The world economy has become a more complex, interconnected place; changing patterns of international trade combined with significant changes in how businesses organise their production over global value chains demands a rethink of conventional approaches to policy. In addition, the recession that has followed the global financial crisis has been both deep and prolonged, creating further challenges for academics and policymakers alike.

This eBook forms the basis of a joint BIS-CEPR-ESRC conference on '*The UK in a Global World: How can the UK focus on steps in global value chains that really add value?*' held in London on 14 June 2012. The volume brings together the research of leading experts in international trade, innovation and economic history. The first of the chapters takes an historical view of the role of policy in creating comparative advantage; the second considers UK innovation and R&D in a global world. The third chapter looks at value creation and trade in manufactures and draws a number of important policy implications for UK manufacturing. The focus of the final chapter is on comparative advantage and service trade, what drives export growth and whether policy can influence the drivers.

As David Greenaway concludes in his introduction, this collection is timely reminder of the importance of looking beyond the current financial crisis when thinking about innovation and international competitiveness; it offers a sophisticated and nuanced evaluation of the scope for policy intervention and the processes that need to be worked through to raise the likelihood of efficacious intervention. Some of the key messages relate to infrastructure and environment, some to demanding due diligence and some to the imperative of long term commitment. Together they really add value and will be helpful and useful to both the research and policymaking communities.

The UK in a Global World

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How can the UK focus on steps in global value chains that really add value?

Edited by David Greenaway

BIS Department for Business Innovation & Skills

CEPR

E·S·R·C ECONOMIC & SOCIAL RESEARCH COUNCIL

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Foreword

The world economy has become a more complex, interconnected place. Changing trade patterns combined with a dramatic transformation in how businesses organise their production over global value chains (GVCs) requires us to reassess how we approach our policies today. Following the international fragmentation of production, the concept of an "industry" has become less relevant. Furthermore, value added can be created at all parts of the GVC, but what does GVCs exactly mean for a country's comparative advantage? Given that stages and activities of the production process are located across different countries; competitiveness and comparative advantage might increasingly have to be interpreted in terms of tasks instead of industries. This isn't just a marginal change. Two thirds of the EU's imports of goods are of intermediate products; intra industry trade.

It is therefore crucial that we strengthen our knowledge base and understanding. The rise in GVCs makes interpreting traditional trade statistics increasingly difficult, as they suffer from double counting. A new World Input Output Database has been created to identify the value added of trade, eliminating the double counting in traditional data, which overestimates the trade surpluses in 'assembly countries'. The new database suggests that around 80% of the value of EU's "traditional" gross exports is indeed EU domestic value added, emphasising the great importance of the Single Market as our exports tend to be "made in Europe". Another interesting result is that less than 1% of EU exported value added comes back to the EU.

However, we should not fall into the trap of blindly pursuing "high value added". What matters is how participation in GVCs compares with alternative use of those resources in other activities. We need to be more sophisticated in our policy making, recognising we may specialise in a range of tasks of varying skills and added value.

This eBook has been prepared for a joint BIS-CEPR-ESRC conference on 'The UK in a Global World' on 14 June 2012 and brings together the leading experts in the following fields: international trade, innovation and economic history and provides cutting edge knowledge and research. The evidence presented in the papers and the debate they stimulate will help ensure that we have the right policies in place for the future policy questions. These include: Is comparative advantage still relevant today? To what extent can governments influence comparative advantage? Are we negotiating trade deals with the right counties/ regions? How can we strengthen the capacity of firms to compete in the global market?

If we can create the right business environment, firms operating within the UK and the EU can prosper and deliver the economic growth which is required for the present and future generations.

The Rt. Hon. Dr Vince Cable MP
Secretary of State for Business, Innovation, and Skills

1 Introduction and Overview

David Greenaway
University of Nottingham

1 Context

The events following the 2007 sub-prime crisis have been remarkable: credit crunch, global financial crisis, recession and Eurozone crisis.

Even against the context of what Reinhart and Rogoff refer to as "Eight Centuries of Financial Folly'" the crisis struck with some ferocity and the recession which followed has been deep and prolonged. Naturally, these events and their consequences form the focus of most current commentary and analysis, and provide a bit of a headache for policymakers.

The financial crisis is important context for this book, if only because we do not yet know what its legacy will be and, in particular, when we can expect meaningful growth to resume. But this is not a book about the short-term problem of stimulating the economy out of its current torpor. Rather it is about medium-term growth prospects and the role that policy might have in shaping the economy's growth trajectory once it emerges from recession.

2 Policy lessons from history

When thinking about the future, the past is often the best place to start.

In Chapter 2 Nicholas Crafts takes the long view of the role of policy in creating comparative advantage and, in this case, the long view goes all the way back to the 1930s.

In setting out first principles, Crafts begins with the important distinction between 'horizontal' and 'selective' policies. The former refer to a range of fiscal, regulatory, infrastructure and innovation policies which alter the environment in which enterprises operate. By contrast, selective policies target specific sectors or even firms, an approach to policy often damned by the descriptor 'picking winners'.

Much more has been written about selective than horizontal intervention. Despite the availability of some supportive economic theory around infant industries, agglomeration spillovers and redistributing income from trading partners, it is a form of intervention which, though widely used, has few real exemplars of effectiveness.

Crafts begins his evaluation of supply side policies in the 1930s when protectionism of one form or another prevailed and persisted in the post WW2 years, indeed into the 1960s. From the change of government (in 1965) through to the 1979 election, extensive intervention took place, both horizontal and selective. Slow productivity growth and a marked relative decline in living standards were to be addressed through active intervention which at its peak consumed more than 5% of GDP. As well as targeting specific (declining) industries, policies were designed to change the composition of output across sectors (the Selective Employment Premium, which discriminated against services) and geographically (the Regional Employment Premium). As Crafts notes, "both were expensive failures".

After the election of Mrs Thatcher in 1979, there was a profound change in approach, which survived the demise of Conservative administrations in 1997: state-owned enterprises were privatised; the highest marginal tax rates were reduced; competition policy was strengthened; legislation was promulgated to erode the power of trades unions; enhancing the stock and quality of human capital became a priority, as did strengthening the science base. The period from the 1980s through to the financial crisis turned out to be a period of catchup in terms of productivity.

So what are the lessons for policy? Crafts lists four. First, deregulation and promotion of competition delivered real benefit, in contrast to protectionism and picking winners. Second, horizontal policies are of great importance, in regulation, education and promotion of rapid diffusion of new innovations. And on this front, there are areas of deficiency in the UK: in transport infrastructure which raises trade costs and in a number of areas of education. Third, agglomerations are increasingly important in a world of vertically disintegrated trade. They deliver productivity spillovers and attract investment.

The fourth lesson relates to the politics of delivering effective policy: all of the above are long term commitments and deliver in a period beyond an electoral cycle. Much political action is tied to the electoral cycle, which engenders status quo bias.

3 National innovation policy in a global world

Historically, then, innovation policy has been selective or horizontal and motivated by a desire to benefit from what Harold Wilson memorably referred

to as the "white heat" of the scientific and technological revolution. Fifty years on, opportunities are even greater. To give us a chance of exploiting these Alan Hughes argues we need to adopt a systems approach to innovation policy.

Broadly speaking, systems analysis has three broad components: agents operating in the domain under consideration; the institutions that frame that domain; and the myriad connections between agents. Adopting such an approach immediately shits the focus from targeting market failure to targeting system failure.

Hughes begins by looking at the UK innovation and R&D landscape in an international perspective. In overall gross domestic expenditure on R&D relative to GDP and researchers per 1,000 employees, the UK ranks relatively low in the OECD. This is even more so when the focus is narrowed to manufacturing. When higher education is brought in the picture improves, and in terms of international collaborations the UK is second only to the US.

Hughes looks at other ways of tracking the internationalisation of the UK innovation system, including rest of the world ownership of UK quoted shares (where there has been strong upward growth) and the impact of FDI (where the UK also figures strongly, especially in financial services and ICT). He also examines the extent to which UK R&D expenditures are generated by foreign controlled affiliates and the share of R&D funded from abroad. In both cases there is clear and strong evidence of internationalisation.

The extent of internationalisation and the dependence of the UK on FDI in increasingly vertically-integrated value chains sets the context for policy. This should not be framed by picking winners, but by 'choosing races and placing bets'. This means firstly assessing whether the UK possesses distinctive and outstanding scientific and technological competence in a particular area, then analysing market potential and national capability to deliver in that area. Foresight and mapping exercises have a key role to play here.

There also needs to be an evaluation of the wider societal implications of placing a particular bet, and a risk assessment of policy failure. Only when all of this is done should policy makers turn to the issue of what the most appropriate form of intervention. As Hughes acknowledges, following such an approach requires discipline, has significant data requirements and needs special analytical capabilities.

4 Value creation and trade in manufactures

Comparisons of the two great waves of globalisation that bridge the dawns of the last two centuries stress falling trade costs as a common factor, albeit with different drivers: steam power cutting trade costs in the second half of the 19th century

and ICT cutting communication costs in the second half of the 20th century. In Chapter 4 Richard Baldwin and Simon Evenett acknowledge the key role of these drivers, but contend that they had dramatically different consequences.

Baldwin and Evenett characterise these two waves of globalisation as two 'unbundlings'. The first drove dramatic reductions in trade costs facilitating greater separation of production and consumption. Differences in endowments and productivity interacting with scale economies meant that this separation could be profitably exploited and international trade expanded rapidly. Baldwin and Evenett argue that intuition from this unbundling is embedded in the DNA of policymakers and shapes their view of trade policy as well as complementary areas of policy.

In the modern world shaping policy by reference to falling trade costs and traditional notions of comparative advantage is misplaced and may result in perverse outcomes. Why? Because the second unbundling, triggered by the ICT revolution, lowered coordination costs rather than trade costs. Wage differences across countries provided the incentive to disperse production and dramatic developments in ICT meant production could be coordinated more easily across great distances.

One conclusion often drawn from this is that that means good jobs go abroad. But matters are not that simple: the benefits of agglomeration of economic activity mean location specific competitive advantages are very real and as a result, some jobs are viscid and do not relocate.

Baldwin and Evenett draw a number of important policy implications from this. First, it is important to recognise up front that this second unbundling brings opportunities as well as threats, many tasks do remain in high wage industrialised economies and they are consumers of high value services. Second, long term investment in creating a competitive and innovative business environment is essential to support manufacturing. Third, in targeting manufacturing activity, policy makers should be focused on tasks, not sectors, which has important implications for the kinds of policy instruments deployed. Fourth, target viscid rather than mobile tasks and technologies (acknowledging the very exacting information requirements of delivering this). Fifth, take into account the broader regional dimensions of policy across the EU; and finally, in focusing on international dimensions, recognise that cross-border differences are broader than just physical distance.

5 Comparative advantage and services

One consequence of the global financial crisis is a perception that the UK has become too dependent on services in general and financial services in particular.

The follow on from this is that some 'rebalancing' of economic activity is required, on the assumption presumably that that reduces the likelihood of future financial crises. Even if the latter were the case, the importance and value of trade in services is such that significant rebalancing is unlikely.

The focus of Chapter 5 is comparative advantage in service trade. Giordano Mion begins by reminding us of the remarkable growth in service trade in general and in the UK in particular. His focus is what drives export growth and can policy influence the drivers?

Mion builds a gravity type model, where economic size and a range of indicators of trade costs are complemented by a rich array of economic variables, as well as variables which proxy for the ICT revolution and the key role that institutions have to play in promoting (or retarding) trade flows. This is a widely used and well understood approach to evaluating trade flows. Since services might account for up to 75% of GDP globally, and 20% of total world trade, understanding the determinants of exports is clearly important.

Mion's analysis is carefully executed and the results are rich in detail. From a UK perspective, one conclusion is that it is well positioned given its strong legal and financial institutional infrastructure, its stock of human capital and the access it enjoys to large and rich markets. The UK is very competitive in service exports. However, there is some catchup taking place as established and emerging competitors invest in human capital and infrastructure. The implication is that if the UK wishes to sustain its dominant position, continued investment in these areas will be required.

6 End note

This collection is a timely reminder of the importance of looking beyond the current financial crisis when thinking about innovation and international competitiveness. They offer a sophisticated and nuanced evaluation of the scope for policy intervention and the processes that need to be worked through to raise the likelihood of efficacious intervention. Some of the key messages relate to infrastructure and environment, some to demanding due diligence and some to the imperative of long-term commitment. Together they really add value and will be helpful and useful to both the research and policymaking communities.

2 Creating Competitive Advantage: Policy Lessons from History

Nicholas Crafts
ESRC Research Centre CAGE, University of Warwick

1 Introduction

In the 1990s, 'national competitiveness' was defined as "the degree to which the country...can produce goods and services which meet the test of international markets, while simultaneously maintaining and expanding incomes of its people over the long term" (DTI, 1994). This definition still has value and Lord Heseltine, then president of the Board of Trade, is now in 2012 conducting a competitiveness audit.

This version of the 'national competitiveness' concept is useful in several ways. It recognises that international trade is a positive-sum game, that as an open economy the UK can share in the gains from trade but that the growth of real national income depends in part on the terms of trade, and that underlying both the growth of real GDP per person and successful participation in international markets is labour productivity growth. In turn, labour productivity growth comes from the growth of (broad) capital per hour worked and total factor productivity (TFP) growth, i.e. improvements in the efficiency and technology with which capital and labour are used.

So economic growth, and especially productivity growth, is at the heart of the matter. In turn, long-run productivity performance depends upon decisions to invest, innovate, and adopt new technology which in a market economy will be sensitive to incentive structures. This means that a wide range of government actions which comprise 'supply-side policy' can potentially have an impact on productivity growth.

Over the period since the 1930s there has been considerable variation in the design of UK policies intended to improve growth outcomes. Combating British relative economic decline was a major issue from 1960 onwards; in this regard, Table 1 suggests that outcomes were more favourable post-than pre-1979. Informed by key ideas from economics, this brief review seeks to draw out some

of the main lessons from the historical experience and to highlight some policy implications of past successes and failures.

Table 1 Real GDP/head (UK = 100 in each year)

	US	West Germany	France
1870	76.6	57.6	58.8
1913	107.8	74.1	70.8
1929	125.3	73.6	85.6
1937	103.4	75.4	72.2
1950	137.7	61.7	74.7
1979	142.7	115.9	111.1
2007	132.6	98.6	94.3

Note: Estimates refer to Germany from 1870 to 1937.

Sources: Angus Maddison historical database and West Germany in 2007 calculated from Statistiches Bundesamt Deutschland 2010.

2 Key ideas

2.1 Growth in an open economy

Despite attaining laughing-stock status in Punch-and-Judy politics, 'post-neoclassical endogenous growth theory' offers important insights into the way supply-side policy can be designed to promote productivity growth. The main thrust is that growth depends on investment in tangible and intangible capital, in education and training, and on innovation. Decisions to invest and innovate respond to economic incentives such that well-designed policy which addresses market failures can raise the growth rate a bit. This implies that governments need to pay attention to making investments that complement private sector capital accumulation, for example in infrastructure, supporting activities like R and D where social returns exceed private returns, avoiding the imposition of high marginal direct tax rates and fostering competitive pressure on management to develop and adopt cost-effective innovations.

In the long-run, the key to sustained growth in labour productivity (and growth in living standards) is technological progress. In this context, however, it is important to recognise that better technology can be the result of domestic invention or technology transfer from abroad which is implemented by means of appropriate investments in physical and organisational capital. In fact, most new technology comes from abroad and TFP growth depends much more on foreign than domestic R & D; Eaton and Kortum (1999) estimated that even in big advanced countries such as France, Germany and the UK the domestic R & D contribution was in the range 11% to 16% compared with a foreign contribution

of 84% to 89%, of which close to half came from the US. That said, domestic R & D has high social returns and an important part of its payoff is in enabling effective technology transfer (Griffith et al., 2004).

Nevertheless, the contribution of new technology to growth comes from its use. The key to good growth performance is prompt and effective diffusion of foreign technology rather than domestic invention. A key example in recent times has been ICT which has raised growth potential in countries with no ICT production by providing a new type of capital equipment whose price has been falling very rapidly implying that profit-maximising decisions would raise the ratio of ICT equipment relative to other types of capital.[1] Table 2 reports estimates of the long-run growth contribution of ICT. Two points stand out. First, the ICT-use effect dominates the ICT-output effect. Second, if all countries were as effective as Sweden in diffusing these technologies, the growth contribution would be significantly higher in most cases.

Table 2 CT and long-run growth potential (% per year)

	ICT-Use Own β	ICT-Use Swedish β	ICT-Output
France	0.48	0.68	0.17
Germany	0.44	0.68	0.33
Italy	0.36	0.70	0.19
Spain	0.53	0.76	0.10
Sweden	0.70	0.70	0.24
UK	0.60	0.66	0.16
USA	0.70	0.71	0.22

Note: β is the factor share of ICT capital; a high value indicates relatively successful diffusion and is conducive to a higher growth contribution. The estimates assume that the real price of ICT equipment continues to fall at 7% per year and the steady-state growth implication is derived using a neoclassical growth model with 2 types of capital

Source: Oulton (2010)

Growth accounting is a way of further quantifying these arguments. Some recent estimates based on a methodology which explicitly identifies a contribution from intangible capital are reported in Table 3. The important points to note are first, TFP growth is the largest contributor to labour productivity growth but domestic R & D contributes relatively little, second, investment in tangible capital remains important as a source of labour productivity growth, and third, investment in intangibles other than R & D is far more important than R & D per se.

1 Oulton (2010) shows that steady-state growth in a country with no ICT production predicted by a neoclassical model adapted to include both ICT and non-ICT capital in the production function will be augmented by $(\beta\Delta p/p)/s_L$ where β is the share of ICT capital in national income, $\Delta p/p$ is the rate of decline of the price of ICT equipment relative to other capital goods and s_L is the share of labour in national income.

Table 3 Sources of growth in real GDP/hour worked in the UK market sector, 1990-2008 (% per year)

	1990–95	1995–2000	2000–08
Tangible Capital	0.95	0.74	0.67
Labour Quality	0.17	0.25	0.16
R & D	0.05	0.04	0.05
Other Intangibles	0.58	0.63	0.47
TFP	1.19	1.87	0.90
Total	2.94	3.53	2.25

Notes: Derived using the formula $\Delta(Y/HW)/(Y/HW) = \alpha(\Delta TK/HW)/(TK/HW) + \beta(\Delta HK/HW)/(HK/HW) + \gamma(\Delta RD/HW)/(RD/HW) + \delta(\Delta IK/HW)/(IK/HW) + \Delta A/A$ where TK is tangible capital, HK is human capital, IK is intangible capital, RD is the stock of R & D, all weighted by their factor shares, and A is TFP, HW is hour worked. Intangible capital includes capital services from mineral exploration and copyright, from design, from advertising and market research, from firm-level training and from organizational capital.

Source: Dal Borgo et al. (2012)

Table 4 examines sectoral contributions to recent labour productivity growth; the top sector is distribution. There are two points to take from this. First, a sector's contribution depends not only on its productivity growth rate but its weight in the economy. Second, distribution is a sector which does (virtually) no R & D but is big and has benefited greatly from the opportunity to improve productivity using ICT. In sum, policymakers should be aware of the basic arithmetic of growth and realise that diffusion matters much more than invention and that productivity improvement in big service sectors is central.

Table 4 Top 6 sectoral contributions tolabour productivity growth, 1995-2007 (% per year)

	Value-added share weight	Growth Rate of Real GDP/HW	Contribution
Wholesale and Retail Trade	0.123	3.05	0.38
Post & Telecommunications	0.030	9.00	0.28
Business Services	0.220	1.06	0.23
Financial Services	0.046	4.23	0.19
Electrical and Optical Equipment	0.021	6.64	0.14
Transport & Storage	0.048	2.58	0.12

Source: EUKLEMS database.

Economic growth is an unbalanced process – over time, some sectors expand and others contract. This reflects relative productivity growth, differences in income elasticities of demand, and, in an open economy, comparative advantage which reflects relative production costs between the UK and the rest of the world based on differences in productivity and payments to factors of production. Comparative advantage evolves reflecting developments both in the UK and our trading partners in terms of relative wage rates, technological capabilities, labour force skills, agglomeration benefits and this implies the need for sectoral and spatial adjustment as workers are redeployed, especially away from activities

which have become importables in the face of competition from emerging Asia. A key requirement fully to realise the benefits from increased trade in a globalising world is flexibility of labour and product markets. The general trajectory of adjustment for the UK has been and can be expected to be towards human-capital intensive activities including internationally-tradable services.

Increased openness to trade raises income levels and does so by more than the traditional welfare-triangles measure. Trade raises producer efficiency and thus TFP levels. The estimates of Frankel and Romer (1999) refined by Feyrer (2009) suggest that across countries if the sum of imports and exports relative to GDP goes up by one percentage point on average income per person rises by 0.5%. Specialisation in international trade does mean that the proportions of different sectors will vary across countries. It is potentially disadvantageous for overall productivity performance if comparative advantage promotes a high weight in low productivity growth activities. However, it would be wrong to make too much of this point since shift-share analyses always show that intra-sectoral productivity growth totally dominates composition effects.

Although higher productivity may seem attractive, the politics of achieving it may be quite challenging. A central aspect of technological progress is 'creative destruction', i.e., the exit of the old replaced by entry of the new. The pursuit of higher productivity through policies such as trade liberalisation creates losers as well as gainers; realising the potential productivity gains from privatisation involves job losses. The common theme here is that, while there are gains for the economy as a whole, these do not translate into votes whereas the losses of the downsized producer groups are highly visible, matter a lot to the individuals involved, and have adverse implications for vote-seeking politicians.

2.2 Industrial policy

'Industrial policy' is perhaps best defined in the manner of Caves (1987) to encompass public sector intervention aimed at changing the distribution of resources across economic sectors and activities. Thus, it includes both 'horizontal' policies which focus on activities such as innovation, provision of infrastructure and so on, while 'selective' policies aim to increase the size of particular sectors. The classic justification for industrial policy is that it remedies market failures, for example, by providing public goods, solving coordination problems, or subsidising activities with positive externalities.

More generally, the development of endogenous-growth theory suggests that horizontal policies which raise the appropriable rate of return to innovation and/or investment can have positive effects on the rate of growth. Quite a wide range of government policies might be relevant here including the structure of taxation, extent and type of regulation, quality of state education and supply of

infrastructure capital which raises private sector profitability.[2] For example, there is good reason to believe that the social rate considerably exceeds the private rate of return to R & D (Jones and Williams, 1998) and reliance on the market alone will mean too little R & D. Of course, since research intensity varies across industries, horizontal policies to encourage R & D help some sectors more than others. Similarly, there is evidence that investment in transport infrastructure has positive impacts on private sector investment and TFP (Kamps, 2005b; Egert et al., 2009) but these effects are greater in sectors that use transport intensively (Fernald, 1999).

The case for selective industrial policies has always been more controversial. However, the modern literature highlights three arguments in their favour, namely: infant-industry related capital market failures, agglomeration externalities, and rent-switching under imperfect competition. At the same time, a number of pitfalls in the use of such policies have been noted.

'Infant industry' arguments are not new but they have been reworked in recent times, notably by Bardhan (1971) and Young (1991). The case is for temporary protection of industries which are not currently internationally competitive but will be when productivity has improved through increasing returns and, in particular, learning by doing. The case for intervention really depends on the capital market's inability to finance these activities even though they will become privately profitable, perhaps because the learning effects accrue to the industry as a whole rather than being firm-specific. A key issue is whether the government can credibly commit to the policy intervention being temporary.

The advent of the new economic geography has increased awareness of the potential importance of agglomeration benefits which accrue when economic activity is characterised by scale economies together with market size effects. As city size increases, productivity gains can be realised through knowledge spillovers, better availability of intermediate inputs and the advantages of a thicker labour pool. Policy interventions may then be justified on the grounds of spatial externalities which are now recognised by the Department for Transport (2006) as an example of the 'wider economic benefits' that can result from transport projects. In cases where size matters, there may be gains from policy interventions that facilitate the expansion of an agglomeration or, indeed, the establishment of a successful cluster which obtains first-mover advantages.

The rent-switching argument came to prominence in the 1980s through the work of Brander and Spencer (1985). The argument here is that in cases of strategic rivalry in international trade the state can influence entry and exit decisions by offering subsidies that result in higher market share for its firm at the expense of a foreign rival and redistribute super-normal profits accordingly.

2 It is important to remember that the supply of public capital has to be financed and that the taxes that are levied to this end tend to have offsetting effects on private rates of return. For a discussion of the growth-maximizing ratio of public to private capital, see Kamps (2005a).

Because government values objectives other than private profits it may be able credibly to commit to finance entry where capital markets cannot. Whether such interventions will succeed may be hard to predict, however, and where their size and/or timing turn out to be inappropriate they may be expensive failures.

It should also be acknowledged that there are important potential downsides to the use of selective industrial policy. In particular, it has been widely remarked that, in practice, support is disproportionately given to sunset rather than sunrise industries and some economists argue that this 'government failure' is an inherent aspect of the political economy of industrial policy. Recently, Baldwin and Robert-Nicoud (2007) have used a variant of the well-known 'protection-for-sale' model to argue that the asymmetric appropriability of rents implies losers lobby harder while earlier explanations include the 'social insurance' explanation of Hillman (1989) and the suggestion by Krueger (1990) that known losers in ailing industries are more visible than unknown gainers in expanding industries. It should also be recognised that insofar as selective industrial policy works through protection of domestic producers some of the potential gains from trade are given up.

An important issue is whether industrial policy reduces competition. Although theory is ambiguous about the impact of competition on productivity performance, the evidence for the UK is very strongly that there is a positive effect. This has worked in several ways including encouraging innovation to protect rents (Aghion et al., 2009), reducing agency problems within firms (Nickell, 1996), improving management practices (Bloom and van Reenen, 2007) and reducing the power of unions to resist organisational change (Machin and Wadhwani, 1989). Ideally, industrial policy should be used in a competition-friendly way and not through aiming to create 'national champions' (Aghion et al., 2011).

3 A short history of British supply-side policy

3.1 The 1930s

The interwar economy saw a major shift in supply-side policy away from Victorian orthodoxy. Prompted initially by high unemployment and the travails of the old staple industries and given considerable impetus by the world economic crisis, governments became more willing to intervene. This period saw the beginnings of industrial policy in the 1920s, the general tariff on manufacturing in 1932, encouragement of cartels and imposition of controls on foreign investment in the 1930s. These changes were complemented by exit from the gold standard in 1931 followed by the era of cheap money so that Britain in the 1930s has been described as a 'managed economy' (Booth, 1987). The hallmark was a

central objective of a steady increase in the price level - which on the assumption that money wages would not react also amounted to reducing real wages and restoring profits – subject to not letting inflation spiral out of control. The rise in the price level would be promoted through cheap money, a weak pound, tariffs, and encouraging firms to exploit their (enhanced) market power. This was entirely understandable as a short-term fix. However, this was a major retreat from competition which turned out to be quite long-lasting. What were the implications for productivity performance?

The growth performance of the British economy in the 1930s has sometimes been viewed quite favourably, especially by writers sympathetic to the view that Britain failed in the pre-1914 period (Pollard, 1983). It is, however, difficult to accept the claim that there was a marked improvement in growth performance in the 1930s. The most obvious point to make is that the growth rate of real GDP and TFP between 1929 and 1937 fell back from that of 1924 to 1929 and was lower than in the late 19th century while TFP growth remained well below the standard set by the United States during the first half of the twentieth century. Time series econometric analyses do not indicate a break in 1929 either in GDP or industrial production growth (Mills, 1991; Greasley and Oxley, 1996). Notwithstanding the much greater severity of the depression in the United States, output per hour worked continued to grow faster in American manufacturing with the result that the level of American labour productivity was 2.74 times that of the UK in 1937 compared with 2.41 in 1913 and 2.64 in 1929.

As might be expected, the interwar economy exhibits symptoms of a considerable increase in market power. Mercer (1995) showed that by 1935 at least 29% of manufacturing output was cartelised. A proxy for the price-cost margin calculated from the Census of Production shows an average increase of 3.8 percentage points across manufacturing sectors (from 0.563 to 0.601) from 1924 to 1935 while in the cartelised sectors the increase was 9.0 percentage points. Hart (1968) estimated that the rate of return on capital employed for manufacturing companies had risen to 16.2% by 1937 from 11.4 % in 1924.

There is no evidence that the retreat from competition in the 1930s was good for productivity performance; if anything, the opposite is the case. Broadberry and Crafts (1992) examined the impact of reduced competition on productivity performance. Controlling for other variables, they found a negative correlation between changes in the price-cost margin and productivity performance for a cross-section of British industries in the period 1924 to 1935, and that British industries which had a high 3-firm concentration ratio had lower labour productivity relative to the same industry in the United States in 1935/7. They also presented a number of case studies which led them to conclude that cartelisation, weak competition and barriers to entry had adverse implications for productivity outcomes. It is also clear that government-sponsored restraint of competition in coal (Supple, 1987), cotton (Bamberg, 1988) and steel (Tolliday, 1987) was ineffective in promoting productivity improvement through rationalisation

although this was supposedly a key policy objective. Tariffs were definitely not an 'infant-industry' policy; in fact, the largest increases in effective protection went to 'old' industries such as hosiery and lace and railway rolling stock (Kitson et al., 1991). A difference-in-differences analysis based on timing and extent of protection of manufactures finds no evidence that tariffs improved productivity performance (Crafts, 2012).

Finally, it is clear that macroeconomic crises can have long-lasting effects on trend growth (rather than simply levels effects on GDP) through the policy responses which they generate at the time and then become entrenched. For the UK, the 1930s bred protectionism and an economy in which the typical business enjoyed considerable market power. There is clear evidence that this was bad for productivity performance but the politics of reversing these developments was difficult. The risks of a supposedly 'temporary' abandonment of competition policy, and the likelihood that the long-term downside of so doing would heavily outweigh any short term gain, are apparent. Although during the war some officials at the Board of Trade had planned a tough anti-trust policy, lobbying by industry and the exigencies of the post-war export drive meant these plans were abandoned. The only significant measure was the 1956 Restrictive Practices Act but even this was an accident where the interpretation of the law by the courts turned out to be very strict, contrary to the expectations of business. Mercer (1995) documents the strong commitment of industrialists to the retention of their anti-competitive practices and their success in using the political process to obstruct reforms that would have introduced effective competition policies in early post-war Britain.

3.2 The 1950s through the 1970s

During these years Britain experienced its fastest-ever economic growth but at the same time relative economic decline proceeded at a rapid rate vis-à-vis its European peer group. During the so-called 'golden age' which ended in 1973, UK growth was slower by at least 0.7 percentage points per year compared with any other country including those who started the period with similar or higher income levels. The proximate reasons for this were weak capital per worker and TFP growth compared with more successful economies such as West Germany. Maddison (1996) attempted a decomposition of the sources of TFP growth which concluded that the shortfall could not be explained away by lower scope for catch-up or the structure of the economy, although clearly very rapid TFP growth in countries such as West Germany did reflect reconstruction, reductions in the inefficient allocation of resources, and lower initial productivity (Temin, 2002). Being overtaken by France and West Germany (Table1) is a clear sign of avoidable failure.

In the early post-war years, supply-side policy continued along the trajectory established in the 1930s. The striking feature is how long it took to reverse

this; not until the 1980s were most of these issues addressed. Table 5 underlines the slowness of the retreat from protectionist policies. Average tariff rates for UK manufacturing remained at 1930s levels until the early 1960s and were considerably higher than in West Germany in the late 1950s. Trade costs remained above the 1929 level until the 1970s when liberalisation under the GATT and entry to the EEC drove them down; the contrast with countries which signed the Treaty of Rome in 1957 is apparent. However, early post-war governments were interventionist and this was the heyday of selective industrial policy (Table 6). It was also a period when there was increasing disappointment at relative economic decline and policymakers tried hard to increase the rate of economic growth during the 1960s and 1970s. Generally speaking, the literature has been highly critical of both horizontal and selective industrial policy in this period which saw substantial spending on them, peaking at 5.4% of GDP in 1970 (Wren 1996a).

Table 5 Trade Costs Index, 1929-2000

	UK-France	UK-Germany	France-Germany	Germany-Italy
1929	100	99	99	110
1938	121	122	133	112
1950	122	142	112	127
1960	122	115	91	101
1970	110	105	73	79
1980	74	66	55	61
1990	70	61	53	56
2000	75	66	61	66

Note: Trade costs include all barriers to trade (policy and non-policy) and are derived from estimation of a gravity equation.

Source: Data underlying Jacks et al. (2011) kindly supplied by Dennis Novy.

With regard to horizontal policies, several points deserve to be noted. First, this period was characterised by a big emphasis on investment subsidies, amounting to about 10% of fixed investment at their peak in 1978 (Driver and Temple, 1999). These are widely thought to have been a badly-designed policy which was poorly targeted and represented very poor value for money. The econometric evidence is that they had little effect on the volume of investment over the long run (Sumner, 1999) with the implication that there was a large deadweight cost. Second, the UK spent heavily on R & D; at 2.3% of GDP in 1964 this was second only to the United States and a high fraction was government financed. Here there was a market-failure justification in principle but unfortunately, this seems to have been badly directed and to have had little impact on productivity performance (Verspagen, 1996). Ergas (1987) summed up British policy as much too concerned with trying to produce radical innovations and too little aimed at effective technology transfer. Third, Table 6 reports large amounts spent on employment subsidies in the late 1960s and early 1970s. The schemes involved were the Selective Employment Premium and Regional Employment Premium. Both were costly errors. The former was designed to favour employment in manufacturing at the expense of services on the mistaken belief in Verdoorn's

Law.[3] The latter was an attempt to deal with the difficulties of regions which could not devalue with the UK currency union. It was a very costly way of 'creating jobs' with big deadweight losses (Wren, 1996b). Finally, the tax system was characterised by very high marginal direct tax rates such that Tanzi (1969) described it as the least conducive to growth of any of the countries in his study.

Turning to selective industrial policy, there is also little to celebrate. Although 'picking winners' may have been the aspiration, "it was losers like Rolls Royce, British Leyland and Alfred Herbert who picked Ministers" (Morris and Stout, 1985, p. 873). There was a very clear tendency for selective subsidies to be skewed towards relatively few industries, notably aircraft, shipbuilding and, latterly, motor vehicles (Wren, 1996a). The high expenditure on shipbuilding is striking since this was clearly an industry in which the UK no longer had a comparative advantage in the face of Asian competition. More generally, there is quite a strong bias towards shoring up ailing industries which is well reflected in the portfolio of holdings of the National Enterprise Board (Wren, 1996b), in the pattern of tariff protection across sectors (Greenaway and Milner, 1994), and also in the nationalisations of the 1970s where the prevalence of very poor rates of return reflected a lack of political will to eliminate productive inefficiency (Vickers and Yarrow, 1988).

Moreover, policies to subsidise British high-technology industries with a view to increasing world market share in sectors where supernormal profits might be obtained were notably unsuccessful in this period in a number of cases including civil aircraft, which by 1974 had cost £1.5 billion at 1974 prices for a return of £0.14 billion (Gardner, 1976), computers (Hendry, 1989) and nuclear power (Cowan, 1990). A combination of subsidies to American producers linked to defence spending and the relatively small size of the British market undermined these attempts at rent-switching. One sector which did represent a success was pharmaceuticals. It is generally agreed that government policy underpinned this success but it is less clear what have been the relative contributions of different aspects of that policy.

One major impact of government may have been through the demand side and the drug-purchasing policies of the NHS. The Pharmaceutical Price Regulation Scheme (PPRS) has shaped the incentives facing pharmaceutical companies. It is suggested by some that over time this acted as a successful industrial policy which provided a distinctive form of rate of return regulation which could be manipulated by the Department of Health to encourage R and D in the UK (Thomas, 1994). Moreover, given that the industry has earned significant rents on its exports (Garau and Sussex, 2007) this might also be seen as an example of success with strategic trade policy. Other writers are sceptical of this view noting

3 Verdoorn's Law was a favourite idea of Nicholas Kaldor. It claims that in manufacturing the rate of growth of labour productivity is positively related to the rate of growth of employment (dynamic economies of scale). This hypothesis was rejected by the evidence in Chatterji and Wickens (1982) who showed that there was a short-run cyclical relationship of this kind (Okun's Law) but no long-run one.

that the UK is a small part of the world market and arguing the quality of the science base is by far the most important factor in location decisions for R & D in pharmaceuticals (NERA, 2007). From this perspective, the most important aspect of government support has been the provision of elite research universities with world-class departments in the key sciences together with public funding for research through the Medical Research Council. This was the view taken by OFT (2007) in its report which argued for the end of the PPRS.

Competition policy was inaugurated with the Monopolies and Restrictive Practices Commission in 1948, evolved through the Restrictive Practices Act (1956) and the Monopolies and Mergers Commission (1965), but was mostly ineffective (Clarke et al., 1998). Few investigations took place, very few mergers were prevented, the process was politicised, a variety of 'public-interest' defences for anti-competitive activities were allowed, and there were no penalties for bad behaviour. Not surprisingly, there is evidence that the British economy was characterised by substantial market power in this period (Crafts, 2012). The evidence on lack of competition and British productivity performance during the Golden Age both shows an adverse effect and also that this worked at least partly through industrial relations and managerial failure. Broadberry and Crafts (1996) found that cartelisation was strongly negatively related to productivity growth in a cross section of manufacturing industries for 1954-63. This result is borne out by the difference-in-differences analysis in Symeonidis (2008) who showed that when cartels were abandoned following the 1956 Restrictive Practices Act labour productivity growth in formerly-colluding sectors rose by 1.8 percentage points per year in 1964-73 compared with 1954-63. This finding suggests that a more vigorous competition policy would have improved productivity performance. Finally, econometric analysis found that in the 1970s and 1980s greater competition increased innovation (Blundell et al., 1999) and raised productivity growth significantly in companies where there was no dominant external shareholder (Nickell et al., 1997). Both these results underline the role of weak competition in permitting agency-cost problems to undermine productivity performance.

3.3 1979 to 2010

After the election of the Thatcher government, the stance of supply side policy changed markedly. Selective industrial policies were phased out, horizontal policies were downsized and narrowed in scope with the ending of most investment and employment subsidies, while competition in product markets was strengthened considerably, initially through reducing trade barriers and deregulation rather than by strengthening anti-trust policy. Table 6 shows that spending on 1970s style industrial policy had largely been discontinued by the later-1980s. Privatisation, reform of industrial relations, and restructuring taxation were the new priorities.

Table 6 Grant-equivalent expenditure on industrial subsidies (£ million, 1980 prices)

	Investment	Employment	Industrial Support	Civil Aircraft	Shipbuilding	Technology & Other	Total
1963/4	2680		15	70			2765
1964/5	2922		14	62			2996
1965/6	2632		10	93	22		2757
1966/7	1121	1226	2	144	25		2518
1967/8	1302	3474	7	213	30		5026
1968/9	1554	3794	48	272	56		5724
1969/70	1814	4988	36	292	143		7273
1970/1	2133	6352	41	269	124		8919
1971/2	2496	3458	35	400	47		6436
1972/3	2732	2199	57	345	102		5435
1973/4	3188	695	97	235	108		4323
1974/5	3467	361	50	276	232		4386
1975/6	3870	406	30	211	125		4642
1976/7	4130	499	52	67	128		4876
1977/8	4482	254	497	37	153	6	5429
1978/9	4902	193	344	83	84	17	5623
1979/80	4483	125	300	22	105	33	5068
1980/1	4050	365	373	7	108	39	4942
1981/2	3754	226	469	1	118	62	4630
1982/3	3622	185	322	7	78	83	4297
1983/4	3195	91	103	8	52	99	3548
1984/5	2317	30	16	44	37	109	2553
1985/6	1507	22	9	53	54	107	1752
1986/7	756	19	3	57	11	93	939
1987/8	223	10	1	61	30	77	402

Notes: 'Industrial support' excludes aircraft and shipbuilding and is mainly given to the motor industry; 'other' includes business consultancy and small firms loan guarantee schemes.

Source: Wren (1996a)

When Labour won a landslide victory in the 1997 election, it was possible to wonder whether in government it would revert to 'Old Labour' policies. The answer soon became apparent and was a resounding 'No'. 1970s-style policy was conspicuous by its absence: there was no nationalisation programme, no move to subsidise manufacturing investment, no counterpart of the National Enterprise Board, no return to high marginal rates of direct tax, no attempt to resist de-industrialisation by supporting declining industries, and no major reversal of industrial relations reform. Implicitly, the Thatcher supply-side reforms had been accepted. The changes that Labour made were to strengthen some aspects of horizontal industrial policies with a new emphasis on education, R & D, investing in public capital and strengthening competition policy.

In fact, before, during and after Thatcher, government policy moved in the direction of increasing competition in product markets. In particular, protectionism was discarded with liberalisation through GATT negotiations,

entry into the European Community in 1973, the retreat from industrial subsidies and foreign exchange controls in the Thatcher years, and implementation of the European Single Market legislation in the 1990s. Trade liberalisation in its various guises reduced price-cost margins (Hitiris, 1978; Griffith, 2001). The average effective rate of protection fell from 9.3% in 1968 to 4.7% in 1979, and 1.2% in 1986 (Ennew et al., 1990), subsidies were reduced from £9 billion (at 1980 prices) in 1969 to £5 billion In 1979 and £0.3 billion in 1990 (Wren, 1996a), and import penetration in manufacturing rose from 20.8% in 1970 to 40.8% by 2000. The downward trend in the mark-up from the 1970s onwards appears to have intensified further after the early 1990s (Macallan et al., 2008). Anti-trust policy was notably strengthened by the Competition Act of 1998 and Enterprise Act of 2003 which increased the independence of the competition authorities, removed the old 'public-interest' defence, and introduced criminal penalties for running cartels.

Increased competition and openness in the later twentieth century was associated with better productivity performance. Proudman and Redding (1998) found that across British industry during 1970-90 openness raised the rate of productivity convergence with the technological leader and, in a study looking at catch-up across European industries, Nicoletti and Scarpetta (2003) found TFP growth was inversely related to PMR, a measure of the extent to which product market regulation inhibits competition. The implication of a lower PMR score as compared with France and Germany was a TFP growth advantage for the UK of about half a percentage point per year in the 1990s. At the sectoral level, when concentration ratios fell in the UK in the 1980s, there was a strong positive impact on labour productivity growth (Haskel, 1991). Entry and exit accounted for an increasing proportion of manufacturing productivity growth, rising from 25% in 1980-5 to 40% in 1995-2000 (Criscuolo et al., 2004).[4] The index of competition policy reported in Table 7 shows British competition policy was still very weak by international standards in 1995 but much stronger ten years later; the analysis in Buccirossi et al. (2009) suggests this was a move conducive to better productivity performance.

4 This comes entirely from more entry and exit rather than a greater productivity impact from entry and exit, see Criscuolo et al. (2004, Table 2).

Table 7 Competition Policy Indicator (0-1)

	1995	2005
France	0.45	0.52
Germany	0.49	0.52
Italy	0.41	0.44
Netherlands	0.42	0.53
Spain	0.36	0.42
Sweden	0.69	0.66
United Kingdom	0.31	0.60
USA	0.59	0.62

Note: first year for Netherlands is 1998 and for Spain is 2000.
Source: Buccirossi et al. (2009).

The impact of stronger competition was felt at least partly through greater pressure on management to perform and through firm-worker bargains which raised effort and improved working practices. Increases in competition resulting from the European Single Market raised both the level and growth rate of TFP in plants which were part of multi-plant firms and thus most prone to agency problems (Griffith, 2001). Liberalisation of capital market rules allowed more effective competition for corporate control and a notable feature of the period after 1980 was divestment and restructuring in large firms and, in particular, management buyouts (often financed by private equity) which typically generated large increases in TFP levels in the period 1988-98 (Harris et al., 2005). The process of privatisation raised productivity performance appreciably as nationalised industries were prepared for sale (Green and Haskel, 2004).

An interesting example of this is Rolls-Royce, which was nationalised in 1971 and successfully privatised in 1987. In one way, this can be seen as a success for selective industrial policy which saved a company that had made a disastrous error in signing a fixed-price contract to supply the RB-211 engine to Lockheed which bankrupted it when development and production costs rose far above initial estimates. Eventually, the sale of Rolls-Royce realised £1.36 billion. for the government compared with net subsidies of £0.83 billion. over the previous 20 years and Rolls-Royce went on to become the highly-profitable, second largest producer of civil-aircraft engines in the world (Lazonick and Prencipe, 2005). It should be noted, however, that it was only as the prospect of privatisation loomed in the mid-1980s that, under new management, the company developed a viable business strategy and worked out a cost-effective way of upgrading the RB-211 for the big-engine market.

The 1980s and 1990s saw major changes in the conduct and structure of British industrial relations. Trade union membership and bargaining power were seriously eroded. This was prompted partly by high unemployment and anti-union legislation in the 1980s but also owed a good deal to increased competition (Brown et al., 2008). The 1980s saw a surge in productivity growth in unionised firms as organisational change took place under pressure of competition (Machin

and Wadhwani, 1989) and de-recognition of unions in the context of increases in foreign competition had a strong effect on productivity growth in the late 1980s (Gregg et al., 1993).

Selective industrial policy fell out of favour. This was partly because the 1970s experience led to disillusionment and partly because international treaties and, in particular, EU rules on state aids constrained policy. DTI expenditure on industrial policy measures was £421.4 million in 1997/8 (prior to devolution) of which £121.9 mn. was on science and technology schemes, £171.3 mn. for support for small firms, and £128.2 mn. on regional policy, almost all of which went on Regional Selective Assistance (RSA) (Wren, 2001). Whereas in 1981/6 state aids were 3.8% of manufacturing GDP by 1994/6 this had fallen to 0.9%. Virtually all (91%) of state aid in 2006 was for horizontal rather than selective policies (Buigues and Sekkat, 2011).

It is true that politicians were not immune from selective intervention notably close to elections, for example in 1987 launch aid for Airbus, and in 2005 a loan of £6 million to keep the Longbridge plant open for just one more week. The latter was probably ill-judged but taxpayers escaped very lightly by earlier standards.[5] Airbus appears to have been a successful example of a rent-switching industrial policy (which, although a European venture, has provided opportunities for British wing designers and producers). Neven and Seabright (1995) estimated that Airbus was likely to produce an acceptable rate of return for Europe over fifty years while at the same time reducing Boeing's profits significantly and cutting world-wide aircraft prices a bit.[6] That said, Airbus would not be easy to repeat – and was possibly illegal under WTO rules.

RSA was on a much smaller scale than earlier policies designed to address unemployment problems in disadvantaged regions. It was designed to create and safeguard employment and targeted heavily at investment in manufacturing for projects which could demonstrate additionality. It was granted on a discretionary basis and has been the subject of many evaluations. The evidence is quite strong that it has been successful in promoting employment at a low cost per job but it is equally clear that it has not raised TFP or labour productivity (Criscuolo et al., 2012; Harris and Robinson, 2004).

Turning to horizontal industrial policies, the picture is mixed both across and within categories although it is fair to say that changes in the composition of expenditure (for example away from investment subsidies towards support for innovation and R & D) has been appropriate, seen from the perspective of addressing market failures that might adversely affect productivity growth.

5 A report by the National Audit Office (2006) concluded this was the case.

6 The modelling exercise in Neven and Seabright (1995) is complicated by the presence of McDonnell Douglas. In that firm's absence the value of the Airbus subsidies policy is potentially greater especially in holding down aircraft prices.

New growth economics has tended to stress the importance of policies towards education and R & D. In each of these areas, it might be argued there have been some policy successes. The most important changes in education have included expansion of higher education, the national curriculum and league tables for schools. The good news is that, based on international test scores in mathematics and science, the UK showed slow but steady improvement between 1975 and 2003 which regression analysis suggests would have added a small amount to productivity growth, but the bad news is that it is well below the top country (Hanushek and Woessmann, 2009). Nevertheless, growth accounting estimates show a relatively strong contribution to growth in the recent past based on increasing proportions of the workforce with higher qualifications, as Table 8 shows. With regard to R & D, a policy which seems to have been notably successful in generating positive TFP spillovers is public spending on R & D sponsored by the Research Councils, a result which does not seem to apply to other forms of public R & D (Haskel and Wallis, 2010). The big innovation in policy has been the R & D tax credit introduced in 2001 and subsequently expanded in its coverage. A careful ex-ante study suggested that the policy might raise UK TFP growth by about 0.3 percentage points per year (Griffith et al., 2001), although subsequent analysis has found that estimates of benefit-cost ratios are highly sensitive to methodology (HMRC, 2011).

Table 8 Growth accounting for labour productivity growth in the market sector, 1995-2005 (% per year)

	Labour Quality	ICTK/HW	Non-ICT K/HW	TFP	Labour Productivity Growth
Ireland	0.2	0.4	2.1	1.8	4.5
Sweden	0.3	0.6	1.1	1.6	3.6
Finland	0.1	0.6	-0.1	2.6	3.2
UK	0.5	0.9	0.4	0.8	2.6
Netherlands	0.4	0.6	0.1	1.0	2.1
France	0.4	0.4	0.4	0.9	2.1
Austria	0.2	0.6	0.1	1.1	2.0
Portugal	0.2	0.6	1.3	-0.3	1.8
Belgium	0.2	1.0	0.4	0.1	1.7
Denmark	0.2	1.0	0.2	0.2	1.6
Germany	0.1	0.5	0.6	0.4	1.6
Spain	0.4	0.3	0.5	-0.8	0.4
Italy	0.2	0.3	0.5	-0.7	0.3
USA	0.3	1.0	0.3	1.3	2.9

Source: Timmer et al. (2010).

Unfortunately, with regard to public capital and transport infrastructure the picture is much less encouraging. The UK net stock of public capital relative to GDP, and to the stock of private capital, fell sharply between 1980 and 2000 (from 63.9% to 40.3% and from 61.5% to 37.0%, respectively) and recent levels

of public investment imply these ratios will continue to fall over the long run to a level that is clearly suboptimal. To maintain the level of public capital to GDP at a growth maximising level, investment of about 2.7% of GDP per year would be needed (Kamps, 2005a) but over 1997-2008 the UK invested only 1.5% of GDP. In terms of cost-benefit analysis, Eddington (2006) reported that there was a substantial backlog of road projects with very high benefit-cost ratios (typically strategic roads near urban areas not 'grand projects' like high-speed rail) and estimated that a ten-year programme worth £30 billion was required to catch up with this backlog which would deliver annual welfare benefits of £3.4 billion. Continuing the traditional roads policy, memorably described by Glaister (2002) as 'predict but don't provide', runs the risk of a growing disincentive to private investment and of productivity being impaired as journey times increase (Rice et al. 2006).

The Thatcher period was notable for a shift from direct to indirect taxation as top marginal rates of income tax were reduced and VAT rates increased, and it is certainly true that the revenue from 'distortionary taxes' is much smaller as a proportion of GDP than in many European countries. Nevertheless, it is still fair to say that UK policy has been quite timid in making the sort of reforms that recent OECD research suggests would be most effective in stimulating long-run growth. This would entail reducing the effective rate of corporate tax while extending the VAT base. The effective average corporate tax rate in 2007 was only about two percentage points lower than in the early 1980s (Devereux, 2007) while the current VAT regime with many exemptions entailed revenue of only about 48% of that which would be raised if VAT was applied to all consumer expenditure. Using the estimates in HM Treasury (2007), imposing the standard rate of VAT on everything except food would allow a reduction of 12 percentage points in the corporate tax rate which the OECD study estimates would raise the labour productivity growth rate by about 0.25 percentage points per year over 10 years (Johansson et al., 2008).

The UK has benefited more than most European countries from the adoption of ICT, as is reflected in Table 8. The diffusion of ICT has been aided by complementary investments in intangible capital and high-quality human capital and importantly also by regulation policies. The international evidence is that diffusion of ICT has been significantly inhibited in countries which are heavily regulated. Employment protection has been shown to deter investment in ICT equipment (Gust and Marquez, 2004) because reorganising working practices and upgrading the labour force, which are central to realising the productivity potential of ICT, are made more expensive. Research at OECD indicates that restrictive product market regulation has deterred investment in ICT capital directly (Conway et al., 2006) and the indirect effect of regulation in raising costs has been relatively pronounced in sectors that use ICT intensively.

For the UK, the 1980s' de-regulation of services that are intensive in the use of ICT (notably finance and retailing) which reduced barriers to entry, was important to its relatively successful response to new technology, as OECD cross-country comparisons reveal.[7] It is also clear that investment in ICT is much more profitable and has a bigger productivity payoff if it is accompanied by organisational change in working and management practices (Crespi et al., 2007). This would not have happened with 1970s-style industrial relations in conditions of weak competition. For example, Prais (1981, pp. 198-199) noted the egregious example of the newspaper industry where these conditions precluded the introduction of electronic equipment in Fleet Street although an investment of £50 million could have reduced costs by £35 million per year.

This leads us to the important qualification that has to be made regarding the 'success story' rehearsed above. De-regulation was central to the growth of an unusually large financial services sector in the UK, amounting to about 8% of GDP in 2007, and a banking system that was very highly leveraged by previous standards. This left the UK exposed to a very costly financial crisis which may well have permanently reduced the sustainable level or even the trend rate of growth of real GDP, possibly substantially. In time, it will be possible to reassess the growth performance of the late 20th and early 21st century with these issues in mind but at present it is too soon to tell.

It should be noted, however, that not all UK regulation is productivity friendly. Land-use planning is an aspect that creates massive allocative inefficiency and reduces labour productivity both by making land unduly expensive and by restricting city size which means that agglomeration economies are foregone and spatial adjustment is impeded – successful British cities are too small (Leunig and Overman, 2008). Cheshire and Sheppard (2005, p. 660) concluded that "controlling land supply by fiat has created price distortions on a par with those observed in Soviet-bloc countries". One of the implications is an implicit regulatory tax rate of around 300% which makes office space in cities like Leeds and Manchester much more expensive than even New York and San Francisco (Cheshire and Hilber, 2008). Similarly, planning policy by making land for retailing very expensive and by constraining retailers to choose less productive sites has reduced the level of TFP in the sector by at least 20% – TFP in new stores has been falling steadily since the late-1980s (Cheshire et al., 2011).

These findings, together with suboptimal investment in transport are quite worrying in the context of the role of agglomerations in underpinning productivity and competitive advantage. Graham (2007) analysed productivity on a very disaggregated spatial basis and found it was very strongly related to measures of market potential, in particular proximity to GDP defined in terms of time rather than distance, with elasticities being much larger for services than

7 The sensitivity of productivity performance in retailing to regulation is underlined by the sharp reduction in TFP growth in this sector in the UK after the introduction of stricter limits on out-of-town supermarkets in 1996 (Haskel and Sadun, 2009).

manufacturing and particularly big for financial and business services. Similar results were obtained by Rice et al. (2006) who found labour productivity in a city depends on its own size and the size of populations up to 80 minutes travel time away. Their results indicate that if all journey times in the UK were cut by 10%, labour productivity would increase by 1.2%.[8]

Finally, it may be useful to look at the UK in terms of its ability to adjust to the challenges resulting from globalisation, in particular, the rise of dynamic Asia. This turns on export mix, the flexibility of labour and product markets, strengths in innovation and education according to the index devised by Rae and Sollie (2007). They found that the UK ranked 8th of 26 OECD countries based on having a relatively small share of low-technology and a relatively large share of high-technology exports, a labour market which redeploys workers relatively quickly and has limited insider power, strong product market competition together with respectable scores on education and innovation.

That said, it should be recognised that productivity performance in the UK not only exhibits agglomeration benefits but also has quite a strong regional component. Econometric analysis of production functions finds that, across all sectors, plants in the South East have a substantial TFP advantage over the rest of Britain (Harris and Moffat, 2011). This suggests that resilience in the face of foreign competition would be strengthened by the removal of some of the obstacles to spatial adjustment to the challenges of globalisation that are imposed by the planning system and sub-standard transport infrastructure.

4 Policy lessons

It is important not to forget the lessons of historical experience; to do so is to risk repeating past mistakes, some of which have been very expensive. It is also worth recognising that prior to the crisis growth performance was respectable and that, by 2007, the UK had regained parity with France and West Germany in terms of real GDP per person, an outcome that would have looked most unlikely at the end of the 1970s after decades of relative economic decline compared with those countries.

A very strong message related to this is that the UK benefited greatly from strengthening competition in product markets by abandoning protectionism, de-regulating and, eventually, strengthening competition policy. This addressed long-standing problems of industrial relations and bad management which had appeared intractable. The empirical evidence is unequivocal; increased competition promoted better productivity performance. At the same time, it

8 Their results imply that the UK's past investments in its motorway network had a favourable impact on productivity since average journey time between major cities fell by about 40% between 1959 and 2006 (RAC Foundation, 2007).

is equally clear that selective industrial policy has deservedly got a bad name. The evidence of the 1960s and 1970s is that it delivered a very poor payoff and was hijacked by politicians who were afraid of deindustrialisation and creative destruction with the result that it was skewed towards backing losers such as British Leyland and British Shipbuilders. A big implication, as stressed by Aghion et al. (2011) is that, if there is to be a return to a more active industrial policy, it should be designed to minimise the adverse effects on competition.

A second key point is that good horizontal industrial policies are important in supporting productivity performance in the private sector. Here it is important to note that a wide range of government policies are relevant, including for example, regulation, rather than just the obvious categories such as provision of infrastructure and education, and that policies which facilitate diffusion of new technologies can be expected to have a bigger impact than those which seek to promote invention. Planning rules may well matter more for productivity than R & D subsidies. In fact, the evidence suggests the UK has benefited considerably from having light regulation which has been helpful in taking advantage of the opportunities of ICT but has questions to answer about the quality of its education as reflected in cognitive skills well below the world leaders and underinvestment in transport infrastructure.

A third, and rather depressing, message is that the politics of improving growth performance are not very attractive. The problems include the short-termism of politicians in an area where the policy choices often involve status-quo bias, the distributional implications of some policy options, and the fact that many worthwhile policy moves will attract no positive headlines. It is unfortunate that this has severely constrained supply-side policy, for example, by making serious pro-growth reforms to the tax and planning systems no-go zones.

Finally, it is increasingly apparent that an important aspect of productivity performance and choice of location in a world of vertically-disintegrated international trade is an ability to develop and to sustain successful agglomerations whose advantages are hard to replicate elsewhere. Productivity advantages from an agglomeration which developed on the basis of market forces sustained the Lancashire cotton industry against low-wage Asian competition for many decades. That is a useful example to bear in mind in a globalising world.

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3 Choosing Races and Placing Bets: UK National Innovation Policy and the Globalisation of Innovation Systems

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Systems thinking now permeates innovation policy discussions at national and international level. Documents relating to the development of innovation policy are now routinely couched in systems terms (see e.g. Sainsbury, 2007; BIS, 2011; OECD, 2010). This is an important development since adopting a systems approach involves addressing innovation in specific national, sectoral, regional or technological contexts.

As Carlsson (2006) has pointed out, whilst the notion of national innovation systems has become a key element in policy development, it has been accompanied by systems based analyses which have focused on different domains. Thus work on technological and sectoral systems has emphasised the potentially cross-national influence of different technological and sectoral systems whilst other work has emphasised the development of regional innovation systems.[2]

Irrespective of domain there are certain core elements of a systems approach, typically three are identified. (Metcalfe, 1997; Edquist, 2005). The first consists of the agents operating within the particular system domain. This includes not only private sector consumers and businesses, but also the public sector in its various manifestations and the third (or charitable) not-for-profit sector. The second element is usually defined as 'institutions' which are not to be understood as organisations or entities, but rather as the norms of conduct or rules of the game, including contractual legal and regulatory systems within which agents operate. The third is usually defined in terms of the connections between agents. This will

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2 For sectoral systems see for example Malerba (2004, for regional systems Cooke (1992) and for technological systems Carlsson (1997).

include, but is not restricted to, market connections. System connections include a wide variety of non-market relationships including collaborative and formal and informal interpersonal and inter-organisational networking connections. A significant feature of variations across sectors, technological trajectories and national systems of innovation is seen to lie in their strength, nature and variety and their interplay with institutional differences. These may be used to characterise differences between systems of innovation.[3]

Adopting an innovation systems approach means extending the rationale for policy intervention beyond market failure. In market-failure based approaches intervention is based on problems arising from the public good nature of knowledge, spillovers, and capital market failures arising from the riskiness of innovation and asymmetric information. This leads to standard arguments in support of public expenditure on basic research as opposed to more applied research and for the development of patent protection and subsidisation of R&D. (Dasgupta and David, 1994). These arguments provide important rationales for public sector intervention, but rarely provide sufficient guidance for the degree of intervention in particular instances; nor do they address the many other potential institutional and connection failures which may arise in an innovation system. (See for example Metcalfe, 2005; Dodgson et al., 2011; BIS, 2011).

System failures can arise from various sources. Transition and lock-in problems, for example, arise from inertia due to substantial sunk investment by private and public sectors in existing or dominant technologies and are linked to transition failures in moving to new technological structures which pose major problems of investment and business reorganisation (e.g. in the switch to low carbon vehicles (HMG, 2008; King, 2008). Then there are institutional system failures arising from a lack of congruence between formal and informal rules and incentives affecting different parts of the organisation of the system. A particularly prominent case is the alleged difference in norms and incentives between scientists conducting research emphasising open publication and disclosure, and the private sector in its pursuit of research connected to private exploitation, secrecy and patent protection. This has engendered a major debate in the UK over the extent to which the allocation of public funds should be directed according to the motivations and the incentives of the former as compared to the latter, the nature of UK university-industry links, and the design of intermediary organisations on the boundaries of universities and industry. (See for example the references and discussions in Royal Society, 2011; Hughes, 2011; Hauser, 2011; Mina et al., 2010; Deiaco et al., 2012; Hughes and Kitson, 2012).[4]

One of the most important implications arising from the development of more systemic views has been the emphasis placed upon the development of demand side as well as supply side policies in addressing lock in and transition problems and uncertainties. This is based around the potential role of the public sector

3 See for example Edquist (2005) and Lundvall (2007).
4 For a comparison of systems and market failures see for example Chaminade and Edquist (2010).

as a procurer of R&D and in a wider sense the role of public procurement in influencing the scale, direction and form of the provision of the goods and services it purchases. (OECD, 2010c; Connell and Probert, 2010). These are seen as potentially important innovation policy devices for reducing uncertainty in areas where lead user activities are important. They are also seen as complementary to supply side measures linked to standard market failure arguments which through taxation and subsidy influence the relative prices at which businesses conduct their innovation related activities. (OECD, 2010d).

The development of specific sectoral or technology based systems approaches to innovation has pointed to the need for a fine grained approach to understanding the particular nature of each as sub-systems operating within a national or international context. They also raise the question as to whether global technical or sectoral system trends may leave little scope for distinctive national systems or policies, and whether the regional or sectoral agglomeration or technological system may be the most appropriate level for analysis and policy rather than or in addition to the nation state.

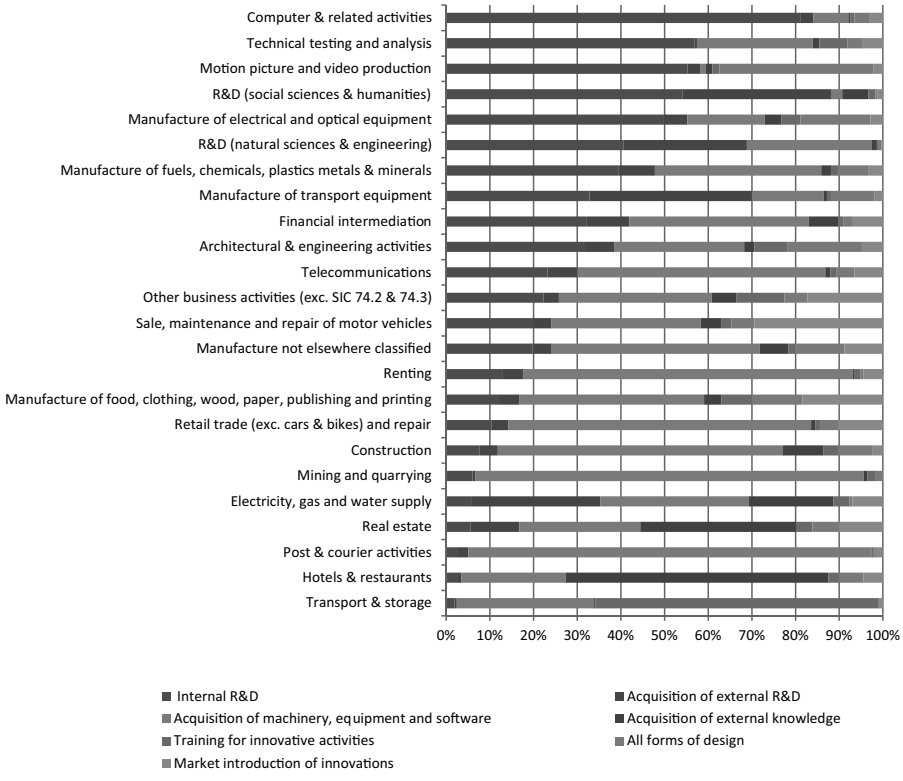
This chapter reviews evidence relating to the internationalisation of innovation systems and the implications this may have for the prospects of developing national innovation policy in the UK. It begins with a brief overview of evidence on the nature of the innovation system in the UK and internationalisation of key elements of it. This focuses on the generation of knowledge in the higher education and university sectors, the internationalisation of UK business ownership (as captured by international share-ownership patterns and mergers and acquisitions) and internationalisation of innovation activity proxied by R&D flows and patenting. This serves to position the UK in terms of the degree of globalisation of its innovation system and implications this may have for the development of innovation policy.

The chapter argues that the UK is an extreme example of the internationalisation of innovation systems, but that a national innovation policy is still feasible. It concludes with an outline of a way forward in a specific domain of innovation policy, building on the insights arising from the need to understand specific technological or sectoral innovation sub-systems, and outlines a strategic resource allocation process to support their development. This is characterised as choosing races and placing bets to recognise the inherent uncertainty and risks involved in innovation policy design and emphasises the variety of system level policy interventions which may be needed.

The UK innovation and R&D landscape[5]

Much of this chapter is concerned with the internationalisation of innovation in terms of investment in and ownership of assets, and the funding of and conduct of R&D. It is useful therefore to bear in mind the relative importance of these compared to other expenditures in support of UK firms innovation activities and the way the various components vary significantly by sector. Figure 1 shows the shares of different types of expenditure on UK firms' innovation related activities at a fairly broad sectoral level.

Figure 1 Shares of expenditure of UK firms' innovation-related activities by sector



Source: Hughes and Mina (2011) derived from Office for National Statistics (UK Community Innovation Survey 2009)

It shows the proportions of expenditure accounted for by R&D internal to the firm, the acquisition of R&D from other firms external to the business, acquisition of machinery, equipment and software, general acquisition of external knowledge other than R&D, training for innovative activities, design costs and marketing costs associated with the introduction of the innovations. The sectors are ranked in terms of the importance attached to internal R&D. R&D intensive sectors are computer and related activities, technical testing and

5 This section draws heavily on Hughes and Mina (2012)

analysis, motion picture and video production, R&D services and manufacturing of electronics and optics. In all other sectors acquisition of new equipment and machinery and software plays a more important role with the exception of the manufacturing of transportation equipment. The relative importance of R&D and other expenditures varies significantly across sectors. This is the first clue to the need to adopt a disaggregated approach to innovation support policy in terms of key inputs.

It is also useful to keep the scale of UK activity in an international perspective.

Figure 2 GERD: Gross domestic expenditures on R&D (as a % of GDP) and researchers per 1,000 employees, 2009 or latest available Year

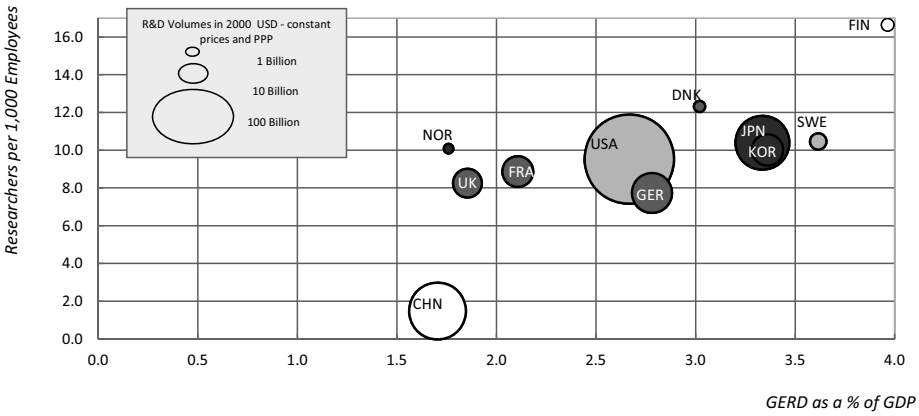
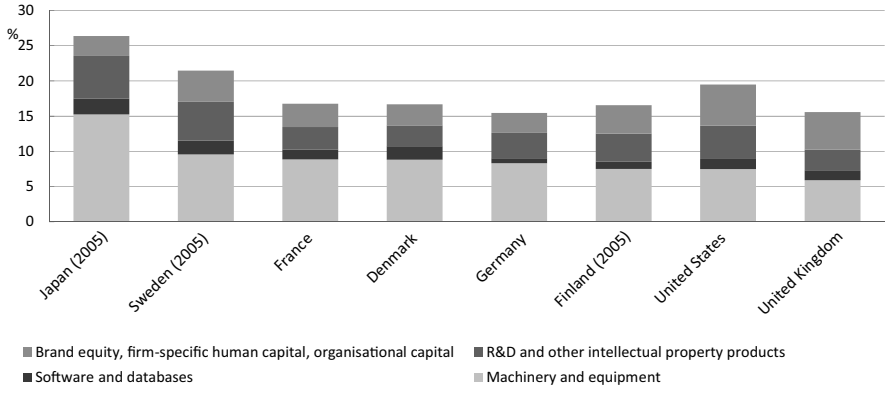


Figure 2 shows overall gross domestic expenditure on R&D (GERD) as a percentage of GDP and researchers per 1,000 employees across a sample of OECD economies. The dominant global position of the USA in R&D, followed by Japan, is clear. It is also clear that in this sample the UK is amongst the lowest. This could reflect the structural features of the UK economy as relatively service intensive and, hence, relatively dependent on investment in non-R&D intangible assets. This is explored further in Figure 3. Although the gap is closed with some other countries when the overall level of investment in tangible and intangible assets as a share of GDP is considered, the UK still lags behind the USA, Sweden and Japan, but becomes more comparable with Germany and narrows the gap with France, Denmark and Finland.

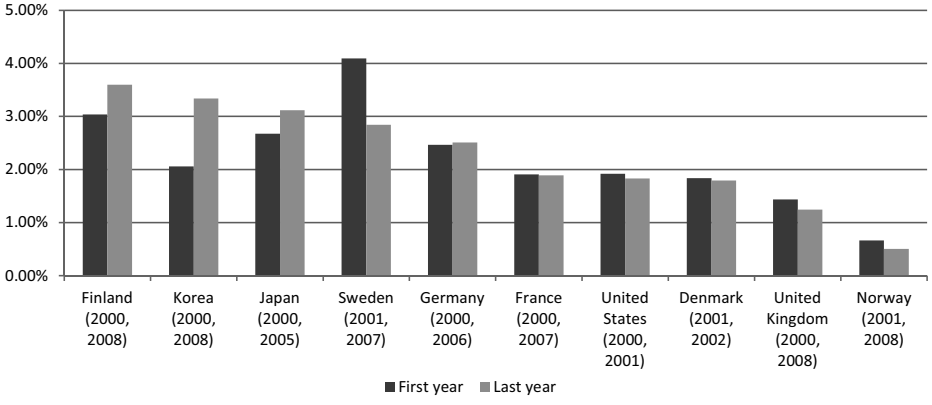
Another way to carry out a broad check on the structural impact is to focus on manufacturing alone. This is done in Figure 4 which looks at business expenditure on R&D as a percentage of value added in manufacturing.

Figure 3 Investments in tangible and intangible assets as a share of GDP, 2006



Source: Hughes and Mina (2011) derived from OECD

Figure 4 BERD as a % of value added in manufacturing

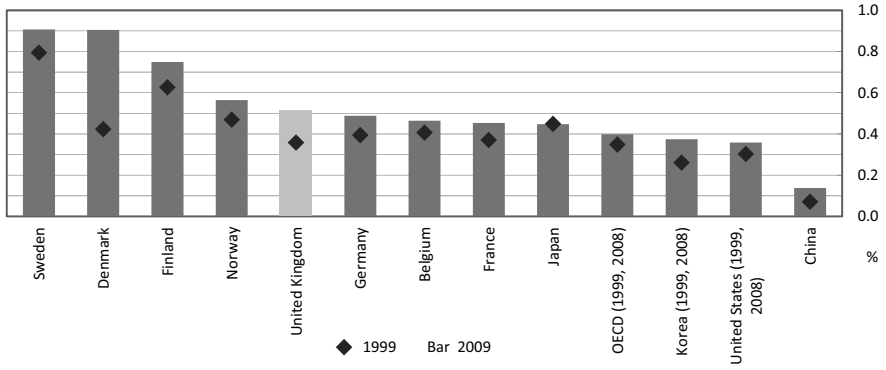


Source: Hughes and Mina (2011) derived from OECD

It is clear that even within manufacturing itself the UK is a low R&D performer in terms of R&D as a percentage of value added and that this position has, if anything, worsened over the course of the current century.

So far we have looked at expenditure on R&D as a whole and expenditure in the business sector. In view of the significance attached to the role of universities in the current international discussions of rebalancing economies in the aftermath of the financial crisis, it is also important to look at higher education expenditure on R&D (HERD) and the UK's relative position. Figure 5 looks at higher education expenditure and R&D in 1999 and 2009 as a percentage of GDP.

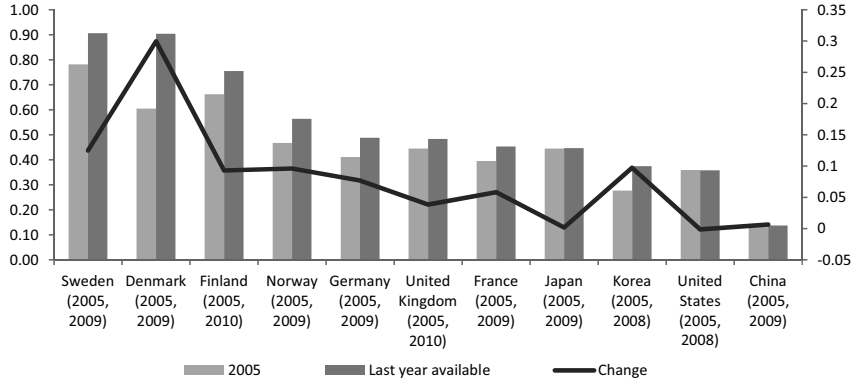
Figure 5 HERD: higher education expenditure on R&D, 1999 and 2009 (as a % of GDP)



Source: Hughes and Mina (2011) derived from OECD

The UK ranks below the Nordic economies, but invests as much or more relative to GDP than the major European economies, Japan, Korea, the US, China and the OECD as a whole. Moreover, it is apparent that, with the exception of Japan, all economies have been increasing the scale of their higher education R&D expenditures relative to GDP. The UK has over this 10-year period been amongst the leaders in this trend so that its innovation system has experienced weak and declining overall R&D intensity but a stronger HERD performance. However, as Figure 6 shows, this has not been the case since 2005 where the UK has fallen behind Germany, Norway, Finland, Denmark and Sweden as well as France and Korea in the rate of change of higher education R&D expenditures as a percentage of GDP.

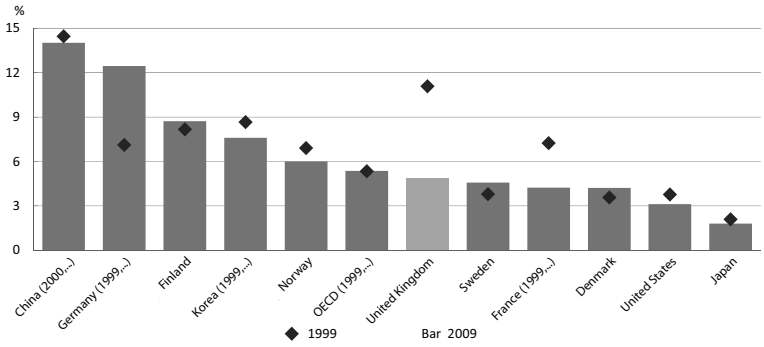
Figure 6 HERD as % of GDP (2005 to latest average year)



Source: Hughes and Mina (2011) derived from OECD

It is also useful to consider interactions between the business sector and higher education and the connections between the system components. Figure 7 shows business funded R&D carried out in higher education and government sectors. In each case it is expressed as a percentage of the R&D performed in those sectors combined.[6] In 1999 the UK had one of the highest proportions of business funded R&D in the higher education and government sectors. By 2009 this had decreased dramatically and fallen below the OECD average, Norway, Korea, Finland and Germany as well as France. In 1999 the ratio was significantly higher than in those countries. Insofar as these connections through business funding are thought to be more likely to lead to direct effects in terms of the application of research, this system shift might imply a weakening of connections between academia and industry leading to direct industrial applications. This may be offset by increased indirect 'spillover' effects from more 'basic' open science. (Guellec and van Pottelsberghe de la Potterie, 2004).[7]

Figure 7 Business-funded R&D in the higher education and government sectors, 1999 and 2009 (as a % of R&D performed in these sectors (combined))



Source: Hughes and Mina (2011) derived from OECD

Government support for R&D – the UK in an international perspective

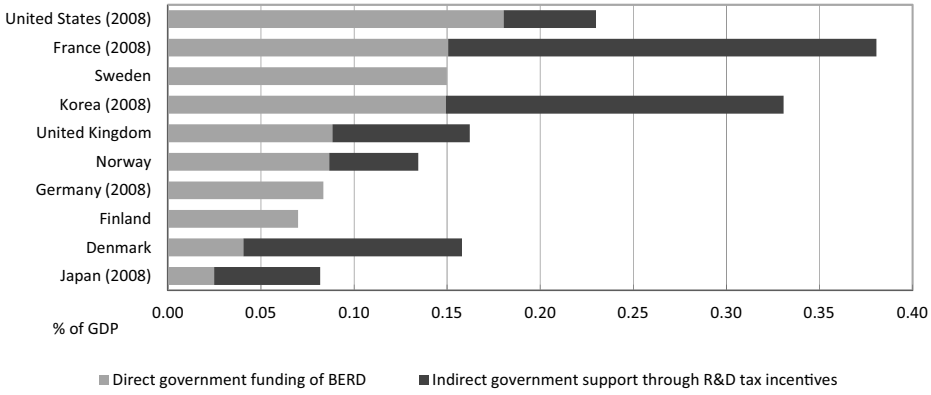
A further system feature is the nature and scale of government support for R&D. Figure 8 shows that the United States, France and Korea all have systems with much higher levels of overall public sector support than the UK. It is particularly noticeable that the United States is the innovation system that has the most significant direct government funding of research and development expenditure which reflects in part the very large demand side lead user expenditure flows

6 There is no separate comparable series for the higher education sector alone.

7 For detailed evidence in relation to the depth and nature of academic-business links in the UK see Hughes and Kitson (2012) and Salter et al. (2010). There is little evidence to suggest that the balance between basic and applied research in the UK has moved significantly away from basic to more applied research funding over this period (or indeed that there has been any move in the opposite direction). (Hughes and Martin, 2012).

through defence, health and other major government agencies (see also e.g. Connell, 2008).

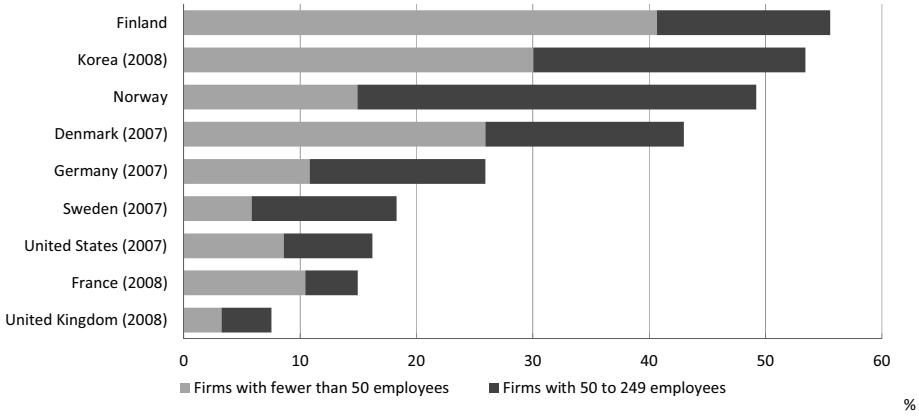
Figure 8 Direct government funding of business R&D and tax incentives for R&D, 2009 (as a % of GDP)



Source: Hughes and Mina (2011) derived from OECD

The UK system has a relatively balanced pattern of direct versus indirect funding and occupies a mid-position in terms of overall level of support provided for the business sector. However, when we look at the extent to which government support is distributed by size of firm, a striking feature emerges. Research and development expenditure in the UK is heavily dominated by a handful of large firms. In 2009 the 10 largest R&D performers accounted for 34% of all UK R&D and the top 50 accounted for 56% (Business Enterprise Research and Development Expenditure 2009, Office of National Statistics, Table 18). Independent small firms (as opposed to small firms which are the subsidiaries of larger businesses) account for less than 4% of UK business sector R&D (Hughes and Mina, 2012). Even if small and medium-sized firms which are subsidiaries of larger firms are included in the definition of the small business sector, taken together they account for just over 20% of R&D while such firms with fewer than 50 employees account for around 7%. As a result over 90% of government supported R&D in the enterprise sector is focused on businesses employing more than 250 employees. As a consequence Figure 9 shows support for the small and medium-sized business sector as a proportion of total support in the UK innovation system is lowest by far of the countries shown.

Figure 9 Government-financed BERD by firm size, 2009 (as a % of total government-financed BERD)

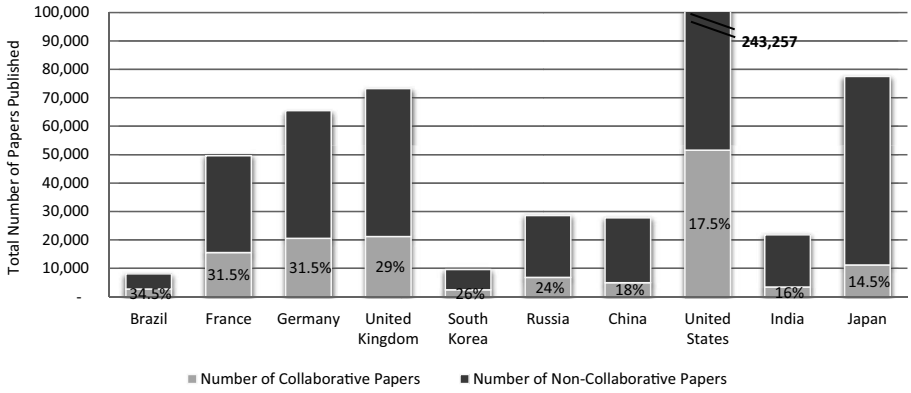


Source: Hughes and Mina (2011) derived from OECD

Internationalisation of science

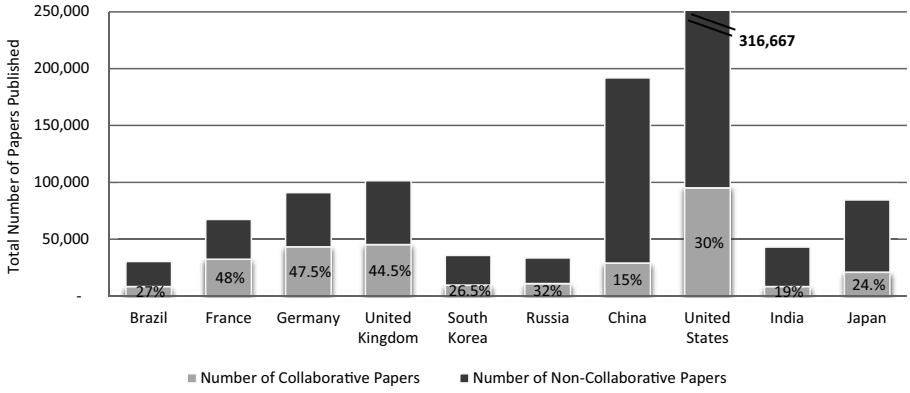
The underlying production of knowledge for innovation through the university sector is reflected in the nature and extent of scientific publication. Increasing internationalisation is reflected in patterns of co-authorship across national boundaries. Figures 9 and 10 show for 1996 and 2008 respectively the numbers of papers published allocated to selected economies. In 1996 the total number is dominated by the United States followed by Japan, the UK, Germany and France. The proportion produced involving international collaboration was highest in France, Germany, the UK and Brazil at around 30% whilst in the case of the US and Japan the proportions were 17% and 14% respectively. By 2008 there had been a major shift in the international pattern of production with the US now followed by China rather than Japan in terms of numbers and with the proportions of publications produced in international collaboration rising systematically across the largest producers of publications. Thus, in the UK, international collaborative publications rose from 29% to 44%, in Germany from 31.5% to 47.5% and in France from 31.5% to 48%. In the US collaborative publications rose from 17.5% to 30% and in Japan from 14% to 24%. The only economies where the proportion showed a decline were Brazil and China where small decreases occurred reflecting the internal expansion of their HEI sectors.

Figure 10 International collaborative publications in selected countries (1996)



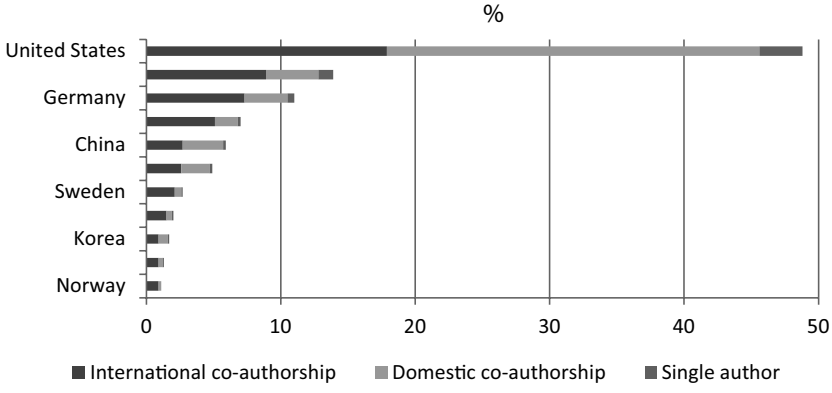
Source: Derived from Royal Society 2011

Figure 11 International collaborative publications in selected countries (2008)



Source: Derived from Royal Society 2011

Figure 12 Highly cited scientific articles by type of collaboration in selected countries (2006-2008)



Source: Derived from Royal Society 2011

The degree of collaboration is also apparent if the analysis focuses on highly cited scientific articles. Thus, Figure 10 shows once again the dominance of the United States followed by the UK, Germany, France and China and the higher proportions in each that are accounted for by international co-authorship. Thus the US accounted for around 48% of the world's highly cited scientific articles and of that around 17% were accounted for by international co-authorship. In the UK its overall highly cited scientific articles accounted for around 14% of the world's total. The extent to which the highly cited articles involved international co-authorship was a much higher proportion than in the US. The UK's highly cited scientific impacts therefore are more likely to involve international collaboration than in the US. This is to be expected given the relative scale of the higher education sectors in these two countries.

From a systems perspective this suggests strong and productive connections between the UK and the international science base.

Internationalisation and patenting

It is often stated that the UK is good at invention, but poor at innovation. Patent data are a potentially useful source of information for tracking cross border patterns in the invention component of innovation systems. Patent applications contain the geographical location of the inventor and identity and location of the firm that makes the application. It is thus possible to cross classify any patent in terms of the location of the inventive activity and the location of the owner of its potential output. (Cantwell, 1989; Cantwell and Janne, 1997; Guellac and Van Pottelsberghe, 2001; Harhoff and Thoma, 2010). A potential problem with this is that the business entity indicated as the owner on a patent application may be the subsidiary of a parent located elsewhere. Harhoff and Thoma (2010) have attempted to deal with these issues for the period 1986-2005 for a large sample of individual business organisations cited on EPO and PCT patent applications and have consolidated them into over 3,000 corporate groups, including 1,500 US corporations. Table 1 sets out changes over time in the proportions of applications in this sample which list 'home' country inventors. There is substantial variation across countries in the degree of so-called 'home bias' (dependence on home country inventions). There is also evidence of less reliance on home sources in the later than earlier periods. High levels of dependence on domestic investors characterise Japan, the US and Canadian economies which all experience slight falls over the period as a whole. Korea experienced a substantial increase in reliance on domestic invention from 49.3% in the first period to over 86% in the period 2001-05 by which time it was matching Japan. In general this data does not suggest a substantial or major move away from reliance on domestic invention except in the UK where the proportion fell from 33.3% in 1986-90 to 22.8% in the 2001-05 period. The UK system thus appears to be an extreme example in terms of combining both a low level of reliance of domestic invention and a substantial decline in that reliance over time. The nearest comparators

Table 1 Share of country's business applications naming home county inventors

	UK	Germany	Japan	France	Netherlands	Italy	Other EU	Sweden	Switzerland	Korea	US	Canada	Rest of world
1986-1990	33.3	62.6	90.6	43.4	18.6	62.7	39.7	46.1	29.2	49.3	78.8	76.4	31.8
1991-1995	25.4	57.9	87.4	41.7	15.5	59.8	38.1	42.5	24.2	74.9	78.2	73.3	33.9
1996-2000	23.2	59.6	84.7	37.2	16.4	58.8	40.3	38.6	22.6	74.3	76.5	64.2	42.2
2001-2005	22.8	62.3	86.2	40.0	18.4	68.7	46.5	38.1	24.4	86.6	75.6	69.0	56.9

Source: Harhoff and Thoma (2010) Table 2.

Table 2 Share of a country's business applications naming UK inventors: Top European and R&D performers only

	Business Applicant								
	Switzerland	Germany	France	UK	Italy	Netherlands	Other EU	Sweden	US
1986-1990	7.0	2.9	4.3	33.2	11.4	6.8	4.9	4.9	2.7
1991-1995	7.6	2.7	3.5	25.4	8.1	6.6	4.8	5.0	2.7
1996-2000	5.7	3.2	2.9	23.2	4.9	4.9	5.4	5.8	3.4
2001-2005	4.9	3.0	2.7	22.8	4.1	5.3	4.2	7.0	3.6

Source: Harhoff and Thoma (2010) Table 3

Sample: Top R&D performing European and US business groups and subsidiaries consolidated to parent group level

are Switzerland and the Netherlands, the latter being the most open to overseas inventions in home country business applications, but where there has been little trend over time.

An alternative way of looking at this is to ask to what extent UK inventors form the source of national business patent applications in each country in the sample. Table 2 focuses on the top European and US R&D performers only. It shows that there is no evidence of a widespread increase in the extent to which the largest overseas multinational corporations are relying on the exploitation of UK inventions in their patent applications.[8] In Switzerland there has been if anything a decline over the period and the same is true for France and the Netherlands. In Germany there has been little change whilst the US has increased its utilisation of UK invention from 2.7% to 3.6%. It does not appear that the often cited view that the UK is good at invention, but bad at innovation is reflected in the extent to which overseas multinational applications are increasing their reliance on UK patenting at the same time as UK multinationals are decreasing their dependence on UK invention. Nor do there appear to be very significant changes over time in this aspect of globalising innovation outside of the UK so that significant national system differences remain.

International diffusion of patent citation

The patenting data suggests minor decreases in some countries in their reliance on national invention. Another aspect of internationalisation is the speed with which one country's innovators cite foreign patents. Griffith et al. (2011) analyse how long it takes inventors in one country to cite inventions patented in another. There is 'home bias' in speed of citation in the sense that, say, British firms are quicker at citing British patents and Germans quicker at citing German patents. However, they also show the speed of citation has changed over time. They show, for example, that in the period from 1975-89 on average it took a German inventor 1,559 days to cite a German patent, whereas it took 1,770 for an American inventor - a gap of approximately seven months. In the ten years after 1990, however, this gap fell to around five months with the speed to first citation falling in both economies, but fastest in the US. They note that this pattern is repeated in most of the countries analysed in their data. They also show that the extent to which 'home bias' declines varies across sectors. 'Home bias' effects are much stronger in traditional sectors, such as chemicals and mechanical engineering, compared with sectors such as computing and they conjecture this is consistent with the idea that increased ease of international communications and travel has affected these sectors more dramatically than others. These variations across sectors (and nations) suggest the need for more detailed analyses at a fine grained level to understand the sources of change and their implications for different sectoral technological and national systems.

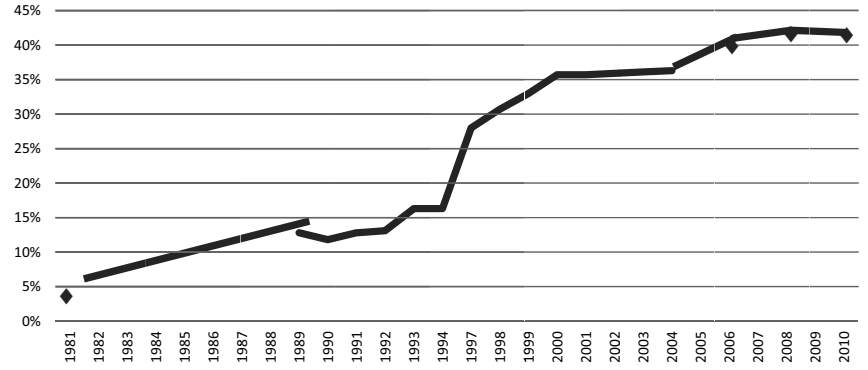
8 The UK data in this table are of course the same as that in Figure 13.

Share-ownership

A third way to track the increasing degree of internationalisation of the UK innovation system s to analyse the changing ownership of business assets. This can be done via share-ownership per se and changes in company control through takeovers and mergers.

There are difficulties in identifying ultimate beneficial holdings of share-ownership, but the latest review published by the Office of National Statistics (ONS) has produced updated estimates which showed that at the end of 2010 investors from outside the UK owned 41.2% of the value of the UK stock market. As Figure 13 shows this figure represents a major increase from 30.7% in 1998 and from much lower percentages in earlier years.[9]

Figure 13 Rest of the world holdings of UK quoted shares



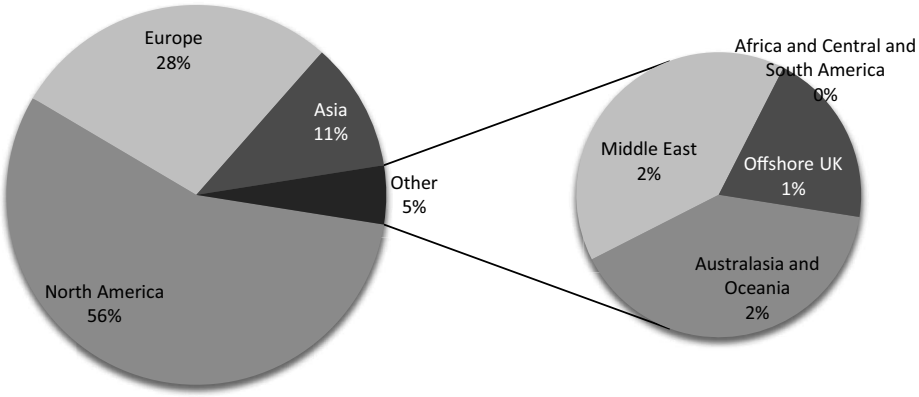
Note: Missing data for 1982-1988, 2005, 2007 and 2009 have been interpolated
Source: ONS M&A Share Ownership Database

The long-run trend observed reflects increased holdings by overseas sovereign investment funds as well as the extensive diversification into the UK stock exchange by individuals and institutional investors in other countries. When an analysis is carried out of the largest 100 companies which dominate UK R&D, it turns out that these are the corporations in which the rest of the world's holdings are greatest. Thus, at the 31st December 2010, 84.6% of the rest of the world's shareholders in UK quoted companies were within the FTSE 100. Although great interest has centred on the role of newly emerging financial powers such as India, Russia and the Asian economies, it is important to note that the breakdown of the rest of the world's holdings of UK shares shown in Figure 14 reveals that

9 It should be noted that part of the changes in any year in the proportion of stock held by overseas entities can arise from takeover activity by UK firms. Thus, for example, if a British firm makes a major acquisition abroad and pays for that by issuing its own equity, then a large number of overseas investors will be created holding shares in the UK stock exchange. In addition as a result of the financial crisis the public sector has also increased its holdings substantially in UK companies' equity largely as a result of the major interventions in Lloyds Banking Group and the Royal Bank of Scotland. Thus virtually 100% of the public holdings of the UK's stock exchange are within the FTSE 100 company group as a result of these financial rescue investments.

Europe and North America continue to be the dominant overseas holders of UK equity. Thus the whole of the Asian economies account for only 11% of holdings compared to 56% in North America and 28% in Europe. To the extent that overseas shareholders bring a longer term perspective to the performance of UK stocks this may have a favourable impact on business investment for innovation finance. There is little evidence this has occurred. There is for example no change in the generally abject performance outcomes from merger and acquisition over time (Cosh and Hughes, 2008).

Figure 14 Geographic breakdown for rest of the world holdings of UK shares, 2010



Notes: Rest of the world investors owned 41.2% of the value (or £732.6 billion) of the UK stock market at the end of 2010, up from 30.7% in 1998. At 31 December 2010 the UK stock market was valued at £1,777.5 billion.

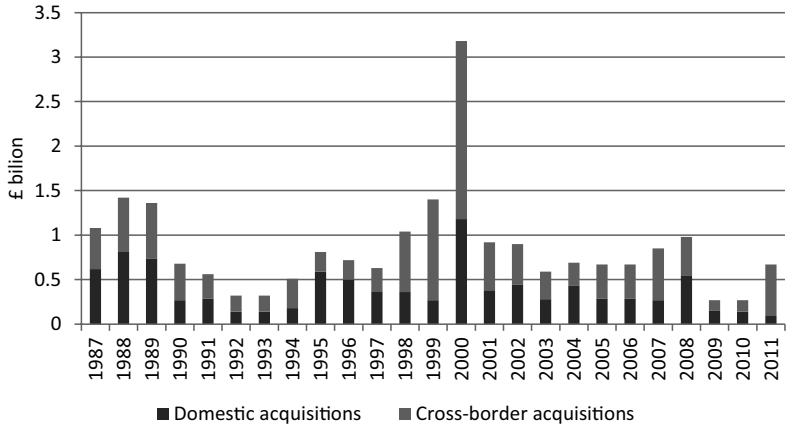
Source: ONS (2012)

In addition to the general globalisation of ownership through share purchases, the UK also has, by international standards, one of the highest levels of inward and outward merger and acquisition activity (in which share purchase goes along with changes in control. (Conn et al., 2005)). Merger and acquisition activity into the UK and acquisitions by UK based businesses overseas are frequently newsworthy transactions and attract a great deal of public and policy attention. For example in 2011 the acquisition by Hewlett Packard of Autonomy Corporation for around £7.1billion sparked a debate about the implications for development of an independent technology based business sector in the UK. More controversial still were the events surrounding the acquisition of Cadbury's by Kraft which was finalised in early 2010. In this case the issue related to the closure of a plant in the UK and extent to which there had or had not been undertakings given in relation to the future operation of plant prior to the acquisition.[10]

Figure 15 shows long run trends in the name of domestic and overseas acquisitions by UK firms. Both series exhibit major waves and a rising proportion for overseas acquisition since the late 1990.

10 For a full discussion of the issues see House of Commons Business Innovation and Skills Committee (2010).

Figure 15 Value of domestic and cross-border acquisitions

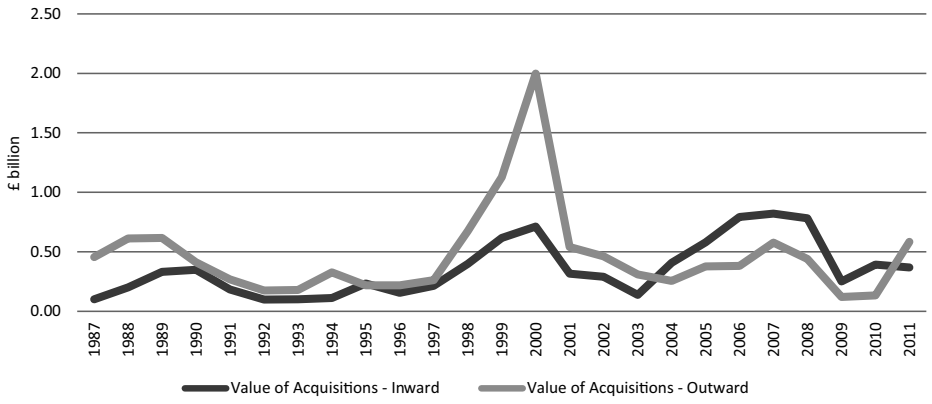


Notes: The values used are expressed in 2007 sterling values (billions), deflated using the FTSE All-Shares Index.

Source: ONS M&A Database

Figure 16 compares the outward M&A flow with the inward flow of acquisitions of UK companies by business based overseas. Between 1987 and 2003 the value of acquisitions abroad by UK companies was greater than the value of inward acquisitions. After 2005, however, the position has been reversed so the UK as an inward focus of merger and acquisition activity has outstripped investment in the opposite direction. The result is that a substantially higher proportion of the control of UK assets in the UK system has been transferred abroad at the same time as the ownership of shares generally has been shifting towards overseas holders.

Figure 16 Value of acquisitions

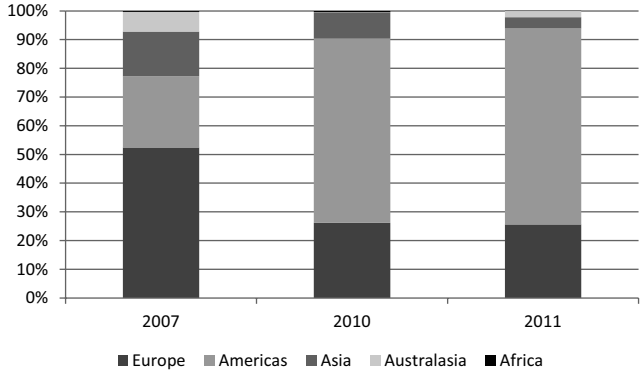


Notes: The values are expressed in 2007 sterling values (billions), deflated using the FTSE All-Shares Index.

Source: ONS FDI Database

Figure 17 shows that as with the ownership of shares in general, the bulk of the acquisition activity which has been inward into the UK has emanated from Europe and from the Americas. Asian inward acquisitions have played a minor part. The UK system's pattern of international M&A connections remains therefore heavily focused on Europe and the USA.

Figure 17 Total inward acquisitions value by world region

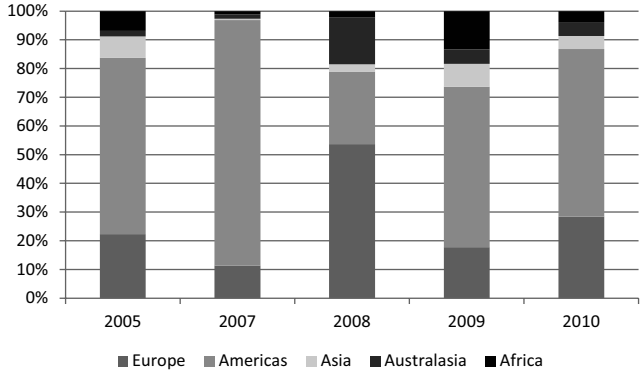


Note: No breakdown is available for 2006, 2008, 2009 and 2011.
Source: ONS FDI Database

On the other hand, Figure 18 shows that UK acquisitions overseas, although still dominated by acquisition activity into the US and rest of Europe, have in some years demonstrated a significant investment in Asian economies, although there is no clear pattern over time in the available data.

The implications of these changes depend upon the impact of this particular form of Foreign Direct Investment (FDI) for performance of the companies concerned and any spillovers which may affect other businesses in their sectors. Evidence on these effects is discussed after we discuss FDI patterns as a whole.

Figure 18 Total outward acquisitions value by world region

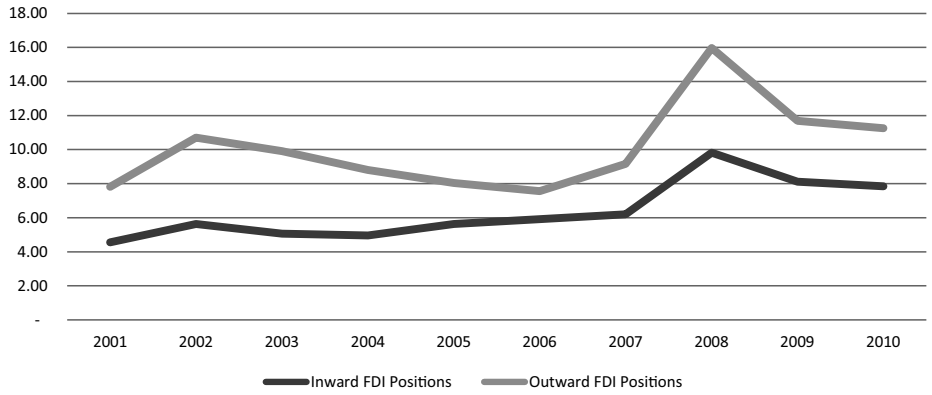


Note: No breakdown available for 2006 and 2011.
Source: ONSFDI Database

Foreign direct investment (FDI)

Mergers and acquisitions are a substantial part of the overall pattern of FDI into and out of the UK system which as a result shows a steady upward trend in the course of the present century as is reflected in Figure 19. This charts movements in UK net foreign direct international investment positions abroad. It also shows UK net foreign direct international investment positions into the UK. These trends broadly reflect the cumulative effect of FDIs and disposals by foreigners into the UK and similar patterns involving UK investors overseas. In general, UK FDI positions abroad are greater than those in the opposite direction, although both have increased over time. These investment flows are sectorally highly concentrated.

Figure 19 UK FDI international investment positions

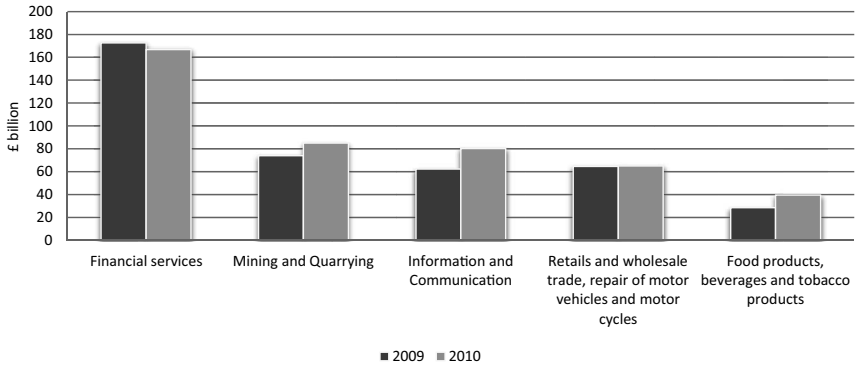


Note: The values used are expressed in 2007 sterling values (billions), deflated using the FTSE All-Shares Index.

Source: ONS FDI Database

If we look at 2009 and 2010 together in Figure 20, it is apparent that the inward investment positions the UK are dominated by financial services followed by mining and quarrying and information and communications. Fourth and fifth positions are occupied by retailing and wholesaling and the food sector.

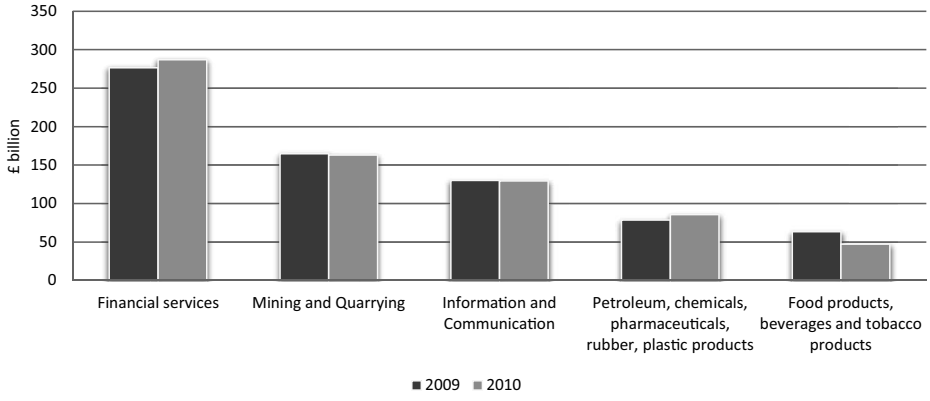
Figure 20 Net inward FDI investment positions in the UK by industry sector in 2009 and 2010



Source: ONS FDI Database

The overseas positions held by UK foreign direct investors shown in Figure 21 are also concentrated and the top five include, once again, financial services, mining and quarrying and information and communications technology and food products, beverages and tobacco products, petroleum, chemicals, pharmaceuticals, rubber and plastics making up the list.

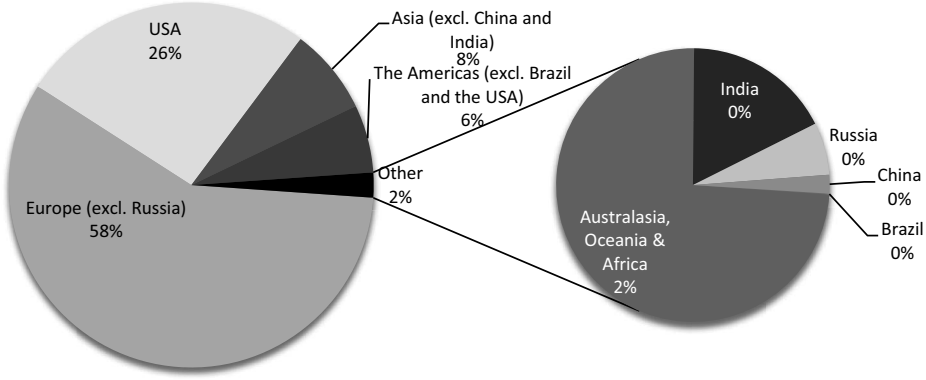
Figure 21 Net UK FDI investment positions abroad by industry sector in 2009 and 2010



Source: ONS FDI Database

In terms of the international distribution of these positions, it is interesting to compare the distribution in 2002 and for the latest years available. This is done in the pie charts in Figures 24-26.

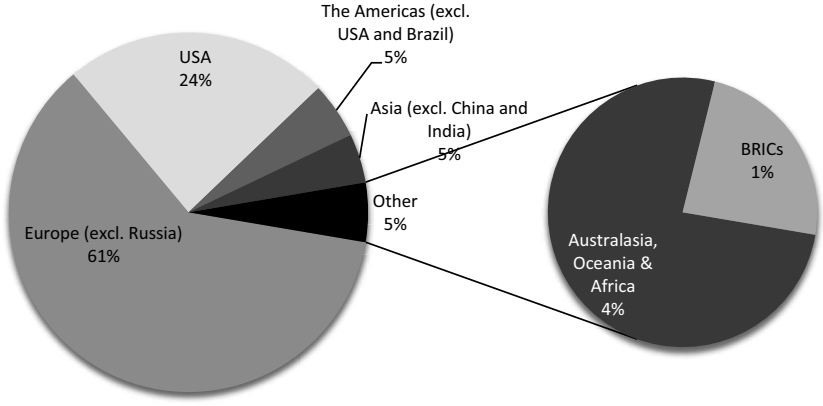
Figure 22 Net FDI international positions in the UK by area and selected countries (average of 2007 and 2008)



Source: ONS FDI Database

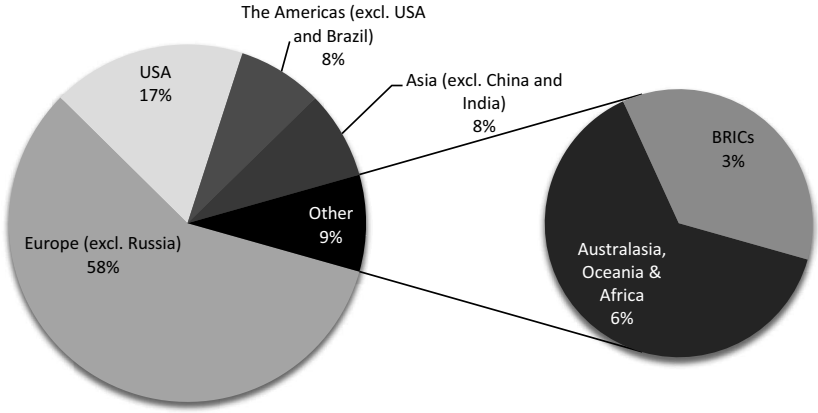
Figure 22 thus shows overseas holdings in the UK in 2007 and 2008. As with the mergers and acquisition series, the US and Europe account for the vast proportion of holdings in the UK. The BRIC economies (Brazil, Russia, India and China) held less than 0.5% between them. This indicates the extent to which this aspect of internationalisation impinges on particular sectors in the UK innovation system. Figure 23 and 26 compare the UK's positions abroad by area and selected countries in 2001 and 2010.

Figure 23 Net FDI international investment position abroad by area and selected countries (2001)



Source: ONS FDI Database

Figure 24 Net FDI international investment position abroad by area and selected countries (2010)



Source: ONS FDI Database

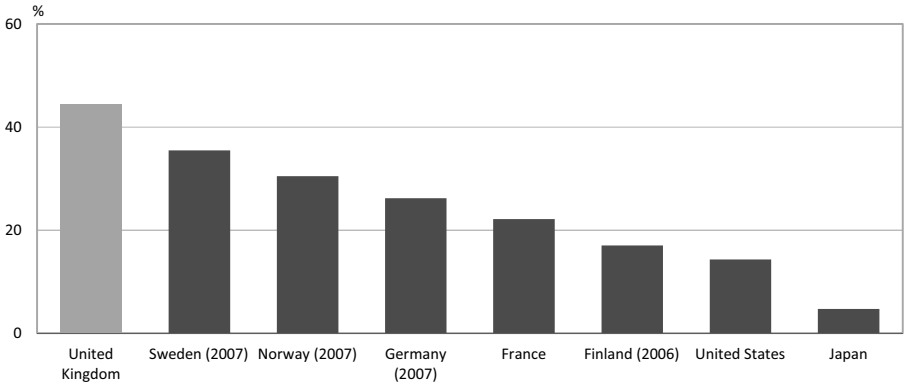
In both years the picture is dominated by UK holdings in the US and Europe (excluding Russia) with the BRICs accounting for only 1%. By 2010 the relative position of the US and Europe had declined from 24% to 17% in the US and from 61% to 58% in Europe (excluding Russia). This is reflected in an increase in shares accounted for by Asia (excluding China and India) and the Americas (excluding USA and Brazil). There is an increase in the other category from 5% to 9%. This was accounted for by an increase in UK holdings in Australasia, Oceania and Africa which rose from 4% to 6% and in the BRICs which rose from 2% to 3%.

The central position of the US and Europe in the pattern of both inward and outward international investment positions has experienced only minor changes in recent years. Understanding the impact of those two blocs on the UK system is therefore of central importance as is recognising the concentrated sectoral distribution of those flows.

Trends in internationalisation of R&D

So far we have focused on investment as a whole. It is also possible to look at R&D expenditure on its own. There are two ways of considering this. One is to look at the extent to which R&D expenditure in the UK is generated by foreign controlled affiliates; the second is to look at the overall extent to which R&D carried out in the UK is funded from abroad. Figure 25 shows the UK is heavily dependent on the extent to which its R&D expenditure is associated with the activities of foreign controlled affiliates which in turn is a reflection of the high inward flows of FDI and M&A discussed earlier.

Figure 25 R&D expenditures generated by foreign-controlled affiliates, 2008 (as a % of BERD)

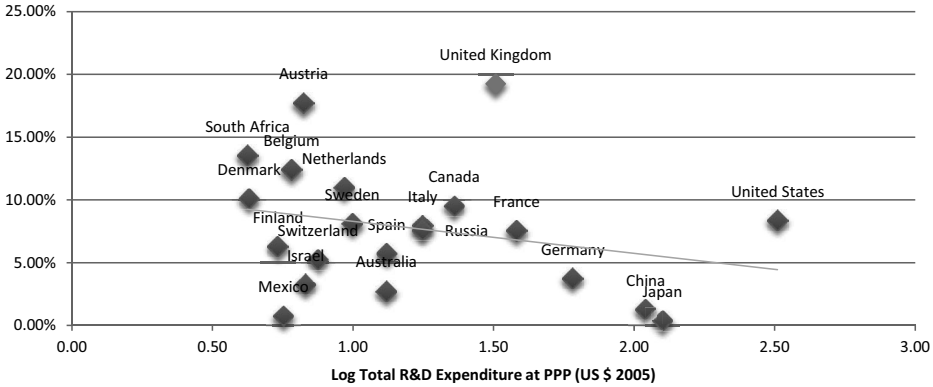


Source: Hughes and Mina (2011) derived from OECD

There is evidence across OECD economies that the conduct of R&D is becoming more globally dispersed. (See for example Hall, 2011). There is less systematic evidence on changes in external funding of R&D, not least because of problems of inconsistent data collection. The UK appears, however, to be characterised by relatively high levels of overseas funded R&D. Figure 26 shows for 2005 a scatter plot of all countries spending more than $5 billion in that year. It charts the share of R&D funded from abroad versus total R&D expenditure. The horizontal axis takes the log of expenditure on R&D at US$ 2005 of purchasing power parity values, because of the extreme skewness of the underlying distribution of R&D expenditure.[11] The fitted regression line shows an overall slight downward trend so that countries with high R&D shares tend to have somewhat lower shares funded from abroad. It is clear that the UK innovation system is an extreme outlier in terms of its dependence on overseas funding for its domestic R&D. Thus, compared to the other largest R&D spenders (United States, China, Germany and France), the UK is twice as dependent on overseas R&D funding as other countries, or to put it another way, it is able to attract twice as much funding in support of its domestic R&D.

11 The data is taken from Hall (2011).

Figure 26 R&D share funded from abroad versus total R&D expenditure, 2005



Source: Derived from Hall (2011) Table 2 p.183 based on data drawn from UNESCO Institute of Statistics (2010) Science and Technology Statistics.

Internationalisation and the UK innovation system: summary

The patents, FDI, mergers and share ownership discussed so far indicate some evidence of increased globalisation on some indicators and a relatively extreme degree of openness in the UK innovation system. The analyses have been at a necessarily high level of aggregation, but similar conclusions may emerge from more disaggregated approaches. In a recent examination of trends in innovation and technological change in US industries, including personal computing and software, semiconductors, flat panel displays, lighting, pharmaceuticals, biotechnology, logistics and financial services, a number of globalisation changes were noted whilst other system elements remained the same (Macher and Mowery, 2008). In a US context changes related to the rising innovation capabilities of China, India, Taiwan and South Korea in the period from the 1980s onwards, both in terms of domestic and international innovation competitiveness. There was also an increase in outsourcing across sectors in terms of manufacturing and changes in the nature of demand, in particular for advanced and high quality applications, in the domestic markets of Asian economies in particular. The latter led to the reversal of the conventional product cycle in which advanced products were typically developed in domestic markets before marketing and manufacturing offshore. Finally, increased vertical disintegration in a wide range of industries produced an increased focus for particular businesses on specialised or limited sets of activities in the value chain. This move from a vertically integrated set of research and development and innovation structures inside businesses to a contract based value and supply chain system based on collaboration and contracting between specialised firms has accompanied offshoring. This has altered patterns of appropriability from returns in most sectors. Despite this, as the authors of the study point out, in the case of the US the majority of advanced R&D remains concentrated in the domestic economy and patterns of invention,

for example as reflected in patent statistics, still reveal a strong home bias.[12] Nevertheless, the vertical disintegration of value and supply chains means the performance of firms in individual economies including the UK will be intimately linked to the extent to which they can occupy and appropriate gains from value and supply chains spanning many national jurisdictions. (See for example Sydor, 2011; de Backer and Yamano; 2012). Any analysis of the scope for innovation policy in the UK must start from an understanding of these value chain structures and the possibility of developing strategies to support the appropriation of value through innovation from them.

Internationalisation: Foreign direct investment (FDI), direct, indirect and spillover effects

So far we have focused on the structural features of the UK's innovation system in an international context. A central question is what implications these features have for the performance of UK firms and the UK economy. In the main attempts to answer this have been econometric and paid little direct attention to the system level patterns of institutions and connections which may drive those relationships. Most of this literature focuses on productivity effects rather than innovation per se, and seeks to identify direct and indirect (or spillover effects) in terms of the underlying productivity performance of firms, and the sectors experiencing foreign direct investment flows, takeovers or foreign ownership. This is a complex area both in terms of underlying conceptual approaches and the quality of the empirical evidence.[13]

Harris (2009) provides a succinct overview for the UK and identifies a number of problems. First, the underlying data do not directly measure spillovers and difficult problems of inference and causality arise when statistical associations are estimated between FDI and claimed spillover effects, not least because direct evidence on the process generating spillovers are not well understood. Second, there are major issues in identifying foreign ownership effects because of the need to disentangle the impact of initial characteristics of the firms and plants involved in, for example, M&A on their subsequent performance. It transpires that in terms of foreign ownership of UK plants there is evidence to suggest that where foreign ownership is located in the US such plants have higher levels of productivity performance.[14] That effect does not extend to ownership by other countries. Foreign owned firms that also export are overall best in terms of productivity performance. However, this appears to vary significantly

12 The authors also point out that the data available to study these changes have not kept pace with the underlying changes in the nature of the activity itself, so that R&D statistics typically have not kept pace with the important changes in the contribution of other intangible inputs, such as skills and software, into the innovation process. This has led to major attempts to develop new measures for innovation at national and OECD level. See for example OECD (2010a).

13 See for example Haskel et al. (2007).

14 There are few studies which look at innovation related impacts. Those which do find neutral negative impacts for public acquisitions (see for example Desyllas and Hughes, 2010).

by region. Thus, in Northern Ireland overseas owned plants tend to have no clear productivity advantage compared to UK owned plants operating there. The fact that foreign owned plants have productivity performance implies a higher overall level of UK performance than might otherwise be the case. Although in Northern Ireland, however, it appears that foreign owned firms actually lowered productivity growth between 1998 and 2006.

Plant level evidence on the impacts of inward acquisitions suggests that at best there are only short-term productivity gains and in the medium term the overall impact is negative. Thus three years after the acquisition the productivity growth of firms acquired by overseas owned multinationals reverts to much the same as those for domestic exporters that were not acquired. (Girma et al., 2007). This is consistent with a wide range of evidence using financial data which suggests the impact of acquisitions in general produces neutral or negative performance changes for the firms involved (see for example Conn et al., 2005, who note however differences between the impact the acquisition of public companies and private companies with the latter (which account for 58% of the value of cross border acquisition in the period 1985-98) having more positive effects on the acquiring company).

In relation to inward spillovers (i.e. indirect benefits arising foreign direct investment into the UK not captured by the firms involved themselves) Harris (echoing Görg and Greenaway (2004) concludes that "the results from studies measuring intra-industry, inter-industry and agglomeration spillovers tend to provide mixed and overall unclear answers as to their presence and importance". (Harris, 2009, p.24). 15 It also appears that where productivity spillovers are identified they may be rather small. For example, a 10% increase in FDI may raise total factor productivity in domestic plants by around 0.5% (though this may vary across types of FDI in particular when the investment is related to exporting activity). It also appears that spillovers may be more likely in agglomerations. In the case of the UK this tends to mean the effects mostly occur in London and the South East. Overall Harris (2009) concludes that the evidence indicates the need to approach these issues in a more disaggregated fashion and to link approaches relying more on detailed survey based research and the absorptive capacity of firms which may yield less generalisable but more direct policy relevant evidence on the nature of the spillover linkages in particular contexts. These remain hidden in many of the econometric based studies which have dominated this field so far.

15 Griffith et al. (2006) report a positive association between US R&D and the total factor productivity of UK firms which have an innovative presence in the USA. This suggests spillover benefits from outward as opposed to inward FDI although as the authors point out uncovering the process by which this relationship may be interpreted causally remains to be done.

Where they have been analysed for other countries more robust results emerge (see for example Smeets, 2008 and Coe et al., 2009).16

In view of the extent to which attention in policy discussion focus on the importance of attracting and maintaining multinational inward investment flows, this suggests the need for a much deeper understanding of the operations of these effects in specific locations, sectors and technological spaces in the UK. UK policy has recently increasingly and helpfully begun to focus on such issues, e.g. in relation to biotechnology and life sciences (BIS, 2009 and 2012).

Internationalisation of the innovation system: Overview

The fact that there have been some increases in some aspects of the internationalisation of innovation activities is supported by a variety of evidence presented in this chapter. What is most marked, however, is the extreme position of the UK innovation system in terms of some of these indicators. However, it does not follow from this that there is no scope for the development of appropriate innovation policies at the national level in the UK. Such policies will doubtless encounter more constraints (and potential opportunities) given the openness of the system. Moreover, the extent to which different sectors are affected by different aspects of the globalisation process in the UK including the vertical disintegration of value chains means policy needs to adopt a granular approach. Opportunities may be best identified not at the level of particular sectors or regions, but in relation to particular components of the value chain as the vertical disintegration of production in many sectors proceeds.

One of the striking features of the review of evidence relating to the impact of globalisation per se has been the difficulties in identifying clear performance impacts in relation for example to FDI to guide policy. There is also a lack of clear evidence in the UK on the connection mechanisms by which spillovers are generated and the degree to which effects occur in different sectors. This relates precisely to the importance of understanding the connections (frequently not mediated directly through markets) which affect the absorption and diffusion of new ideas and innovations in the innovation system and which characterise the systems approach, and this is where future research could usefully concentrate.

16 Keller (2010) provides a good overall review of the evidence in relation to trade, FDI and technology spillovers covering a wide range of countries beyond the UK. He argues that the evidence on FDI generally (and not just in the UK) suggests that there is vastly different spillover potential by sector and location. The degree of variation in FDI spillover estimates across countries for example suggests that there is still a great deal to be learned about the characteristics which affect these estimates and their reliability. Thus, for instance, spillover effects estimated for the US in some studies suggest impacts which are ten times as large in the US than in the UK.

National innovation in the UK: An illustrative example

One of the most pressing debates in innovation policy in the UK and elsewhere is the extent to which investment in the science base is linked to the generation of significant economic and welfare benefits in the country concerned. We have seen that in the UK there have been substantial increases in real investment in higher education in support of research and the UK has an outstandingly successful track record in the scientific output of its university base. Although funding has tailed off in recent years and there will be cuts in real terms in the aftermath of the financial crisis, higher education R&D as a percentage of GDP remains one of the few upward trending R&D variables in the UK over the past decade. Understanding how this may be best supported in developing productivity, innovation and growth effects elsewhere is therefore of great importance. (See for example Deiaco et al., 2012, and the references therein). It is also of particular significance given the emphasis of location close to centres of scientific excellence and skilled labour in the motivation for location decisions by MNCs (See for example OECD, 2008). It is therefore interesting to consider how innovation policy might be developed in this area

The approach proposed is based on work undertaken by the Council for Science and Technology (CST, 2007) in which the current author was involved. The work and subsequent report arose from a request by government to "advise" on "what would be the best areas to focus resources for science, technology and innovation which could lead to applications with commercial or social benefits in around 5 years". (CST, 2007, p.3). The outcome of the exercise in terms of technologies proposed is less important in this context than the methodology developed and recommended for the strategic identification of areas to support.

Any exercise of this kind immediately falls prey to the argument that it is 'picking winners', and because the government cannot pick winners, it is therefore a fruitless exercise. This argument is largely irrelevant in current innovation policy discussions. The argument against picking winners is based on a period over thirty years ago in which a particular government policy focused on what was then the private sector's fashion to merge businesses into a national champion in anticipation of substantial gains from reorganisation and scale. In the main such gains failed to materialise (as is the case on average with private sector mergers). That kind of policy is not at issue in discussions of strategic choice between innovation support for different technologies. Instead it is intended to capture the essential nature of portfolio selection in supporting high risk innovative ventures with potentially high, but uncertain outcomes. The appropriate language should therefore be 'choosing races' and 'placing bets' rather than 'picking winners'. The key issue is how to choose the races and place the bets and how to improve on what is already a resource allocation process driven by less transparent and largely uncoordinated parts of the UK innovation policy framework.

The CST report proposes a staged approach and the form of policy support which may be required. This essentially involves collating and assessing evidence against six key criteria. The first involves an assessment of whether there is evidence that the UK possesses distinctive and outstanding scientific and technological competence in particular areas. Second, and following on from this, there should be an analysis of the potential market size of successful innovations in the relevant technology space. This should be supported by an analysis of the UK's capacity to deliver in terms of private sector investment in the innovation and commercialisation process (whether in terms of companies currently located in the UK or overseas firms which could be attracted to invest alongside the area of a scientific expertise identified). This must include a clear value chain analysis in areas of potential applications and assessment of the extent to which it will be possible to appropriate a significantly large element of it. It is at these stages that internationalisation of the applications and value chains and their future potential trajectories must be identified and understood. Here the role of foresight and public, private road mapping exercises have a central role to play. The emphasis is not upon picking individual firms or favouring particular existing industrial sectors, but developing potential future trajectories from scientific and technical knowledge.

There are then three further stages involved. The first looks at wider societal implications beyond strictly economic and financial returns. The second examines the risks involved in public support policy failure and failure of the developing technology itself. This in turn involves building into any proposed policy support, a real options approach in which policy is developed in the light of information acquired at each stage of development of the support process in the technology development pathway.

The final stage is to identify the form of government intervention which would be most appropriate. It is important to note that such policy interventions need to be developed in the context of a systems approach. They go beyond issues of relative price adjustments in response to market failures through, for example, R&D subsidies. They include, in particular, the potential for the government to play a lead role as a procurer of R&D services, or ability of the public sector to promote (or not inhibit) appropriate co-location and agglomeration effects. It includes also the development of appropriate intermediating organisations which in particular science and technology areas may span both national and international university/industry boundaries and enhance the commercialisation process. (Mina et al., 2009; Hauser, 2010).

Such an approach involves the development of an appropriate capacity in the public sector itself to generate in combination with business the kind of data required to drive such a process. It will also require persistence and incremental learning in the process of policy delivery. Failure will be a feature of the system of support and a few successful outcomes will dominate overall gains.

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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

1 The authors thank BIS officials and researchers associated with this initiative for their comments on an earlier draft of this paper. Comments on this paper are most welcome and can be sent to either author.

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).

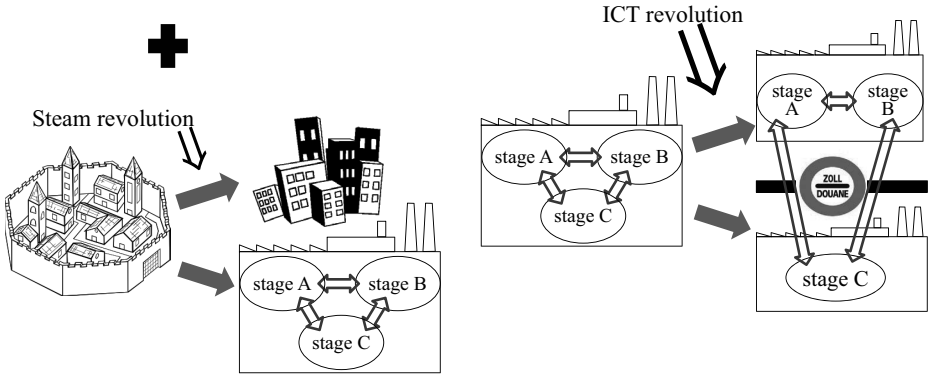
1.1.1 The 1st unbundling: Steam made it possible, scale economies made it profitable

When sailing ships and stage coaches were high-tech, few items could be profitability 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).

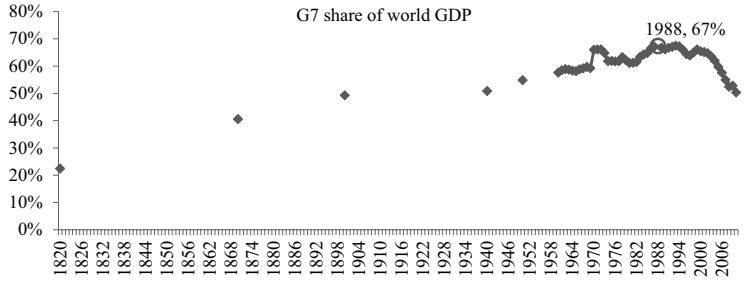
Beyond trade: Heightened international mobility of firm-specific technology
The 2nd unbundling also greatly heightened the cross-border mobility of technology. By allowing better control at distance, the information revolution helped firms from advanced-technology nations combine firm-specific know-how 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 show 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

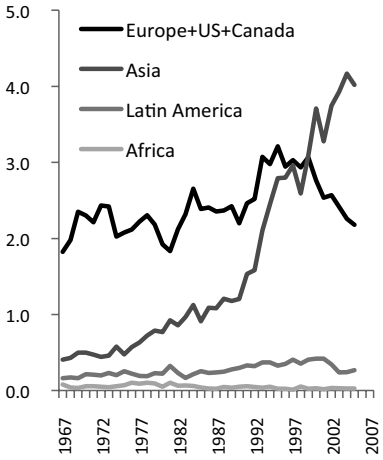
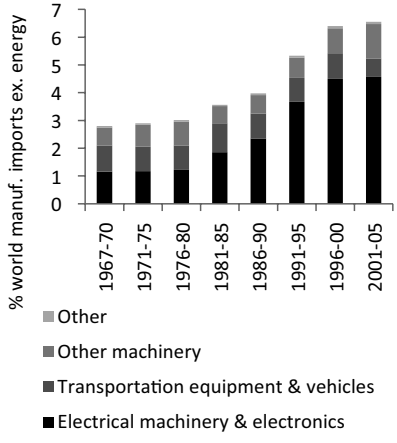


Figure 4 Sector measures of supply-chain trade, 1967-2004



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%	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

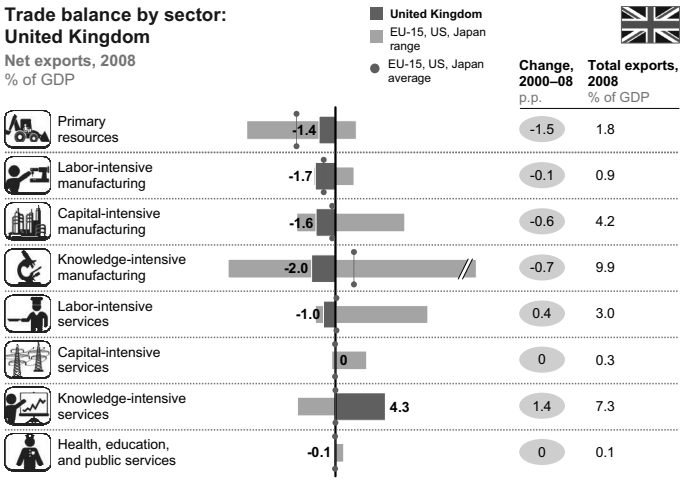
3 While these studies discuss UK performance, both have wider country coverage. McKinsey (2012) focuses on the first 15 members of the European Union, Japan, and the United States. Timmer et al (2012) considers both the largest industrialised countries—often taking the EU as a separate unit—and several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

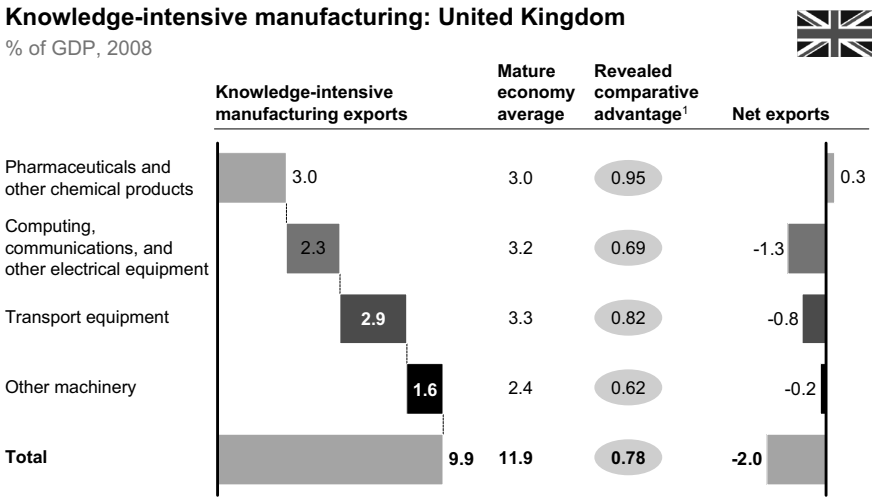


Source: McKinsey (2012), page 44.

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.

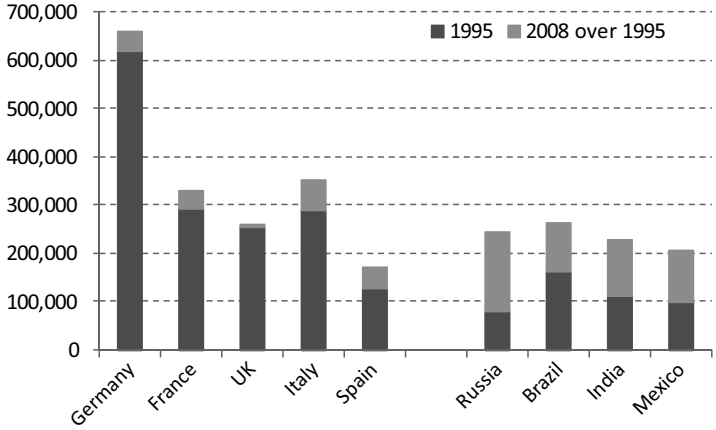
From gross sales to value added

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.

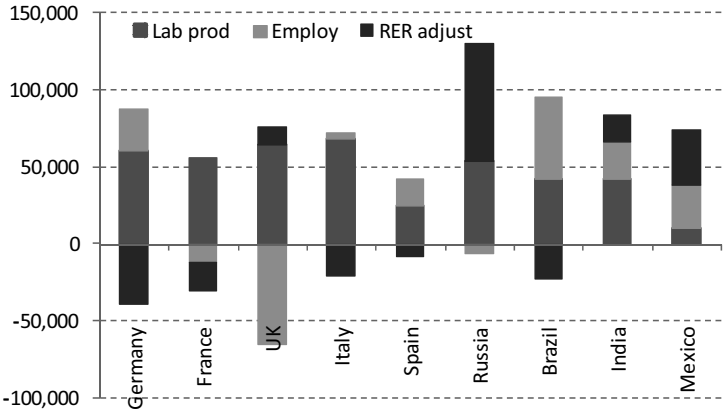
Figure 8 Income in UK value chains



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



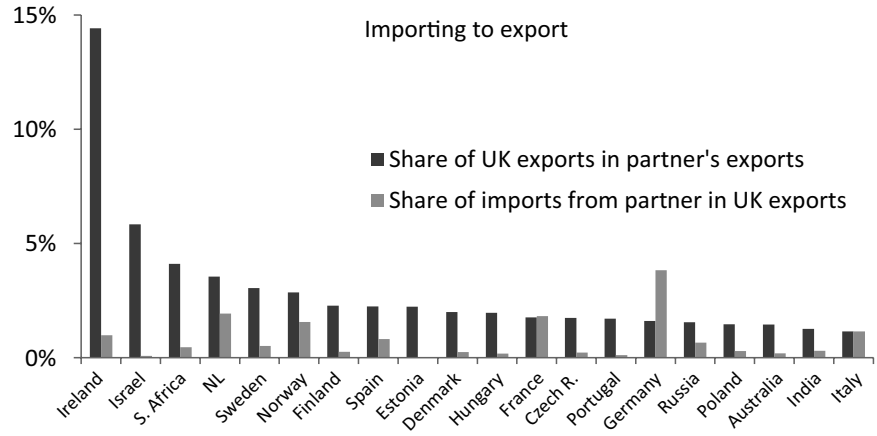
Source: Timmer et al (2012) Figure 10, page 33. Notes : Vertical axis provides the decomposition of change between 1998 and 2005 in gross value added in manufacturing supply chains into three sources: changes in labour productivity, changes in employment, and changes in real exchange rates. Data reported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



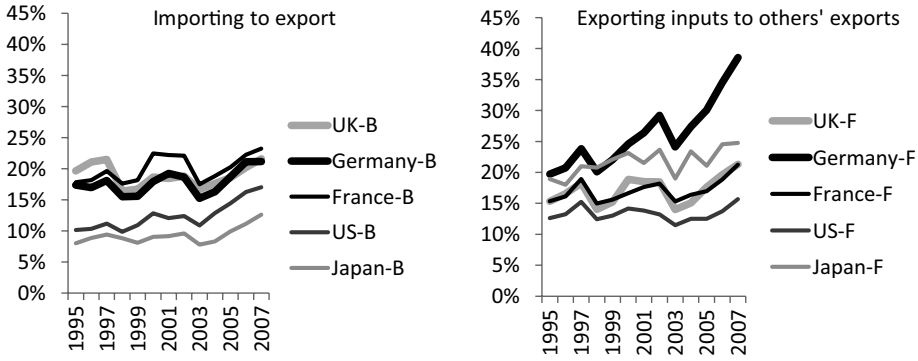
The top bars of Figure 10 show the value share of the listed nation's intermediates in a dollar of UK exports. Britain's most important suppliers are Germany, France, Netherlands, Italy and Norway. The bottom bars show the reverse – the share of the partner's exports made up of British intermediates. 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

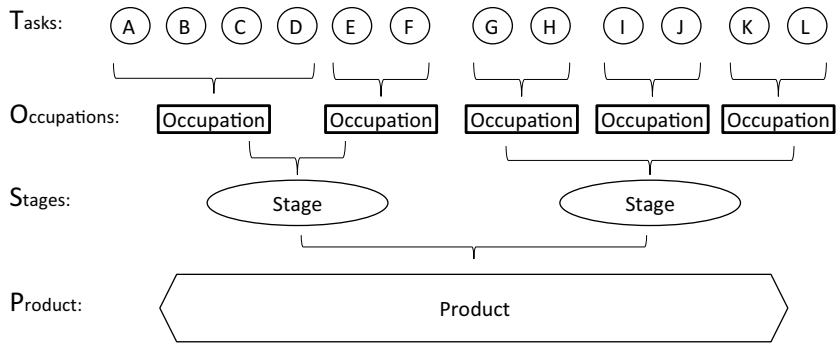
Supply chains are a familiar concept. Laptops require hard drives which require electric motors which require magnets. The supply chain is the sequence of facilities that provide these inputs. The value chain is a broader concept popularised by Michael Porter just as the 2nd unbundling took off (Porter 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.

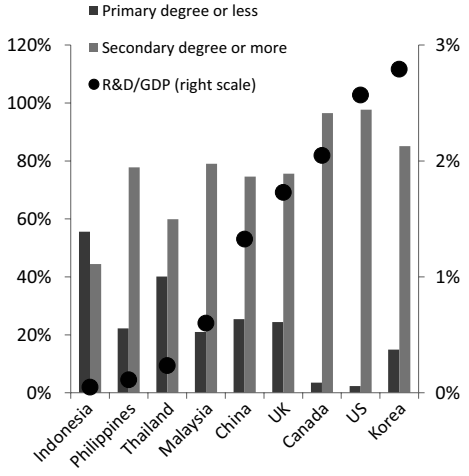
For example, when it comes to automobile air conditions, the French company Valeo dominates the European market through excellence – not low wages. While each European carmaker could make their air conditioners, scale economies mean that it is cheaper for Italian and German automakers to source them 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.

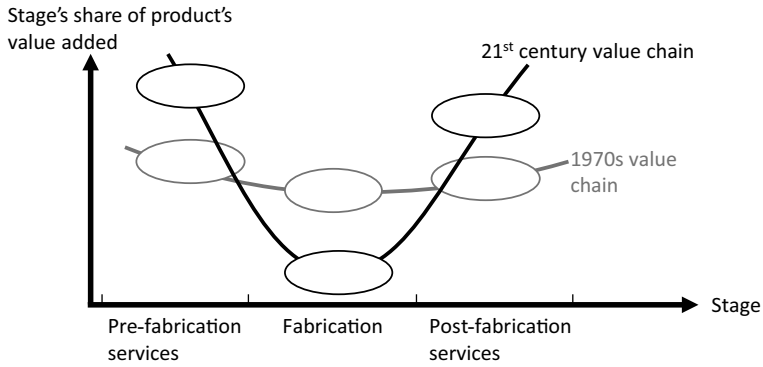
This widely known feature of the New Economic Geography logic explains why lower trade costs are good for clustering at first but bad beyond some threshold. This explains how globalisation's first and second unbundlings could have diametrically opposed effects on agglomeration of industry and overall 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.

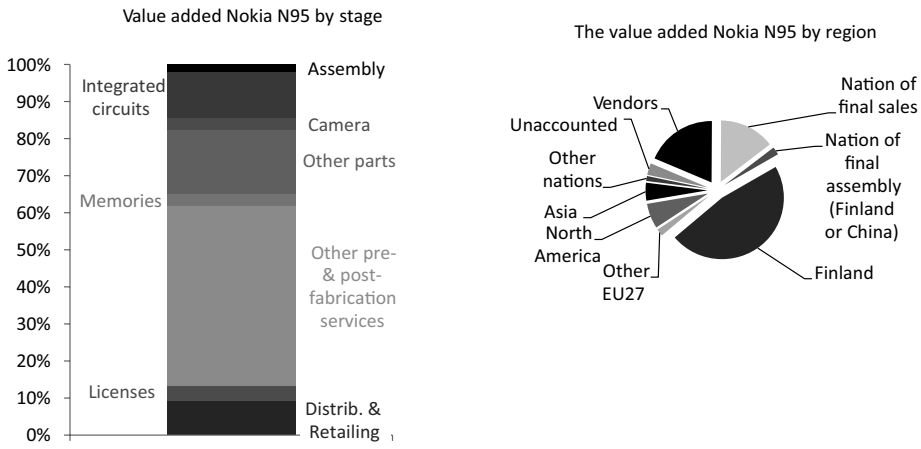
Figure 15 The smile curve: Good and bad stages in the value chain



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

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

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

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

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

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

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

This is a workable starting point. It tells us: 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 = γi L

where γi 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 = γi (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 γi 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

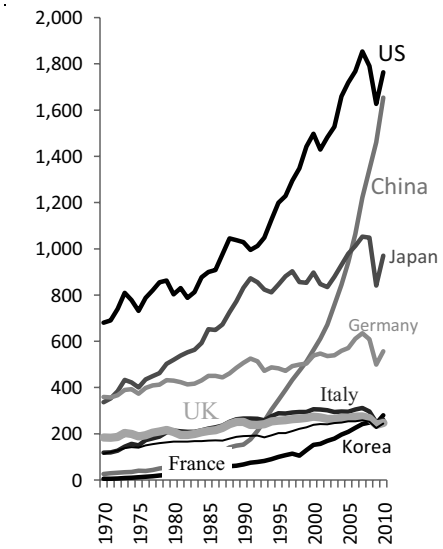
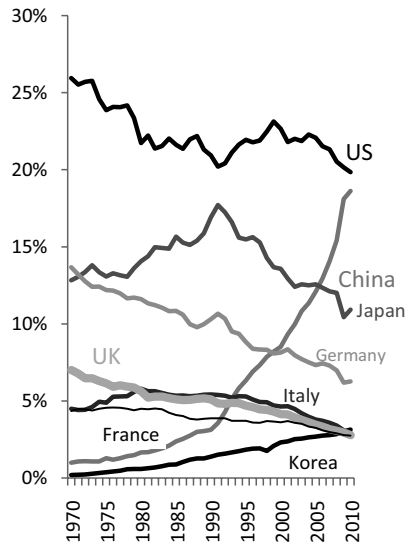


Figure 18 Shares of global manufacturing GDP shares, 1970-2010



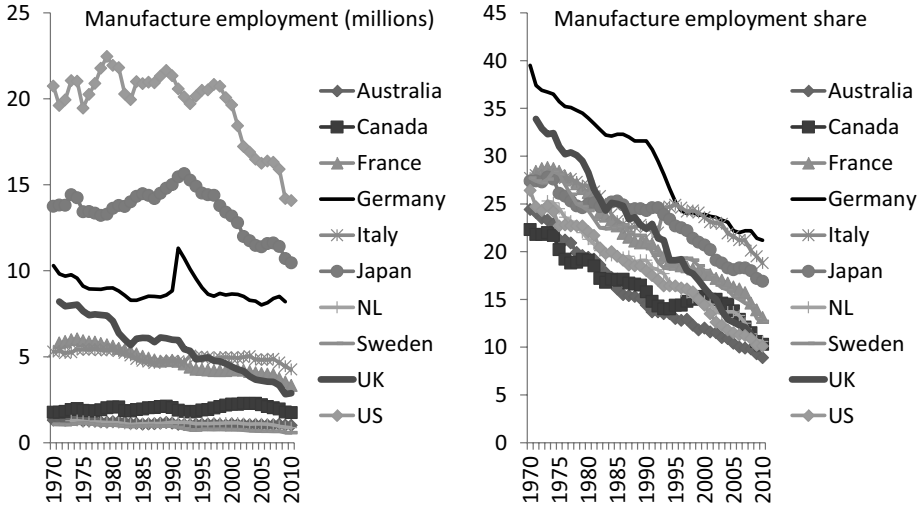
Source: UN Data.

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 products[9];
- 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.

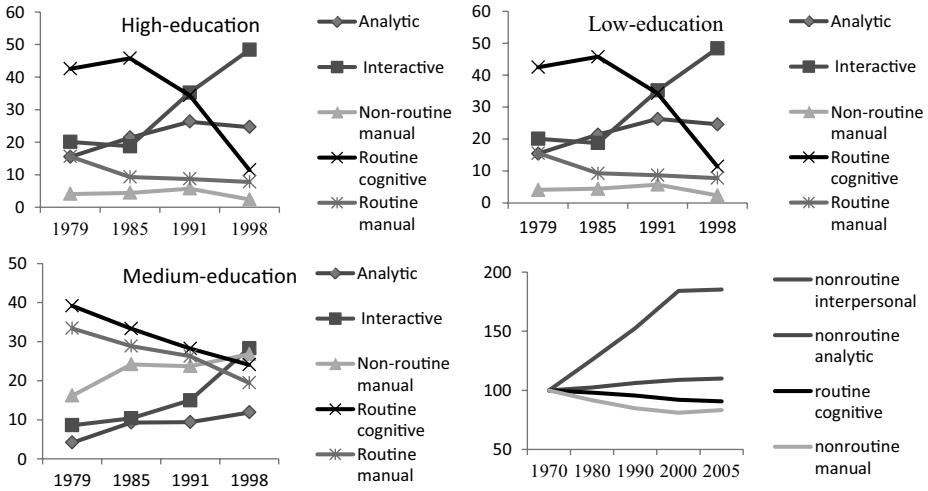
An instructive example of this can be found in the recent Boston Consulting Group study, BCG (2011). This shows that faster wage growth in China brings US job competitiveness close to the 'tipping point', i.e. the point where making things in the US will be cheaper than in China. "By around 2015," the 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* comparatives 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:

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

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.

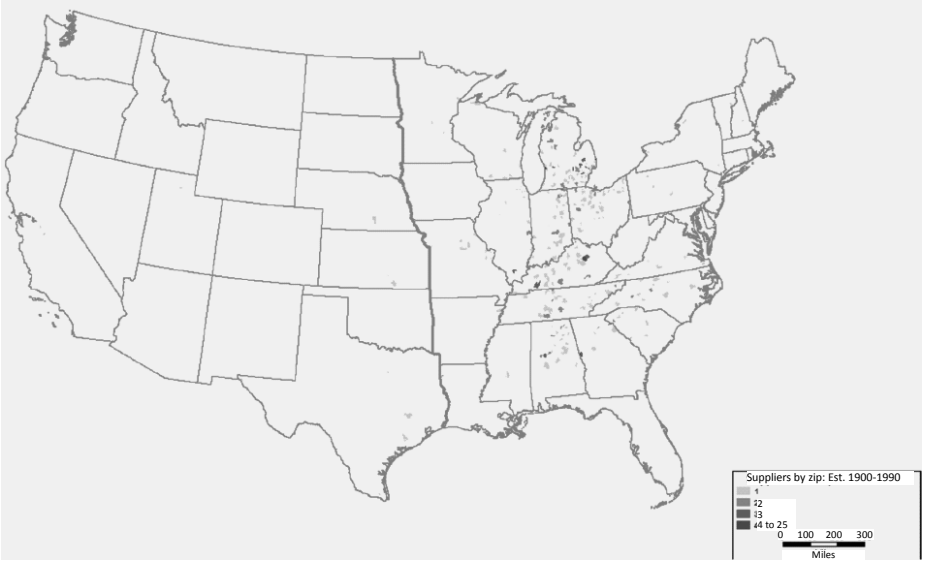
Before turning to the policy implications, we consider a case study (autos) that hammers home the key point– comparative advantage can no longer be thought of without a map in hand.

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-measureable 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.

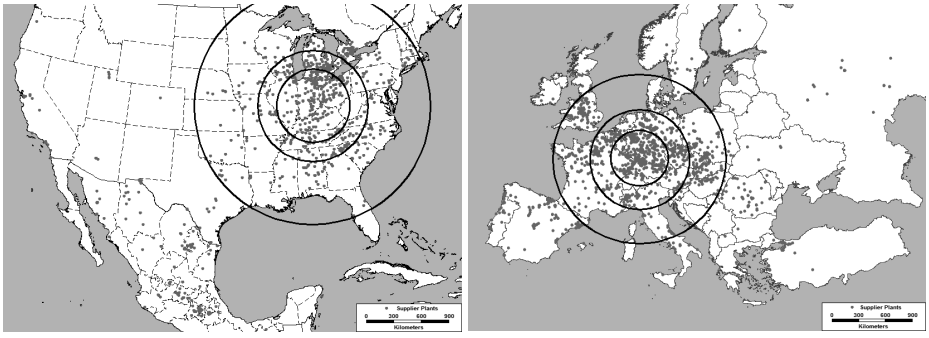


Source: Klier and McMillen (2008).

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 viscidity -- 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 polices 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 strips, 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

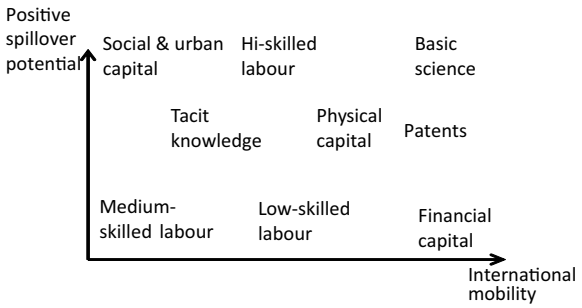


Figure 23 schematically presents a general conceptualisation of seven potential targets for pro-manufacturing policies: three types of labour, two types of knowledge and two types of capital. This is meant to organise thinking about the effects of various input-promoting industrial policies – not an 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 foster 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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5 Comparative Advantage and Service Trade

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1 Introduction

Service exports, and in general competitiveness in services, is important for a number of reasons. First, we live in the era of services. Fifty years ago the service sector represented only 30% of the GDP and a negligible share of world trade while. As reported in Francois and Hoekman (2010), services now account for 75% of world GDP and about 20% of total trade. Second, services are the fastest growing component of trade over the past few years, with a two-digit average annual growth rate that was only marginally affected during the 2009 world trade collapse (Baldwin, 2009). Third, the contribution of the sector to world trade is much higher than can be inferred from raw trade statistics. By taking into account global value chains and input-output relationships, Timmer et al. (2012) find that almost half of all jobs related to global manufacturing production are found in non-manufacturing sectors while Francois and Hoekman (2010) conjecture services represent more than 50% of world trade when measured in terms of value added. Last but not least, the UK is (relative to its economic size) possibly the most successful service trader in the world, which makes it even more interesting from the BIS perspective.

Despite the major role services are currently playing in world trade (and the UK in particular) they have received relatively little attention. On the theoretical side, services have traditionally been treated as a sector whose output is non-tradable. As a result, the existing body of research on trade and trade policy is focused mainly on agriculture and (especially) manufacturing. On the empirical side, there is also a gap which is mainly due to the fact that data on trade flows and FDI in services across countries have become available only very recently.

The aim of the present study is to shed light on the fundamentals driving patterns and volumes of service trade across countries, to provide policy recommendation on how to maintain and potentially improve the leading role of the UK in this area. Building on the principle of comparative advantage, we aim to identify the scope and interactions of key institutional, geographical, and endowment

features driving specialisation in service trade and the creation of service-sector value added.

The principle of comparative advantage, dating back to Ricardo, still plays an important role in trade theory and empirics. Comparative advantage arises as long as there are differences in productivities across countries. Despite the economic mechanisms resulting in productivity differences across countries being the object of a wide debate, Ricardo's idea remains fresh and vital to understanding trade. Indeed, many recent trade models couple Ricardian differences in productivities with firm heterogeneity generating 'probabilistic comparative advantage' (see for example Eaton et al, 2011).

In terms of the implementation of the principle of comparative advantage a number of considerations are in order. First, as discussed in Prescott (1998), differences in productivities across countries are hard to understand if one does not take into account the role of competition, institutions, and human capital. Second, 'New Trade Theory' (NTT) has shown that consumers' love for variety and increasing returns to scale in production represent first-order determinants of trade volumes and patterns so downplaying the importance of factor, and in particular capital, endowments differences across countries as a reason for trade. Third, the 'New Economic Geography' (NEG) literature has highlighted the role of geography and trade costs in determinants the level of development of a country as well as the presence of multiple equilibria.

In our analysis we take these into account and build on what has become the milestone of trade flows analysis: the gravity equation. Trade models incorporating comparative advantage, NTT, and NEG features deliver structural gravity equations in which the volume of exports from country i to country j depends on economic size, trade costs, and productivity/competitiveness of the two countries. The presence of cross-country variation in productivity/competitiveness, once controlled for size and trade costs allows the identification of the key institutional, geographical, and endowment factors driving productivity differences across the globe and, for the sake of this analysis, specialisation in service trade and creation of service-sector value added.

Among those factors we will pay particular attention to:

- the importance of the quality of contract enforcement, property rights, police, and courts (rule of law)
- degree of financial development
- stock of human capital and its recent evolution
- size of a country and level of economic development
- availability and use of IT technology
- infrastructures and accessibility to foreign markets

All of these arguably contribute to the comparative advantage of a country in service trade. However, what is not trivial is how important are these factors in actually determining trade volumes and patterns. Given current tight finances, should the UK concentrate on factors X and Y instead of Z and W to sustain and possibly improve its position? The answer depends on the relative costs and benefits, as well as political feasibility, of intervening on X,Y,Z, and W. The goal of this study is to provide insights on potential benefits arising from policy interventions on the different factors determining comparative advantage.

The analysis makes use of service trade exports data by country of origin and service type from the WTO over the period 2000-2010. We draw on the information provided by the World Bank's database, as well as by Barro and Lee (2011), to identify measurable proxies for the above factors. The econometric model is based on a cross-country analysis of services trade flows with two twists. First, we consider both current (2010) and historical data (2000) to gain insights on possible structural parameter changes and growth patterns. Indeed, given the rapid growth experienced by service trade and numerous political and economic factors having characterised, it is likely that the magnitude, significance, and interactions among the factors driving comparative advantage have changed substantially.

Second, we further break down data by service type to see whether the underlying drivers of export growth affect differentially various types of services. Given the very different nature and capacity to create value added characterising service types/products) it is to be expected that some factors play a more important role in some cases, while some others score across the board, and with the overall mix of effects across products is important in evaluating overall gains. To be able to provide concrete policy recommendations while bearing in mind their different advantages and costs, it is therefore necessary to push the analysis to the product level.

The policy recommendations flowing from this analysis are, therefore, evidence-based and pertain to steps the UK government could take to stimulate service sector trade in general and particular types of service sector trade.

2 Data

To conduct our analysis we merge trade in commercial services data with country-level proxies for comparative advantage factors. Data have been merged by country ISO2 codes.

2.1 Trade in commercial services

The first piece of information concerns "Trade in commercial services" and comes from WTO datasets. Data are derived from country statistics on international service transactions which are included in balance of payments statistics. They provide information on yearly exports and imports of different service categories by country over the time frame 1980-2010. Despite its richness, WTO data does not include exports and imports of services belonging to mode 3, where the service is provided by a supplier of one country through commercial presence in the other. However, the data does contain information concerning modes 1, 2, and 4. In Section 4 we will come back to this issue to qualify its implications for our analysis.

In the fifth edition of the *Balance of Payments Manual*, the current account is subdivided into goods, services (including government services, n.i.e.), income (investment income and compensation of employees), and current transfers. The commercial services category is defined as being equal to services minus government services, n.i.e. Commercial services is further sub-divided into transportation services, travel, and other commercial services.

Transportation Services covers sea, air and other including land, internal waterway, space and pipeline transport services that are performed by residents of one economy for those of another, and that involve the carriage of passengers, movement of goods (freight), rentals (charters) of carriers with crew, and related supporting and auxiliary services.

Travel includes goods and services acquired by personal travellers, for health, education or other purposes, and by business travellers. Unlike other services, travel is not a specific type of service, but an assortment of goods and services consumed by travellers. The most common are lodging, food and beverages, entertainment and transportation (within the economy visited), gifts and souvenirs.

Other commercial services correspond to the following components defined in BPM5:

- *communications services* includes telecommunication, postal and courier services. Telecommunication services encompasses the transmission of sound, images or other information by telephone, telex, telegram, radio and television cable and broadcasting, satellite, electronic mail and facsimile services, including business network services, teleconferencing and support services. It does not include the value of the information transported. Also included are cellular telephone services, Internet backbone services and on-line access services, including provision of access to the Internet,
- *construction* covers work performed on construction projects and installation by employees of an enterprise in locations outside the

territory of the enterprise (the one-year rule to determine residency is to be applied flexibly). In addition goods used by construction companies for their projects are included which implies that the 'true' services component tends to be overestimated,

- *insurance services* covers the provision of various types of insurance to non residents by resident insurance enterprises, and vice versa, for example, freight insurance, direct insurance and reinsurance,
- *financial services* covers financial intermediation and auxiliary services provided by banks, stock exchanges, factoring enterprises, credit card enterprises, and other enterprises,
- *computer and information services* is subdivided into computer services (hardware and software related services and data processing services), news agency services (provision of news, photographs, and feature articles to the media), and other information provision services (database services and web search portals),
- *royalties and licence fees*, covering payments and receipts for the use of intangible non-financial assets and proprietary rights, such as patents, copyrights, trademarks, industrial processes, and franchises,
- *other business services*, comprising trade-related services, operational leasing (rentals), and miscellaneous business, professional and technical services such as legal, accounting, management consulting, public relations services, advertising, market research and public opinion polling, research and development services, architectural, engineering, and other technical services, agricultural, mining and on-site processing,
- *personal, cultural, and recreational services* is subdivided into two categories: audiovisual services; and other cultural and recreational services. The first includes services and fees related to the production of motion pictures, radio and television programmes, and musical recordings. Other personal, cultural, and recreational services includes services such as those associated with museums, libraries, archives, and other cultural, sporting, and recreational activities.

In our analysis we use exports data for 2000 and 2010 by service type and exporting country.

2.2 Country-level fundamentals

The second piece of information concerns a number of country-level proxies for factors driving the pattern and volume of trade across countries. The following country-level variables are deployed:

1. GDP in current USD (World Bank Database)
2. Population (World Bank Database)
3. Bilateral distances (CEPII Database)

4. Measures of the quality of the governance of a country (World Bank Database):
    - Voice and Accountability
    - Political Stability and Absence of Violence/Terrorism
    - Government Effectiveness
    - Regulatory Quality
    - Rule of Law
    - Control of Corruption
5. Measures of the ease to start a business (World Bank Database):
    - Starting a Business - Procedures (number)
    - Starting a Business - Time (days)
    - Starting a Business - Cost (% of income per capita)
    - Starting a Business - Paid-in Min. Capital (% of income per capita)
6. Measures of the quality of contracts enforcement (World Bank Database):
    - Enforcing Contracts - Time (days)
    - Enforcing Contracts - Cost (% of claim)
    - Enforcing Contracts - Procedures (number)
7. Measures of the ease of getting credit (World Bank Database):
    - Getting Credit - Strength of legal rights index (0-10)
    - Getting Credit - Depth of credit information index (0-6)
    - Getting Credit - Public registry coverage (% of adults)
    - Getting Credit - Private bureau coverage (% of adults)
8. Measures of the tax hurdle and efficiency (World Bank Database):
    - Paying Taxes - Payments (number per year)
    - Paying Taxes - Time (hours per year)
    - Paying Taxes - Profit tax (%)
    - Paying Taxes - Labour tax and contributions (%)
    - Paying Taxes - Other taxes (%)
    - Paying Taxes - Total tax rate (% profit)
    - Business taxes
9. Expenditure in R&D as a % of GDP (World Bank Database)
10. Financial Development measures as domestic credit to private sector as a % of GDP (World Bank Database)

11. ICT use (World Bank Database):
    - Internet users per 100 population
    - Broadband Internet subscriptions per 100 population
12. Average number of years of schooling referring the population aged 25 or more (Barro and Lee, 2011)
13. Gross enrolment in tertiary education as a % of the population in tertiary schooling age.

Some of these, such as GDP, population, quality of governance, are available for all years from 2000 and 2010. Others, such as tax hurdle and efficiency, are available only from 2004 onwards. Finally, the average number of years of schooling is available only for 2000. However, given that we will estimate a cross-sectional model and these variables change little over time, this is not a major issue. We thus use in our analysis the average (over the period 2000-2010) of available data.

After preliminary correlation analysis, a number of institutional variables have been discarded to avoid multi-collinearity problems. Furthermore, expenditure in R&D has also been discarded due to the limited number of countries for which this is available.[1] The final set of covariates is:

1. Size: log of the GDP of country *i*
2. Legal Institutions: rule of law index of country *i*
3. Financial Institutions: domestic credit to the private sector as a % of GDP of country *i*
4. IT: Number of broadband Internet subscriptions per 100 population of country *i*
5. Human Capital Stock: log of the average number of years of schooling of the population of country *i*
6. Human Capital Growth: % change in between 2000 and 2010 of gross enrolment in tertiary education (as a % of the population in tertiary schooling age) of country *i*
7. Market Access: log of the market access of country *i* defined as: $MA_i = \log (\Sigma_{j \neq i} Y_j/d_{ij})$, where Y_j is the GDP of country *j*, d_{ij} is the distance between countries *i* and *j* and the sum is taken across all countries but *i*.[2]

1 Expenditure in R&D has also been discarded because figures refer to the whole economy rather than to the service industry, which is particularly problematic given that manufacturing and services have a very different R&D behaviour. As a matter of fact, expenditure in R&D was rarely significant in our estimations.

2 See Head and Mayer (2004) for an example of how market access can be derived from a theoretical model.

3 Econometric models

We model both the level and growth of service exports in between 2000 and 2010. In the case level, we use log service exports value of country *i* to the rest of the world in year *t* as dependent variable (EV_{it}). We consider data for both t=2000 and t=2010 and pool observations together while adding a year dummy for 2010. Formally:

$$EV_{it} = const + \beta^t X_i + \delta_t + \varepsilon_{it} \quad (1)$$

where const is constant term, δ_t is a time dummy, ε_{it} is an idiosyncratic component capturing (among other) measurement error in EV_{it}, and the vector X_i contains our variable of interest: size, legal institutions, financial institutions, IT use, stock of human capital, and market access.

Size (and in particular GDP of a country) is dictated by the empirical relevance of the gravity equation and its deep economic foundations,[3] as shown by Head et al. (2009) for service trade. As for quality of legal and financial institutions Prescott (1998), and other recent literature,[4] point to the importance of institutions in determining productivity and wealth. We focus here on the rule of law and degree of financial development.[5] Despite having a wide number of institutional variables, the high degree of correlation among them suggest a more parsimonious approach.

The use of IT is important because, as documented in Freund and Weinhold (2002), diffusion of IT technologies and the internet goes hand in hand with the expansion of service trade. The stock of human capital is clearly another important determinant which is particularly relevant in the case of service trade. Indeed many service types require a high level of human capital for both production and provision. Finally, as highlighted by Head et al. (2009) among others, geography and accessibility to foreign markets are key and are well captured, within a gravity equation framework, by market access.

We assume ε_{it} is uncorrelated with X_i which means that (1) can be consistently estimated via OLS.[6] On the other hand, due to the high degree of heterogeneity across countries and need to provide estimates which are in line with aggregate figures, we allow for heteroscedasticity in ε_{it} and employ weighted LS instead of OLS in the estimation of (1).[7] Finally, to ease the comparison of coefficients across covariates, we report in the Tables the beta coefficients. These are scaled

3 See Anderson and van Wincoop (2003) for an example of how gravity can be derived from a theoretical model and use to provide counterfactual scenarios.
4 See for example Acemoglu et al. (2002).
5 See Nunn (2007) among others.
6 Although we recognise that endogeneity is likely to be an issue in our analysis, the lack of suitable instruments make it impossible to deal with it.
7 We use EV_{it} to construct weights. This means that observations referring to countries exporting more receive a higher weight in the estimation procedure. As a matter of fact, simple OLS results look very similar to weighted LS.

coefficients which allow us to convert a one standard deviation increase of a given covariate into a given increase in the outcome variable, i.e., log service exports value is our specific case.

In the case of service exports growth, we use the change of log service exports value of country i to the rest of the world in between 2000 and 2010 as dependent variable ($\Delta EV_i = EV_{i2010} - EV_{i2000}$). Formally:

$$\Delta EV_i = const + ß^t X_i + \varepsilon_i \qquad (2)$$

where const is a constant term, ε_{it} is an idiosyncratic component, and the vector X_i contains our variable of interest.

We employ the same set of covariates used for the level analysis with two exceptions. First, we use EV_{i2000} instead of sizeI, to assess whether there has been convergence or divergence across countries conditional on the initial situation. This is an important question related to the existence of multiple equilibria. Second, we replace the stock of human capital with the growth of human capital. Measures of legal and financial institutions as well as market access change very little over time so considering their change makes little sense. However, tertiary education enrolment is booming in a number of developing countries which calls for particular attention to this dimension. As for IT and the internet there is indeed rapid growth in the number of users between 2000 and 2010. However, such an increase is highly correlated with 2000 levels meaning that the two effects cannot be separately identified.

We assume that ε_i is uncorrelated with X_i which means that (2) can be consistently estimated via OLS.[8] However, due to the high degree of heterogeneity across countries and need to provide estimates which are in line with aggregate figures, we allow for heteroscedasticity in εi and employ weighted LS instead of OLS in the estimation of (2).[9] Finally, to ease the comparison of coefficients across covariates we again report beta coefficients.

4 Results

Before proceeding to estimation results, two important considerations are in order. First, the ongoing world economic downturn started in late 2008 might be affecting our results. However, in unreported estimations where we focus on the period 2000-2008 we find almost identical results. Second, service exports data does not include mode 3. While having such additional information would

8 Although we recognise that endogeneity is likely to be an issue also in this case, the lack of suitable instruments make it impossible to deal with it.

9 We use EV_{i2000} to construct weights. This means that observations referring to countries exporting more receive a higher weight in the estimation procedure. As a matter of fact, simple OLS results look very similar to weighted LS.

certainly be desirable, we do not believe its omission substantially biases our results. Indeed, mode 3 entails FDI across countries and, as shown for example in Kleinert and Toubal (2010), our building modeling block (gravity) works very well in this case too.[10] Furthermore, the same country fundamentals we use in our analysis are known to be at least as important for FDI than for trade.[11]

4.1 Service exports level

Table 1 shows estimation results for model (1). Column 1 provides estimations with the full set of covariates while column 2 contains estimates of a restricted model where only covariates corresponding to significant coefficients in column 1 are considered.

The two sets of estimations provide very similar results and the R^2 are, as is typical with gravity-like models, very high. Perhaps surprisingly, IT does not appear to be a key determinant of service exports level across countries. Indeed, our IT use measure is not significant. It should be noted, however, that this is not necessarily in contrast with the idea that IT and the internet have increased the tradability of services. Indeed, when considering later service exports level and growth across different service products, we do find IT use has a positive impact.

Other country-level fundamentals are all significant and have expected signs. Size is the most important determinant of service exports level with a beta coefficient of 0.68 (column 2). This means that a one standard deviation increase in log GDP is associated with an increase of (exp(0.68)-1)*100=97,39% of service exports value. Both legal and financial institution measures score positively and correspond to sizeable magnitudes. In particular, a one standard deviation increase in legal institutions is associated with an increase of 16.46% of service exports value. Human capital stock matters even more with a beta coefficient of 0.2111, moving up the cross country human capital stock distribution by one standard deviation corresponds to an increase of service exports value of almost 25%. Last but not least, market access has a beta coefficient of 0.0841, that proximity to large and rich markets is also associated with a higher level of service exports.

10 See also Helpman et al. (2004).
11 See Head and Mayer (2004).

Table 1 Aggregate service exports level in 2000 and 2010

Dependent variable	Log of service exports level		Potential for UK development: service exports log points increase
	(1)	(2)	
Size	0.6832***	0.6800***	
	(0.021)	(0.021)	
Legal Institutions	0.1720***	0.1524***	4.4563
	(0.033)	(0.030)	FIN is top country
Financial Institutions	0.1175***	0.1058***	5.3503
	(0.024)	(0.025)	US is top country
IT	-0.0511		
	(0.035)		
Human capital stock	0.2331***	0.2111***	4.0736
	(0.067)	(0.068)	US is top country
Market access	0.0912***	0.0841***	
	(0.017)	(0.016)	
R-squared	0.9018	0.8976	
Observations	335	335	
Number of years	2	2	
Number of countries	171	171	

Notes: The Dependent variable is log service exports level of a given country for the years 2000 and 2010. Weighted Least Squares estimations. Beta coefficients are shown. Robust standard errors in parentheses. *** indicates significance at the 1% level, ** indicates significance at the 5% level, * indicates significance at the 10% level. A constant and a dummy for the year 2010 are included in the analysis but are not reported here. Sample: Countries reporting a positive amount of service exports in 2000 and/or 2010 and for which information on covariates is jointly available

Our findings provide an indication of the key drivers of differences across countries as implied magnitudes. What our findings so far do not provide is an answer to questions such as: in order to increase service exports level should the UK focus on improving financial institutions or push towards increasing the level of the human capital stock? To partially address these we provide additional results in column 3 of Table 1. Of the five significant fundamentals two are not really under the control of the government. Size is an outcome measure largely determined by those market forces leading to firm innovation, productivity growth, technology adoption, full employment and so on. Furthermore, market access is essentially an exogenous, the UK, being close to the EU, is quite well endowed but with limited room for improvement.[12]

Legal and financial institutions as well as the stock of human capital are more directly influencable. To assess the potential for UK service exports increase stemming from these dimensions we report in column 3 of Table 1 the increase of log service exports corresponding to an increase of a given covariate matching the value of the top country. For example, the country with the best legal institutions

12 Nevertheless, our findings do suggest that policies enhancing proximity to final consumers beyond what can be captured by physical distance (the measure we use in constructing market access) will likely increase UK service exports.

in the world is Finland. Using the estimated coefficient of legal institutions in column 2 of Table 1 we compute the change of log service exports value the UK would experience if it was to raise the quality of its legal institutions to the level of Finland. That increase is 4.4563 log point, i.e., (exp(0.044563)-1)*100=4.5571% increase in service exports value. Corresponding figures for financial institutions and the stock of human capital are, respectively, 5.3503 and 4.0736 log points.

Four comments are in order. First, these 'gains' should be carefully compared with the costs of changing/improving financial institutions, legal institutions, and the stock of human capital. For example, besides direct costs, changing UK financial institutions in the direction of the US can have consequences for the degree of stability of the UK financial system. Second, these gains should be considered within a wider macro-economic framework. Indeed, an increase of the UK stock of human capital is likely to positively affect the economy along many other margins than service exports value. Third, the UK is already very well ranked in terms of institutions and human capital which means there is not much space for improvement. Fourth, as endogeneity is likely to be an issue, numbers should be treated with caution.

A final remark concerns the time evolution of the relationship. In unreported estimations we have considered a more general version of model (1) where coefficients were allowed to be time-specific. The key insight of this is that there has not been any significant change in the relationship. More specifically, coefficients referring to 2000 were never significantly different from those referring to 2010.

4.2 Service exports growth

Table 2 shows estimation results for model (2). Column 1 provides estimations with the full set of covariates while column 2 contains estimates of a restricted model where only covariates corresponding to significant coefficients in column 1 are considered. Again, the two sets of estimations provide very similar results and the R^2 are much lower than in the case of service exports level.

Before discussing results it is important to stress what service exports growth adds to the previous analysis. The latter provides the big picture of how the service exports market behaves with respect to its fundamentals at a given point in time. These results indicate that such behaviour is very similar when comparing 2000 and 2010 exports levels. However, this does not mean that the market is not changing. Changes might be not big enough to affect levels over a 10-year horizon but they can have a substantial impact over a longer time horizon. In this respect, it is important to also analyze where the market is possibly leading to. This is, in a nutshell, what the service exports growth analysis can tell us more.

Table 2 Aggregate service exports growth between 2000 and 2010

Dependent variable	Log of service exports growth		UK position with respect to competitors (good/ bad news)
	(1)	(2)	
Log Value of service exports in 2000	0.1514***	0.1380**	2nd
	(0.055)	(0.055)	(Good)
Legal institutions	-0.0905		
	(0.059)		
Financial institutions	-0.1090**	-0.1874***	5th
	(0.050)	(0.045)	(Bad)
IT	-0.0322		
	(0.037)		
Human capital growth	0.1220***	0.1284***	Among the last
	(0.038)	(0.042)	(Bad)
Market access	0.0780***	0.0607**	18th
	(0.028)	(0.027)	(Good)
R-squared	0.2244	0.2083	
Observations/number of countries	164	164	

Notes: The Dependent variable is log service exports growth of a given country in between 2000 and 2010. Weighted Least Squares estimations. Beta coefficients are shown. Robust standard errors in parentheses. *** indicates significance at the 1% level, ** indicates significance at the 5% level, * indicates significance at the 10% level. A constant is included in the analysis but is not reported here. Sample: Countries reporting a positive amount of service exports in both 2000 and 2010 and for which information on covariates is jointly available

Table 2 tells us that the growth of service exports is not related to legal institutions and IT. However, countries with an initial (year 2000) higher level of service exports have experienced higher growth. This is a strong result which is suggestive of a polarisation of service exports market shares in favour of the big players which includes the UK. This is reminiscent of those agglomeration forces identified by the NEG literature which are known to become stronger whenever trade integration gets deeper and the initial situation is not too unequal. This is good news for the UK which is already positioned among the big players (the UK was 2nd highest in 2000).

The quality of financial institutions has a negative coefficient, which i tells us that service exports have been growing in dimensions/products that are less reliant on such institutions. This is not good news for the UK which is the 5th best in the world in terms of financial institutions. Further, human capital growth has played a key role in the expansion of service exports with a beta coefficient of 0.1284. In terms of gross enrolment in tertiary education the UK has not been doing very well between 2000 and 2010. Actually, data indicates there has been a decrease in tertiary education enrolment which is in stark contrast with the exceptional rise of some developing countries such as Brazil and China and the steady rise of most developed countries including Korea, Italy, Spain, the US, and Japan.

However, market access provides a reassuring message. The positive coefficient indicates that the geography of service exports growth favours the UK, which is well ranked (18th position) in this dimension. Service exports growth has been tightly linked to the proximity of a country to large and rich markets and, in this respect, the physical, economic, and institutional proximity to the European market provides the UK with a comparative advantage. Furthermore, the strong economic and cultural links of the UK with the US, and in general with all English speaking countries which happen to be rich and/or fast growing in many instances, mean good prospects for UK service exports growth.

4.3 Product-level findings

Tables 3 and 4 contain highlights of estimation results for models (1) and (2) at the product level and are the equivalent of, respectively, Tables 1 and 2. We consider the following 8 product categories and estimate separately for each category:

1. Transportation services
2. Communication services
3. Insurance services
4. Financial services
5. Royalties and licenses fees
6. Computer and information services
7. Other Business services
8. Personal, cultural, and recreational services (PCR)

Table 3 reports log points changes of service exports levels across product categories stemming from an increase of the four country fundamentals on which the UK government has some control (legal and financial institutions, IT, and human capital stock).[13] The specific increase considered is the same we used in Section 4.1., namely an increase that matches the level of the top country.[14] It is important to stress that, in interpreting our results, the same four caveats discussed above apply here.

Table 3 reveals that, as expected, changes in service exports level are, whenever significant, all positive. The pattern emerging in Table 1 is thus strongly confirmed at the product level. Furthermore, Table 3 tells us that financial institutions matter more for financial services while IT use matters for both royalties and licenses fees and (especially) computer and information services. Finally, institutions

13 Size is always positive and significant in product-level estimations of model (1). Market access is positive and significant in most cases. The pattern emerging in Table 1 is thus strongly confirmed at the product level.

14 The top world country for IT use is Korea.

Table 3 Evidence from the analysis of service products exports level in 2000 and 2010

Reported: Potential for UK development, service products exports % increase

Dependent variable	Service products							
	Transport	Communication	Insurance	Financial	Royalties & licenses	Computer & information	Other Business	PCR
Legal institutions	4.4124	--	4.8043	3.3568	--	7.6582	4.1434	--
Financial institutions	--	4.6676	5.2391	12.4302	5.7600	--	5.4312	--
IT	--	--	--	--	4.9863	7.3274	--	--
Human capital stock	4.3592	5.1002	6.1076	--	13.6257	9.9323	--	12.7033

Notes: Numbers refer to the same econometric model of Table 1. Separate estimations have been carried out for each service product. -- indicates that the corresponding parameter was not significant. Sample: Countries reporting a positive amount of service exports in 2000 and/or 2010 for a given product and for which information on covariates is jointly available. Reported: Potential for UK development, service products exports % increase.

Table 4 Evidence from the analysis of Service products exports growth between 2000 and 2010

Reported: coefficient sign

Dependent variable	Service Products							
	Transport	Communication	Insurance	Financial	Royalties & licenses	Computer & information	Other Business	PCR
Log value of service Exports in 2000	Positive	Positive	Positive	--	Positive	Positive	Positive	Positive
Legal/financial institutions	Negative	Negative	Negative	--	--	Negative	Negative	--
IT	--	--	--	--	--	--	Positive	--
Human capital growth	--	Positive	Positive	Positive	Positive	--	--	Positive
Market access	--	Positive	Positive	--	--	--	--	--

Notes: Numbers refer to the same econometric model of Table 2. Separate estimations have been carried out for each service product. -- indicates that the corresponding parameter was not significant. Sample: Countries reporting a positive amount of service exports for a given product in both 2000 and 2010 and for which information on covariates is jointly available.

(legal and financial) have a significant impact in many cases but the stock of human capital matters in even more cases while being associated to quite large gains especially for royalties and licenses and PCR.

Table 4 provides coefficients signs of service exports growth estimated for each of the eight different categories.

Table 4 reveals that the same patterns emerging for aggregate exports growth in Table 2 extends to product types. In all but one case (financial services) initial conditions positively affect exports growth which is good news for the UK. Furthermore, other business services growth is positively affected by IT use in which the UK is relatively well ranked (25th). On the negative side, growth in quite a few service categories has been negatively related to the quality of institutions (and in particular financial). This result suggests the comparative advantage in service trade of the UK stemming from its good institutions has been losing ground over time. In the same spirit, the decline in tertiary education enrolment in the last 10 years works against the direction in which service exports are expanding. Though, the preferential links of the UK with the EU, the US, and other large and rich markets is a valuable asset to be, if possible, exploited even more.

5 Conclusions

In this chapter we provide a number of insights about the fundamentals driving the patterns, volumes, and growth of service trade across countries. Building on a gravity-type model and the principle of comparative advantage, we quantify the impact of some key institutional, geographical, and endowment features in driving the level and growth of service trade during the period 2000-2010. Furthermore, we also provide a number of UK-specific findings and figures which are meant to shed light on how to maintain and potentially improve the leading role of the UK in this area.

Service exports, and in general competitiveness in the service sector, is important for a number of reasons. First, we live in the era of services. Fifty years ago the service sector represented only 30% of GDP and a negligible share of world trade while, they now account for 75% of world GDP and about 20% of total world trade. Second, services are the fastest growing component of trade, with a two-digit average annual growth rate that was only marginally affected during the 2009 world trade collapse. Third, the contribution of the service sector to world trade is much higher than can be inferred from raw trade statistics, almost half of all jobs related to global manufacturing production are found in non-manufacturing sectors and services may represent more than 50% of world trade when measured in terms of value added. Last but not least, the UK is possibly the most successful service trader in the world.

The key policy findings/recommendations from our analysis can be summarised as follows:

1. The level of service trade, both at the aggregate and product level, is driven by a number of fundamentals in which the UK is well positioned. In particular, due to its good legal and financial institutions, good accessibility to large and rich markets, and high level of human capital stock, the UK has a strong competitive position in the service exports market. The importance of these fundamentals does not seem to be dramatically changing over time which is rather good news in terms of the future UK position.
2. There is scope for improving UK competitiveness in service exports and our study provides some figures about potential gains in terms of service exports increase. Nevertheless, the scope for improvement is relatively limited due to the high rank of the UK in all fundamentals. More generally, we believe that a more comprehensive study is needed to take into account the costs of improving UK fundamentals as well as the implications for other parts of the economy.
3. In terms of service growth, both at the aggregate and product level, there are a number of patterns in the data which deserve attention. On the positive side, exports growth has been larger for the big players group, in which the UK is well placed. Furthermore, service exports growth and market access are positively related. The links of the UK with the EU, the US, and other large and rich markets is thus a valuable asset to be exploited even more.
4. On the negative side, service exports growth has been negatively related to the quality of institutions. This suggests the comparative advantage in service trade of the UK stemming from its good institutions has been eroding. Furthermore, exports growth has been larger in countries that have experienced a higher increase in their human capital. The decline in tertiary education enrolment in the UK is in stark contrast with the exceptional rise of some developing countries such as Brazil and China and the steady rise of most developed countries including Korea, Italy, Spain, the US, and Japan, thus work against the direction in which service exports are expanding.

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