shows that the UK is unusual in that the number of employees that contribute to international value chains has fallen so much that the effect of

productivity gains on total value added is almost entirely offset by employment losses.

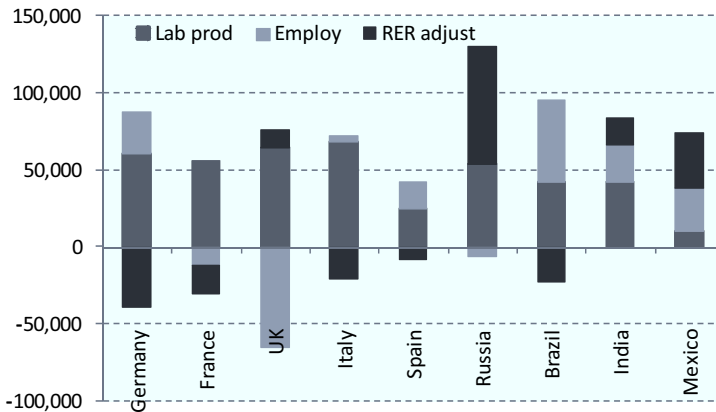
Figure 8 Income in UK value chains



Source: Timmer et al (2012) Figure 7, page 29. Notes: Vertical axis represents gross value created by a nation in international production chains, measured in millions of constant 1995 US dollars.

While total employment in manufacturing has been falling for every industrialised country (Figure 18), the total number of employees contributing to international value chains (which includes employees in service sectors) has actually risen in Germany, Italy, and Spain. The UK is joined by France, the US, and Japan (the latter two not shown in Figure 5) in employing fewer persons to contribute to international value chains. These differences show that the development of international value chains can be associated with higher—not lower—employment levels.

Figure 9 Decomposition of value added in manufacturing: UK compared



Source: Timmer et al (2012) Figure 10, page 33. Notes : Vertical axis provides the decomposition of change between 1998 and 2005 in gross value added in manufacturing supply chains into three sources: changes in labour productivity, changes in employment, and changes in real exchange rates. Data reported in millions of constant 1995 US dollars.

This has important implications for framing policymakers' expectations about the sources of jobs in the decades to come. Although there are good reasons to believe employment in manufacturing is unlikely to regain its previous levels, this does not imply that the number of employees contributing to international value chains will necessarily fall over time.

British participation in international value chains

Turning back to the linkages data presented in Figure 5 and focusing on the British situation specifically, Figure 10 shows the backward linkages for Britain and its major partners. (Recall that backward linkage, in this content, means 'importing to export', i.e. the share of one dollar of UK exports that are made up of imported intermediates from a particular partner.)

Figure 10 Backward linkages: Focus on Britain



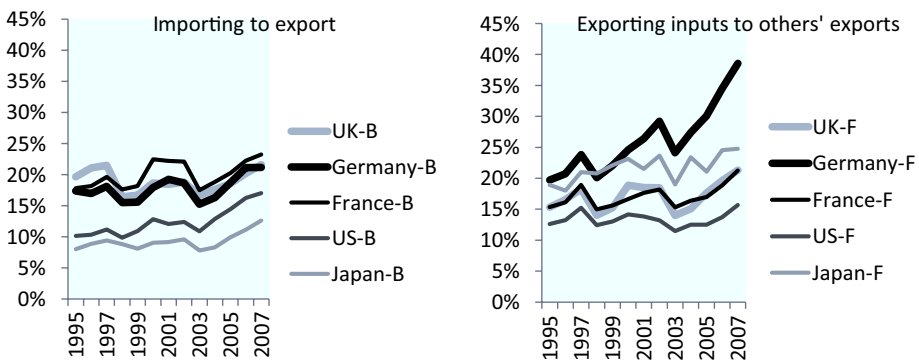
The top bars of Figure 10 show the value share of the listed nation's intermediates in a dollar of UK exports. Britain's most important suppliers are Germany, France, Netherlands, Italy and Norway. The bottom bars show the reverse – the share of the partner's exports made up of British intermediates. The numbers shows that Britain's partners are systematically more dependent of British intermediates than vice versa (with the exception of Germany). This great dependency on UK intermediates is by Ireland, Israel, South Africa, and Netherlands.

Another important perspective it is compare changes in Britain's participation in international supply chains with that of other major industrial nations (Figure 11). The left panel show the evolution of Britain's import-to-export tendency. Here we see that the UK has not experience the backward internationalisation that Japan and especially the US have lived through in the past decades. The share of imported intermediates in British exports has fluctuated but not clearly trended upwards. Importantly, the UK's share tracks that of Germany and France very closely. The other chart, however, tells a different tale.

The right panel of Figure 11 shows the share of the listed nation’s exports that are used in the exports of other nations – basically the share of the nation’s exports that are to an internationalised supply chain. Here we see that Germany has clearly broken away from the pack. The take away message is that the UK’s participation in international supply chains is very much like Germany’s when it comes to sourcing inputs, but Britain is far behind in selling to supply chains in other nations. Note that the Gonzalez numbers behind the charts ignore services’ role in selling to and buying from international supply chains due to a lack of data.

This is a set of facts that probably merits closer study.

Figure 11 Britain’s buying from and selling to international supply chains



Source: Data from Gonzales (2012).

Summary

Whether seen, then, through the lens of the first or second unbundling, the relative performance of UK manufacturing on certain key metrics is found wanting. Before jumping to conclusions, however, it is worth recalling that the manufacturing sector is not the only sector in the economy and that government policy ought to reflect these broader considerations. Indeed, given that international value chains draw upon services and raw materials as well as manufacturing, this is another reason why a solely sector-based approach stands at odds with the realities of 21st century commerce.

2.2 A primer on value-chain economics

There is nothing original in the principles of value-chain economics; the only difference is the subject of study. Until very recently, few economists or government officials cared about value chains. Before turning to the economics, it is worth setting out the traditional thinking on why value chains didn’t matter for policy making.

2.2.1 *Good jobs before globalisation's 2nd unbundling*

When stages of production are bundled in a single factor or within a single nation, workers generally got paid the value of their marginal contribution. Competition would not allow any stage in the value chain to pay over-the-odds wages or charge a price much above costs. There was thus little reason for policy makers to worry about where the nation's workers are located along the value chain.

Of course different stages involved workers with different educational attainments, skill levels, and individual productivities and thus paid different wages. In this sense there were good jobs and better jobs, but the stage of production was not the key – skill was.

In this first-unbundling world, governments could improve the economic fortunes of their workers only by boosted productivity with policy initiatives such as training, education, R&D, infrastructure, product and factor market efficiency.

Such policies are still very much at the heart of most nations' competitiveness policies, and rightfully so. Unhindered market forces tend to find appropriate jobs for workers, so nations that managed to upgrade skills have better outcomes – higher average wages and more of the workforce in 'good' jobs.

The other standard way of improving a nation's wellbeing was to open borders. The best way to think of this is in terms of 'artificial' scarcity. A closed economy with a predominately highly skilled workforce is an economy where low-skilled workers are artificially scarce (and over paid) and high-skilled workers artificially over-abundant (and under paid). Opening to global markets corrects this pricing since the demand for the two types of labour is no longer artificially determined by national factors. There will be winners and losers from opening, but the winners win more than the losers lose. If the government has in place burden and benefit sharing arrangements (such as social welfare nets, free education, re-training schemes, unemployment benefits, progressive taxation.), openness policies can garner a national consensus since they enlarge the size of the cake.⁵ The logic behind open-market policies remains unchanged by the fact that globalisation is now affecting economies at the level of stages rather than sectors.

The point here is that nothing about value chains challenges the wisdom of opening markets and upgrading skills. The tried-and-true competitiveness policies are valid independently of value-chain considerations.

⁵ When the economy opens up to trade, allowing market forces to determine the employment pattern is generally the optimal policy. Or more precisely, protecting uncompetitive bundles/sectors was a sure way to boost the share of workers in uncompetitive industries. Moreover, such protection is equivalent to negative wage premiums (when output is valued at the nation's true opportunity cost, namely international prices, not tariff-inflated domestic prices).

2.2.2 Value chain unbundling: The TOSP framework

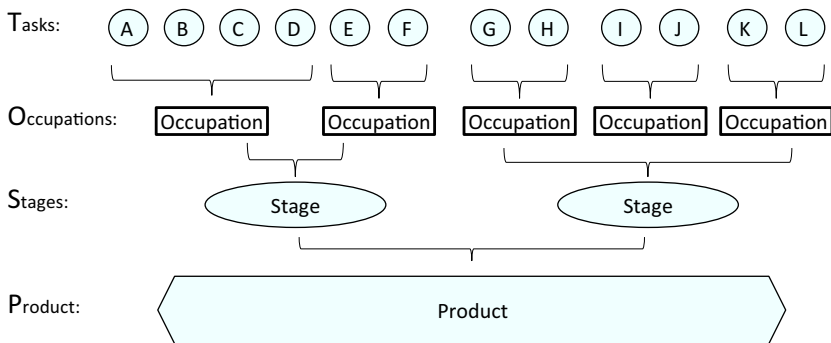
Supply chains are a familiar concept. Laptops require hard drives which require electric motors which require magnets. The supply chain is the sequence of facilities that provide these inputs. The value chain is a broader concept popularised by Michael Porter just as the 2nd unbundling took off (Porter 1985). A value chain is a supply chain with pre- and post-fabrication stages added along with any related ‘support’ activities (human resource management, accountancy services, etc.).

The economics of unbundling is best presented into two parts:

- Functional unbundling (fractionalisation); and
- Geographic unbundling (dispersion).

Standard economics ignores value chains by working with black-box production functions where workers and materials march into a factory; final goods march out. Addressing production unbundling and its determinants therefore requires greater granularity activities and organisation inside the factory. Four levels of aggregation are useful: tasks, occupations, stages and product (Figure 12).

Figure 12 The TOSP framework: Tasks, occupations, stages and product



At the bottom is the product, which is conceived of as including after sales services. At the top are tasks – the full list of everything that must be done to get the product into consumers’ hands and provide them with associated after-sales services. Two natural, policy-relevant intermediate aggregations are ‘occupations’, i.e. the set of tasks performed by individual workers, and ‘stages’, i.e. a collection of occupations that are performed in close proximity due to the need for face-to-face interaction, fragility of the partially processed goods, and so on.

Stages are pivotal to the study of unbundling since supply chain internationalisation typically involves the offshoring of stages rather than individual occupations or individual tasks.

2.2.3 *The economics of functional unbundling*

Functional unbundling turns on the determinants of a) the equilibrium tasks per occupation; and b) the equilibrium occupations per stage. The basic trade-off in both is specialisation versus coordination/transportation.

- At the occupation level, specialisation pays, as Adam Smith explained so well with his pin factory case-study. The sources of such gains include, among others, classic scale economies, task-specific training, and learning-by-doing.
- The downside of specialisation is the difficulty of coordinating the whole process – the too-many-cooks-in-the-kitchen problem.

At the stage level, coordination is also important, but transportation plays more important role. As fabrication progresses workers must move to the partially completed product, or vice versa. Such issues determine the range of occupations in each stage of production. Indeed as we are defining stages as the lowest level that can be spatially separated, a stage is defined by the states where the partially completed product could economically be transported within or between factories.

By making coordination cheaper and more reliable, the ICT revolution massively shifted the balance of this specialisation-gain-versus-coordination-cost compromise in favour of specialisation. Advances in transportation and logistics similarly favoured greater fractionalisation.

ICT's effect, however, is not one-dimensional (Bloom et al 2006). Some ICT improvements reduce the benefits of specialisation; others reduce the cost of specialisation.

ICT: Coordination technology versus information technology

Bloom et al (2006) stress the two faces of ICT:

- Communication and organisational technology – call it coordination technology for short – facilitates transmission of ideas, instructions and information.

Good coordination technology favours the unbundling.

- Information technology makes it easier for individual workers to master more tasks.

Good information technology reduces the benefits of specialisation. This happens in several ways. Computerising tasks and embedding them in machinery is one. Numerically controlled machines, robots, computer-aided manufacturing, etc. embed information in capital in a way that allows a single worker to perform a wider range of tasks. Task that used to be done by a team of specialised workers can be done by a single worker operating the machine.

In short, better coordination technology reduces the cost of specialisation and thus fosters functional unbundling. Better information technology reduces the benefits of specialisation and thus disfavours functional unbundling; it also fundamentally altering occupations (more on this below).

2.2.4 The economics of geographical unbundling

The next question is where stage should be located. The mainstream framework for studying the impact of market size on industrial location is the New Economic Geography (NEG) literature launched by Paul Krugman in the 1990s (e.g. Krugman 1991, Fujita, Krugman and Venables 1999). The New Economic Geography perspective views the locational outcome as balancing dispersion forces and agglomeration forces.

Dispersion forces

Dispersion forces favour the geographic dispersion of stages; two are pertinent here: wage gaps and firm-level excellence. Wages gaps determine ‘vertical specialisation’; firm-level specialisation and excellence determine ‘horizontal specialisation’.

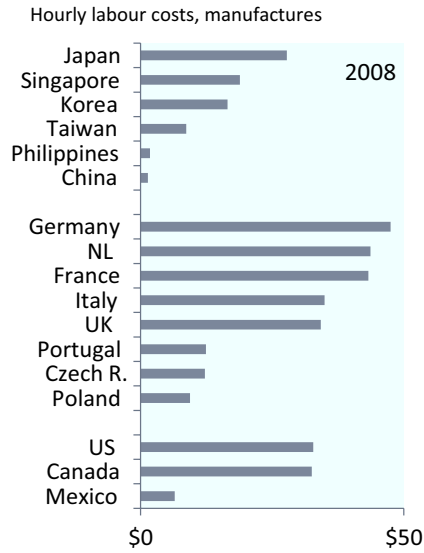
Two wage gaps matter: low-skilled and high-skilled. ‘Headquarter economies’, such as the UK, have sent labour-intensive stages to nearby low-wage neighbours – what might be called ‘factory economies’ (Figure 13). High-skill labour, however, remains relative abundant and thus relative cheap in headquarter economies (Figure 14).

Wages gaps are not the only motive for supply chain internationalisation. International supply chains existed among high-wage economies long before the second unbundling (Figure 3). The dispersion here is driven by a much more micro gain from specialisation.

For example, when it comes to automobile air conditions, the French company Valeo dominates the European market through excellence – not low wages. While each European carmaker could make their air conditioners, scale economies mean that it is cheaper for Italian and German automakers to source them from France. Given the systemic importance of learning-by-doing and the growing role of scale economies in an ever more fractionalised supply chain, it is natural that regional champions will emerge in particular parts and components.

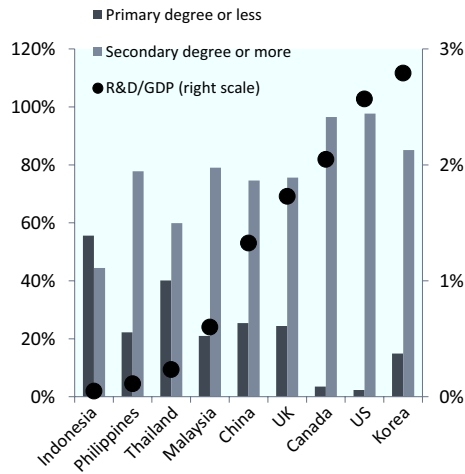
This firm-level excellence is the key to the ‘horizontal’ internationalisation of value chains among high-wage nations that is so important to Britain (Figure 10)

Figure 13 Wage differences in Factory Asia, Factory North American and Factory Europe



Source: US Bureau of Labor Statistics, International Labor Comparisons.

Figure 14 Education and R&D: ASEANs, China, Korea, US, Japan and Canada, 2005



Source: World Databank online.

Agglomeration forces

Agglomeration forces encourage spatial clustering and there are many. Some operate on a very local scale – labour market pooling and knowledge spillovers for example. While critical for understanding urban and regional outcomes, these are too local to provide much explanatory leverage for why globalisation's 2nd unbundling is global. The key agglomeration forces for this are supply-linkages and demand-linkages.^{6,7}

- Demand-linkages turn on market-size.

If an economy already enjoys the presence of great deal of economic activity (GDP), then doing business there will – all else equal – be attractive to firms who benefit from being near customers. As this attraction draws more firms and more economic activity, demand-linkages have a self-fulfilling nature that has important policy implications (more on this below). A rough measure of this agglomeration force is the size of demand.

Britain is well placed when it comes to proximity to demand; Europe accounts for 30% of world income and spending, and Europe's demand more spatially concentrated than that of the US. Moreover, Britain is close to the US's east coast demand mass. Both points are especially noteworthy in light of recent thinking that views economic 'distance' as involving much more than cartography (more on this in Section 6).

- Supply-linked circular causality rests on cost-of-inputs.

Firms source intermediate inputs from other firms, so the presence of many firms is attractive to new firms from the input-cost perspective. Again Britain is well placed geographically.

2.2.5 Trade costs and hump-shaped agglomeration

The preferred location of industry balances agglomeration and dispersion forces. Extreme solutions are occasionally observed, but interior solutions are the more common outcome.

Improvements in 'connective technology' have non-linear effects on agglomeration. Lower communication and trade costs makes distance less of an issue and thus weaken both agglomeration and dispersion forces. If the agglomeration forces weaken more than the dispersion forces, clustering weakens. Clustering get more pronounced if the reverse holds.

This is why clustering tends to follow a 'hump shaped' pattern as connective technologies improve. When trade is highly restricted, it is very unprofitable

⁶ Called forward and backward linkages by 20th century writers such as Albert Hirschman.

⁷ Generally speaking, demand-links operate on an economy-wide basis, while supply-links operate more on a sectoral basis. The reason is that a clustering of firms means a clustering of workers and thus a clustering of purchasing power. However, the purchasing power tends to get spent on the whole range of goods.

for firms in one region to sell to other regions; each region makes their own. At the other extreme of perfectly costless trade, location region is immaterial. For intermediate trade costs clustering matters since it is both possible and rewarding.

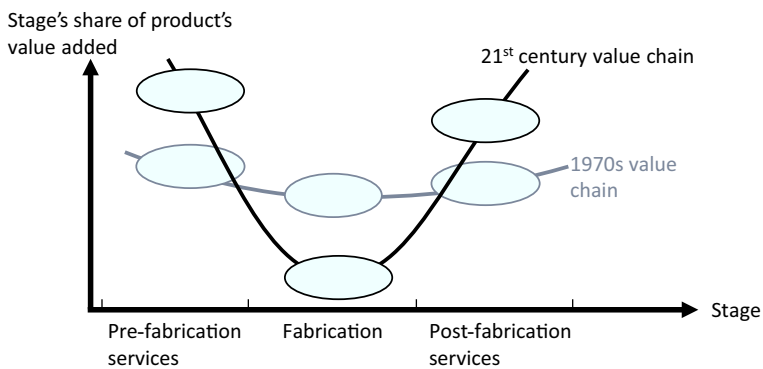
This widely known feature of the New Economic Geography logic explains why lower trade costs are good for clustering at first but bad beyond some threshold. This explains how globalisation's first and second unbundlings could have diametrically opposed effects on agglomeration of industry and overall economic activity of the type that drove the rise and fall of the G7's global income share (Figure 2; see Krugman and Venables 1995 for the original presentation).

2.3 Smile curve economics

Until the 2nd unbundling, globalisation's main impact was at the level of sectors. Globalisation's 2nd unbundling – and the attendant offshoring – changed this. As it turns out, some stages in the value chain provide better jobs than others; governments need to understand why and how. This section explores and explains why value-added shares have shifted along value chain thus turning some formerly 'good' jobs into 'bad' jobs.

One highly visible aspect of the 2nd unbundling is offshoring. As it turned out, some stages moved abroad; others did not. Curiously, value added along the value chain seemed to have shifted away from the offshored stages. (See Box 1 for the simple economics that determine value-added per stage.). This observation is known as the 'smile curve', which shows value added per stage starting from R&D and moving right down to final sales and after-sales services.

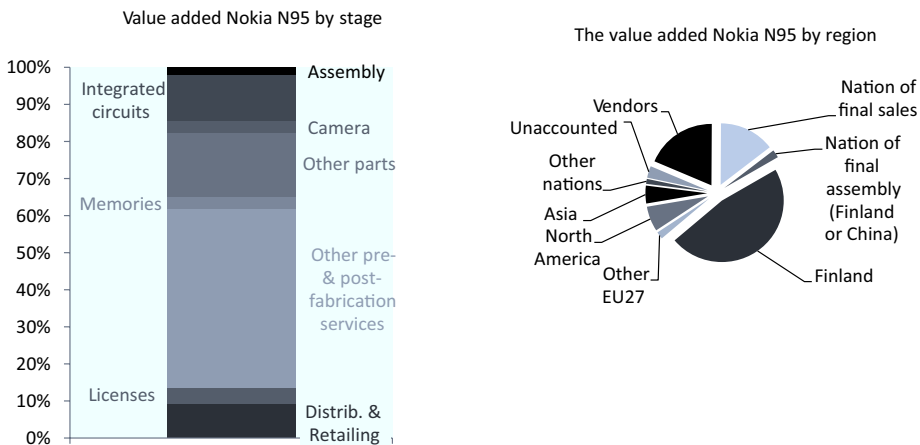
Figure 15 The smile curve: Good and bad stages in the value chain



The standard assertion is that the smile curve has gone from flat (goods jobs all along the chain) to U-shaped, with fabrication stages – especially final assembly – now received much lower shares of value than in the 1970s.

The allocation of value added along a value chain can be seen in the decomposition of the total value-added of Nokia's N95 phone (see Ali-Yrkkö et al 2011 for details and further analysis). Figure 16 shows the value break down by stage. Although the phone is mostly 'made' in Asia, most of the value added accrues in Europe. The total value added in Europe depends on where the phone is sold (retail margin) and assembled (China or Finland). In the worst of cases – an N95 assembled in China and sold in the US – more than half the value added is in Europe; the high end figure is 68%.

Figure 16 Breakdown of the phone's €546 pre-tax retail price circa 2007



Source: Ali-Yrkkö et al (2011)

2.3.1 Why did the smile deepen?

There is surprisingly little empirical research on this question, in part because there is so little systematic detail on value added per stage. Simple economics, however, suggests an obvious explanation based on cost accounting. As Box 1 shows, a stage's value added depends upon the payments to factors and the price-cost mark-up. When a stage's cost is reduced by offshoring, its share in value added automatically falls – even if the cost saving is fully passed on to final consumers.⁸

This basic cost-accounting effect can be amplified by:

- Relative market power.

Offshored stages tend to be things that can be done in many low-wage nations. The non-offshored jobs tend to involve stages where firms naturally have market power due to product differentiation, branding, etc. In short, offshored stages became commoditised; the onshore stages did not.

⁸ Say the stage-cost falls by 20% but given its importance in production, the final price falls only 2%. For the stage concerned, the numerator of its stage-to-total value-added ratio falls ten times more than the denominator.

- Internationally mobile technology.

If the offshoring firm moves its advanced technology to the offshore location, it drives down the cost of the offshored task even further. As before, this automatically shifts value shares towards the non-offshored stages.

Box 1 Analytical framework: Linking value added per stage to observables

To understand the smile curve phenomenon and think clearly about what it means for policy, it is convenient to have an analytic framework linking value-added per stage to observables. When it comes to value chains, the first question is to ask is: How is it possible for a nation's position in the value chain matters?

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

$$\text{Value Added} = \text{Price} \times \text{Output} - (\text{Per-unit cost of intermediates}) \times \text{Output}$$

This definition is rather uninformative on its own. If it is to help us organising our thinking, we need to connect it to things that might be subject to policies. The first step is to relate the price to the costs of capital, labour and other primary factors, intermediate costs, and the mark-up, namely:

$$\text{Price} = \text{Per-unit factor payments} + \text{Per-unit cost of intermediate inputs} + \text{mark-up}$$

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

$$\text{Value Added} = (\text{Per-unit factor payments} + \text{mark-up}) \times \text{Output}$$

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

$$\text{Value Added/Output} = \text{Per-unit factor payments} + \text{mark-up}$$

This is a workable starting point. It tells us: value-added at each 'link' in the chain consists of factor payments and profits, and the only way to boost value-added per unit in a given link is to boost factor payments or the profit margin.

Many policy concerns surrounding the chain value issue are ultimately about jobs – good jobs in particular. It is thus also useful to look at value added per worker. The output per worker varies radically across different production stages, but for any given stage it is reasonable to take output as proportional to output, namely:

Output = $\gamma_i L$

where γ_i is the factor of proportionality for any given stage i (this is proportional to stage-level labour productivity). With this, the value-added per worker is:

Value Added/Worker = γ_i (Per-unit factor payments + mark-up)

This complementary starting point tells us: value-added per worker depends on:
i) workers' productivity – note that an increase in γ_i means each worker produces more – ii) factor payments, and iii) profit margins;

Importantly, value-added per worker does not correspond to payment per worker – that would be wages – but using the value-added per job is a common way of evaluating the worthiness of various stages of the value chain.

3 Manufacturing as a source of jobs: The new landscape of work

The golden age of European growth – roughly 1950 to 1973 – deserves the nostalgia it elicits. In 1950, a fifth of Europeans worked on farms, incomes were low, and little of the modern welfare state existed. By the first oil shock, mass consumerism and middle-class affluence had transformed European societies. National social models and Keynesianism transformed governments' role, and rural to urban migration transformed the economic geography.

This golden age – what the French call 'les trente glorieuses' – was closely associated with the rise of manufacturing. Industrial output rose faster than national incomes and industrial exports grew faster than either. Industrial productivity growth was the jet fuel driving all this. Little wonder many of today's pundits, labour unions, and governments get misty-eyed when thinking about the 'return' of good manufacturing jobs. It worked for the post-war generation, why couldn't it work for the post-Crisis generation? The facts suggest otherwise.

British manufacturing output has been growing steadily (Figure 17) even as it loses global market share (Figure 18). But it is no longer the charioteer of growth and prosperity – certainly not of jobs. Today, only about one in ten Britons works in manufacturing and the number has declined almost every year since 1973.

Figure 17 Manufacturing output, main producers, 1970-2010

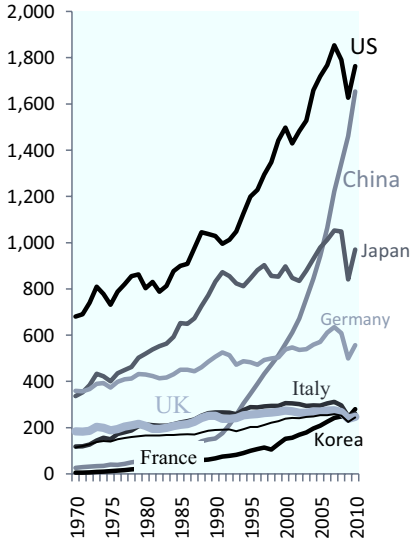
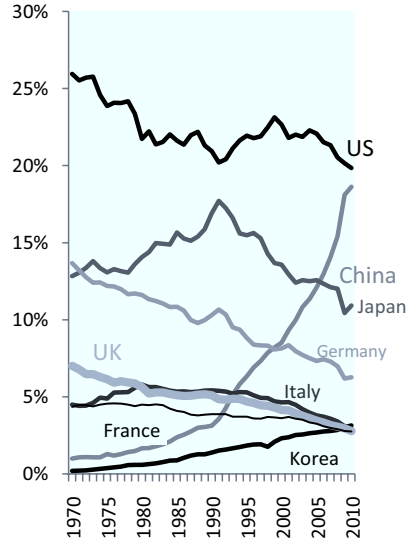


Figure 18 Shares of global manufacturing GDP shares, 1970-2010



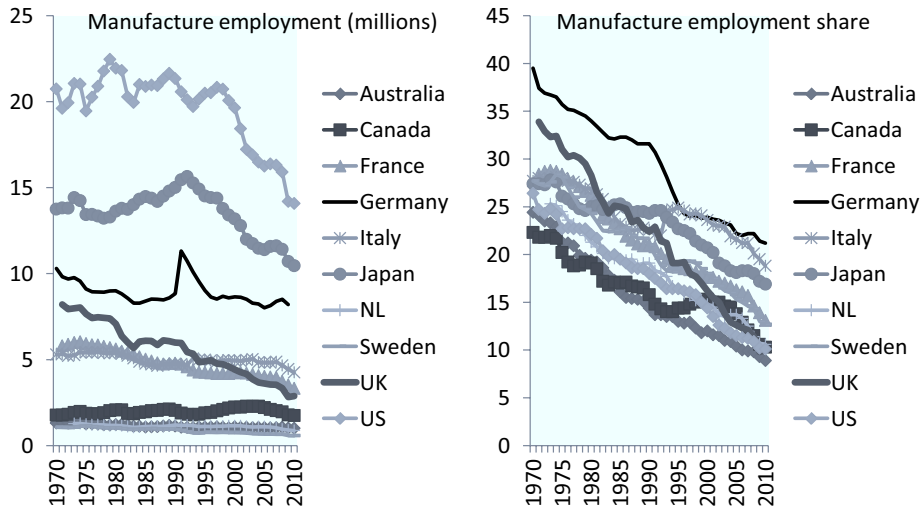
Source: UN Data.

This is part of a trend shared by all the nations we used to refer to as industrialised nations.

- The absolute number of manufacturing jobs has fallen in every developed economy since globalisation's 2nd unbundling, say 1990 (Figure 19 left panel).
- Manufacturing's share of these nations' employment has been falling for even longer (Figure 19 right panel).

The charts show that Britain's experience is middle-of-the-road, although its share of workers in manufacturing declined faster than other major European nations.

Figure 19 Number and share of employment in manufacturing, rich nations, 1970-2010



Source: US Bureaus of Labor Statistics online data.

Globalisation has been only part of the reason for this relative de-industrialisation. Debande (2006) notes that de-industrialisation is driven by several 'internal' factors as well. First is the shift in expenditure shares away from manufactured goods and towards non-traded services (health, medical, leisure, etc.). Being non-traded, prices and wages adjust until enough local labour is pulled into these sectors to meet local demand. Given that there is so little labour left in agriculture, the shift to services necessarily comes at the expense of industry. Second is the productivity 'paradox'. Rapid productivity growth reduces the number of workers necessary to produce any given output. This is how UK manufacturing output rises as employment falls. Third is the external factor – basically competition from low-wage nations for unskilled manufacturing jobs. This competition comes either via market competition or directly via offshoring.

Two studies, Rowthorn and Ramaswamy (1998), and Rowthorn and Coutts (2004), decompose the decline in industry's share of employment into internal and external factors. For the 1970–1994 period (i.e. before the brief 'new economy' years), they estimate that more than 80% of the deindustrialisation was due to internal factors in the US and the EU and 90% in Japan. After globalisation's second unbundling, i.e. post-1994, they find that external factors are much more important in all three regions. Boulhol (2004) confirms these findings.

3.1 The changing landscape of manufacturing work

The catch-all ‘productivity effect’ hides important technological developments that are reshape the landscape of work in the manufacturing sector. The information revolution introduced a tectonic shift in manufacturing called Computer Integrated Manufacturing (CIM), Computer Aided Design/Computer Aided Manufacturing (CAD/CAM), or sometimes ‘advanced manufacturing’. It started with numerically controlled machine tools in the 1950s, but today many factories can be thought of as computer systems where the peripherals are not printers and hard drives but rather industrial robots, computerised machine tools, automated guided vehicles and so on.

This has moved manufacturing from a situation where machines helped workers make things to one where workers help machines make things. Perhaps in the future it will be called ‘compufacturing’. In terms of the TOSP framework (Figure 12), this is an advance in information technology that brings many routine tasks within the ambit of a single machine operator.

The integration and automation of tasks, however, does not stop at the factory gate. Many design, engineering, and management tasks have been computerised (Alavudeen and Venkateshwaran 2010). Computers have greatly boosted the productivity and speed of product design as well as greatly reduced the need for prototyping. Once designed, the production process can be outlined using computer-aided process planning systems and design programmes can create instructions for numerical-control machines. Models of the manufacturing system can be simulated before they are built. The basic manufacturing functions – machining, forming, joining, assembly, and inspection – are supported and integrated by computer-aided manufacturing systems and automated materials-handling systems. Inventory control is automated, tracking inventory movement, forecasting requirements and even initiating procurement orders.

The key economic effects of Computer Integrated Manufacturing, or CIM, are:

- a radical reduction in the fixed cost and time delays associated with introducing new models and new products⁹;
- a shift away from mass production of identical goods to mass production of customised goods;
- an heightened possibility for spatial unbundling of certain segments of the value chain as digitised information makes coordination at distance less complicated;
- an bundling of many tasks previously undertaken by individual workers of varying skill levels into advanced machinery and computers; and, consequently,

⁹ This is of commercial significance as time-to-market has become an important differentiator between rival suppliers.

- a polarisation of the shop floor.

The polarisation, as Autor et al (2003) pointed out, stemmed from the fact that computers were substitutes for some workers but complements for others. Demand for routine, low-skill tasks dropped as they were easy to computerise and robotise. By contrast, computers boosted labour productivity in tasks demanding flexibility, creativity, generalised problem-solving capabilities, and complex communications. In short; cheaper computers and robots lowered demand for low-skill labour and raised demand for high-skill workers.¹⁰

A recent special report by *The Economist* extrapolates these trends even further (*Economist* 2012). It notes that manufacturing may be going through a new industrial revolution due to the advent of '3D printing' or additive manufacturing. This bundles virtually all stages of manufacturing into a single machine. While this is an important trend, it is not new; *Automation, the Advent of the Automatic Factory* was the title of a 1956 book and indeed the Luddite movement was about the same thing.

3.1.1 Examples of factory floor polarisation

For a century, Greenville (South Carolina) had plentiful textile mill jobs for workers of all education levels. Davidson (2012) explains how globalisation and digitally assisted manufacturing transformed Greenville. Globalisation (specifically the integration into world markets of China and Mexico) shut down most mills. Digitally assisted manufacturing transformed the rest into "nearly autonomous, computer-run machines." The local joke, as Davidson relates it is "that a modern textile mill employs only a man and a dog. The man is there to feed the dog, and the dog is there to keep the man away from the machines." A critical result is the polarisation of the factory floor (man-and-dog jobs, on one hand, and highly-trained technicians on the other).

The principal example in Davidson (2012) contrasts workers in a Greenville factory making fuel injectors. One type of worker does manual tasks that require little training or education. Her real competitors are not Chinese workers, but American-designed robots. Earning \$13 an hour, she is still cheaper than the robot but many of her co-workers have already been replaced.

The second type is a \$30-an-hour skilled machinist who got his job after three years studying machine tooling, five years of on-the-job experience in another factory, and a month of training on his particular piece of the digitised manufacturing revolution – a half-million-dollar turning contraption which machines valves to a tolerance of a quarter micron. For the machinist, manufacturing is basically applied engineering. To maintain such extreme precision, he tests parts every few

¹⁰ Of course, this is not the first time automation has polarised the factory jobs. In the 19th century, mechanised looms replaced medium-skilled textile workers with low-skilled, low-wage workers. A process immortalised by the machine wrecking of Luddites.

minutes with sophisticated testing tools and makes the necessary adjustments – about 20 per shift – by entering them into the machine’s computer.

This polarisation of the shop floor has many implications but for the low-education worker, the worse is that there is no longer a gradual path of skill accumulation between the \$13 and \$30 jobs. The in-between-skilled jobs have all been bundled in to the machine.

The digitisation of manufacturing is changing the nature of the stages not offshored in a way that is important for policy makers. Many of the manufacturing jobs being ‘reshored’ are of the \$13 type, not the \$30 manufacturing jobs that still come to mind when people speak glowingly of manufacturing.

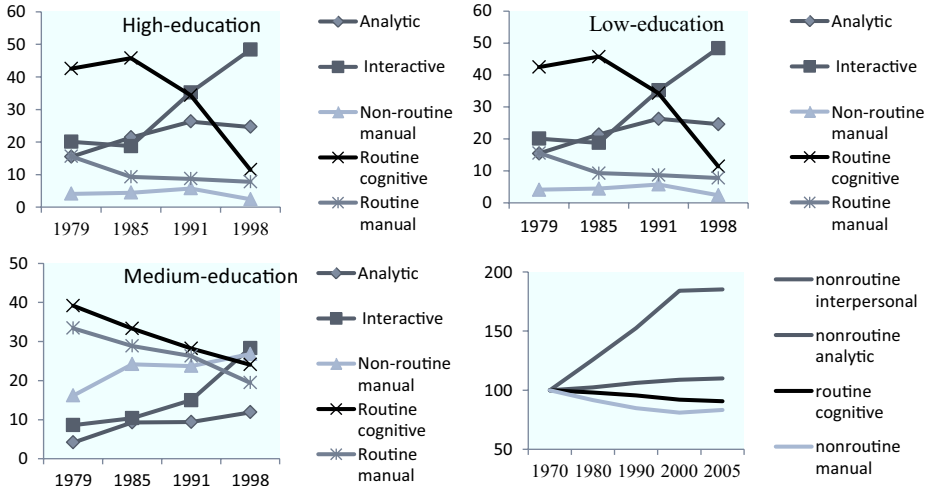
An instructive example of this can be found in the recent Boston Consulting Group study, BCG (2011). This shows that faster wage growth in China brings US job competitiveness close to the ‘tipping point’, i.e. the point where making things in the US will be cheaper than in China. “By around 2015,” the report notes, “the total labour-cost savings of manufacturing many goods in China will be only about 10 to 15% when actual labour content is factored in.” But new manufacturing jobs created here will be low-skill/low-wage jobs.

The fact that low-skilled Americans are almost competitive with low-skill Chinese is not an unmitigated blessing. Chinese wage rose by almost 20% per year while US manufacturing wages have actually fallen (Moretti 2012 p.25). For example, as part of the deal that let it survive the recent global economic crisis, Ford now pay new hires only \$15 to \$16 per hour – about half what the legacy workers receive.

3.1.2 Data on the composition of tasks

A dominant outcome from the offshoring of low-skill jobs and the computerisation of stages not offshored is a pervasive shift in the nature of manufacturing work. Evidence for this can be found in how high, medium and low skilled workers have been doing fewer and fewer routine tasks in their various jobs – and this regardless of which sector they work in (Figure 20 which focuses on West German workers). The two key trends are a reduction in routine tasks at all skill levels and an important rise in tasks that require interactions with other proximate workers. Note that the rise in analytic tasks is rather modest.

Figure 20 Share of tasks by type for high-skilled (top), medium-skilled (middle) and low-skilled (bottom) workers in West Germany 1979–1998.



Source: Spitz (2004). Table 6. Note: the numbers show the share of all the tasks an employee performs that fall into the five categories of tasks, so apart from rounding issues, each row sums to 100. The survey behind this did not ask employees about the amount of time they spent on each task. For US source is Kemeny and Rigby (2012).

The same trend is found in US manufacturing. The bottom right panel of Figure 20 shows a drop in ‘routine manual’ and ‘routine cognitive’ tasks, but a sharp rise in non-routine interpersonal tasks. Again the rise in analytic tasks have been modest. These results, which are from Kemeny and Rigby (2012), are broadly in line with the well-known earlier study by Autor et al. (2003).

3.2 Bottom line for policymaking

Digitisation of manufacturing is changing the nature of the stages not offshored in a way that means manufacturing plants in rich nations will never again be a source of high paying jobs for the ‘common man’.

- The total number of manufacturing production jobs will almost surely continue to decline, and the remaining ones will increasingly resemble applied engineering positions that require post-secondary education.
- The ‘third industrial revolution’ of 3D printing that some futurists (e.g. Economist 2012) point to would be one more step in this direction.

These labour market outcomes are as much a consequence of technological advance as they are globalisation. Even if the latter was turned back, the former will continue to erode the demand for low-skilled manufacturing labour.

PART 2: WHAT UNBUNDLING MEANS FOR POLICYMAKING

4 Unpredictable comparative advantage

Traditionally, comparative advantage analysis was a reliable tool for crafting globalisation policies. Studying the sectors where the nation already has a comparative advantage helped predict which sectors that would win from further global market opening. Likewise, studying features of the sectors that recent lost from globalisation provided an excellent way of predicting which sector would be hurt in the future.

Armed with this predictive tool, governments arranged all manner of policy to help shift resources from losing sectors to winning sectors. The range included policies on education, re-training, relocation subsidies, housing, unemployment insurance, regional assistance and others.

The main message of this section is that the 2nd unbundling – 21st century globalisation, if you will – has made this tool much less useful. Globalisation is affecting the economy at the level of stages of production, not sectors or skill groups. The finer degree of resolution means traditional comparative advantage analysis does a poor job of guiding policy reactions to globalisation that affects the economy stage-by-stage.

4.1 Comparative advantage analysis works for sectors and tasks, not stages

European policymakers have long used comparative-advantage analysis to design policy – even if most were unaware of the fact. To see this, recall the basic comparative advantage dictum:

“Do what you do best; trade for the rest.”

By and large, this maxim can be used to predict the future course of globalisation. As trade barriers come down, market forces shift resources out of sectors where the nation is inferior – so-called sunset sectors – and into sectors where it is superior – sunrise sectors. Armed with this predictive tool, European policymakers crafted policies to facilitate the shift of resources from the ‘sunset’ sectors to the ‘sunrise’ sectors. The EU’s Lisbon Agenda identification of the ‘information society’ as a sunrise sector is a classic example of this thinking.

Critical links in this chain of economic logic are:

- Globalisation affects an economy at the sectoral level; some sectors win, others lose, but the right level of aggregation is the sector.

- The sectors that will win from future globalisation are similar to those that already won, i.e. are already exporting; and the sectors that will lose are similar to those currently imported.

In short, this line of thinking – based on the 1st unbundling view of globalisation – views further globalisation as exaggerating the existing pattern of comparative advantage.

For example, since UK firms are successful in exporting goods that require lots of technology, lots of highly skilled workers and world-class organisation, e.g. pharmaceuticals, globalisation’s inexorable forward motion will help such industries in the future, but hurt industries, say, ‘toiletries and perfumes’ where the UK industry is already ailing.

4.2 Did production unbundling break comparative advantage?

The second unbundling per se does not change anything in the deep economic logic of comparative advantage. Indeed if globalisation proceeded to the logical extreme, we would have free trade in tasks and absolutely all comparative advantage thinking would hold – only applied to tasks rather than sectors (see Grossman and Rossi-Hansberg 2008, which applies the trade-in-task framework to study the impact of offshoring on US wages).

Problems arise at intermediate levels of trade and coordination costs. As the composition of tasks per occupation and occupations per stage shift (see Figure 12), the predictive power of comparative advantage analysis breaks down.

This is compounded by the use of statistical categories based on pre-unbundled realities (as they most are today). For example, the international HS classification for ‘Motor vehicles for transport of goods’ contains only six classifications (Table 1). The main distinctions involve the size and type of engine despite the fact that trucks can vary greatly in terms of their embedded technology (engines, brakes, safety features, emissions, etc.). In reality, trucks range from incredibly high-tech Volvo trucks to basic Tata trucks made for India’s rough roads.

Table 1 HS classification of ‘Motor vehicles for transport of goods’

870410	Dumpers designed for off-highway use
870421	Trucks, nesoi, diesel engine, gvw 5 metric tons & und
870422	Motor Vehicle transporting goods com-ig int c p e gvw >5nov20 mtn
870423	Truck, diesel engine, gvw > 20 metric tons
870431	Motor Vehicle transporting goods spk ig in c p engine, gvw nov 5 mtn
870432	Motor Vehicle transporting goods spark-ignition in c p engine, gvw > 5 m tn
870490	Trucks, nesoi

Source: www.foreign-trade.com (see appendix for the complete list for vehicles).

Such examples abound. Given this, it is surely understandable that many observers would conclude that comparative advantage is broken as far as 21st century trade in manufactures is concerned – even if it was operating to perfection in reality.

4.3 Comparative advantage with mobile technology

Boosting the international mobility of goods is a good thing. With some famous exceptions, globally freer trade improves all nations' welfare. The same is not true for technology. Freer international mobility of technology will typically raise global output and welfare, but in many cases it lowers the welfare of technologically advanced nations. As noted in the introduction, allowing trade in goods is like allowing cricket teams to exchange players – any voluntary exchange will almost surely make both teams better. Transferring technology, however, is like the better team training their opponents' batters. The resulting game will surely be at a higher level, but it is not clear that both teams benefit.

To focus on the preoccupation of many European policymakers, consider the movement of technology from an advanced technology nation to a nation with productivity that is inferior in every sector. As it turns out, the effects depend on type of technology moving.

4.3.1 *Import-biased versus export-biased technology transfers*

The traditional and intuitive distinction is between import-biased and export-biased technology transfer.

- If the less-advanced nation gets better technology in sectors where the advanced nation is importing already, the transferred technology will mean lower import prices.

For the advanced nation, this is a pure terms of trade gain. In this case, the advanced nation would not have been producing the imported good, so the advanced technology was idle. Deploying it abroad displaces no domestic workers and yet provides the advanced nation with a terms-of-trade gain. In other words, the technology transfer means the advanced nation has to devote fewer resources to paying for its imports. For the less-advanced nation the impact cuts two ways; the higher productivity is good, but the lower export prices are bad (overall impact is ambiguous but generally expected to be positive).

Importantly, a large amount of offshoring falls into this category. Production stages that used to be done with British technology and British labour are offshored, so the stage is done with British technology and Polish labour. If the result is exported back to Britain, Britain gains from the cheaper imported input. This is basically a terms of trade gain from offshoring.

The other type is export biased technology transfer.

Box 2 Comparative advantage analysis with full unbundling

The 2nd unbundling is the spatial separation of production stages that used to be organised in a single factories/offices. To keep things simple, we consider only two goods, A and B; suppose all trade costs have been eliminated; and assume each good has two production stages. To be concrete, assume Britain initially has a comparative advantage in A while Foreign has it in B, so we think of A as technology-intensive relative to B. The 2nd unbundling separates A's and B's production into its component tasks, which we assume are, in this example, A1 and A2 in sector A, and B1 and B2 in sector B.

With just a moment of thought, it is clear that comparative advantage applies just as well to fully unbundled tasks as it does to sectors. To be concrete, suppose tasks A1 and B1 are technology-intensive relative to A2 and B2. Following the usual logic of comparative advantage, the result of full unbundling is that all technology-intensive stages are undertaken in Britain, the other stages are done in Foreign.

At this level of abstraction, unbundling is a crystal-clear example of comparative advantage working its magic. In no way is comparative advantage broken; quite the opposite. Before the unbundling, Britain is fully specialised in its comparative advantage sectors, but some British workers were employed in low-tech stages of production (namely A2) since they are bundled with high-tech stages. After the unbundling, each nation is fully specialised in its comparative advantage stages (not sectors).

To a statistician who developed a product classification system during the decades between the first and second unbundling, however, the new pattern of trade may appear puzzling. Before considering this mis-measurement issue, we point out how unbundled averages leads to more extreme comparative advantages.

Pure unbundling exaggerates comparative advantage

In the example, total world output of both goods rises unambiguously and there is a strong tendency for the global value of trade to rise. High-tech components are all shipped from the UK to the foreign nations and some of them are re-imported by Britain embodied in final goods. Britain's average labour productivity rises as its workers shift out of stages where they have a comparative disadvantage (A2) to stages where they have a comparative advantage (B1). British real wages rise in response and the same happens in the other nation.

In short, unbundling per se *exaggerates* comparative advantage. After all, final goods are bundles of production stages with different technology or skill intensities. A nation's comparative advantage in a final good is therefore a *weighted average* of its comparative advantage in the constituent stages. As a matter of pure logic, the range of comparative advantages in the stages will be greater than the range in the original bundles of stages.

- If the less-advanced nation gets better technology in things it used to be importing, then it may turn from an import of the goods to an exporter.

This will have a clear, negative effect for the advanced nation.¹¹

This line of thought immediately establishes the notion that there may be a schism between the interests of rich-nation firms and the interests of their home nations. Technology is for the most part firm-specific, so firms view moving technology abroad as a private matter. There is, however, a terms of trade spillover that they are unlikely to worry about. This schism may be especially marked when the private firms are using technology that was in part paid for by public R&D funding or tax credits.

4.4 Key points: unpredictability, suddenness and individuality

The key point is that the unbundling greatly reduces the usefulness of comparative advantage analysis as a policy guide. There are three central elements: unpredictability, suddenness and individuality.

Unpredictability. In the 2nd unbundling it is much harder to predict which stages in which sectors will lose competitiveness and thus be offshored than it was in the first. The main difference is that the impact of lower trade costs on UK competitiveness is much easier to predict than the impact of lower coordination costs. The source of the difference is our lack of understanding of the ‘glue’ that held stages together in the first place in all the different sectors. Simple indicators such as telecommunications usage is not enough since such costs interacts in complex and poorly understood ways with the nature of the production stage and the task’s interconnectedness with other production stages.

Suddenness. Bundled production stages are subject to non-linear forces including network externalities, backward and forward linkages, etc. For example, the chains of communication are not linear, they are networked. Such features create economic forces that are typically characterised by ‘tipping points’, i.e. situations where a gradual change in underlying conditions (say better ICT) causes no visible effect right up to a threshold beyond which a massive reaction (offshoring) occurs. This is not the gradual loss of jobs in clothing experienced by Britain during the first unbundling, it’s the massive and rather sudden offshoring of, for example, back-office tasks to India.

Individuality. In the first unbundling world, factories – and indeed whole sectors – could be viewed as teams. Lower trade costs could help or hurt, but the team

¹¹ This import-versus-export distinction has been known at least since David Ricardo. More recently, Paul Samuelson restated it as what some call the ‘Samuelson conjecture’ (Samuelson 2004), namely advance-nation multinationals helping China and other emerging markets to move up the value chain is very much like training the opposing team to bat better.

Table 2 Towards a broader notion of distance: CAGE's 4 dimensions of distance

Cultural Distance	Administrative Distance	Geographic Distance	Economic Distance
A country's cultural attributes determine how people interact. Differences in religion, social norms, race and language can create distance between countries.	Historical and political associations shared by countries greatly affect trade between them.	The further an economy is from a trading partner, the harder it will be to conduct business in that country. It also refers to the country size, access to waterways and ocean, and topography. This attribute has a direct relationship with the cost of transportation.	The wealthy or income of customers creates distance between countries, and has a marked effect on the levels of trade and type of partners a country trades with.
Attributes creating distance			
Products have high linguistic content (TV); Products affect cultural or national identity of consumers (foods); Product features vary in terms of size (cars), standards (electrical appliances), or packaging; Products carry country-specific quality associations (wines)	Government involvement is high in industries that are producers of staple goods (electricity); producers of other 'entitlements' (drugs); large employers; large suppliers to government; National champions (aerospace); Vital to national security (telecom); Exploiters of natural resources (oil, mining); Subject to high sunk costs (infrastructure)	Products have a low value-of-weight or bulk ratio (cement); Products are fragile or perishable (glass, fruit); Communications and connectivity are important (financial services); Local supervision and operational requirements are high (many services)	Nature of demand varies with income level (cars); Economies of standardisation or scale are important (mobile phones); Labour and other factor cost differences are salient (garments); Distribution or business systems are different (insurance); Companies need to be responsive and agile (home appliances)

Source: Ghermawat (2007).

rose or fell together. Second unbundling globalisation suggests that the forces of globalisation will achieve a far finer resolution, at the level of stages. Particular workers in particular firms in a given sector could suffer from globalisation while others in the same firm and same educational attainment prosper.

Consider the impact of further globalisation on a UK hospital. Given the excellence of British medicine, foreign patients would like to buy more. As ICT progresses, certain medical tasks may well be able to be performed over long distances. Arthroscopy (so-called keyhole surgery) is done by a doctor manipulating controls while looking at a computer screen. In principle, the patient and surgeon could be in different rooms, and again in principle the rooms could be in different countries. If this happened, the best UK surgeons would become very busy; everyone would want their torn meniscus repaired by the world's leading expert. The worst surgeons would have to find something else to do. But in the same hospital, globalisation might harm low-skill workers in billing and record-keeping (offshoring to India) while help other low-skilled workers (unskilled patient-care).

The example of winning and losing surgeons and winning and losing unskilled workers shows that the 1st unbundling correlation between skill/education and winner status need not hold as the second unbundling proceeds. Second unbundling competition is more individual.

5 The regional dimension of unbundling

Comparative advantage is, traditionally, a nation-level concept. This was really the only sensible way to think about it before the 2nd unbundling. After all, goods were bundles of national inputs, the ultimate determinates of comparative costs were therefore national. The 2nd unbundling changes all that.

Today, goods are bundles of many nations' inputs, as Figure 5 showed and Figure 10 stressed for Britain. When the following two premises hold then comparative advantage is regional:

- The cost of undertaking a given production stage in Britain depends upon the cost of imported inputs;
- The cost of imported inputs is higher for inputs made in more distant nations.

Consider an illustrative example. Comparative advantage boils down the question of where it is cheapest to make things. Consider the cost of making, say, a generic drug in the UK versus Ukraine. We break the production cost into direct production costs and the cost of imported inputs. The UK has the competitive edge over Ukraine if its total production costs are lower:

$$\frac{(\text{UK direct production costs}) + (\text{UK imported input costs})}{(\text{Ukraine direct production costs}) + (\text{Ukraine imported input costs})} < 1$$

The first term in parentheses (in both numerator and denominator) reflects traditional, nation-based comparative advantage determinants. To give the illustrative example very sharp edges, suppose these terms are identical top and bottom. If, in addition, the cost of imported inputs were identical in the UK and Ukraine, the two nations would be equally competitive in this industry. But this misses the critical role of distance-from-suppliers.

This can have an enormous impact on costs. For example, suppose the specialty chemicals are made in Basel and trade costs between Britain and Basel are lower than between Basel and the Ukraine. In this case, Britain has an edge. This is really basic economics; lowering intermediate input costs raises the competitiveness of downstream stages. The example shows how Britain's comparative advantage depends upon what is made in nearby nations. This brings us to the concept of regional comparative advantage, which has decisive implications for policymakers – especially in Europe where the existence of the EU means regional policy setting is a real possibility.

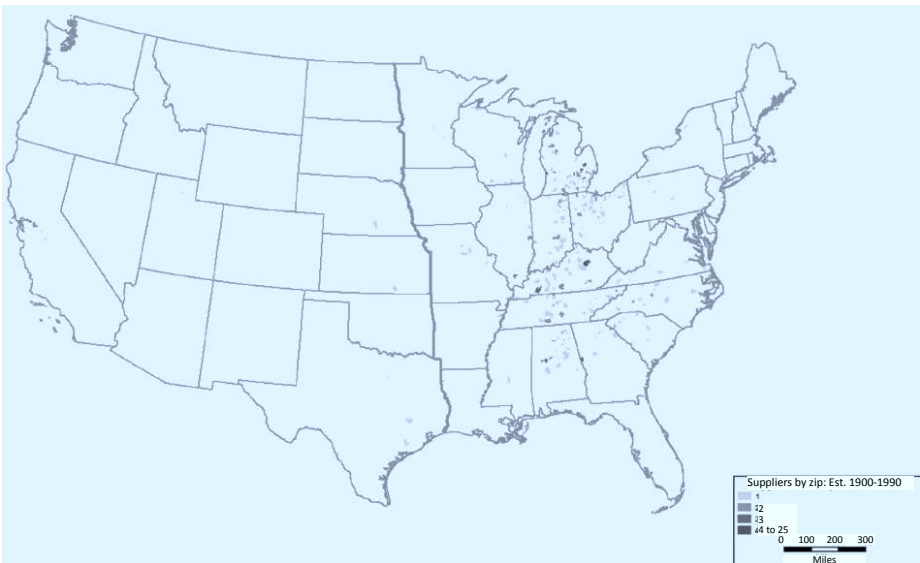
Before turning to the policy implications, we consider a case study (autos) that hammers home the key point– comparative advantage can no longer be thought of without a map in hand.

5.1 Regional clusters and comparative advantage: Some examples

The geographic dimension of a location's comparative advantage is most cleanly demonstrated with data from within a single nation as this controls for all sorts of un-measurable influences that vary across nations. Figure 21 shows the distribution of auto supplier plants in the US (by postal code) in 1990 (left panel), and the location of new plants set up between 1991 and 2003 is shown in the right panel. The obvious fact is that the two distributions are very similar, even if the new plant distribution is more concentrated. What does this tell us?

Assuming new plant locations were chosen to reduce production costs, the fact that the new-plant pattern is very similar to the old suggests today's 'comparative advantage' of each US postal code districts in autos depends very much on the pre-existing location of other plants in nearby districts. Traditionally this is called 'forward linkages'.

Figure 21 US old and new auto supplier plants.

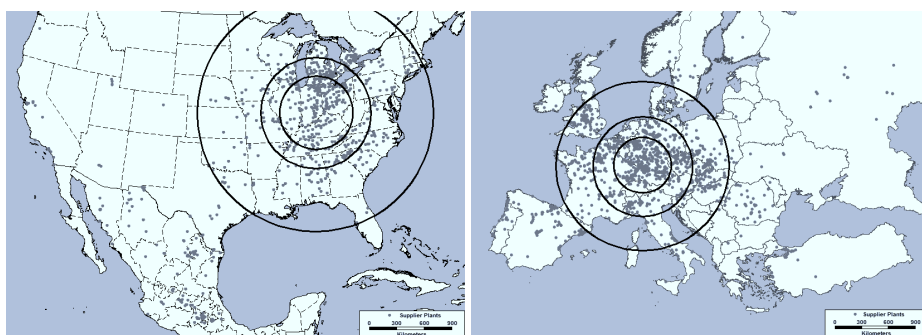


Source: Klier and McMillen (2008).

Using econometric techniques on this data, Klier and McMillen (2008) show that new-plant locations are well explained by good highway access, proximity to Detroit and assembly plants. In short, despite the ICT and logistic revolutions, distance still matters enormously, maybe even more than before. As an aside, it is worth pointing out that during this decade, incomes grew faster in the West and South of the US, so production was not driven by location of demand.

The auto example also provides an excellent segue into international comparative advantage issues since it is quite integrated with Canada and Mexico. Or, to put it more directly, the comparative advantage of Canada and Mexico in autos cannot be separated from that of the US.

Figure 22 North American and Europe auto supplier plants.



Source: Klier and Rubenstein (2011).

The point is clear from the left panel of Figure 22, which shows the location of US, Canadian and Mexican auto supplier plants. What we see is that Canadian industry is basically an extension of the US supply network. The Mexican plant distribution is less clearly affected by the US concentration although even here clustering is obvious.

The right panel of Figure 22 shows a similar map for European auto suppliers. Again the role of geography of this is rather obvious.

5.2 Some policy implications of regional comparative advantage

Policy implications here follow from two real world features. First, distance-related costs of imported intermediates can be thought of as comparative advantage 'spillovers'; second, 'cost linkages' matter -- as shown in the New Economic Geography literature.

Markets characterised by spillovers rarely achieve first best outcomes. In this case, the decision of firms and governments in one European nation has spillovers, generally positive, for other European firms and nations. Generally speaking,

positive spillovers across jurisdictions typically produce too little supportive policy action, as governments ignore the benefits received by other jurisdictions. This suggests that helping UK industry adjust to on-going globalisation is a task that should, at least in part, be undertaken at the EU level -- either with EU member states agreeing to take into account of intra-EU knock on effects or by enhancing the capabilities of the European Commission.

Markets characterised by supply and demand linkages are frequently marked by multiple equilibriums. In this case, there is both a sectoral dimension of the multiplicity and a location dimension. The key implication of this is that government policy can have unexpected and highly non-linear effects given the tipping-point economics that is so normal in New Economic Geography.

A third set of implications has to do with the difference between economic distance and geographical distance. The economic logic that leads us to worry about continental comparative advantage is based on the cost of selling to customers and cost of buying from suppliers. While distance matters, all sorts of 'second nature' geography is also important -- such as efficient ports, airports and surface transportation. This point is quite clear in maps on industrial plants that also display motorways and rail lines.

While the importance of infrastructure to industry is rather obvious, it is worth pointing out that production unbundling greatly magnifies its importance. As linking British industry to the rest of Europe is not something the UK can do entirely unilaterally, improving Europe's 'second nature' geography is one obvious area that has implications for UK foreign economic policy.

6 The spatial dimension and 21st century manufacturing: towards a more elaborate notion of distance

Let's begin by considering the implications of a well-known finding from the literature on New Economic Geography, namely, that public policy has a larger than usual role in activities marked by important agglomeration economies. Baldwin et al (2003 Chapter 2) highlights three features of agglomerations that for cast doubt on the wisdom of a laissez faire approach to manufacturing policy:

- threshold effects,
- hysteresis
- coordination effects.

Threshold effects. When an industry is clustered, agglomeration forces induce spatial inertia -- or viscosity -- that robs most small, location-specific policy interventions of their effectiveness. Agglomeration produces rents that hold firms and factors in place even when they face certain outside inducements

created by relative wage gaps or technology differences. However, once the size of the inducement crosses a threshold – that is, when it creates a profit advantage to firms or mobile factors that outweighs the agglomeration rents – then firms and employees will move. And as relocation gets under way, the size of the agglomeration rents decrease and this makes the site even less attractive. The end result could be a substantial delocation of industry.

The fact that incremental policy changes tend to have little or no impact on industrial location as long as inducements remain below a threshold value is worth keeping in mind when designing public policies for agglomerations and value chains. Surely this implies that unless location-specific incentives are sufficiently large, they should not be tried in the first place. Tinkering won't work.

Moreover, given that available state resources are scarcer and scarcer, then a smaller number of more generous interventions are preferred to spreading resources thinly across many initiatives. Combined with the observation that technological and organisational innovations in supply chains are unpredictable, then the presence of threshold effects suggests incentives be targeted at a smaller number of locations -- probably large towns or cities -- and to firms and employees willing to undertake qualified tasks in those locations. The logic here points to selective interventions that require considerable knowledge on the part of government of which tasks generate most value added and are either inherently non-tradable or where private incentives not to migrate abroad are strong.

An even more controversial observation is that, if government is convinced that the private sector is over-estimating the benefits of relocating a task abroad, then avoiding loss of critical mass in a cluster may justify interventions to discourage, even prevent, exit. Given the disappointment among industrialised country firms with prior outsourcing decisions -- which has been documented in the past year (Economist 2011) -- the private sector can hardly be credited with flawless insight. If poor corporate governance, undue pressure for short term profits, and poor understanding of the effects of international relocation bias corporate decision-making towards relocation of a task abroad, then the adverse knock-on effects for those firms that remain imply private and social returns may diverge.

Hysteresis. A system exhibits hysteresis when an external force causes a change that is not reversed when the force is removed. This is true both in terms of geography (agglomeration fosters concentration but doesn't guide the location of that concentration), and in terms of tasks (agglomeration leads nations to specialise in particular tasks or sectors but not necessarily which ones). When a shock shifts a cluster of industry from one nation to another, reversing the shock will not necessarily reverse the location change.

Hysteresis effects are all the more reason why implementing protectionism won't necessarily reverse the effects of previous prior steps towards open borders.

Turning the clock back to an era of less open borders cannot guarantee a return of jobs lost in manufacturing. More generally 'bad policies', even when they are temporary, may have long-lasting adverse effects. Moreover, if government is determined to restore the status quo that prevailed before the bad policy was imposed, whatever new policies are put in place may have to have much larger effects on firm profits to stand a chance of being successful. Or, as the old saying goes, it is easier to get the toothpaste out of the tube than to get it back in.

Coordination effects. While the logic is rather intricate, it is widely understood that the location of a particular agglomeration can be affected by expectations. That is, if all firms believe a cluster will appear in a particular nation, then their actions may make it so. This is a case where, as Krugman (1991) put it, expectations rather than history matter. Agents' rational choice is to move where they believe others will move. This opens a somewhat novel role for governments. If firms *believe* Britain will be an excellent location for, say, developing new 3D printing machines, then more will be inclined to move there.

There is a more subtle point to be made. In reality firms and skilled employees will only consider moving to locations that they know enough positive things about. A location should be seen as a centre of excellence in a particular task- or plausibly developing to become a first class centre. There is an asymmetric information problem here. Every location will have an incentive to claim that it is a terrific place for a firm to invest and the latter knows this.

Two implications follow. First, those designing initiatives to promote a location must pay careful attention to what potential firms and employees say they want is important -- bearing in mind that, as noted earlier, circumstances can change fast in international value chains. Second, credible signalling through independent verification of quality and associated rankings could also be determinative.

In short, give the private sector credible information to consider coordinating a desired location in the first place. In this regard the impressions that little of high value is manufactured in the UK anymore and that UK universities don't produce enough high quality engineers, scientists, and the like are very unhelpful. The extraordinary lengths to which the Swiss go to promote their country as a source of high quality goods and services may provide useful pointers for UK policymakers.

6.1 Towards a broader notion of distance

Distance plays a key role in the analysis of why firms and talented employees co-locate. Typically, however, distance is viewed in physical terms, really as a proxy for international transportation costs. Firms are said to trade-off the benefits of co-location with the costs of distance from customers. Arguably, in a world of international value chains where goods, employees, and knowledge can

frequently cross national and internal borders, then the set of relevant distances expands considerably.¹²

6.1.1 Reduce internal distances

The costs and quality of internal transportation and communications infrastructure are a case in point (Ghemawat 2011, page 292). If talented employees can reliably and quickly travel to work over longer distances, then the benefits of agglomeration do not necessarily have to be at the expense of spatial inequalities within a country. In short, securing the benefits of co-location need not mean further migration to the UK's cities and depopulation of rural areas. Similarly, the development of more high quality transportation infrastructure in the UK would take the pressure off those existing quality modes of transport.

Having said that, given the thick labour pools in cities, the greater variety of producer services available there (with the implied greater competition between service sector providers), and potential for easier transfer of tacit knowledge and other innovations, it is no wonder that some view the development of clusters and modern manufacturing as inextricably linked with the growth of cities. The Netherlands, another open trading nation with a tradition of manufacturing, has adopted such a strategy for its cities (CPB 2010).

6.1.2 Consider a wide set of external distances (differences)

Many studies of the volume of different types of cross border commerce between two countries find that own country characteristics matter (such as national income) and differences and similarities between the countries matter (e.g. physical distance, membership of a free trade area or common currency, shared colonial history and legal regime).

These robust empirical findings have led some corporate strategists to ask whether governments can choose their policies so as to best align cross-country similarities and differences to meet their commercial goals. Ghemawat (2007, Chapter 2) is a leading example of such thinking. Based on the view that the world is far from 'flat' (uniform), that the world is only semi-globalised he has developed a broader conceptualisation of distance called the CAGE framework (CAGE is short for Cultural, Administrative, Geographic and Economic); see Table 2. He uses this to argue that governments can and should fine tune their integration into world markets.

For example, if assisting national firms to exploit economies of scale is a policy goal, then encouraging major trading partners to adopt mutual recognition

¹² For analyses of international business strategy and national economic strategy that give pride of place to different types of distance, see Ghemawat (2007) and Ghemawat (2011) respectively. Ghemawat devised the CAGE Framework to characterise the types of international differences between countries that have commercial implications. This matter is taken up in subsection 8.1.2.

agreements for technical product regulations is a sensible goal of a government's foreign economic policy. In this case, the government seeks advantage in narrowing differences with trading partners. Likewise, measures to integrate EU markets that permit UK firms to source from a wider variety of suppliers would allow those firms to better capitalise on outsourcing possibilities.

However, there may be instances when governments seek commercial advantage by widening differences with trading partners. Ireland and the Netherlands' favourable tax regimes for corporations are cases in point, and both countries reaped considerable amounts of foreign direct investment as a result. The key point is that policy need not always be driving towards eliminating policy differences with trading partners.

If cross country differences in policies matter in a particular sector or task, then the degree to which a country's advantageous policies can be successfully copied and implemented is an important determinant of the durability of any advantage. Clearly developing harder to copy measures or capitalising on inherent advantages that others find difficult to emulate is desirable.

In this regard, the UK's primary business language being the world's business language is an advantage that few of its European trading partners can easily emulate. There are implications here for immigration policy and, less obviously, for potential UK certification of overseas universities, technical colleges, and training institutes that educate engineers and the like to a high standard and in English.¹³

Steps that credibly signal higher quality or lower risk can also be facilitated by national standards or state encouragement of higher standards set by private sector bodies. It is noteworthy that the additional capital reserve requirements imposed by the Swiss government on their banks was justified, not just in terms of prudential supervision, but in terms of the competitive advantage it would convey as Swiss banks would be able to withstand larger shocks than foreign rivals without putting clients' funds at risk.

By providing a taxonomy of potential international differences as part of his CAGE Framework, Ghemawat (2007, 2011) has identified many dimensions upon which governments can seek to differentiate or align their economy's business environment with trading partners. The taxonomy identifies differences of a cultural, administrative, geographic, and economic nature.

The very fact that there is a wide range of differences has other implications for UK policymakers: first, that their relative importance almost across tasks --

¹³ Indeed, the likelihood of a successful application for a UK visa might be conditional on attending such a certified school. There is precedent for this. The UK operated from 2005 to 2008 a scheme where graduates from a publicly known list of MBA programmes are eligible for preferential visa treatment should they wish to work in the UK. Many of the listed MBA programmes were outside the UK.

so learning which really matter from the private sector is important. Second, that combinations of differences will determine the relative profitability of operating from the UK. Therefore, if progress along one dimension is not possible because of other compelling policy considerations, then there may be plenty of other options to consider. So design of the entire UK regulatory state need not be subsumed to the interests of international value chains and associated manufacturing policies.

Another implication of different types of 'distance' is that physical distance may not always be a reliable guide to the UK's trading partners that pose the greatest threat -- or offer the greatest promise--to British business. Nor are international wage differences. This is not to downplay the significance of close by European trading partners or competition from low-wage locations in East Asia. Rather, it is to highlight that there are other sources of relative advantage that need to be monitored and possibly capitalised upon. Which cross-border differences matter is likely to be highly task-specific.

Overall, then, once distance is conceived of broadly as cross-country differences -- some of which are within the control of the UK government -- then a much richer set of policy options becomes available for supporting the development of high value added value chains. Now that tariff barriers have fallen -- and assuming that higher oil prices do not raise international transportation costs so much that they offset the impact of prior trade reforms -- then other cross-border differences matter more and the UK ought to have a comprehensive strategy that is flexible enough to calibrate such differences to optimise economic performance.

7 Way forward: Human capital, cities and jobs

While long popular with governments of all stripes, policies that promotes industrial production and employment have come back into the spotlight following the Global Crisis. In a 'landscape of work' that is fragmented, footloose, and unpredictable, it can be fairly difficult to ensure that the promoted production stays in nation promoting it. 21st century governments must distinguish carefully between factors of production that are internationally mobile, and internationally immobile. Both matter. Both contribute to national income. But good jobs created in Britain have a local multiplier effect that good jobs created by British firm abroad do not (Moretti 2010).

This suggests that an important consideration for policy should be 'stickiness', especially the mobility of the inputs affected by the policy. As usual, government intervention is only a good idea when the market is missing something, so spillovers also matter. This suggests a two-way consideration of factors of production -- their mobility and their spillovers potential.

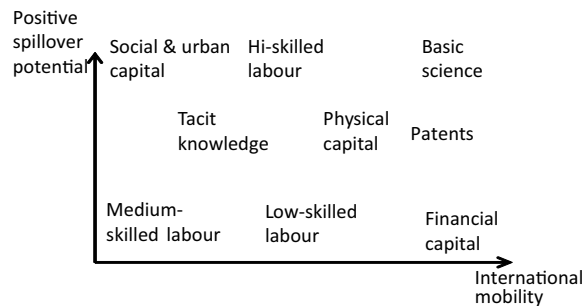
Figure 23 Targets of policy: Stickiness and spillovers potentials

Figure 23 schematically presents a general conceptualisation of seven potential targets for pro-manufacturing policies: three types of labour, two types of knowledge and two types of capital. This is meant to organise thinking about the effects of various input-promoting industrial policies – not an exact empirical statement.

Trying to promote British manufacturing by policies aimed at highly mobile factors, such as financial capital and basic science, are likely to have little local effect on industrial production. The newly created financial or knowledge capital tends to flow to the nation where its reward would be highest. Since the Britain has to pay for the promoting policy but gets little of the benefit, this sort of support should be accompanied by international coordination if it is tried at all. Moving back the mobility scale, physical capital is somewhat less mobility internationally (after it is sunk) and it has intermediate spillovers.

High skilled labour presents an attractive combination of low mobility and high spillovers. This combination is one of the reasons that almost all governments believe that subsidising technical and business education is one of the best ways to promote their nation's industrial competitiveness. Although highly educated workers do switch nations, they are far, far more attached to the nation who paid for their education than, say, financial capital, or basic science.

Tacit knowledge is the next in the schematic diagram, defining it as knowledge that seems to encourage spatial clustering of production. This knowledge is difficult to promote directly, but it has the great advantage of being unlikely to leave the nation once it is created. This unique combination explains why so many nations are trying to create industrial clusters, or hubs. The position of medium and low skilled labour requires little comment; they are marked by a close connection between the public and private benefits.

Finally, each nation, and indeed each location in each nation, has 'social and urban capital' that affects the attractiveness of the location for workers and firms. Here urban capital means things like commuting and communications infrastructure, clean and safe streets, appropriately priced housing and office space, and transparent governance.

Social capital means human interaction that depends upon trust, reliability and so on. As everyone knows, the extent to which societies are marked by these intangible factors varies enormously. Since economic interactions require trust, the presence of a sense of social justice and trust can be an important magnet for economic activity. In a sense, good social capital lowers transaction costs and thus fosters economic activity. In terms of spillovers, social capital is very localised, but it provides benefits across many stages and sectors.

7.1 Human capital is key

This check list of targets suggest that of the many immobile factors of production, people and skills are perhaps the most important when thinking about new paradigm globalisation, value chains, ICT, etc. After all:

- Human capital is sticky.

Most workers are not internationally mobile; domestic investment in human capital tends to stay domestic.

Skilled service workers are often subject to agglomeration economies that make the cluster more than the sum of its parts in a way that allows the cluster to pay over-the-odds wages – agglomeration rents; such activities are in the ‘right’ part of the smile curve.

- Human capital is flexible.

Skills that produce excellence are often transferable across sectors and stages; this allows workers to adapt to changing demands.

- Human capital is central in the input-output structure.

Skill-intensive services are inputs into many different stages and products, so demand for such tasks is more stable. With Skill-intensive services, the eggs, so to speak, are not all in one basket, or much less so than, e.g. solar panel production.

- Demand for skilled workers is rising faster than supply globally
- Education, training, skills upgrading also generates positive social payoff.

7.2 Cities as 21st century ‘factories’

Since talented people gather in cities and make each others more productive, human capital and cities are likely to be the foundations of the 21st century landscape of work.¹⁴ This logic is straightforward. After all cities are where:

- People meet; they are local networks for face-to-face connections and exchanges;
- People exchange of ideas, and competition among ideas plays out and new technologies often developed.
- Start-ups flourish and face-to-face interactions increase productivity.

Cities also optimise the matching between workers and firms, and between suppliers and customers. In this sense, cities become skill-clusters – or as Moretti (2012) call them, ‘brain hubs’. The link between city success and human capital is a close one. One of the most persistent predictors of urban growth over the last century is the skill level of a city.¹⁵

Recent research

Important thinking in CPB (2010) and a new book by Enrico Moretti (2012) suggest that ICT advances are leading to a spikier landscape of work. The reason is that high-skilled jobs in the tradable sector tend to be subject to agglomeration economies. One type is highly localised knowledge spillovers where workers and firms implicitly benefit from each other’s knowledge creation. Another type is the chicken-and-egg aspect of labour-pooling; firms locate near wide and deep local labour markets that are in turn supported by the presence of many firms. The City of London is a classic example of this.

In writing about the US Moretti (2012 p.5) say: “More than traditional industries, the knowledge economy has an inherent tendency towards geographical agglomeration. ... The success of a city fosters more success as communities that can attract skilled workers and goods jobs tend to attract even more. Communities that fail to attract skilled workers lose further ground.”

Of course, most Europeans will never work in innovation activities. But just as good factory jobs created multiplier effects in communities, high-tech jobs can create/attract many more jobs. Approximately two-thirds of jobs are in local service sector, such as government administration, health, and education sectors, retail, leisure and hospitality sectors. For the most part, these are sheltered from international competition by the dictates of proximity. But their location is very

14 There is a symmetry with history here. In the 1st unbundling phase of globalisation, workers clustered in factories, and factories clustered in industrial districts in part to benefit from knowledge spillovers. A standard story was that they were jointly working out how best to exploit a ‘general purpose technology’ that were new at the time – electric motors and chemical processes. Cities are now playing a similar role when it comes to today’s new general purpose technology, ICT.

15 Glaeser and Resseger (2009)

sensitive to 'anchor' jobs. Moretti estimates, for example, that each new high-tech job creates an additional 5 jobs in the local economy.

The agglomeration economies mentioned create another important fact: 'sticky' jobs tend to be good jobs and vice versa. As Moretti (2012 p.15) writes: "In innovation, a company's success depends on the entire ecosystem that surrounds it. ... it is harder to delocalise innovation than traditional manufacturing. ... you would have to move not just one company but an entire ecosystem."

CPB (2010) – a study that was greatly influenced by the work of Ed Glaeser – writes: "At the beginning of the twentieth century, manufacturing firms settled near each other in order to benefit from knowledge spillovers in the development of electricity. ... Later on ICT emerged and strongly affected services that concentrated in space. Cities are the places where high-educated people cluster, where start-ups flourish and face-to-face interactions increase productivity. As a result, cities are the places where productivity grows." Cities should not be thought of as mere collections of people, but rather as complex work spaces that generate new ideas and new ways of doing things.

In a nutshell, cities are to the 21st century what factories were to the 20th century.

8 Conclusions and policy implications

Technological and organisational changes -- some triggered by globalisation and some not -- will continue to profoundly reshape UK manufacturing and its contribution to national employment and living standards. Concerns have been raised that UK firms are not well placed to capitalise on these developments and that performance on leading metrics has failed to impress. Revisiting the policy mix towards manufacturing is necessary given these developments. Moreover, the framing of the associated policy discussion in terms of intervention (including 'picking winners') versus laissez-faire is as tired as it is inadequate.

After describing recent technological and organisational developments in manufacturing, the purpose of this study has been to reason through their implications for policymaking. The phrase 'reason through' was deliberately chosen because one facet of our approach has been to provide a number of conceptual arguments to examine these developments and upon which policy recommendations can be based. We have sought then to blend empirical and conceptual insights to better inform UK policymaking.

It should be acknowledged that by design a number of potentially important matters were not addressed in this study. For example, we have said little about national and other innovation systems. Nor have we examined the UK's and other countries' records on implementing industrial policy. Interested readers are

referred to other papers that have been drafted for this volume that address these matters. What follows now are six broad policy implications.

- **Don't overdo the fears – there is more to the 2nd unbundling than meets the eye**

Careful consideration of the implications of the 2nd unbundling sheds light on why many decision-makers and analysts are so concerned about a further expansion in the potential for relocating economic activities across borders. Goods and services are no longer viewed as amalgams of distinct stages conducted under one roof. Rather, some collections of tasks – stages – are being outsourced and firms are focusing their attention on others. In addition, the replacement of low-skilled labour in manufacturing by robots is generating productivity increases at the same time as it is limiting one well-established route to longer-term gainful employment for those not educated at university.

The unpredictability of these developments reflects collective knowledge gaps concerning what makes a stage offshore-able and the development and adoption of robotics in those factories that remain. That unpredictability along with the potential for sudden, significant relocations of economic activity has raised fears among citizens and decision-makers.

Another factor is that outsourcing has spread to some stages conducted by persons with certain professional and other qualifications that were previously thought of as affording respite from international competition and capable of sustaining middle class income levels. The job dislocation from outsourcing has become markedly more democratic, calling into question which investments in human capital have the best payoff.

Taken together, further unbundling, associated outsourcing, and the use of robotics, imply that the UK manufacturing sector is most unlikely to be the widespread employer of yesteryear. Policymakers need to align their expectations accordingly -- just like agriculture over the past 50 years, productivity growth has exceeded sales growth so manufacturing firms, like farmers, need fewer employees.

While these fears exist and have a certain salience among policymakers, they represent only part of the picture that is 21st century manufacturing. Falling tariffs and low transportation costs have revealed that many stages that do remain in high wage industrialised countries are ones that are supported by dynamics that provide strong individual disincentives to relocate production. It is not a matter of globalisation progressively chipping away at the 'good jobs' in a country, as was the case under the first unbundling.

Where productivity levels and growth are supported by co-location, that is, when a firm has to locate in a certain place to obtain the benefits of thick labour markets, substantial tacit knowledge flows, high quality infrastructure, strong

university-business linkages and so on, then good jobs are more viscid. This should be a source of reassurance -there has been an overemphasis on fear that has obscured the opportunities facing policymakers.

Another positive development is that 21st century manufacturing has made more and more use of high quality services, which are a source of employment too. The total level of UK employment engaged in international value chains exceeds the number of people paid to manufacture things. As Timmer et al (2012) show, some of the UK's EU trading partners have seen the total level of employment associated with international value chains increase while their total levels of manufacturing employment have fallen. The development of international value chains does not have to be a job killer.

It is wrong, therefore, to see the second unbundling of manufacturing solely in terms of production relocation and job loss. The 2nd unbundling highlights the importance of factors which enhance productivity that no individual firm can appropriate entirely and move abroad. That some of these *non-appropriable* benefits can be provided by the state takes the debate beyond picking winners versus laissez-faire. Unless as part of a simultaneous pan-EU initiative, one operating principle is that the UK government should be reluctant to support initiatives for business in which the direct beneficiary appropriates all the benefits and has full control over the cross-border transfer of any associated technology and managerial technique.¹⁶

- **Longstanding policies to promote a competitive and innovative national business environment should remain – but are not enough.**

While an understanding of the second unbundling does point to a different package of UK measures towards value creation, we are not suggesting the whole scale abandonment of existing policy. Longstanding policies towards improving the national business environment -- better infrastructure, schools, and universities, removing constraints on the access to finance, and promoting innovation, competition, and meritocracy still have their place, not least because they generate benefits beyond the manufacturing sector. Still, one implication of our analysis is that promoting the traditional elements of the business environment is not enough.

However, the emphasis on generating more value added in international value chains should not be elevated above other legitimate considerations. For example, most value is created at the innovation and distribution ends of the value chain. Policies that artificially inflate the value created at either end of the chain -- such as excessive intellectual property rights protection and barriers to entry in distribution--should be avoided as they typically amount to redistributing resources from customers to firms. As a result, 21st century manufacturing should not call into question the rivalry-promoting UK competition regime.

¹⁶ This is not to suggest that there are not other, perhaps more traditional considerations, in determining what measures the UK government should pursue—such as value for money.

- **UK policies towards manufacturing should be conceived of and measured in terms of stages, not sectors.**

One important consequence of the 2nd unbundling is that sectors become the wrong operational unit with which to frame policies and evaluate performance. Nowadays some stages in a sector can be performed in one country and others in another country. The division of economic activity into stages implies a far more granular breakdown of UK manufacturing and reveals that a lot of business, transportation, and financial services contribute to the total value added in contemporary manufacturing.

Rather than view the UK manufacturing base as a portfolio of sectors, a better approach is to view it as a portfolio of a larger number of stages. Moreover, some of those stages are used in many international value chains, reminding us that in value-added terms not all stages are equal. The relocation of a stage abroad does not imply the death of a UK sector or industry. Moreover, the fact that each final product is the aggregation of the costs of many stages implies that protecting from foreign competition any stage undertaken in the UK ultimately creates a cost disadvantage that will undermine the commercial viability of the entire value chain. This is the worst type of Robbing-Peter-To-Pay-Paul policy.

Furthermore, once a foreign location can undertake a stage cheaper, then UK policymakers should quickly move beyond lamenting the loss of British jobs and ask if anything needs to be done to ensure that UK firms can source that stage from abroad as cheaply and as quickly as possible (bearing in mind that time is an important competitive dimension in many commercial activities.) This involves taking steps to limit whatever policy-induced distances exist between the UK and the potential new suppliers of a recently outsourced stage.

Even more so than in the past, predicting which skills and stages are most in demand will be almost impossible as technological and organisational innovations unfold. With 'form' hard to predict, UK government measures to promote upgrading of skills and value creation should focus on incentives that individuals and entrepreneurs can employ to a wide range of circumstances. Individual retraining accounts should be preferred, for example, to sector-specific skills initiatives. Unpredictability means life-long learning should become the norm, supported where private sector finance is not available by state loans and support.

- **Promote viscid stages and technologies – through the benefits of co-location**

Those firms whose profitability and productivity is enhanced by locating close to competitors and skilled employees and suppliers would have to experience substantial wage and other cost savings from relocating abroad to offset the subsequent loss of co-location benefits. Some stages then are more viscid than others. There may be a role for public policy in ensuring that the calculus faced by such high productivity stages discourages relocation.

The UK has established strengths in a number of stages where co-location is important. As firms and employees don't capture all of the positive knock-on effects from moving to a district where the benefits of co-location are present, then there is a market failure that state action can seek to rectify. Search costs (for desirable locations) are relevant too. In reality firms and skilled employees will only consider moving to locations that they know enough positive things about. A location should be seen as a centre of excellence in a particular stage-or plausibly developing to become a first class centre.

There is another aspect to the asymmetric information problem here. Every location will have an incentive to claim that it is a terrific place for a firm to invest and the latter knows this. Two implications for policymaking follow. First, those designing initiatives to promote a location must pay careful attention to what potential firms and employees say they want is important -- bearing in mind that, as noted earlier, circumstances can change fast in international value chains. Second, credible signalling through independent verification of quality and associated rankings could play an important role here. Moreover, competition between districts, cities, and the like could be encouraged. Furthermore, national image is important. The impressions that little of high value is manufactured in the UK anymore and that UK universities don't produce enough high quality engineers, scientists, and the like are very unhelpful.

With state resources are at a premium, a smaller number of more generous interventions are preferred to spreading resources thinly across many initiatives. Effective policies to promote viscid locations will require considerable knowledge on the part of government of which stages generate high value added and are either inherently non-tradable or where private incentives not to migrate abroad strong as well as concentrating resources on a subset of potential stages and locations.

An even more controversial observation is that, if government is convinced that the private sector is over-estimating the benefits of relocating a stage abroad, then avoiding loss of critical mass in a cluster may justify interventions to discourage or prevent exit. Given the disappointment among industrialised country firms about outsourcing outcomes (Economist 2011) the private sector can hardly be credited with flawless insight. If poor corporate governance, undue pressure for short term profits, and poor understanding of the international relocation individually or together bias corporate decision-making towards relocation of a stage abroad, then the adverse knock-on effects for those firms that remain imply that private and social returns diverge.

Since much international technology is mobile, the logic underlying state-provided incentives for innovation should be rethought too. As shown earlier, the international relocation of technology can pose a threat to UK living standards. While banning UK exports of technology is impractical (because it is often embedded in new, better UK products) and counterproductive (not least because

it might entice other governments to retaliate and thereby deny UK buyers the benefits of foreign technologies), there is a further argument against granting state subsidies for the development of internationally transferable innovations that could eventually threaten UK living standards. There may well be other arguments in favour of such subsidies, so the point here is that the calculus should shift towards less subsidisation.

- **On net, a more integrated EU economy will support greater value creation by UK manufacturing**

Further measures to integrate EU markets that permit UK firms to source from a wider variety of suppliers would allow those firms to better capitalise on outsourcing possibilities. Sourcing a greater variety of inputs has been found to raise the productivity levels of buyers. Given the substantial manufacturing base in Continental Europe, regional infrastructure initiatives and improved trade facilitation in general should remain UK policy priorities. Defence of the Single Market -- including the free movement of persons--should remain a UK government priority.

- **Adopt a broader notion of cross-border differences to include cultural, administrative, geographic, and economic distance - not just physical distance.**

Distance should not merely be conceived of in physical terms. Countries also differ along cultural, administrative, economic, and other geographic dimensions. Now that tariff barriers have fallen and been eliminated within the EU (on manufactured goods at least) -- and assuming that higher oil prices do not raise international transportation costs so much that they offset the impact of tariff cuts -- then other cross-border differences matter more and the UK ought to have a comprehensive strategy that is flexible enough to calibrate such differences to optimise British economic performance.

On this score, UK foreign economic policy should continue to tackle government and private-sector measures that block competition from imports. Reducing administrative measures that unduly raise the cost of adapting products to foreign markets should be a priority. Likewise, wherever possible mutual recognition of product standards and educational qualifications should be encouraged within Europe. While this will provide non-EU firms a greater incentive to locate in clusters in the UK, it will also intensify competition between clusters within Europe. These measures should be complemented by others that capitalise upon differences which other EU jurisdictions find too hard, or wrenching, to emulate. Knowing when to narrow cross-border differences and when to widen them will become a central challenge facing UK policymakers seeking to promote manufacturing in the 21st century.

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