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EIB Papers

Productivity and growth in Europe

Long-term trends, current challenges and the role of economic dynamism

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Preface

Support to Europe's long-term growth is at the heart of the EIB's mandate. Since its founding by the Treaty of Rome in 1958, the European Investment Bank has become a major financial institution supporting the European Union's policy objectives. Among such objectives, economic integration, convergence and regional cohesion have featured most prominently for the EIB. The Bank has provided financial and advisory support to countless investment projects connecting European countries, regions and people.

If the EIB is to intervene effectively in support of economic growth, we clearly need to improve our understanding of the mechanisms that are behind it. This need is all the greater because Europe failed at rejuvenating growth in the past decade, despite the ambitions of the Lisbon strategy. Drawing on the 2011 *EIB Conference in Economics and Finance*, this volume of the *EIB Papers* sheds light on where our economies grow, why they grow at different speeds and how public policies can foster economic growth and productivity.

Four key insights are worth stressing. The first relates to the composition of economic growth. Europe needs faster productivity growth because it will get less employment growth in the face of demographic ageing. Moreover, the sectoral composition of our economies has been evolving, with market services occupying an ever-larger share of GDP. Increasingly, Europe's underperformance in market services is weighing on overall economic performance.

The second insight is that competition is good for productivity growth. Put differently, anti-competitive product market regulations slow down the entry of new competitors, the adoption of modern technology, firm restructuring and innovation, resulting in low productivity growth. This is particularly true for the service sector where anticompetitive regulations persist in many countries. Via intersectoral linkages, an underperforming service sector acts as a drag on the overall economy because many services are used as inputs by other producers, for example manufacturing firms. Getting rid of harmful regulations has become even more urgent with globalisation. Indeed, the *EIB Conference* underscored that only the most productive firms manage to be internationally active and, hence, benefit from international production sharing and growing world market shares.

The third insight is that we have to allow more resource reallocation in order for our economies to reap the additional growth potential of new markets, new know-how, new consumer needs and new opportunities. Firms, industries and countries are constantly hit by demand and supply shocks and have to reinvent themselves all the time. In this context, it may not be enough that established firms innovate and invest more in fixed and intangible capital. In a number of sectors, new firms are inherently better at adapting to changing business environments than old ones. Therefore, structural rigidities that prevent the entry and growth of new firms hamper productivity growth.

The fourth insight – gained from the articles in the companion issue (Volume 16, Number 2) of this issue – is that Information and Communication technologies and the Internet are powerful drivers of innovation and productivity growth. The EIB has a particularly keen interest in this insight because securing further benefits from the Internet economy would require significant investment in network infrastructure.

You may ask whether this is the right time for a volume on long-term growth, now that the world is preoccupied with short-term fire-fighting and preventing government solvency crises in the euro area.



Philippe Maystadt
President

To be sure, the fires must be extinguished before we can return to rebuilding the house. However, there is an immediate link between long-term growth prospects and short-term debt sustainability. Whether or not a government debt-to-GDP ratio at 100 percent of GDP makes a country insolvent depends crucially on its GDP growth outlook. The latter determines the growth of tax revenues that will service and pay down the debt. Financial markets do react to credibly announced and full-heartedly implemented growth policies, affecting the ability of governments to borrow on reasonable terms also in the short run.

Let me add that waiting for better times before undertaking reforms would be a mistake. All too often has the balance of political forces favoured avoidance of reform's short-term pain over the associated long-term gain. By contrast, history holds many examples of countries that changed an unsustainable course of action under high pressure. Indeed, some of today's better-performing economies in Europe undertook decisive policy reforms during the 1990s and early 2000s amidst severe economic crises or under the threat of long-term economic decline.

This makes me think that this volume of the *EIB Papers* could actually not come at a better time.

A handwritten signature in blue ink, appearing to read 'May'. The signature is stylized and includes a large, sweeping flourish that extends to the right and then loops back under the name.

Productivity and growth in Europe

Long-term trends, current challenges and the role of economic dynamism

The 2011 EIB Conference in Economics and Finance, held at EIB headquarters in Luxembourg on October 27, brought together academics, policy makers and companies to discuss productivity and Europe's long-term growth potential. It reviewed the empirical evidence on productivity growth and its drivers, with a particular focus on industrial structure and flexibility and discussed policies to boost productivity growth in Europe. The conference also zoomed in on the particular role of ICT and the e-economy for productivity growth.

Speakers included:

Erik BRYNJOLFSSON

of the Massachusetts Institute of Technology

Richard CAWLEY

of the European Commission

John HALTIWANGER

of the University of Maryland

Jussi HÄTÖNEN

of the European Investment Bank

Giuseppe NICOLETTI

of the Organisation for Economic Co-operation and Development

Gianmarco OTTAVIANO

of the London School of Economics

André SAPIR

of Bruegel

Hubert STRAUSS

of the European Investment Bank

Kristian UPPENBERG

of the European Investment Bank

Bruno van POTTELSBERGHE

of the Solvay Brussels School of Economics & Management



ABSTRACT

I summarize the main results and policy insights from the 2011 EIB Conference on “Productivity and Long-Term Growth Potential in Europe”. Europe’s need for productivity growth has become more pressing against the backdrop of huge government debt and a beginning slowdown in labour supply. The contributors to the EIB Conference and this volume suggest that governments should embrace domestic and international competition by dismantling anti-competitive product market regulations, especially in services. Private and public R&D should feature high on the policy agenda, but their effectiveness should be enhanced by removing overly protective elements of the patent system. Education attainment and quality as well as life-long learning should be fostered and more emphasis put on an ICT-literate workforce. Productivity-enhancing resource reallocation may further require lower employment protection and stronger incentives for regional and sectoral mobility. Finally, Europe faces large broadband investment needs, calling for a predictable network regulation framework and targeted public support to broadband roll-out to less profitable areas.

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Productivity and growth in Europe: Editor's introduction

It has been said for a long time that the European Union needs higher GDP growth in order to shoulder the costs of demographic ageing and climate change and to remain an attractive production location for European and international companies. The economic and financial crisis and the stretch it has meant for government finances have made this need even more urgent. Fostering GDP growth in Europe essentially boils down to increasing labour productivity growth. Especially now that the population at working age is growing more and more slowly and will soon start shrinking in several EU countries, GDP growth is about how to make the remaining European workforce more productive.



Hubert Strauss

Against this backdrop, the 2011 *EIB Conference in Economics and Finance*, held in Luxembourg in October on the topic of “Productivity and Long-Term Growth Potential in Europe: ICT, the e-Economy and Economic Dynamism”, was a timely event even though European governments completed another Euro area crisis summit at the very same moment. Organised by the EIB Economics Department, the one-day event brought together academics, policy makers and companies at the headquarters of the European Investment Bank to discuss productivity and Europe’s long-term growth potential. The conference tried to cover the most important issues from a European policy perspective, thereby taking a deliberately long-term view and looking beyond cyclical ups and downs. This volume of the *EIB Papers* compiles the contributions made to the conference.

Public-policy interventions to stimulate long-term growth and/or productivity are often given the summary label “structural reform”. Structural reform in Europe has been a *leitmotif* of growth-related policy reports by the European Commission and international organizations, central banks and academics. It encompasses all policy measures to increase an economy’s supply of goods and services and the efficiency of their production. Such measures may pursue quite varied objectives, all part of a greater growth mosaic, for example:

- Fostering incentives to work and to accumulate capital;
- Upgrading the quality of factors of production such as worker skills and technology embedded in machines, computers, vehicles and buildings;
- Improving multi-factor productivity (MFP), *i.e.* the efficiency in combining capital and labour; and
- Ensuring the economy’s ability to reallocate resources from declining to rising industries and, more broadly, to exit from unprofitable undertakings and embark on new activities (creative destruction).

Growth differences between firms, sectors and countries tend to widen in times of disruptive technical change, in particular when new technologies bring sweeping changes to most or all sectors of the economy. Information and communication technologies (ICT) and the Internet are the most recent new general-purpose technologies. Depending on the institutions and policies in place, some countries are faster in taking up a new general-purpose technology and reaping the associated benefits while others resist change and may see their productivity growth peter out. ICT infrastructure is a key enabler of the e-economy and of the ICT-induced organisational innovation that propels productivity growth, not least in services. This is why, after a general part on growth policies in Europe, the *EIB Conference* took stock of ICT and the e-economy and their links to productivity and growth.

This introduction – rather than tackling the vast literature on economic growth – provides a non-technical summary of the articles of Volume 16 of the *EIB Papers* and the presentations made at the *EIB Conference*. It first reviews some empirical evidence on the composition and major determinants of

productivity growth. Section 2 discusses structural policies to boost productivity growth. Section 3 asks how the economic and financial crisis of 2008 has changed the perception of growth policies and socio-economic models in Europe. Section 4 then turns the spotlights on the productivity-enhancing role of ICT and the e-economy, paying due attention to the associated infrastructure needs, which play centre-stage in the activities of the EIB. Finally, Section 5 recaps the main policy insights.

1. Productivity growth in Europe

In his scene-setting article, **Kristian Uppenberg** illustrates the composition of GDP growth in the US, the EU and its member countries for the past three decades, presenting a breakdown of average GDP growth rates both into contributions from economic sectors (manufacturing, market services, social services etc.) and into the respective contributions of employment and labour productivity. Distinguishing sub-periods, his analysis thus illustrates how different sectors in different countries have grown at different speeds and to what extent their output growth came at the back of additional jobs in the sector (as opposed to boosting the productivity of existing workers).

In the 2000s, market services accounted for two thirds of the US-EU productivity growth gap as EU services growth came with disappointingly low productivity advances.

Three main findings are worth highlighting. First, contrary to the ambitions of the Lisbon strategy, the EU has seen its labour productivity growth fall even further behind that of the US in the past decade. Second, referring to the sectoral breakdown, productivity growth has been high in manufacturing, higher than growth in output, and was thus accompanied by a secular decline in the sector's share in total employment (down to about 15 percent on average in the 2000s). By contrast, market services have seen their share in employment increase over time and now employ between 40 and 50 percent of the workforce in advanced economies. In the decade preceding the crisis, output growth in market services consisted of a healthy combination of productivity and employment increases in the US and in a few EU countries. In the major parts of the EU, however, growth in services was heavily dependent on employment and came with disappointingly low productivity advances. In the 2000s, market services accounted for two thirds of the US-EU productivity growth gap, manufacturing for the remaining third. Given the growing relative size of the sector, market services' poor productivity record has increasingly become a drag on overall growth performance of the EU economy.

Third, a few EU countries have nonetheless eschewed productivity growth stagnation, offering insights to peer EU countries with less dynamic track records. High-growth countries typically share many features lacking in low-growth countries. In particular, they tend to rank high on indicators linked to innovation as well as to trade openness and international connectedness. The articles following Uppenberg's look at these issues in turn.

Catherine Duverger and **Bruno van Pottelsberghe** look at research and development (R&D) from various funding sources and find that business R&D, public R&D and R&D performed abroad are indeed positively correlated with advances in productive efficiency as measured by MFP growth. Just how much R&D contributes to productivity varies quite widely across countries and is shown to depend on the set-up of science and innovation policies. For one thing, higher-education R&D is found to be growth-enhancing whereas R&D in government agencies is not, likely reflecting different incentives and different socio-economic objectives. For another, the characteristics of the patent system matter. Business R&D has larger productivity effects in countries where businesses rely to a greater extent on high-quality patents. By contrast, more patent-friendly policies (easier enforcement and fewer restrictions on patent holders) – while desirable for individual patent holders – reduce the productivity effects of business R&D.

Turning to internationalization, international production sharing has been increasingly recognized as being part of the growth success story of advanced and emerging economies alike. **Carlo Altomonte** and **Gianmarco Ottaviano** add to the growing body of evidence on the links between firms'

international activities (exporting, importing, outsourcing and Foreign Direct Investment (FDI)) and their “competitiveness”, best expressed by firm-level MFP. With a dataset covering 15,000 European firms, they show that international production sharing is indeed associated with stronger competitiveness – both at the firm and at the industry level.

The *EIB Conference* saw a lively debate on the direction of causality between internationalization and competitiveness: Does internationalization make firms more competitive or is it that more productive firms are better able to participate in international production sharing? What sounds like an academic question is in fact decisive for devising the right public policies. While the authors’ empirical results do not give a direct answer, the paper provides a careful literature discussion. At the *firm* level, increases in productivity increase the likelihood of becoming internationally (more) active and not the other way around. Firms are not born international. To become exporters, firms already need to be quite productive, and selectivity increases further as internationalization options become more and more complex, culminating in FDI and active outsourcing strategies. True, FDI and outsourcing hold the promise of conquering new markets and increasing profits, but these are risky and costly undertakings, so only the very best succeed in them. By contrast, there seems to be surprisingly little evidence of “learning by exporting”.

These findings are compatible with studies showing trade policy reforms to boost MFP growth at the *country* and *industry* levels. When a relatively closed economy opens up to international trade and FDI, capital and labour are moved (“reallocated”) from less to more productive firms as the weakest firms shut down in the face of foreign competition; the best firms seize international opportunities, increase world market shares and grow; and firms with intermediate MFP survive without growing because they are confined to the domestic market.

Altomonte and Ottaviano find that an industry’s involvement in international production sharing is stronger the higher the average MFP level of firms in that industry, but the connection is weaker when the dispersion of MFP across firms is larger. These results can be read through the “lens of selection” and reallocation just described: the internationalization-induced reallocation of resources from exiting under-performers towards high-performing firms raises average productivity in the industry and lowers productivity dispersion. As heterogeneity is reduced, the scope for reallocation gradually shrinks, and the positive impact of additional international exposure on industry competitiveness weakens.

The policy conclusion of these original findings is that public policies should foster healthy industry dynamics rather than aiming at internationalization *per se* (e.g. by offering targeted tax credits to exporters). Policies that stimulate stiff domestic competition or remove barriers to such competition are better suited to prepare firms to going international. Increasing international activities by firms could then be seen as an indicator of how successful these domestic policies are. This conclusion prepares the ground for the discussion of policies to boost productivity growth.

2. Policies to boost productivity growth: industry-level and firm-level evidence

Among the determinants of productive efficiency, one hot candidate is product market regulation. **Jens Arnold, Giuseppe Nicoletti and Stefano Scarpetta** provide a survey of recent empirical findings on the growth effects of anti-competitive product market regulations from the macro, sector and firm perspectives. While the relationship is rather complex, the bottom line of this literature is that product market regulations hamper productivity growth by impairing efficiency-enhancing resource reallocation.

Unlike in the case of MFP and internationalization, causality can be readily established here as running from the stance of regulation to productivity growth since product market regulations are subject to deliberate policy changes. What springs to mind immediately in the EU context is the unfinished

Opening up to international competition leads to growth of the fittest firms and exit of the weakest, boosting average industry competitiveness.

business in establishing a veritable single market for services. That being said, the richness of the OECD regulation indicators on which the empirical results are based offers a panoply of quite precise pointers to growth-friendly product market reforms.

Among the wealth of interesting results reported by the authors, a few are particularly critical from a European policy perspective. As far as the effects of regulations on the regulated sector itself are concerned, barriers to firm entry and entrepreneurship have the most damaging effects on economic performance and aggregate incomes. Further, regulation appears to have stronger negative effects in ICT-intensive sectors than in other sectors, reflecting the higher pace of innovation in these sectors and their greater reliance on market entrants to bring about productivity-enhancing changes.

Anticompetitive service regulations cause spill-over damage to other sectors, especially to ICT-intensive client sectors.

However, the authors insist that bad regulation does not just affect firms in the regulated sector but also causes spill-over damage to other sectors. When taking into account intersectoral regulation impacts, ICT-intensive sectors, again, are shown to suffer more as they tend to use regulated services such as energy, telecom and business services more intensively. These regulation impacts also help explain why manufacturing industries enjoy lower productivity growth in countries with heavily regulated service sectors.

Finally, when looking at the firm-level evidence on the efficiency of resource allocation, the authors show that product market regulations explain part of the cross-country and cross-industry differences in long-term MFP growth.

Efficiency of resource allocation plays centre-stage in **John Haltiwanger's** article, which takes a firm level perspective and analyzes the effects of firm dynamics on productivity growth. Static allocative efficiency implies that the most productive firms tend to be the largest firms. Similarly, dynamic allocative efficiency means that resources are moved from less to more productive businesses. In countries with high allocative efficiency (notably the US), the more productive firms, on average, are larger and tend to expand, while less productive firms are smaller and more likely to exit ("up or out" dynamics). Such reallocation is productivity enhancing at the aggregate level. As market entry implies new goods or services, meeting latent consumer demand, and newcomers often produce with a newer and technologically more up-to-date capital stock, the entry and growth of new firms is an important contributor to productivity. Policies should therefore encourage start-ups and market entry rather than protecting incumbents.

Informative measures of static and dynamic allocative efficiency are the correlation between firms' MFP and firm size and that between MFP growth and firm growth, respectively. Haltiwanger shows that static allocative efficiency is highest in the US and somewhat lower in other advanced countries (e.g. in the EU-15) with less market-friendly regulatory settings. Increases over time in the correlation between MFP and firm size indicate whether the resource reallocation process is moving in the right direction. For example, the new EU member states – but also China – have seen increases in static allocative efficiency, albeit to levels that still leave considerable room for further improvement.

A number of policy conditions need to be in place to make reallocation of capital and labour work without excessive adjustment costs, suggesting that piecemeal market reforms do not work. In a non-exhaustive list, Haltiwanger points to labour market flexibility; well-specified property rights and strong rule of law; bankruptcy regulations that do not discourage start-ups, even by "second-chance" entrepreneurs; and well-developed, high-performing infrastructure networks.

He also discusses the role of financial markets in providing sufficient funds to new high-growth businesses. Some of the financing channels that work well in good times break down in severe financial

crises, justifying public intervention. Right now, policy makers are facing a daunting trade-off between actively cushioning the most severe effects of the crisis (mass layoffs, insolvencies etc.) and preserving the potential for productivity-enhancing reallocation in the long run.

Indeed, the possibility that the depth of the economic and financial crisis could have deteriorated even the long-term growth outlook in advanced economies has been discussed in policy circles. Given these exceptional times, even a conference focusing on the long run cannot do without asking how the crisis may affect our thinking on economic policies for the medium and longer term.

3. Has the crisis changed the perception of growth policies and socio-economic models in Europe?

The presentation by **André Sapir** from Bruegel, the Brussels-based EU policy think-tank, is unfortunately not represented in this volume. His presentation, which sparked a very lively discussion at the *EIB Conference*, looked at how economic policy can be shaped to make the economic wheels spin again.¹ To this end, one first needs to look back at the past decade.

In fact, the crisis has made Europe's well-known long-term challenges such as demographic ageing, accelerated technological change, globalisation, and climate change more acute. The challenges have by no means gone away. Europe's response to these challenges was the Lisbon Strategy with its central aim of transforming the EU into a fast-growing, innovation-based society. The Strategy was supposed to guide member countries' structural policies from 2000-2010 but largely failed on most of its targets.

As a result, the economic and financial crisis and the ensuing "Great Recession" hit a largely unreformed Europe that, on top, had not used the good times to consolidate general government budgets enough to pre-fund the long-term challenges, let alone to fight a deep and drawn-out recession. Now the immediate danger is that of a vicious circle of weak – or negative – GDP growth raising public-debt-to-GDP ratios, forcing radical consolidation measures that further dampen short-term prospects for aggregate demand.

The broader question is that of the sustainability of Europe's socio-economic model. Several models co-exist in Europe, which Sapir had assessed in past work along a two-dimensional scale of efficiency and equity. At one end of the spectrum, the Nordic countries seem able to reconcile a high degree of economic efficiency with a high degree of equity. At the other end, the Southern EU member states have been struggling with comparatively low levels of efficiency and social justice.

Not surprisingly, the Nordics have weathered the economic and financial crisis best so far. For example, between 2004 and 2010, the general government debt-to-GDP ratio has not increased in the Nordics whereas it increased dangerously in the Southern EU member countries from generally already high levels. Assessed against this – admittedly partial – indicator, the Anglo-Saxon countries, whose public-debt-to-GDP ratio doubled to 82 percent, look more fragile than most observers thought before.

The need for reform is greatest in the Southern EU member states. They had used the introduction of the Euro as an excuse not to reform rather than as an impetus for reform. Artificially low interest rates and the possibility to build up large external debt positions gave an extra lease of life to a socio-economic model that was already under pressure 15 years ago due to increased competition from emerging Asia and Central and Eastern Europe. The South is facing a twin problem of high external (and public) debt and low competitiveness. The latter finds its reflection in a dismal productivity growth record during the 2000s.

The Great Recession hit a largely unreformed Europe that had not used the good times to prepare for its long-term challenges.

¹ Sapir's slides are available at http://www.eib.org/attachments/general/events/luxembourg_27102011_04_sapir.pdf

Completing the Single Market, reforming competition and financial-sector regulations and a more effective use of EU funds would help EU countries to grow out of the crisis.

Drilling down to the structural weaknesses, southern EU countries saw sectorally unbalanced and unsustainable growth as the surge in aggregate demand mainly benefited the construction sector and domestic services, leading to a boom-bust cycle in low-skilled employment. Moreover, the southern members are characterized by low openness to foreign trade, business-unfriendly product market regulations and extremely small average firm size. Small firm size and strong “insider” protection make it particularly difficult to stimulate innovation and technological upgrading.

While all member states have to address their structural weaknesses to jump-start growth in productivity, the EU can also help by further pushing the Single Market into hitherto protected sectors and by reforming and better enforcing competition policy and financial regulation. Moreover, EU financial resources should be used more efficiently.

Given the central role devoted to the policy implications of the research presented, the *EIB Conference* featured **Richard Cawley** from the European Commission as a discussant to put the presentations by Nicoletti, Haltiwanger and Sapir into perspective. Reinforcing their messages, Cawley stressed it was not too late to undertake supply-side reforms, and that countries had much to gain in the process. He reported on policy reform simulations by the EU Commission showing that fiercer product market competition, lower entry barriers, a higher share of high-skilled workers and public R&D support would all boost MFP growth. Yet, the strongest effects are to be expected from slashing barriers to market entry. A version of this simulation had been presented at the 2009 *EIB Conference* on R&D and innovation.²

4. ICT and the e-economy

Zooming in on ICT and the e-economy, the articles of Issue 2 of Volume 16 look at the macro-sectoral links between ICT and productivity; Europe’s broadband infrastructure needs; and on how ICT is reshaping and re-pacing innovation.

Hubert Strauss and **Besik Samkharadze** prepare the ground by providing empirical evidence on the ICT-productivity link. ICT investment accounts for a substantial share of the US productivity acceleration in the late-1990s. In the EU, the growth contribution from ICT capital deepening was notably smaller. They point out that productivity gains greatly rely on complementary investment in human capital and intangible assets, leading to productivity-enhancing product and process innovation. In the US, and to a lesser extent also in Europe, labour productivity growth continued after 2001 despite declining ICT investment. Growth was propelled instead by efficiency gains (MFP), partly as a result of lagged gains from past ICT investments.

Jussi Hätönen discusses the ability of ultra-high-speed Internet to serve as infrastructure for entirely new digital products, services and modes of delivery. Europe has high basic-broadband penetration but is lagging behind other developed economies in the availability and use of very fast broadband. This could be worrying because large economic gains from broadband are materialising, and similarly large gains from ultra-high-speed networks are expected. To propel Europe into the high-speed Internet age, the European Commission launched the Digital Agenda for Europe, one of seven flagship initiatives in support of the Europe 2020 strategy for smart, sustainable and inclusive growth. The Digital Agenda sets ambitious coverage targets for the EU, for example Internet connections of 30 Mbits per second for all EU households by 2020 and connections at 100 Mbps for half of them.

² McMorrow, K. and Röger, W. (2009). “R&D capital and economic growth: The empirical evidence”. *EIB Papers*, (14:1), pp. 94-119.

However, large gains for society do not automatically mean profits for network owners. Up-front costs are high – meeting the Digital Agenda targets in a meaningful way would cost as much as EUR 200bn – while revenues will be drawn-out and subject to uncertainties in consumer demand (actual use may fall short of coverage), regulation (how much may owners collect in fees from network-using competitors?) and technology (could the fibre network be obsolete before it is amortised?).

Analyzing the financing gap, Hätönen concludes that market-based financing is estimated to cover up to 60 percent of the total. While connecting urban areas at a low cost per user is profitable, it is hard to see universal high-speed fixed-line broadband being fully rolled out to rural areas and being exclusively privately financed. EU countries do not currently have the fiscal space to cover all of the balance with outright subsidies. Nevertheless, public policy has an important role to play in various respects. First, telecom regulators need to commit to a long-term policy that is fair to investors and competitors alike, creating a predictable investment climate. Second, grant money should target areas where private investors are unlikely to go. Finally, promotional lenders such as the EIB can contribute by providing long-term finance at advantageous terms and bringing additional private finance on board.

While fibre-based communication infrastructure is technologically new, most of the public-policy issues involved are not. The provision of a universal broadband network may be compared to that of other infrastructure such as highway (or electricity) networks: putting in place the network (grid) is expensive but letting additional users in comes at close-to-zero marginal cost up to the point of saturation. If high-speed broadband is likely to provide welfare gains (e.g. higher productivity, new products and services) in excess of total costs, as Hätönen documents, the claim for public support for broadband can be based on efficiency grounds as well as obvious spatial-equity considerations. Beyond economic-policy problems, various infrastructure policies also share engineering concerns. Hätönen reports that rolling out broadband together with road construction work would increase the cost of the latter by merely 1 percent, calling for coordination between transport and telecommunication planners.

Finally, **Erik Brynjolfsson** sheds light on the economic effects of ICT and the e-economy. Against the backdrop of the revival in US productivity growth since the mid-1990s and the wave of ICT investment that accompanied it, he summarizes the three ways that ICT raises productivity growth: by enhancing ICT equipment (e.g. faster computers); by catalyzing organizational change; and, most importantly, by transforming the innovation process itself.

How is digitisation transforming innovation? The author describes a four-pronged sequence of mutually reinforcing innovative activities: (i) improved measurement of economic activity in real time; (ii) faster and cheaper business experimentation (Internet firms conducting and evaluating controlled experiments within hours); (iii) sharing new insights widely and quickly; and (iv) replicating new products and processes immediately, thereby scaling production up to all outlets/customers. The emerging sequence – experiment, measure, share and replicate – is seen as a new kind of R&D. The lower cost of innovation and up-scaling intensifies Schumpeterian competition, with incumbents constantly challenged by new entrants.

The often disruptive changes brought about by the e-economy are so substantial that a number of areas need to adjust. Specifically, Brynjolfsson mentions public policies in the fields of education, migration, infrastructure, product market regulation and innovation, but also corporate governance and incentive systems.

Private finance might cover only 60 percent of the estimated EUR 200bn investment needed to bring fast Internet connections to the whole EU by 2020.

Fully exploiting current ICT alone would greatly boost productivity, and ICT keeps advancing quickly.

As is characteristic for times of technological revolutions, the period since 1995 has seen growing dispersion in firm performance as some firms were fast adopters of new technologies while others stayed behind. The observation is particularly valid in ICT-intensive sectors. This suggests many firms are still far from exploiting the full potential of current ICT capabilities, leaving room for productivity advances from adopting best ICT practice.

5. Main policy insights

To some extent, policy makers and politicians have done a disservice to urgent growth policies by “hiding” behind the catch-all term “structural reform”. As this summary of Volume 16 of the *EIB Papers* has shown, such reforms may call for politically unpalatable actions that shake up the economy and hit at vested interests, such as

- Pulling down barriers to market entry to make room for newcomers and foreign rivals, implying exit of some existing firms and temporary job losses;
- Encouraging reallocation of resources (capital and labour) towards more productive uses, which may require geographical and sectoral mobility, less employment protection, and stronger work incentives;
- Fostering attainment levels and quality in education and stepping up life-long learning to help people cope with faster technological change;
- Pushing the pace of technological change through R&D – including by a better balance between legitimate intellectual property protection and the anti-competitive use of patents – and accelerating the diffusion of ICT and innovation; and
- Cutting wasteful subsidies and other government expenditure to create space for targeted public support to broadband infrastructure investment, which would allow exploiting the potential of the e-economy more fully.

However, given how much is at stake, EU governments should consider whether the short-term pain would not pale in the face of the historical achievement of a dynamic single market with high sustainable growth. Indeed, which rate of economic growth the EU economy is able to sustain will make a tremendous difference for living standards in the future. Take a simple numerical example. If GDP per capita grew at 2.5 percent per year on average, Europeans would become twice as rich essentially within a generation (28 years). If GDP per capita grew at 1.5 percent, doubling it would take almost half a century. Yet, in economic model simulations, it is not uncommon to find growth-boosting effects of up to a full percentage point from comprehensive supply-side reforms.

ABSTRACT

Drawing on the OECD's structural analysis (STAN) database, this paper contributes to the understanding of European economic growth through a decomposition into employment and productivity, across sectors, and across different time periods and countries. The US productivity surge from the mid-1990s continued for years after the bursting of the dot-com bubble. In the meantime, the EU-15's relative productivity stagnation continued. The sectoral perspective helps us better understand this divergence. While manufacturing remains disproportionately important for aggregate productivity growth, the market services sector, given its size, accounts for the bulk of differences across countries, also within the EU. Market services differ from manufacturing in terms of the nature of innovation and other drivers of growth. This calls for sector-specific analysis when designing growth policy in Europe.

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Economic growth in the US and the EU: a sectoral decomposition

1. Introduction

Europe has good reasons to be concerned about its long-term growth performance. Demographic trends point to an inexorable slowdown in the contribution of employment to growth in coming years and decades. This makes labour productivity (*i.e.* output per hour worked) the only plausible source of high and sustainable economic growth in coming decades. Unfortunately, Europe has so far largely failed to create the conditions needed to foster such economic dynamism.

Following an era of high labour productivity growth and income convergence *vis-à-vis* the US in the 1950s and 1960s, Europe experienced a slowdown in growth from the mid-1970s onwards. The causes for this slowdown are complex and not entirely well understood. The US suffered from a similar slowdown, which led observers at the time to interpret it as a largely exogenous phenomenon, impervious to economic policy. From the mid-1990s onwards however, the US economy has experienced an impressive rebound in terms of productivity growth, sustained well into the last decade, despite its already high level of productivity and incomes. When large portions of the European economy failed to replicate this economic rejuvenation, the growth-impeding features of its economic policies and institutions attracted growing attention from researchers, international institutions and policymakers. The most prominent examples include the EU's own "Lisbon Strategy", launched in 2000¹, and the unwavering promotion of more growth-friendly policies and institutions by international organisations such as the OECD.

The empirical literature has made important progress in understanding the drivers of productivity growth and the paper will refer to key milestones in the empirical literature where appropriate. The main focus of this paper is to present key facts and figures on the sectoral distribution of growth in value added, employment and productivity across countries, thereby shedding light on the nature of the growth gap between the EU and the US, as well as that between individual EU Member States.

The sectoral perspective of growth is illuminating. The fact that sectors are so fundamentally different has important implications for aggregate economic growth. Output growth in different industries is propelled to varying degrees by growth in employment and labour productivity. As a result, changes in an economy's sectoral composition have a direct bearing on the composition of aggregate economic growth. It directly follows from this structural diversity that the underlying drivers of growth differ markedly across sectors. Many researchers have thus come to conclude that growth is more effectively studied at an industry rather than economy-wide level.

Particular emphasis is put on the more recent period, comparing the past decade with the 1990s. Key questions addressed here include whether the relative out-performance of the US in the 1990s has been sustained; what is the relative importance of different sectors in propelling aggregate productivity growth and in accounting for the US/EU productivity growth gap; and which sectors account for most of the sluggishness in aggregate productivity growth in individual EU countries? Another key dimension addressed in the paper is the comparison of growth between the EU-15 and the new member states (NMS). Unlike many recent productivity studies, this paper does not assess productivity growth in complete isolation from employment trends, but instead acknowledges that the two are interdependent. Since the focus is on long-term growth trends, the exceptional period after 2008 is looked at separately.



Kristian Uppenberg

¹ Lisbon European Council, 23 and 24 March 2000.

The data source used is the OECD Structural Analysis (STAN) database. The main advantage of this database is that it is continuously updated. A drawback, however, is that data on hours worked are incomplete. In this paper, labour productivity is therefore calculated on the basis of total employment instead of hours worked. This introduces a distortion to our labour productivity proxy, incurred by changes in hours worked per employee. In level terms, this wedge is quite substantial. In growth terms, however (which is what we look at here), the wedge is sufficiently small – especially in recent years – not to pose a threat to our qualitative observations and conclusions.

The paper focuses exclusively on the sectoral distribution of value added, employment and labour productivity. It does not dig deeper into the underlying decomposition of productivity growth between capital deepening, labour quality and multifactor productivity. These issues are covered by other contributions to this volume of the EIB Papers.

2. The sectoral composition of advanced economies

Different industries often have unique structural characteristics, which affect how they grow.

The mechanisms that propel aggregate productivity growth are complex and the empirical investigation into this issue is a lively field of economic research, as other papers in this volume of the EIB Papers illustrate. One conclusion that has emerged from the growth literature is that the mechanics of productivity growth differ markedly across sectors. Different industries often have unique structural characteristics, relying to different degrees on economies of scale, on fixed and human capital, and on technological and non-technological innovation. They are also exposed differently to foreign and domestic competition, and to domestic regulation.

Before we look at growth at the sectoral level, an important *caveat* needs to be mentioned. The growth literature has shown that aggregate productivity growth is the predominant driver of incomes at the national level. Hence striving for high productivity growth at the national level becomes almost synonymous with boosting per-capita incomes. It could be tempting to take this relationship to hold also at the sectoral level and to conclude that countries should specialise in activities with high productivity growth. This is, however, a fallacy. The link between sectoral productivity growth and aggregate income and welfare is weakened by relative price movements and shifts in demand between product groups. To illustrate this point: If we assume that the production of flat-screen television sets is associated with very high productivity growth, would a country be better off specialising in producing these? Probably not, for two reasons. First, the consumption basket of the average household contains a wide range of goods and services, many of which are not tradeable, e.g. health care and education. Hence these would need to be produced locally, or consumer welfare would suffer from their absence. Second, relative price changes across different types of products and services insert a wedge between real growth and incomes. If productivity gains are offset by falling relative prices, then high productivity growth does not translate into high purchasing power in terms of the goods and services that the workers and capital owners of the flat screen industry can buy. The argument extends to international trade, as shrinking terms of trade can undermine the purchasing power of producers of high-productivity growth manufactures.

Before proceeding to look at the composition of growth across sectors, this section sets the stage by looking at the broad sectoral evolution of the EU and US economies. Observing the relative size of major sectors – as measured by employment – helps us understand their importance in the context of GDP growth. All other things being equal, large sectors contribute more to aggregate growth than small ones. Changes over time in the sectoral distribution of employment have accompanied the evolution of economic activity throughout history. This evolution is characterised first by a shift from the primary sectors (agriculture and mining) to manufacturing. At a later stage, the manufacturing

sector's share in aggregate employment gives way to an expansion of services. This evolution is propelled by two factors. The most important is that the income elasticity of demand differs across different types of products. As incomes rise, at first, a growing share of national income is devoted to manufactured goods and then to services. A second key factor behind these shifts is higher productivity growth in primary sectors and manufacturing, which reduces the resources devoted to them relative to services, where productivity growth has traditionally been lower.

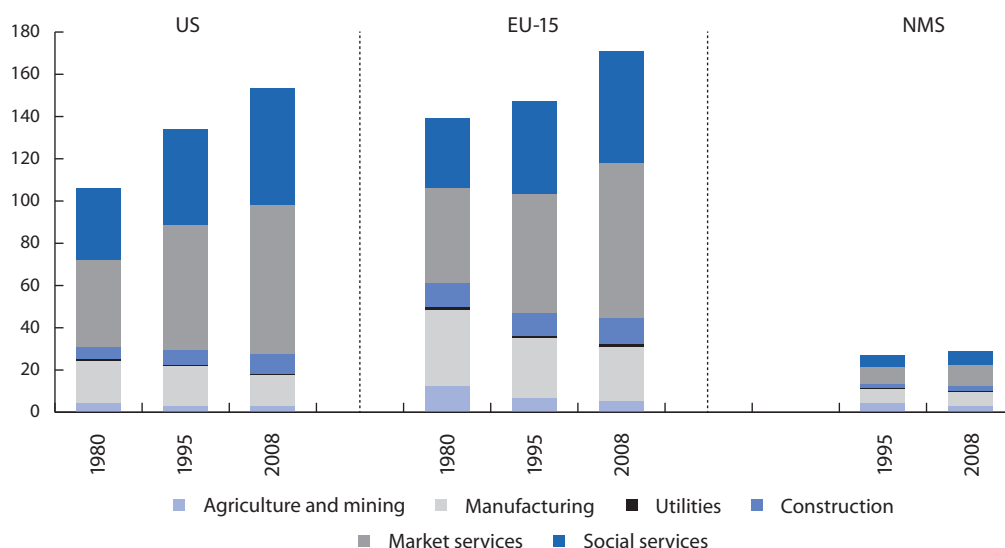
This evolution is illustrated in Figure 1, showing the expansion and distribution of employment across sectors. For simplicity, we have merged sectors into six broad sectors: Social services, market services, construction, manufacturing, utilities, and agriculture and mining.²

Both in the US and in the EU-15, expansion of service sector employment has more than offset contraction in other sectors, with positive employment growth for the economy as a whole. Over time, services have come to completely dominate employment. Social and market services together accounted for 82 percent of employment in the US in 2008, against 74 percent in the EU-15³ and 57 percent in the NMS.

The mirror reflection of the rising share of services is the ever-smaller employment share of manufacturing. At 10 percent in the US in 2007, the employment share of manufacturing was only half of what it was in 1980. In the EU-15 it fell from 26 percent to 15 percent in the same time span. The new member states are the notable exception with a still relatively large 23 percent manufacturing employment share. While the employment share of services – and especially of market services – has increased in the NMS, this has occurred more at the expense of primary sectors than of manufacturing.

Both in the US and the EU-15, expansion of service sector employment has more than offset employment contraction in other sectors.

Figure 1. Employment by sector (millions)



Source: OECD STAN Database

Notes: EU-15 includes Austria, Belgium, Finland, France, Germany, the Netherlands, Spain, Sweden and the UK. It excludes Ireland, Luxembourg, Portugal and Greece for data availability reasons. NMS includes Poland, the Czech Republic, Hungary, Slovakia, Slovenia and Estonia. It excludes Cyprus, Latvia, Lithuania and Malta for data availability reasons.

² See Annex 1 for a description of the OECD data and the way sectors have been merged.

³ The EU-15 is in this study represented by all EU-15 countries except for Ireland, Luxembourg, Portugal and Greece, which have been excluded for data availability reasons. The NMS are represented by Poland, the Czech Republic, Hungary, Slovakia, Slovenia and Estonia.

In line with the shift towards services in aggregate employment and output, global rankings of leading firms, such as the Fortune 500, now contain more service companies than in previous decades. A *caveat* is needed here, however. The distinction between manufacturing and service sectors is less clear-cut today than it was in the past. In some cases, traditional manufacturing firms have transformed themselves into predominantly service-providing companies. One prominent example is IBM, which now considers itself primarily a service business, although it still makes computers. The production of physical goods has become secondary to firms that instead focus on the provision of “business solutions”. This transformation of manufacturing firms into service providers is part of a shift in the comparative advantage of advanced economies. As China and other lower cost producers move up the value-added chain in manufacturing, straight goods production has fallen under intense cost pressure. Many manufactured goods, for instance consumer electronics, have become commoditised. High-income countries have lost competitiveness in such manufacturing. They have been able to stay competitive in part by shifting towards providing business solutions rather than just selling products, as the price elasticity of demand is lower for business solutions than for hardware. This shift has been accompanied by a shift towards subscription pricing. Rather than receiving a single payment for a piece of manufactured equipment, many manufacturers are now receiving a revenue stream for ongoing contracts, which include a non-negligible service component. The management literature refers to this as the “servitisation of products”. For a discussion, see for instance Vandermerwe and Rada (1988).

3. Growth in sectoral labour productivity and employment

3.1 Main concepts

Turning now to the issue of growth and its breakdown between employment and labour productivity, we need first to establish the main concepts. The standard definition of labour productivity (λ) is how much output (Y) is generated per unit of labour – in our case employment (L):

$$\lambda(t) = Y(t) / L(t) \tag{1}$$

This we easily turn inside out by expressing output as the product of employment and labour productivity:

$$Y(t) = L(t) \cdot \lambda(t) \tag{2}$$

Output growth is the sum of growth in employment and growth in labour productivity.

This expression simply shows that output is the result of the number of employees times the output that each employee generates on average. Taking logs and exploiting the fact that the difference in the log of a variable from one period to the next is a close approximation to the growth rate, we get

$$\hat{Y}(t) \approx \hat{L}(t) + \hat{\lambda}(t) \tag{3}$$

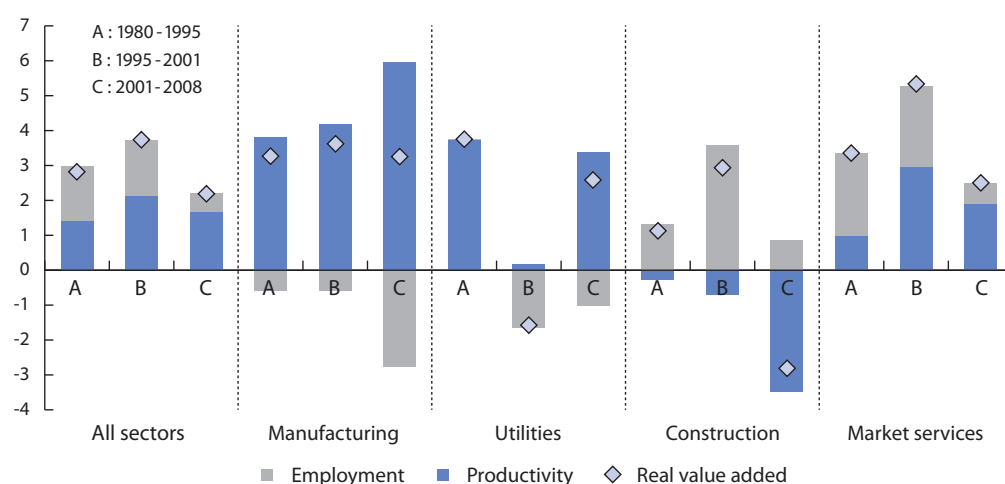
where a hat denotes the year-on-year rate of change in output, employment and labour productivity, respectively. This relationship also holds true at the sectoral level, with a minor semantic difference. Gross Domestic Product (GDP) is the sum of Value Added (VA) across all sectors. VA is thus the sector equivalent of GDP.

On this basis, the figures below show the decomposition of real VA growth between employment and labour productivity. Note that we have chosen not to cover primary sectors and social services in this paper, since these are not central in the context of innovation and aggregate productivity.

3.2 A sectoral decomposition of growth in the US and the EU-15

The US is a natural place to start in its role as a benchmark against which Europe's growth performance is typically measured. The sample is split into three time periods: 1980-1995; 1995-2001; and 2001-2008. The aim is to understand longer-term growth patterns, not short-term cyclical swings. This is achieved by avoiding cut-off years which are at extreme cyclical peaks or troughs, and by including a sufficient number of years in each sub-period. The 1995 break-point has been chosen in part because the mid-1990s is generally viewed as the time when US productivity was rejuvenated. Splitting the post-1995 period in two along the middle allows us to address the question of whether the US productivity boom of the late-1990s – the “New Economy” – has been sustained after the bursting of the dot-com bubble in 2001. As regards the EU, this split also allows for the crucial comparison of growth performance between the late-1990s and the 2000s.

Figure 2. Contribution to average annual real value-added growth in the US (percent)

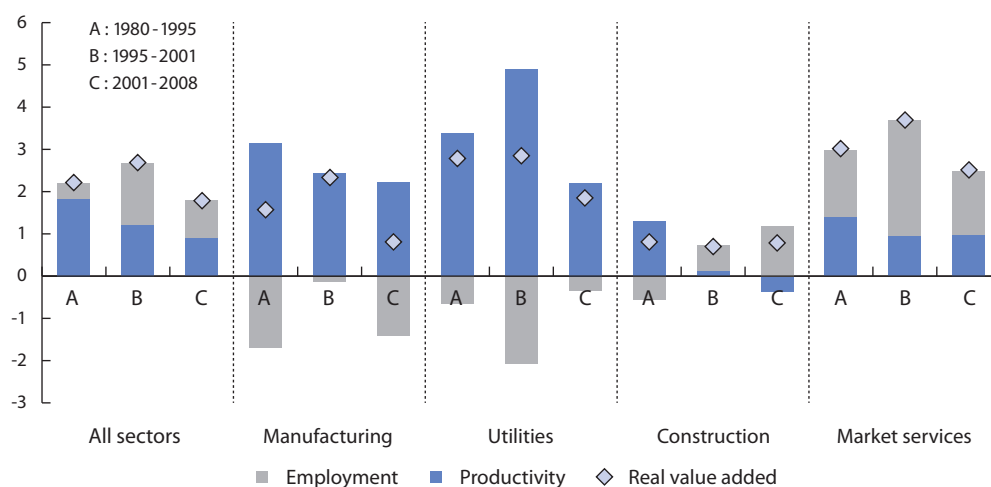


Source: OECD STAN Database

Figure 2 decomposes average growth in real value added into growth in employment and growth in labour productivity, for the economy as a whole and for selected key sectors. Three general observations can be made for the US on the basis of this figure. First, starting with the aggregate economy (“All sectors” is essentially the same as GDP), the US has largely managed to sustain its reinvigorated post-1995 productivity growth after 2001. Employment growth, on the other hand, slowed markedly in the last period. Second, on a sectoral level, the US has achieved a remarkable acceleration in manufacturing productivity growth after 2001. This has been accompanied by accelerated contraction in manufacturing employment, leaving value-added growth largely unchanged. This is consistent with a period of restructuring and streamlining in the wake of the bursting of the dot-com bubble and the ensuing squeeze in corporate profits (see Section 5 below). Third, relatively high productivity growth has also been sustained in market services, accompanied by continued, though sharply decelerated, expansion of employment. Given the large size of this sector, its contribution to aggregate growth has been substantial.

Unlike the EU-15, the US has largely sustained its high productivity growth after 2001, though accompanied by near-stagnant employment.

Figure 3. Contribution to average annual real value-added growth in the EU-15 (percent)



Source: OECD STAN Database

Note: See Figure 1.

The EU-15 economy has been characterised by a long-term decline in labour productivity growth in many sectors.

The EU-15 economy has been characterised by a long-term decline in labour productivity growth, from 1.8 percent per year in the first period, to 1.2 percent in the second, and 0.9 percent in the third period (Figure 3). Some of the aggregate productivity slowdown stems from slower productivity growth within sectors. But especially in the last period, a non-negligible part of the slowdown also stems from the continuing shift in employment from manufacturing (where productivity growth is higher) to market and social services (where it is substantially lower). Total EU-15 employment increased by 26 million between 1995 and 2008. The vast majority of these jobs were in sectors with average (market services) or sub-par (construction) productivity growth. In terms of remedies to this slowdown, substantially higher productivity growth in manufacturing would not be sufficient. The relatively small share of manufacturing in the EU economy means that raising its productivity growth rate by, for instance, 2 percentage points would only raise aggregate productivity growth by 0.3 percentage points (from 0.9 to 1.2 percent growth in the last period). In comparison, if labour productivity growth in market services rose by the same 2 percentage points, (from 1 to 3 percent in the last period), aggregate labour productivity growth would double (from 0.9 percent to 1.8 percent).

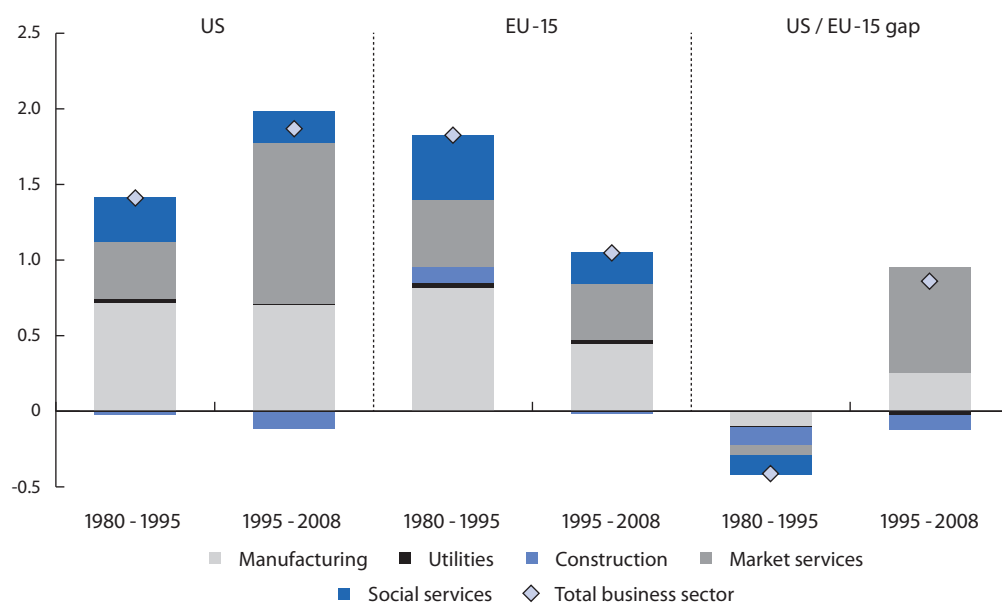
The other sectors shown here – utilities and construction – are relatively small and thus have a marginal impact on the aggregate economy. They are nevertheless of some qualitative interest. Utilities and the network industries included in this aggregate have been subject to far-reaching deregulation in many countries. The 1990s saw a wave of liberalisation and privatisation of utilities and network industries. This led to a period of restructuring visible as a surge in productivity growth and contracting employment. In the EU, this restructuring wave seemed to have reached its peak in the second half of the 1990s. As for construction, this sector has been relatively important for employment in the years before the crisis, in both the US and the EU, while productivity growth has been low or even negative. The pre-crisis building boom should not be extrapolated into the future.

The contribution that each sector makes to aggregate productivity growth can be approximated by the growth rate of each sector times its share in aggregate employment. This is shown for the US and the EU-15 in Figure 4. For simplicity we have merged the last two periods into one (1995-2008).

Several striking observations can be made from this figure. First, as regards the US, the manufacturing sector has made as substantial a contribution to aggregate productivity growth in the second period as in the first. This constancy between the two periods reflects an accelerated pace of productivity growth that has fully offset the fast-shrinking employment share of manufacturing in the economy. Second, the entire US acceleration in labour productivity growth since 1995 is accounted for by market services. This reflects both its growing size and the quickening of productivity growth in market services after 1995.

Market services account for the entire acceleration in US labour productivity growth after 1995.

Figure 4. Sectoral contributions to labour productivity growth (average annual growth rates, percent)



Source: OECD STAN Database
 Note: See Figure 1.

In the EU-15, in contrast, the contribution from manufacturing to aggregate productivity growth was halved between the two periods. In this case, the shrinking employment share of manufacturing was neither offset by faster productivity growth in the sector, nor was the diminished contribution from manufacturing offset by a larger contribution from services. The contribution from market services remained unchanged between the two periods, while that from social services was halved.

Turning finally to the productivity growth gap between the US and the EU-15 (by simply taking the difference between US and EU growth rates in each period), it is noteworthy that the EU still had higher productivity growth than the US in the first period, visible as a negative US-EU growth gap before 1995. The gap was sharply inverted in the second period, with annual US productivity growth in 1995-2008 outrunning that of the EU-15 by nearly a full percentage point. Three-quarters of this second-period gap is accounted for by market services.

To conclude this section, there is widespread agreement in the literature that Europe will not be able to close its productivity growth gap with the US unless it achieves significantly higher labour productivity growth in market services (e.g. Guellec and Pilat 2008). Policies targeting productivity growth primarily via manufacturing may thus have only a limited aggregate effect.

4. Sector composition of growth: cross-country evidence

It is apparent from what we have already seen that sectors differ from each other with respect to the rate and composition of growth, also within countries. These inter-sectoral differences are partly the result of factors specific to each sector, for example: intensity in the use of capital and skilled labour in production; the scope for continuous product and process innovation; the degree of product standardisation; economies of scale; sector-specific regulation; and global demand growth. To the extent that these factors are sector- rather than country-specific, we would expect the growth profile of each sector to display some similarity across countries.

But then there are also factors influencing growth which are country specific, causing sector growth rates to vary across different economies. Such country-specific factors include growth in aggregate domestic demand and incomes, interest rates and exchange rates, and macroeconomic conditions more generally. Other country-specific factors include barriers to trade, domestic competition, regulation of labour and product markets, tax systems, together with financial and other conditions that influence labour supply, fixed and human capital formation, and innovation.

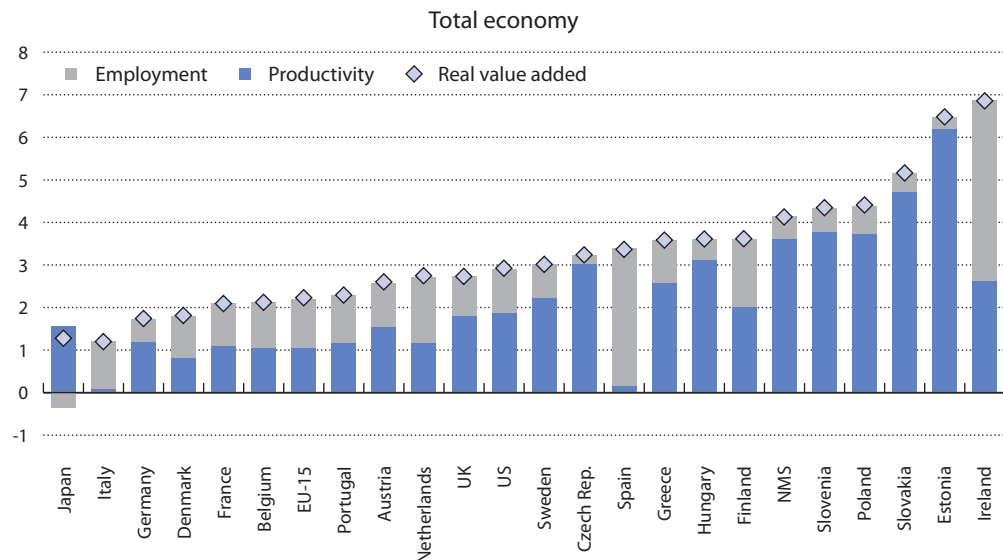
4.1 The composition of value-added growth by sector

The figures below illustrate that there are both similarities and differences in the growth of sectors across countries.

In most fast-growing OECD countries, labour productivity growth is the predominant source of output growth.

Starting with the aggregate economy (**All sectors**, Figure 5), one observation that stands out is that labour productivity growth is the predominant source of value-added growth in most high-growth countries for this period (1995-2008). There are a few notable exceptions. In Spain, productivity growth has been virtually non-existent during this period, offset by very high employment growth. Ireland has enjoyed the EU's highest economic growth rate on the back of a combination of solid productivity and even higher employment growth.

Figure 5. Contribution to average annual real value-added growth (1995-2008, percent)



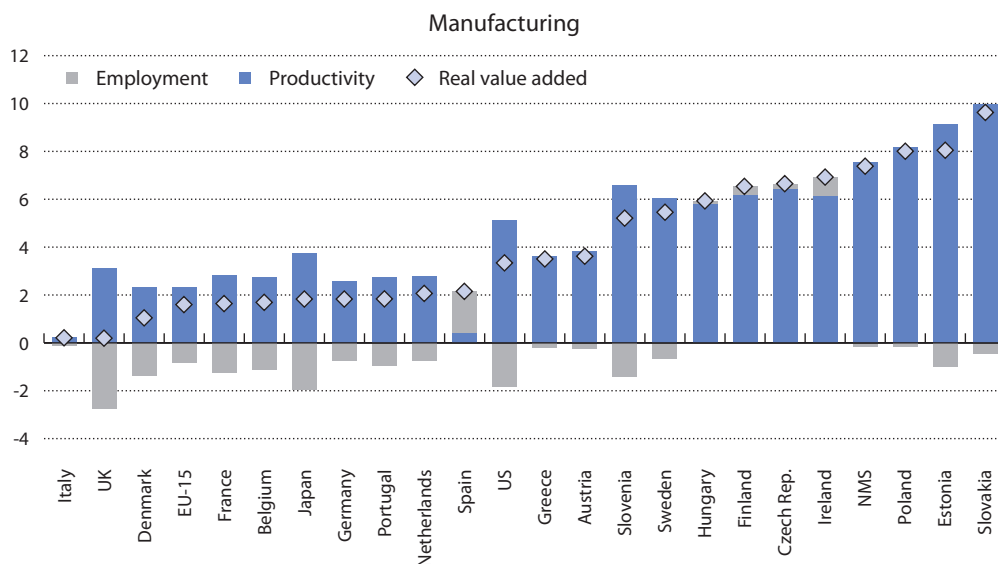
Source: OECD STAN Database

Note: See Figure 1.

Turning to individual sectors, one common pattern in **manufacturing** (Figure 6) is the combination of – oftentimes high – productivity growth and declining employment. For the period 1995-2008, employment growth was positive in only four EU countries: Spain, Finland, the Czech Republic,

and Ireland. Note, however, that there is a negative correlation between productivity growth and the rate of employment contraction. In other words, countries with the highest growth in manufacturing productivity tend to have positive or only slightly negative rates of employment growth.

Figure 6. Contribution to average annual real value-added growth (1995-2008, percent)

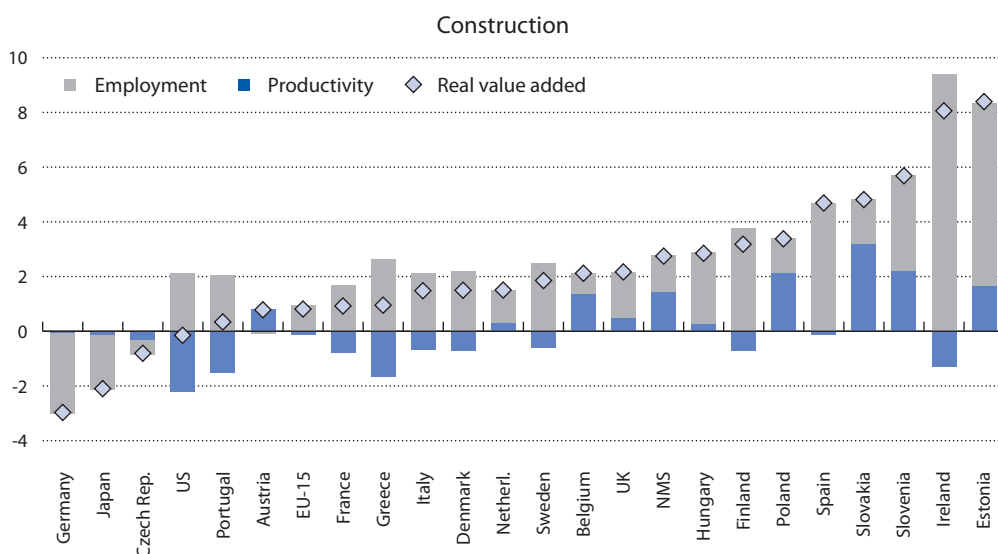


Source: OECD STAN Database
 Note: See Figure 1.

The **construction** sector (Figure 7) differs markedly from manufacturing in that growth has been largely employment-driven. Both the EU-15 and the US had negative productivity growth in construction during this period. However, year-by-year data show that this average stems from a steep decline in output towards the very end of the period. Reflecting very different market conditions across countries (including real estate bubbles in some cases), employment growth has been particularly diverse in this sector.

In both the US and the EU-15, the construction sector differs from manufacturing in that growth has been employment-driven, while productivity growth has been negative.

Figure 7. Contribution to average annual real value-added growth (1995-2008, percent)

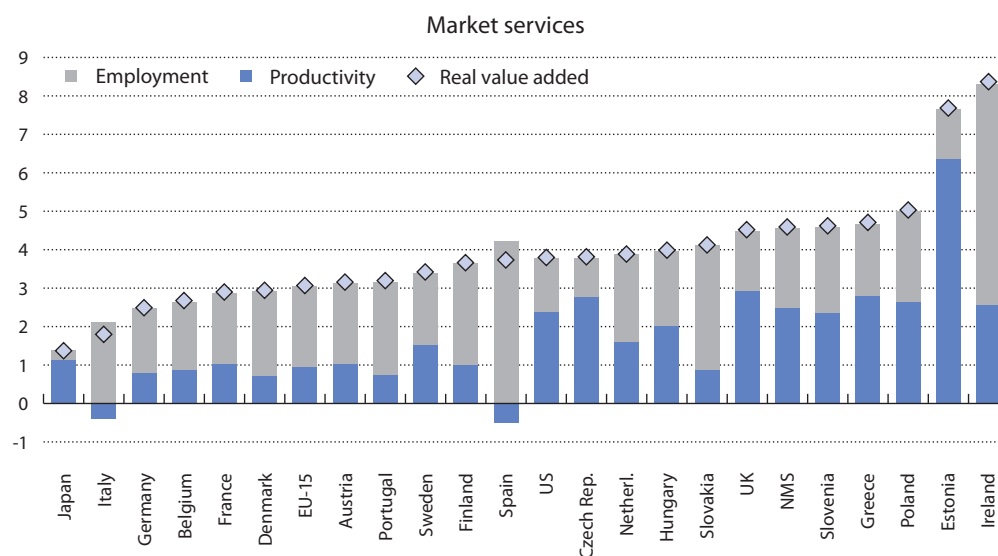


Source: OECD STAN Database
 Note: See Figure 1.

Unlike other sectors, output growth in market services is propelled by a combination of employment and productivity growth.

Market services represent a third type of growth pattern (Figure 8). It is the only sector where both employment growth and productivity growth have been consistently positive. While there is less dispersion across countries than in other sectors, it is possible to distinguish between two groups of countries on the basis of productivity growth. In the high-growth group we find, alongside the US, a small number of EU-15 countries: the Netherlands, the UK, Greece and Ireland. Among the NMS included here, only Slovakia did not enjoy high productivity growth. Because of the large size of this sector, different productivity growth rates in market services account for a very substantial two-thirds of cross-country differences in aggregate productivity growth in the EU.

Figure 8. Contribution to average annual real value-added growth (1995-2008, percent)



Source: OECD STAN Database

Note: See Figure 1.

4.2 Sectoral growth in individual EU-15 countries

Valuable additional observations can be made from snapshots of growth in individual EU-15 countries. Below we therefore provide snapshots of growth on a country-by-country basis. An attempt has been made to group EU-15 countries together according to their sectoral growth patterns. This helps to identify broad growth patterns and may serve as a take-off point for more systematic investigations. We focus here on the two sectors that are the most important for aggregate growth: manufacturing and market services. A more detailed picture of growth, including also the utilities and construction sectors, is provided in the tables in Annex 2.

The EU country whose growth pattern resembles the US the most is the **UK** (Figure 9). Specifically, the UK has experienced similarly high growth in market services, in both employment and productivity. While the manufacturing sector has also achieved reasonably high productivity growth (above the EU-15 average), this has been matched by a steep contraction in employment, resulting in near-stagnant value added after 1995. Overall, the UK has been characterised by a faster-than-average shift in employment away from manufacturing towards market services.

France displays some similarities with the UK. In manufacturing, productivity gains have been largely offset by a decline in employment. In the case of France, the 1995-2008 average hides a noteworthy shift between 1995-2001 and 2001-2008. The first of these sub-periods saw very little contraction

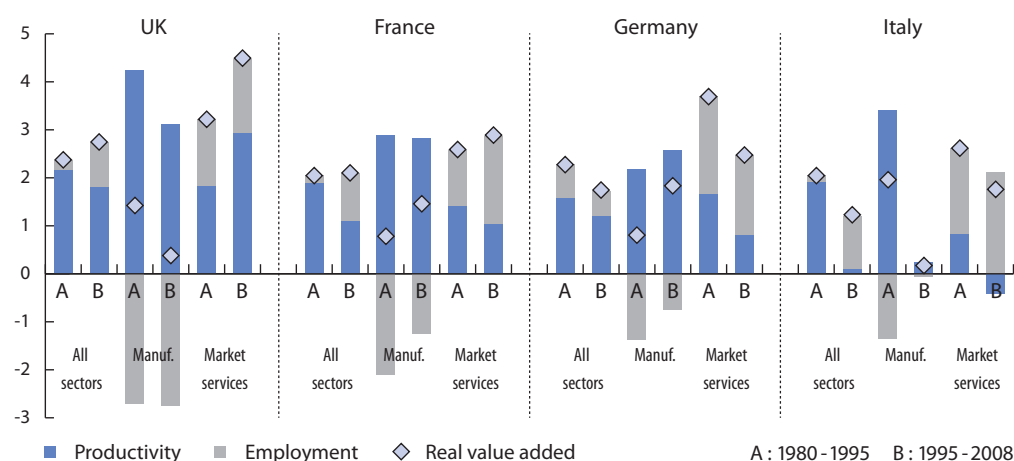
in employment and swift expansion in manufacturing value added. During the second sub-period, employment contracted and value-added growth stagnated (see Annex 2 for details). This suggests a faster pace of restructuring in recent years. In market services, employment expansion was particularly swift in the second half of the 1990s, before moderating in the second half of the 1995-2008 period. Productivity growth in this sector has, however, been substantially lower than in the UK.

Germany suffered from low growth in both output and employment in the years leading up to the financial crisis. Low growth environments tend to be accompanied by low productivity growth (with causality typically going in both directions). Producers struggle to keep their resources fully utilised, while weak growth undermines incentives for productivity-enhancing investments. In manufacturing, value added has expanded at a faster rate than in the UK and France, though still only half that of the US. Manufacturing productivity growth has been lower than in the UK, as has the rate of employment contraction. Similar to other countries, positive employment growth has, in Germany, been concentrated to market services, though it was slowing in the second half of the 1995-2008 period. An important source of Germany's rather moderate aggregate productivity growth after 1995 has been the very low rate of productivity growth in its market services, which stands in notable contrast to that in the US and the UK.

Italy stands out among the large EU-15 economies in its particularly weak growth performance since 1995, dominated by labour productivity for the economy as a whole grinding to a halt. The absence of labour productivity growth in manufacturing is particularly striking in an international context. This has been mirrored by an equally unique absence of decline in manufacturing employment. With negative productivity growth in market services during this period, Italy's weak productivity performance has been remarkably broad-based on a sectoral level.

Germany has enjoyed high manufacturing growth after 1995, while in other large EU countries growth has been propelled relatively more by market services.

Figure 9. Contribution to average annual real value-added growth (percent)

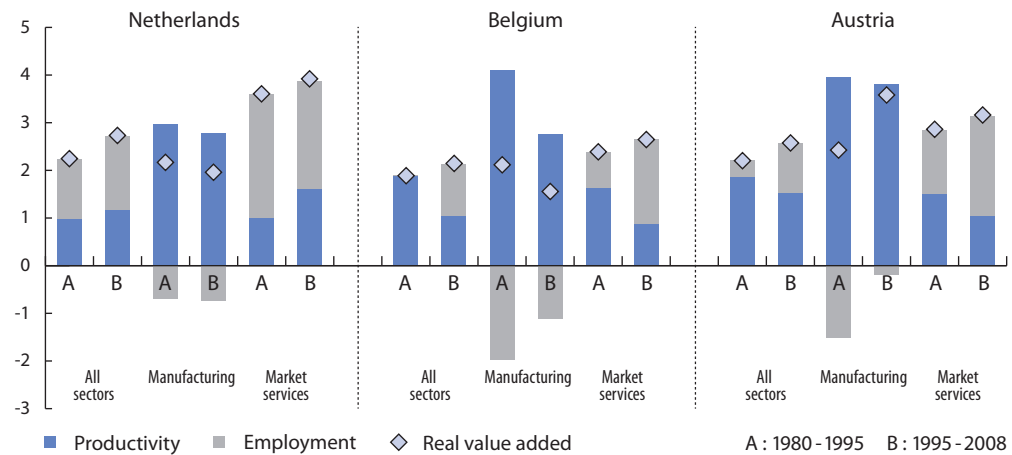


Source: OECD STAN Database

Turning now to three smaller continental EU economies (Figure 10), growth in **the Netherlands** resembles that in the UK and France. Relatively strong growth has been propelled by a combination of employment and productivity. Manufacturing value added has continued to expand, combining above-EU-15-average productivity growth with declining employment. In the market services sector, relatively solid productivity gains have been combined with strong growth in employment. Similar to the UK, the Netherlands has thus experienced a relatively swift transition towards an increasingly service-based economy.

Growth in **Austria** and **Belgium** has been broadly similar to that in the Netherlands, but there are a few notable differences. Aggregate growth has been relatively strong in Austria but less so in Belgium. Growth has typically relied, to a somewhat lesser extent than in the UK or the Netherlands, on productivity gains in the market services sector, while employment gains in this sector have been substantial after 1995.

Figure 10. Contribution to average annual real value-added growth (percent)

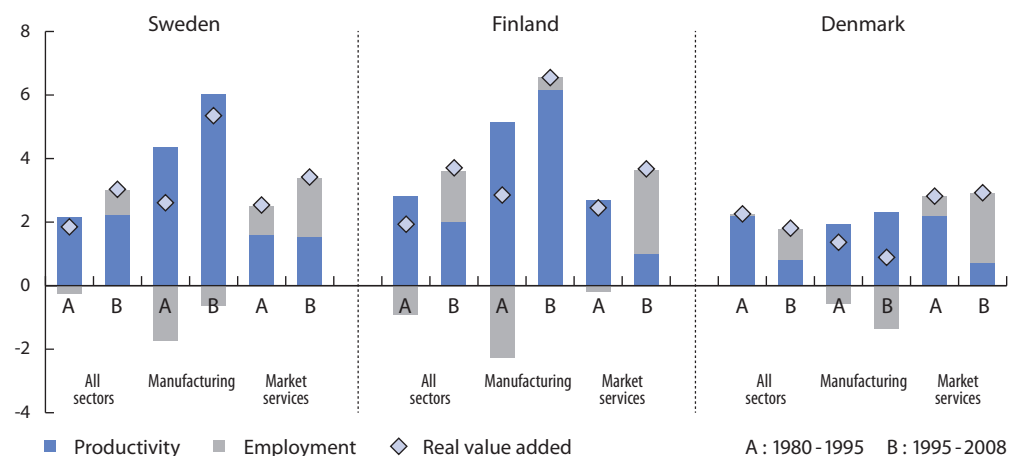


Source: OECD STAN Database

Sweden and Finland are characterised by exceptionally high growth in manufacturing output and productivity.

Growth in the two largest Nordic EU countries, **Sweden** and **Finland** has been more similar to that in Belgium and Austria than to the Netherlands. Aggregate growth in productivity and value added has been relatively high, though propelled to a much greater extent than elsewhere by the manufacturing sector. It has also relied less on productivity gains in the market services sector (although in Sweden there was an acceleration in market services productivity growth after 2001 – see Annex 2). Growth in market services has primarily centred on employment. The large role of manufacturing in economic growth and productivity growth in Sweden and Finland is somewhat unique to these countries. Given the small size and open character of these economies, it is unlikely that similar manufacturing-based growth could be implemented in the larger EU economies.

Figure 11. Contribution to average annual real value-added growth (percent)



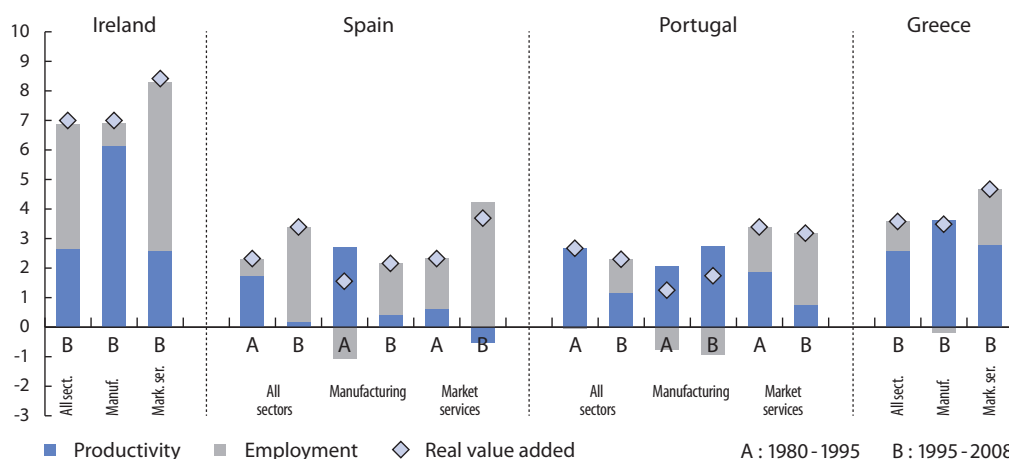
Source: OECD STAN Database

While similar in terms of its size and openness, **Denmark** differs from the aforementioned two groups of small countries in several ways. First, aggregate economic growth has been relatively weak in recent years (and weaker in the second half of the 1995-2008 period than in the first). Aggregate productivity growth has also been low, driven by a sharp slowdown in market services productivity growth after 1995. The manufacturing sector has been able to sustain its productivity growth, but manufacturing output growth has fallen as the pace of employment decline has quickened, especially after 2001 (see Annex 2).

The last group of EU-15 countries consists of Ireland, Spain, Portugal and Greece (Figure 12). These were once referred to as the “EU cohesion countries” in the context of EU financial support, which aimed at facilitating their speedy economic convergence towards the rest of the EU. This group of countries, however, defies easy generalisations as to their economic growth. Aggregate value-added growth has been relatively high up to the financial crisis (with the exception of Portugal, where growth fizzled already a decade ago).

The sectoral drivers of economic growth differ across countries. **Ireland's** sectoral growth patterns have shifted over the course of the last few years. On average for the 1995-2008 period, value-added growth has been evenly distributed between manufacturing and market services. If one splits this period down the middle, however, there has been a non-negligible slowdown in growth after 2001 mainly in the manufacturing sector. Along with construction, market services have accounted for a larger share of growth during these later years. Positive employment growth in manufacturing in the second half of the 1990s also turned negative in the years after 2001 (see Annex 2 for details).

Figure 12. Contribution to average annual real value-added growth (percent)



Aggregate productivity growth has been particularly low in Spain and Portugal.

Source: OECD STAN Database

Note: Period B refers to 1995-2007 for Ireland and to 1995-2006 for Portugal.

In **Spain**, growth has been even more centred on construction (see Annex 2) and market services, though only in terms of employment, not productivity. A wave of high employment-driven output growth occurred in manufacturing in the-1990s, but fizzled after 2001. Productivity growth has been consistently feeble in manufacturing after 1995, and negative in market services.

Portugal shares with Spain a sectorally near universal underperformance in terms of productivity growth. This is particularly the case in market services. The main difference between the two is that

Spain massively expanded its employment, whereas Portugal did not. In Portugal, as we saw earlier for Germany and Italy, weak growth in productivity and value added have accompanied each other in the past decade.

Greece, finally, appeared to be performing strongly in the years leading up to the financial crisis. Three-quarters of its output growth in the past decade took the form of labour productivity. Growth has also been broad-based, including high productivity growth in both manufacturing and market services. In retrospect, Greece serves as a good example of the inherent difficulty of distinguishing between transitory and permanent growth, also with respect to productivity.

4.3 Sectoral growth in the new member states

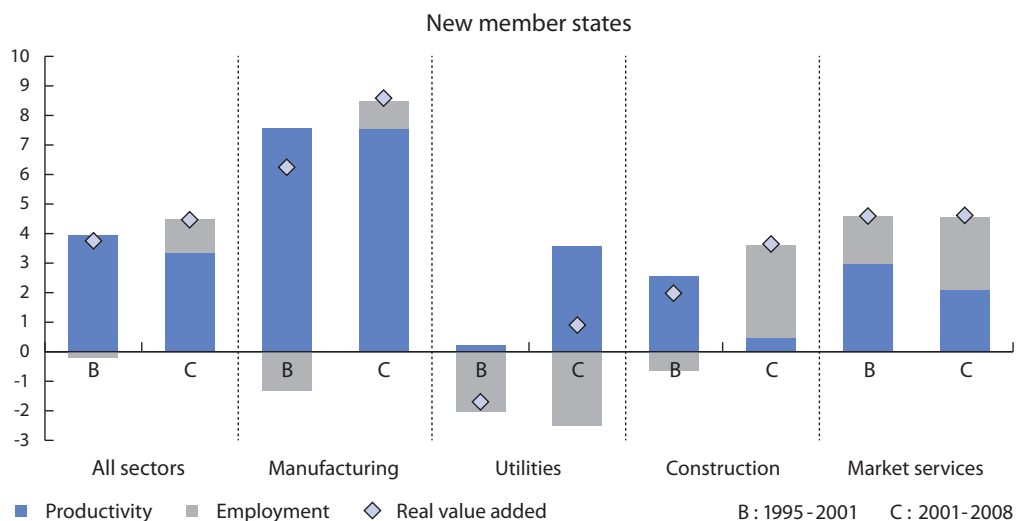
The new member states remain different from most EU-15 countries, having retained an economic structure less characterised by deindustrialisation.

There are several reasons why the new member states (NMS) are preferably assessed separately from the EU-15. The NMS remain different from the bulk of EU-15 countries in some key respects. Their economic structure is still relatively less characterised by the full onslaught of “deindustrialisation”. As we showed earlier, in Figures 1 and 2, the share of manufacturing in aggregate employment in the NMS is notably larger than in the EU-15, and its rate of decline is also slower. There is also a case for arguing that the process of productivity growth in the NMS still differs fundamentally from that in the US and many EU-15 countries. The NMS have retained some distance from the global productivity frontier, which means that productivity growth may to a greater extent be propelled by convergence and the adoption of best practice, for instance through foreign direct investment (FDI), rather than by home-grown innovation. Finally, treating the NMS separately is necessary in order to look at EU growth in a longer-term perspective. For the NMS, OECD data on employment and value added are only available from the mid-1990s onwards. This sub-section therefore concentrates on the two time periods 1995-2001 and 2001-2008.

The OECD STAN data set contains six countries from this region: Poland, Hungary, the Czech Republic, Slovakia, Slovenia and Estonia. A GDP-weighted growth average of this group is shown in Figure 13 below. Several observations can be made from this snapshot. Since 1995, the NMS have consistently had higher value-added growth than the EU-15. The bulk of this expansion stems from productivity rather than employment, although the latter did pick up in the last period. Also noteworthy is that high growth in productivity has been sustained across the two sub-periods. In stark contrast to the EU-15, the manufacturing sector has been a powerhouse for the region. Manufacturing value added has expanded at a rate 10 times higher than in the EU-15 in the period after 2001. This is suggestive of the NMS increasingly being turned into the “manufacturing hub” of the EU-27. Productivity growth in manufacturing has been particularly impressive, averaging around 7.5 percent in both periods. While employment has played a lesser role in the growth of manufacturing, it did not contract after 2001.

In addition to manufacturing, the NMS have also enjoyed a strong expansion in market services, on the basis of both productivity gains and employment. Productivity growth in this sector (as in manufacturing) may in part reflect continued efficiency gains from adopting best practice and addressing past structural impediments. Having entered the transition process with substantial inefficiencies in place, for a while at least, such productivity gains may have been more easily achieved than in the EU-15. At the same time, there has been great scope for expanding the size of this underdeveloped sector. In the NMS, as in the US and in the EU-15, market services have thus accounted for the bulk of new jobs created. As this process continues, the NMS should, over time, adopt an economic structure that is increasingly similar to that of the EU-15.

Figure 13. Contribution to average annual real value-added growth (percent)

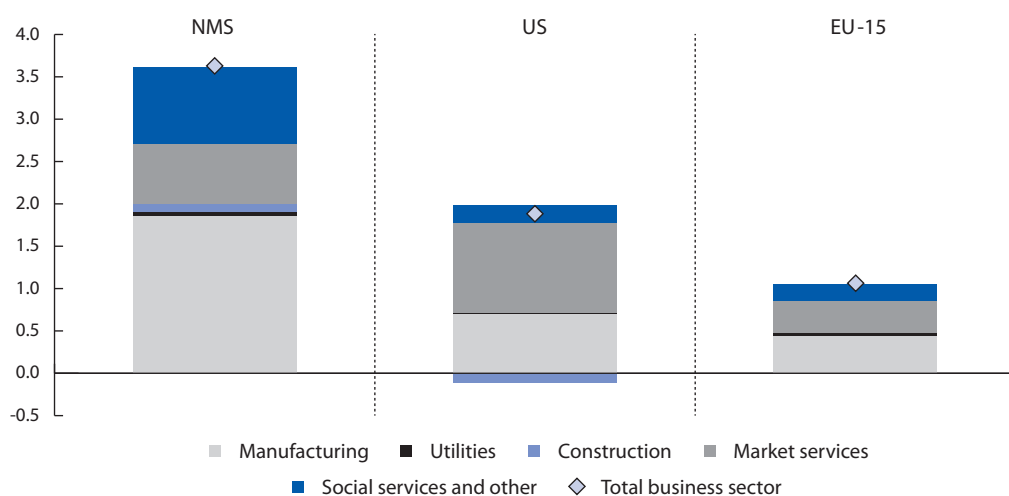


Source: OECD STAN Database
Note: See Figure 1.

A different way to illustrate sectoral productivity is to calculate each sector's contribution to aggregate productivity growth, using employment weights (as was done in Figure 4 above). As shown in Figure 14, in this respect the NMS differ from both the US and the EU-15. The NMS have experienced substantially higher aggregate productivity growth from 1995 to 2008 than either the US or the EU-15. Manufacturing accounts for a larger share (51 percent) of aggregate productivity growth than in either the EU (43 percent) or in the US (37 percent). This is the combined result of the NMS' higher manufacturing employment shares and higher productivity growth in manufacturing than in other sectors. The mirror reflection of this is that the relative importance of market services is smaller in the NMS (19 percent of total productivity growth) than in the EU-15 (35 percent) and the US (57 percent). This comparison across the three economic regions illustrates the importance of economic structure, in addition to sectoral productivity, for aggregate growth.

The new member states have had substantially higher productivity growth than either the US or the EU-15, with manufacturing playing a bigger role.

Figure 14. Sectoral contribution to average annual growth in labour productivity (1995-2008, percent)



Source: OECD STAN Database

We now turn to the individual countries. Inevitably, the GDP-weighted average for the NMS is heavily influenced by **Poland**, which accounts for 50 percent of the NMS-6 GDP at purchasing power parity. Poland's strong growth performance in recent years clearly influences the regional average, even though the NMS group also contains several other strong performers (Figure 15). Poland already achieved high growth in value added and productivity in the 1990s and has managed to sustain this in the past decade. Manufacturing growth has been consistently strong, reinforced in the second period by employment gains on top of high productivity growth. In contrast, productivity growth in market services has slowed down in the second period, with the sector's growth profile shifting towards employment.

The Czech Republic and Slovakia experienced relatively weak growth in the 1990s. Towards the end of the decade, however, an accelerated liberalisation process and massive FDI inflows facilitated a rapid economic transformation. This has paid off in the form of higher productivity growth in the period after 2001 and consequently a decent growth performance for the 1995-2008 period as a whole (for a split into sub-periods, see Annex 2). While employment gains have been concentrated in market services, productivity growth in this sector has been mixed – strong and rising in the Czech Republic but subdued in Slovakia.

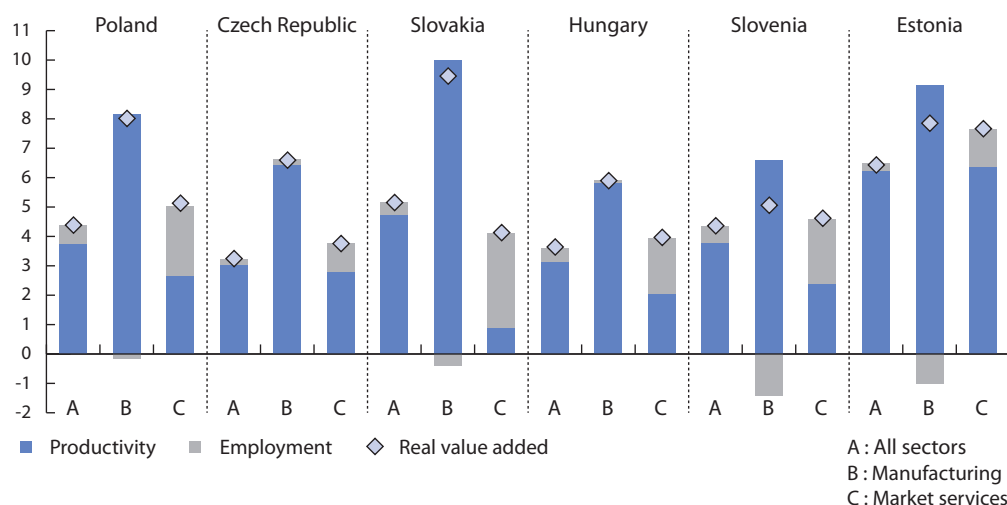
Hungary displays one of the region's weaker growth performances. While not shown in Figure 15, this is particularly visible in the absence of employment gains in the 2000s (see Annex 2). Still, some improvement is visible with respect to productivity growth during this later period, not least in the market services sector.

High productivity growth in the NMS is sectorally broad-based.

Slovenia is broadly similar to Poland in the combination of high productivity-driven growth in manufacturing, and an about equal split of market services growth into employment and productivity.

Estonia, finally, has achieved sustained high growth. In the 1990s, growth was largely productivity-driven. It was augmented by the expansion of employment in the second half of the 1995-2008 period, notably in construction and market services.

Figure 15. Contribution to average annual real value-added growth (1995-2008, percent)



Source: OECD STAN Database

The data presented in Section 4 lend themselves to a few key observations that will inform the analysis going forward. First, the composition of value-added growth between employment and labour productivity is extremely diverse across sectors, in particular between manufacturing and market services. This makes the sectoral perspective indispensable in the study of economic growth. Second, despite continued economic convergence between the NMS and the EU-15, these two country groupings still differ from each other in some important respects. Most notably, while output growth in EU-15 manufacturing has been grinding to a near-halt, with contraction in employment, the NMS have enjoyed very high output growth and employment gains. Third, the market services sector by its sheer size accounts for the bulk of cross-country differences in aggregate productivity growth. Even if the extraordinary productivity boost in US manufacturing in recent years has been impressive, this sector is inevitably becoming too small to drive the bulk of aggregate productivity growth in any advanced economy.

The next two sections zoom in on the two most important sectors in the context of the US/EU productivity gap: manufacturing and market services.

5. Productivity growth in US manufacturing: What's behind the surge?

Despite its relatively small and still-shrinking share in total employment, the manufacturing sector has sustained a non-negligible share of aggregate US productivity growth. As shown earlier, US manufacturing has managed to stage an impressive productivity surge after 2001; one that has been conspicuously absent in the EU-15. Manufacturing accounts for around one-third of the US/EU productivity growth gap since 1995, substantially larger than its share in either economy.

US manufacturing has staged an impressive productivity surge after 2001, largely absent in the EU-15.

A first step towards understanding the underlying mechanics of high productivity growth in the US is to further break this sector down into industry groupings. We have chosen to divide manufacturing into four sub-groups, each of which is large enough to have an impact:

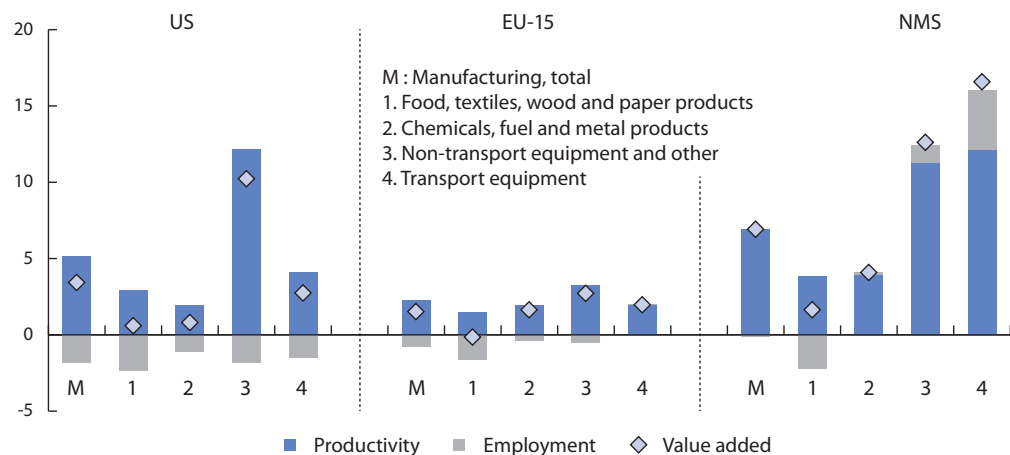
1. Sector 1: Food, textiles, wood and paper products;
2. Sector 2: Chemicals, fuel and metal products;
3. Sector 3: Non-transport equipment and other;
4. Sector 4: Transport equipment.

In both the US and the EU-15, the distribution of employment across these four sub-sectors is roughly as follows: around 30 percent each in Sectors 1-3 and 10 percent in Sector 4. In the NMS, however, the sectoral distribution is somewhat different: Sector 1 accounts for 44 percent of manufacturing employment, Sector 2 for 27 percent, Sector 3 for 23 percent and Sector 4 for only 6 percent.

The first two groups can be described as more traditional industries, where the degree of technical sophistication and innovation is typically lower. In the three economic regions shown here, both value-added growth and productivity growth are lower in Sectors 1 and 2 than in Sectors 3 and 4. Also, at least in Sector 1, the rate of contraction in employment is higher (Figure 16).

Sector 3 is the one with the highest rate of productivity growth in both the US and the EU-15. A major component of this sector is production of information and communication technology (ICT) equipment, which accounts for a non-negligible share of its expansion. Also, this sub-sector has by far the largest US/EU productivity growth gap. Sector 4, finally, is the most dynamic only in the NMS, where it has evolved very differently compared with both the EU-15 and the US.

Figure 16. Contribution to average annual real value-added growth: Manufacturing (1995-2008, percent)



Source: OECD STAN Database

Notes: For EU-15, see Figure 1. NMS includes Hungary, Czech Republic, Slovakia, Slovenia and Estonia. Poland is not included here for data availability reasons.

Figure 17 provides an estimate of the contribution of each sub-sector to aggregate manufacturing productivity growth for the period 1995-2008. What is clear from this figure is that the bulk of the US productivity lead is the result of its exceptionally high productivity growth in Sector 3: non-transport equipment and other. There are, however, substantial differences between the two sub-periods shown. While the large contribution of Sector 3 to US productivity growth has been sustained, a notable increase in the contribution of Sector 1 occurred during 2001-2008. In that period, Sector 1 accounted for roughly one-quarter of the US/EU-15 productivity gap. This sector's growing contribution to productivity growth has in part been propelled by manpower reductions, whereas value added has been stagnant.

Turning to the NMS, finally, the sectoral distribution of manufacturing productivity growth has been notably more broad-based than in the US, even as the aggregate rate of productivity growth has been comparable. This points to continuing efficiency gains throughout the manufacturing sector.

So what are the likely reasons for the strong productivity performance of US manufacturing, and what are the lessons for Europe? To answer these questions, we will draw on a few key observations made in the empirical literature.

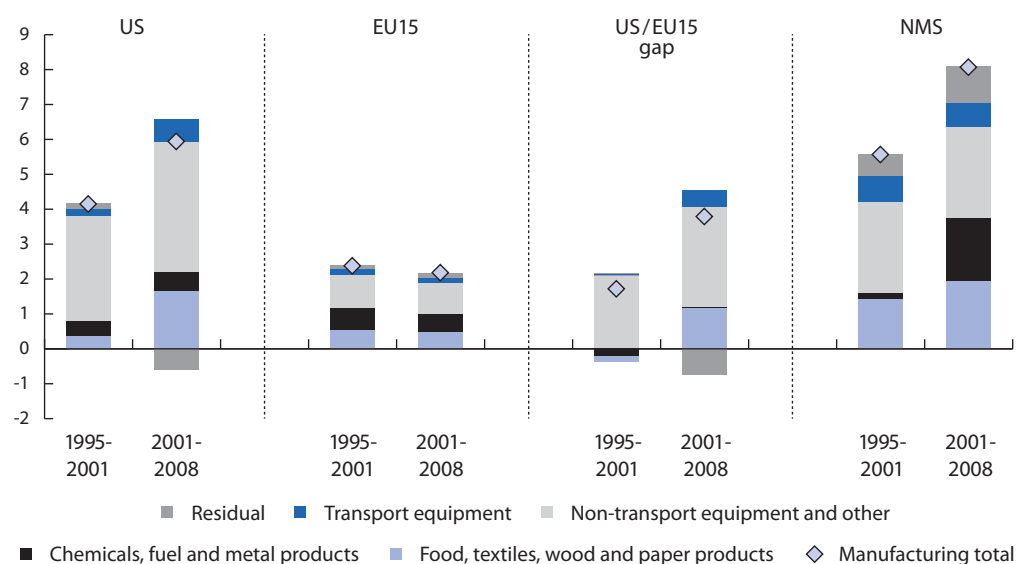
The production of ICT equipment has played an important role in high productivity growth in US manufacturing.

As regards the high rate of productivity growth in US manufacturing since 1995, the production of ICT equipment has been shown to have played a particularly important role. Several studies, including Jorgenson *et al.* (2005, 2008) and Oliner *et al.* (2007), demonstrate that a large portion of the contribution from ICT to aggregate productivity growth stems from ICT-producing industries as opposed to ICT-using industries, especially in the 1990s. The absence of a substantial ICT element in European manufacturing is therefore a central element in the US/EU productivity growth gap in manufacturing overall.

While the ICT-producing sector has clearly been very important, the data presented above show that relatively high productivity growth is visible also in other areas of US manufacturing. Much of these gains can be linked to a combination of ICT investment and productivity-enhancing business practices. Investing in ICT in isolation does not yield the desired effects. Brynjolfsson and Saunders (2010) point specifically to incentive systems, training, and decentralised decision making as important complements to technology in propelling the US productivity lead. Productivity gains from

improved business practices often take time to materialise, however. This may explain partly why high US productivity growth has been sustained for several years after the ICT boom ended in 2001.

Figure 17. Sub-sectoral contributions to labour productivity growth in manufacturing (percent)



Source: OECD STAN Database

Notes: For EU-15, see Figure 1. NMS includes Hungary, Czech Republic, Slovakia, Slovenia and Estonia. Poland is not included here for data availability reasons. Sub-sector productivity growth rates are weighted by 1995 employment shares.

But there is more to the story than this. Firms need the incentive as well as the opportunity to push through with the organisational changes that foster productivity gains. One pertinent observation made by Gordon (2003, 2010) is that competition and a squeeze on profitability seems to have provided the ultimate trigger for an accelerated shake-up of the US business sector. In this respect, the 2000s differ markedly from the 1990s. During the height of the 1990s dot-com bubble, firms invested heavily in new technology and hardware, but reductions in employment were limited. It was only after the dot-com bubble burst in 2001 that the cuts in payrolls gained momentum. Gordon observed that US firms experienced a period of unusually strong downward pressure on profits after 2001, partly linked to the severe underperformance of corporate pension plans when stock prices tumbled. This triggered aggressive cost-cutting in the business sector in the years that followed. After Gordon first introduced his “savage cost-cutting hypothesis” in 2003, Oliner *et al.* (2007) suggested that this could be tested on cross-section industry data. In support of Gordon’s hypothesis, they find that those industries that had experienced the largest declines in profits between 1997 and 2002 also exhibited the largest declines in employment and the largest increases in productivity.

The empirical literature points to a wide range of factors that contribute to high productivity in US manufacturing and beyond, including the level of investment in technology and new knowledge, access to skilled labour, and the relative ease with which finance and other resources are reallocated to high-growth activities, and especially risky ones. All these elements contribute to both continuously pushing out the technological frontier, and ensuring that manufacturing activity focuses on producing high value-added, innovative, products that can compete in world markets. But as this section has shown, US manufacturing productivity is also under intense pressure to contain costs to stay competitive. A continuous stream of process and organisational innovations – which include offshoring – is thus instrumental in ensuring that manufacturing value added grows alongside a rapidly shrinking manufacturing workforce.

In addition to the role of ICT, aggressive cost-cutting in the wake of the bursting dot-com bubble in 2001 also boosted productivity gains in the years that followed.

6. The role of market services in the US/EU productivity gap

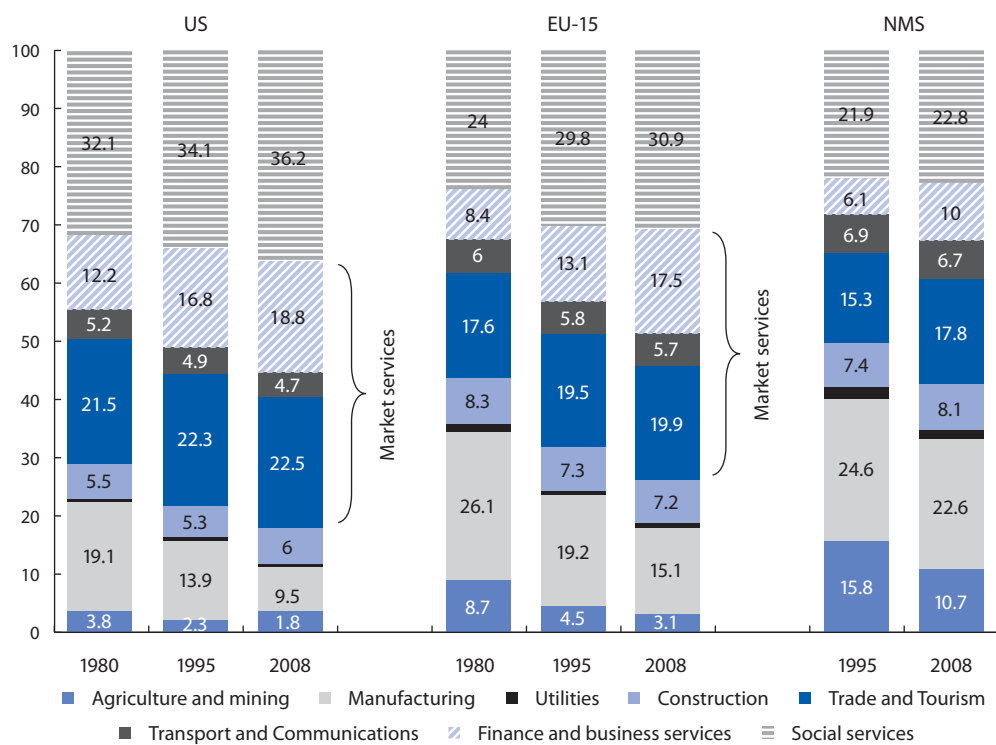
Because of the prominent role of market services in economic growth, a deeper understanding of this segment of the economy is needed. As a first step, a further breakdown of market services into three sub-sectors is contained in the OECD STAN dataset:

1. Wholesale and retail trade, restaurants and hotels (*Trade and tourism*)
2. Transport, storage and communications (*Transport and communications*)
3. Finance, insurance, real estate and business services (*Finance and business services*).

In terms of employment shares, Trade and tourism and Finance and business services are the largest segments of market services in the US and the EU-15.

On the basis of this breakdown, Figure 18 shows the composition of employment across sectors in the US, the EU-15 and the NMS. In terms of employment shares, the two sub-sectors *Trade and tourism* and *Finance and business services* are the largest, each accounting for around one-fifth of aggregate employment in the US and the EU-15. *Finance and business services* has been the fastest-growing sub-sector in both the US and the EU-15. In the EU-15, it has doubled its employment share since 1980. Also in the NMS, the employment share of *Finance and business services* has expanded on the back of high growth, although from a lower starting point. It therefore still accounted for only 10 percent of aggregate employment in 2008.

Figure 18. Employment shares by sector (percent)



Source: OECD STAN Database

Note: See Figure 1.

As we have seen earlier, market services accounted for the bulk of the US productivity acceleration after 1995. The decomposition of the market services sector into its three main components sheds additional light on this insight. As seen in Figure 19 below, after 1995 the US experienced a sharp acceleration in productivity growth both in *Trade and tourism* and in *Finance and business services*. *Finance and business services* had been characterised by negative productivity growth in the 15 years up to 1995. There have also been shifts in the composition of growth over the last two periods. While productivity growth slowed dramatically in *Trade and tourism* in the final period, it held up well in *Finance and business services* and accelerated sharply in *Transport and communications*.

Figure 19. Contribution to average annual real value-added growth in market services (percent): US

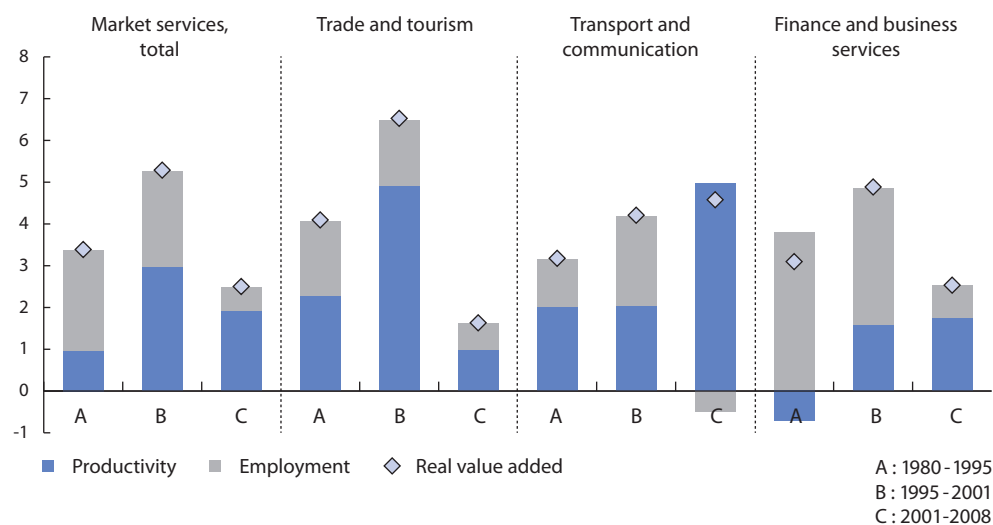
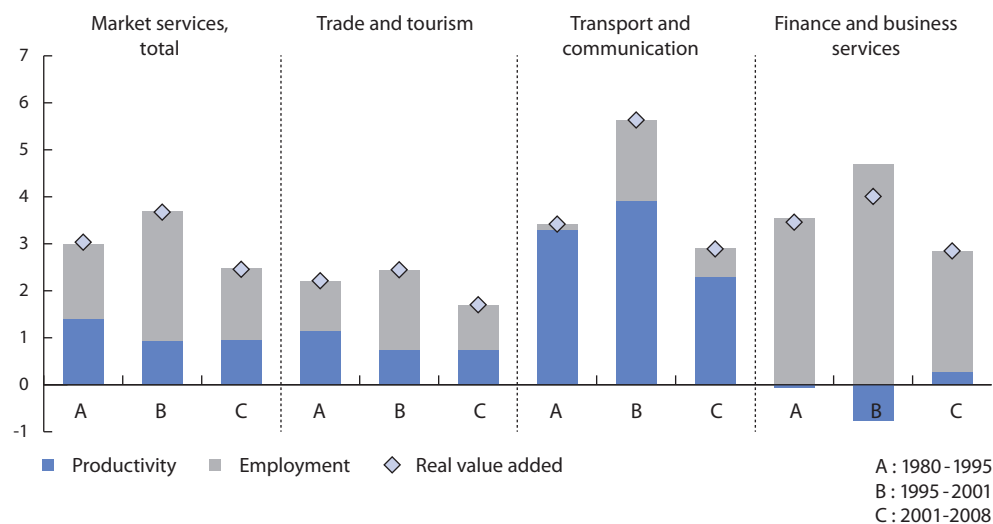


Figure 20 shows the corresponding sources of value added growth for the EU-15. Comparing the US with the EU-15 reveals some similarities that point to sector-specific rather than economy-wide drivers of growth. The decomposition of market services also allows for a better understanding of the exact origins of the US/EU-15 productivity growth gap.

Figure 20. Contribution to average annual real value-added growth in market services (percent): EU-15



First, the US has, over the past three decades, substantially outpaced the EU-15 in terms of productivity growth in *Trade and tourism*, which is dominated by retail and wholesale trade. Sluggish productivity growth in this sub-sector is a well-known Achilles' heel for the EU-15. Reflecting its large size in the economy, *Trade and tourism* accounts for three quarters of the overall US/EU-15 productivity growth gap in market services (Figure 21) and around half of the gap for the economy as a whole, as regards the post-1995 period.

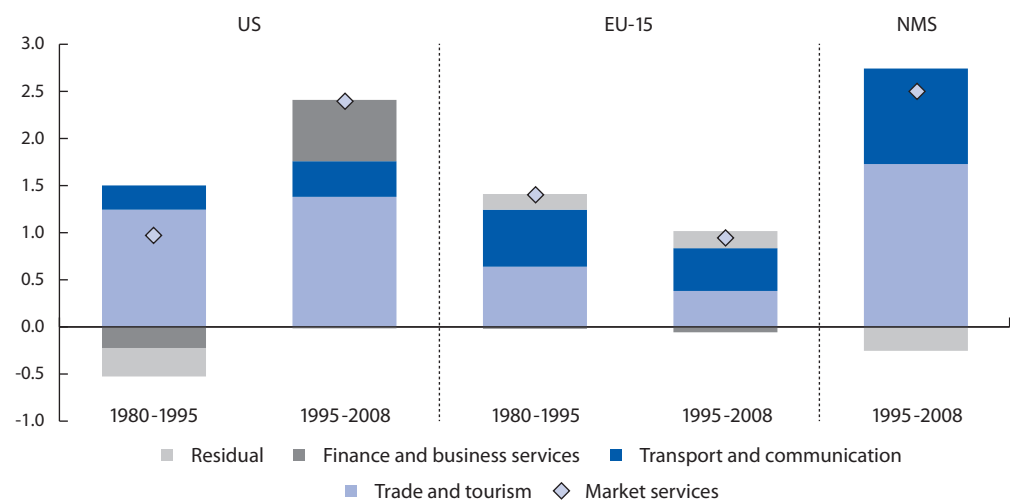
The US has consistently outpaced EU-15 productivity growth in Trade and tourism, which includes retail and wholesale trade.

Second, in *Transport and communications*, the EU-15 has historically outpaced the US in terms of productivity growth, with a reversal of leadership only in the last decade. This sub-sector is substantially more capital intensive than other areas of market services. As it is the smallest of the three sub-sectors, its contribution to the US/EU-15 productivity growth gap is relatively small.

Finance and business services account for most of the acceleration in US productivity growth in market services after 1995.

The third sub-sector, *Finance and business services*, was curiously similar in the US and the EU-15 before 1995, with its combination of high employment growth and negative productivity growth. After 1995, productivity growth took off in the US, even as high employment growth continued. As is apparent from Figure 21, this sub-sector accounts for most of the acceleration in US productivity growth in market services after 1995. In terms of productivity, no such improvement occurred in the EU-15. Instead, *Finance and business services* have continued to generate the bulk of EU-15's new jobs, expanding its share in the economy. Between 1980 and 1995, the employment share of business services in total market services rose in both the US (from 32 percent to 39 percent) and the EU-15 (from 26 percent to 34 percent).

Figure 21. Sub-sectoral contributions to average annual labour productivity growth in market services (percent)



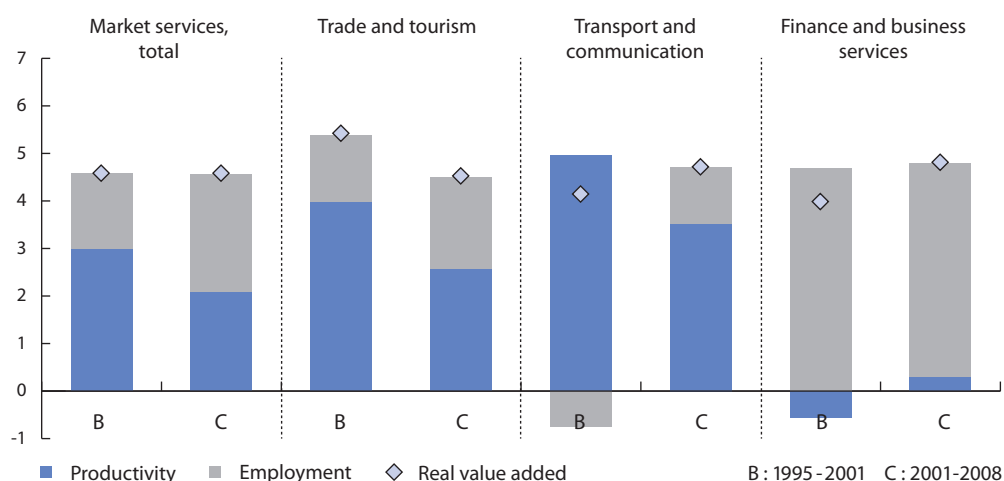
Source: OECD STAN Database
 Notes: EU-15 excludes Ireland, Luxembourg, Greece, Portugal and Sweden. For NMS, see Figure 1. Sub-sector productivity growth rates are weighted by 1995 employment shares.

On balance, while the US has staged a remarkable and broad-based acceleration in market services productivity growth after 1995, the EU-15 has for the most part gone in the opposite direction. It is pertinent to note here that the US/EU-15 productivity growth gap in market services would still largely remain intact if the financial sector was excluded. Although the financial bubble of the pre-crisis years likely inflated financial sector value added, the bulk of the growth gap lies with *Trade and tourism*.

Turning finally to the NMS (Figure 22), the broad pattern displays similarities to the EU-15 that, again, are suggestive of industry-specific elements. *Finance and business services* are, as in the EU-15, characterised by substantial expansion of employment, while productivity has been stagnant. Consistent with the region's greater scope for convergence-driven efficiency gains, productivity growth has otherwise been higher than in the EU-15. It has also been broadly sustained over the two sub-periods.

Due to its large share in market services employment (just over 50 percent in 2008), *Trade and tourism* is the dominant component of productivity growth in the NMS' market services, followed by transport and communication (see Figure 21). As in the EU-15, but in notable contrast to the US, productivity growth in *Finance and business services* has been close to zero in the NMS.

Figure 22. Contribution to average annual real value-added growth in market services (percent): New member states



Source: OECD STAN Database
 Note: See Figure 1.

7. Determinants of productivity growth in market services

One of the main observations emerging from the data presented in this paper is that the EU-15 has not succeeded in accelerating productivity growth in market services since the 1990s. The sectoral decomposition in Section 4 pointed, however, to substantial differences across individual EU Member States. While several countries have experienced sharp declines in the rate of productivity growth, others have seen improvement. Indeed, in half of the EU-15 countries, productivity growth in market services has either risen since the 1990s or been sustained at an already high level. This diversity is indicative of substantial structural differences across EU countries.

A number of EU member states have seen improved productivity growth in market services after 1995 while others have not.

Up to this point, this paper has not explored the underlying drivers of productivity growth. In order to obtain a deeper understanding of the diversity across EU-15 countries, this section draws on the existing empirical literature. The focus here is on the drivers of productivity growth in market services. As we will see, many high-growth countries share a mix of factors known to promote productivity growth, while those trailing behind typically do not.

7.1 Investment and innovation in market services

In services as in other sectors, output per hour worked (productivity) can be expanded through several channels. First, it can result from equipping each worker with more and better equipment. Second, it may stem from having more skilled workers, which are able to operate more sophisticated equipment or engage more generally in higher value-added activities. Third, it may stem from efficiency gains that increase output for any combination of factors of production. The efficiency in combining inputs to produce output is known as multifactor productivity (MFP). MFP growth reflects increases in knowledge, increased use of economies of scale and other efficiency gains that allow for more output from a given combination of inputs.

A natural first step to uncovering the drivers of productivity growth is to empirically separate these different components on the basis of a neo-classical production function. This process is called growth accounting. The simplest version of the neo-classical production function describes output as a function of labour and capital inputs. These inputs are characterised by diminishing marginal returns, which means that increasing one of them while keeping the other constant leads to smaller and smaller incremental increases in output. By assuming reasonable output elasticities of capital and labour – proportional to their shares in aggregate income – the growth contribution of each factor can be easily estimated on the basis of their own growth rates. The “residual”, *i.e.* the part of output growth that is not accounted for by growth in labour and capital, is then defined as MFP. Historically, this residual has made large contributions to output growth.

Directing our attention to market services, the growth accounting approach has proven useful also at sectoral level. It points to differences across sectors in both the size and the composition of fixed, human and intangible capital investment, as well as the role of the MFP residual. In short, the nature of productivity growth differs across sectors in part because they use different types of inputs. Investment in tangible fixed capital is on average not smaller in market services than in manufacturing, but this average is heavily influenced by the high level of investment in *Transport and communications*. In all other sub-sectors of market services, fixed investment is substantially lower than in manufacturing (Uppenberg and Strauss 2010). Also, the composition of fixed investment in market services is different from that in manufacturing. Investment in market services is dominated by buildings, ICT equipment and transport equipment. In manufacturing, around two-thirds of fixed investment consists of non-ICT equipment (*e.g.* machines).

While differences in fixed capital formation play a part, a substantial portion of the differences in labour productivity growth cannot be explained by fixed capital per worker.

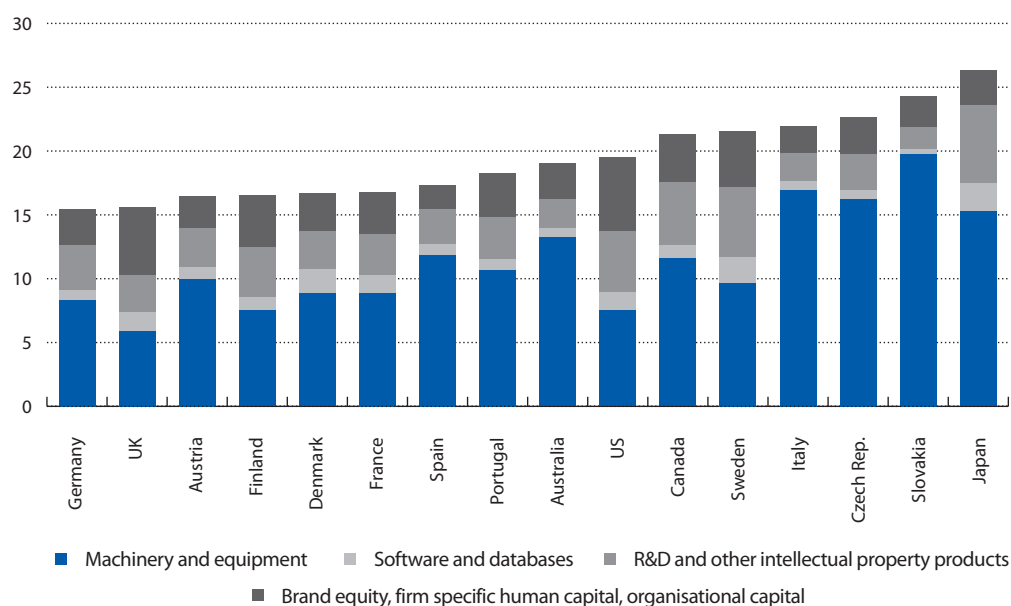
While differences in fixed capital formation play a part, a substantial portion of the difference in labour productivity growth across countries cannot be explained by capital deepening (*i.e.* by the rate of growth in capital available to each worker). This means that better understanding of these growth differences can only be obtained by explaining differences in the rate of growth of the MFP residual. Inklaar *et al.* (2008), for instance, find that while ICT and skilled labour are key to high labour productivity growth in market services, the bulk of the difference across countries stems not from these inputs, but from unexplained efficiency gains, as measured by the MFP residual. Also, the authors’ attempts at uncovering the drivers of MFP growth differences as externalities from ICT investment, the use of skilled labour or entry barriers yield limited results. The decisive role of MFP thus points to a relatively complex innovative process, where many different elements combine to generate productivity gains.

The large role of the unexplained MFP residual in productivity growth has inspired several different responses from empirical researchers. One way of shrinking the MFP residual has been to refine the measurement of traditional inputs by breaking down the labour force into different skill and age groups and the capital stock into various types of ICT and non-ICT capital. The MFP residual shrinks further through the creation of a broader definition of productive capital that includes more intangibles such as R&D capital, firm-specific skills and organisational knowledge. The work of Corrado, Hulten and Sichel (CHS, 2005, 2009) has been seminal in this respect. Key assumptions behind this work are that knowledge is a form of productive capital, that it is accumulated through investment and that it depreciates gradually over time, similar to conventional fixed capital. CHS split intangible investment into three groups:

- Computerised information (software and databases);
- Scientific and creative property (R&D, mineral exploration, copyright and license costs, other product development, design, and other research expenses);
- Economic competencies (brand equity, firm-specific human capital and organisational structure).

CHS find the level of investment in intangible capital to be substantial. Total annual investment in intangible assets by US businesses averaged around 12 percent of GDP in the 1990s, a similar order of magnitude as investment in tangible assets. Other researchers have since applied the CHS methodology to other countries, including many in the EU.⁴ Figure 23 shows estimates for intangible investment in a number of advanced countries, alongside investment in machinery and equipment.

Figure 23. Investment in intangible assets, machinery and equipment (percent of GDP, 2006 or latest available)



Source: OECD (2010)

Closer scrutiny of these investment data shows that the countries with high productivity growth are not always those with the highest overall investment rates. What is striking, however, is that this group of countries (notably the US, UK, Canada, Finland, Sweden and Australia) tend to have a larger share of intangibles in total fixed investment.

Countries with high productivity growth tend to have a larger share of intangibles in total fixed investment.

While the figure above provides a macroeconomic perspective on intangible investment, some sectoral evidence is also emerging. Sectoral data, for instance, show that investment in R&D is heavily concentrated in manufacturing, suggesting that intangible investment in market services is typically less about innovative products than about brand equity, upskilling of staff and organisational innovation. Indeed, it is an inherent characteristic of services that the final product is difficult to distinguish from the organisation that provides it, or from the manner in which it is provided.

One recent study that has made progress in providing a sectoral breakdown of intangible investment is Haskel and Pesole (2011). They find that the distribution of intangible investment between manufacturing and market services differs substantially from country to country. Specifically, in the UK only one-quarter of total intangible investment is conducted in manufacturing, against half or even more in Germany and Sweden. Combining this result with the levels in the figure above,

⁴ For estimates of intangible investment in the US and 10 EU countries, see van Ark *et al.* (2009).

it follows that the intangible-investment gap between the UK and Germany is even greater in market services than it is for the economy as a whole. On balance, the literature suggests that countries with relatively high or rising productivity growth in market services (US, UK, Netherlands) also have market services sectors that invest more in ICT and intangible capital.

7.2 Determinants of innovation in market services

While the positive link between productivity and the resources devoted to intangibles hints at innovation as a key driver of productivity growth, it raises additional questions. First, investment in intangible capital only generates productivity gains as part of an innovative process, *i.e.* through new and improved products, processes and modes of operation. What is the nature of these processes? Second, what underlying business environment gives firms the incentive to invest and innovate in the first place? The answers to these questions are key when designing effective growth policy.

Even the inclusion of intangible investment cannot completely eliminate the unexplained MFP residual in economic growth. The mechanisms behind productivity growth are simply too complex to be fully accounted for as the product of various inputs. From this perspective, the neo-classical production function, while proving a useful benchmark, is too simplistic as a representation of the growth machinery. A second branch of the empirical growth literature accepts this complexity through a freer relationship between economic growth and its many underlying determinants. For instance, growth regressions show that a wide range of structural and policy variables outside the confines of the firm's production technology influence growth. Recognising this complex relationship, one recent OECD study aims to provide a comprehensive set of indicators linked to innovation at the firm level (OECD 2010). The list below provides a summary of some of its key elements at the national level:

Countries with high productivity growth in market services typically rank high on many indicators linked to innovation and economic dynamism.

- The level of investment in ICT hardware and software, and in R&D and other forms of intangible capital;
- The extent of complementary innovation strategies;
- The share of firms with international cooperation on innovation;
- Educational achievement (especially in science and mathematics);
- Employment of university graduates;
- International students in higher education;
- Venture capital investment;
- The patenting activity of young firms;
- Scientific publications;
- Broadband internet access;
- International technology and knowledge flows;

The OECD study shows that countries with high or improving productivity growth in market services (the UK, Sweden and the Netherlands being the stronger cases) typically have relatively high scores on a large number of these indicators, whereas underperforming countries (prominent examples being Italy and Spain) tend not to. As also suggested in the empirical literature, this pattern suggests that high productivity growth in market services will not likely emerge from putting just one or two key elements in place. Instead, success in fostering a more dynamic and innovative market services sector requires a relatively broad-based approach.

Beyond these indicators, productivity growth has been found to be strongly influenced by broader environmental conditions that give firms the incentives and means to engage in innovative activities. Some studies point to elements that are of particular importance in specific industries. One such case is retail and wholesale trade, where the US achieved notable productivity gains from the mid-1990s onwards. Van Ark *et al.* (2003), Timmer and van Ark (2005), Inklaar *et al.* (2005, 2007) and Jorgenson *et al.* (2003, 2005), identify trade as particularly decisive in accounting for the US productivity lead over Europe since the mid-1990s.

Inklaar and Timmer (2008) address specifically the issue of productivity growth in retail trade. As a starting point for their investigation, they refer to the occasional claim that the US productivity boom in the trade sectors was substantially overestimated. Through a rigorous accounting framework for retail trade, the authors find credible and robust evidence that the strong productivity growth in US retail trade has been genuine. Productivity growth in retail trade is known to draw on ICT investment and organisational change to facilitate productivity gains, but other factors such as economies of scale also matter. In this context, Foster *et al.* (2006) link the acceleration in US retail productivity to the spread of national chains and the inroads of “big box” retailing at the expense of traditional smaller stores. Specifically, virtually all of the labour productivity growth in the US retail sector is accounted for by more productive entering establishments displacing much less productive exiting establishments. The productivity gap between low-productivity exiting single-unit establishments and entering high-productivity establishments from large, national chains plays a disproportionate role in these dynamics.

For many European countries, investment in ICT and associated organisational change are about adopting best practice already in place elsewhere, rather than about home-grown innovation. Conway and Nicoletti (2006) investigate the impact that product market regulation has on the adaptation process. They focus explicitly on the split between ICT-intensive and other industries, and find that restrictive regulations that weaken competition have a direct negative influence on productivity growth in ICT-intensive (*i.e.* ICT-producing and ICT-using) sectors, while no such direct impact is detected in non-ICT sectors. They also find that restrictive regulations indirectly slow down productivity growth by curbing the speed of catching up with the productivity leader.

As outlined by Arnold *et al.* (2008), one channel through which product market regulation may affect productivity is via firm turnover. New firms may be better placed to reap the productivity gains from new technologies such as ICT. As we have hinted at before, the productivity benefits from ICT are linked to both organisational innovation and skill composition. Newcomers may have a comparative advantage in adopting new technologies and recruiting appropriately skilled staff, if the incumbents face adjustment costs from doing the same. Consistent with this view, Bartelsman *et al.* (2004) find that the entry of new firms plays a stronger role in boosting aggregate productivity in high-tech industries than in medium and low-tech industries.

Arnold *et al.* (2008) explore in some depth the link between product market regulation and productivity. On the basis of a wide set of evidence, they conclude that delayed regulatory reforms in a number of key ICT-intensive sectors was a major contributing factor behind the relative inability of EU countries to reap the productivity benefits generated by the positive ICT shock of the 1990s.

The authors also show a strong negative correlation between the level of regulation in selected ICT-intensive non-manufacturing sectors and the level of investment in ICT. Industries operating in a relatively liberal regulatory environment seem more inclined to incorporate ICT into the production process than industries operating in an environment of more restrictive product market regulation.

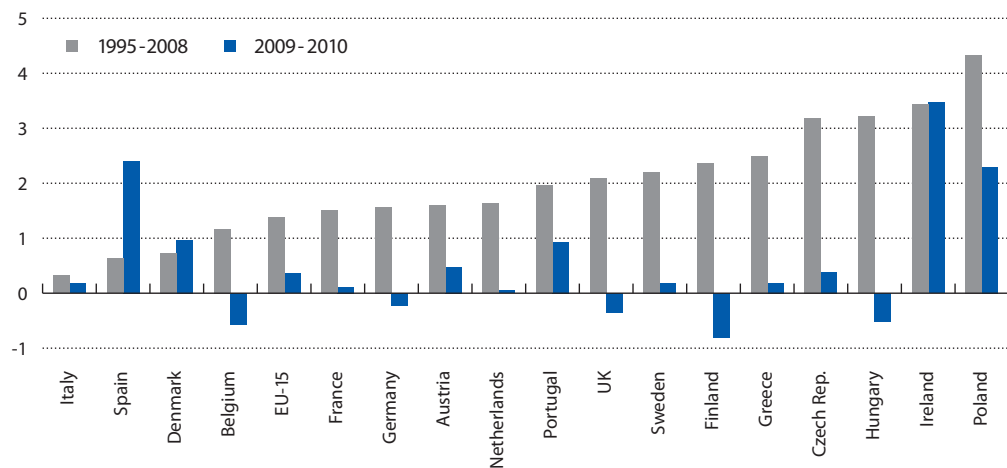
Delayed regulatory reforms in a number of service sectors contributed to the EU's relative inability in reaping productivity gains from the positive ICT shock of the 1990s.

8. EU productivity growth during the crisis

Up to now this paper has looked exclusively at longer-term growth prior to the financial crisis, using data up to 2008. Because of the depth of the financial and economic crisis, however, it is unavoidable that the outlook for growth – even in the longer term – will be affected by it. This brief section discusses a few key issues directly related to the crisis.

First, Figure 24 illustrates the short-term evolution of productivity growth (here more precisely measured as GDP per hour worked as we do not look far back in time). In a majority of EU countries, productivity growth fell sharply during the crisis. Closer scrutiny of output and hours worked data shows that this is the result of output falling relatively more steeply than employment during the crisis. In many countries, employment cuts were initially resisted by employers who wanted to retain access to their skilled labour, sometimes encouraged by government subsidies aimed at dampening unemployment. Interestingly, some countries with particularly severe recessions did not see productivity growth decline during the crisis. In Spain and Ireland, in particular, cutbacks in hours worked were sufficiently steep to sustain or even boost measured productivity growth. According to the European Commission forecast of November 2010, however, a delayed productivity slump was projected for 2011-2012, even as productivity was expected to recover in the EU as a whole.

Figure 24. Average annual growth in real GDP per hour worked (percent)



Source: European Commission Forecast Database (AMECO), autumn 2010

Cross-country comparison of growth prospects is misleading when based on short-term developments due to unsynchronised cyclical swings in output and employment.

These trajectories point to the difficulties of assessing long-term growth prospects on the basis of short-term movements in productivity. Unsynchronised short-term swings in output and employment distort the relationship between short-term and long-term growth in labour productivity. Beyond these short-term cyclical swings, the long-term growth potential of individual EU countries continues to be propelled by the underlying structural drivers discussed at length in this paper.

The crisis may, however, have a more profound impact on long-term growth in some countries. Specifically, in many countries, unsustainable asset price bubbles and borrowing fuelled domestic demand in the run-up to the crisis, leading to peaks in output and productivity growth. The failure to recognise the temporary nature of these developments led to overestimating the productivity potential in a number of sectors. If the ensuing debt overhang and substantial cost competitiveness problems in these countries lead to a persistent drop in the rate of growth in aggregate demand, productivity too may shift down to a slower growth trajectory. The strong productivity performance of Greece in the years leading up to the crisis looks particularly suspect in this context.

As suggested in a recent study by the European Commission (2010), restoring growth in Europe amidst the current imbalances would be easier if more structural flexibility was introduced, *i.e.* if existing nominal price and wage rigidities were removed. This would allow for a smoother reallocation of resources towards industries with a higher growth potential.

9. Concluding remarks

Drawing on the OECD's STAN database, this paper has provided a decomposition of value added, employment and labour productivity growth in the US and the EU, across major economic sectors, across EU countries, and across three time periods. Its main contribution lies in illustrating Europe's productivity slowdown since the mid-1990s. Concerns about the EU's relatively feeble productivity performance emerged towards the end of 1990s, following a remarkable acceleration of US productivity growth which Europe had failed to replicate. But if the main ambition of the resulting Lisbon strategy was to invigorate EU productivity growth in the decade that followed, it has for the most part not succeeded. During this period, the EU-15 saw productivity growth decline even further, even as the US extended its run from the dot-com years.

If the main ambition of the Lisbon strategy was to invigorate EU productivity growth, it has for the most part not succeeded.

One key observation is that the continuing US productivity lead has been relatively broad-based, originating in both manufacturing and market services. As demonstrated by the broader empirical literature, those EU-15 countries that have been able to replicate the US productivity performance (at least to some extent), typically also share with the US a broad set of growth-friendly structural and institutional characteristics, accompanied by higher levels of investment in ICT, and in human and intangible capital. Rather than drawing on the US as a benchmark for high productivity growth, trailing European countries can thus find several role models closer to home. As frequently stressed by academic researchers and international institutions, these European examples show that, putting in place the proper conditions for growth pays off.

The picture has been somewhat complicated by the outbreak of the financial and economic crisis at the end of 2008. Several of the strongest-performing countries of the past couple of decades (including the US, the UK, and Ireland) have been hard-hit by the crisis. They all experienced high financial sector growth in the years leading up to the crisis, boosted in part by financial bubbles that have since been deflated. We chose to limit the bulk of our analysis to the period before 2009, as it is still premature to assess the long-term growth consequences of the crisis. But one can nevertheless not avoid asking whether the pre-crisis growth patterns were distorted by the existence of financial bubbles and unsustainable debt-fuelled demand growth. Some of the strongest pre-crisis performers will not likely sustain their high growth in coming years. Be that as it may, the sectoral distribution of high productivity growth has been sufficiently broad-based to suggest that the financial bubble was not the main driver of past productivity gains.

Perhaps a more constructive way to frame the issue going forward is to focus on the causes of underperformance among trailing countries rather than on the precise extent and nature of the leaders' outperformance. Even if some of the past gloss will eventually fade on the likes of the US and the UK, there is still enough evidence that the impediments to efficiency gains and innovation in a number of European countries are causing them to fall dangerously behind. Specifically, many EU countries have been too slow in implementing competition-friendly product market reforms. These remain essential in unleashing innovative and fast-expanding market services capable of taking over from stagnant or retreating traditional manufacturing as an engine of long-term growth.

Annex 1: The OECD STAN database for Structural Analysis

OECD Industry classification	Sectoral aggregates in this paper
CTOTAL TOTAL	All sectors
C01T05 AGRICULTURE, HUNTING, FORESTRY AND FISHING	Agriculture and mining
C10T14 MINING AND QUARRYING	
C15T37 MANUFACTURING	Manufacturing, total
C15T16 Food products, beverages and tobacco	1. Food, textiles, wood and paper products (Sector 1)
C17T19 Textiles, textile products, leather and footwear	
C20 Wood and products of wood and cork	
C21T22 Pulp, paper, paper products, printing and publishing	
C23T25 Chemical, rubber, plastics and fuel products	2. Chemicals, fuel and metal products (Sector 2)
C26 Other non-metallic mineral products	
C27T28 Basic metals and fabricated metal products	
C29T33 Machinery and equipment	3. Non-transport equipment and other (Sector 3)
C36T37 Manufacturing n.e.c. and recycling	
C34T35 Transport equipment	4. Transport equipment (Sector 4)
C40T41 ELECTRICITY GAS AND, WATER SUPPLY	Utilities
C45 CONSTRUCTION	Construction
C50T74 BUSINESS SECTOR SERVICES	Market services
C50T55 WHOLESALE AND RETAIL TRADE - RESTAURANTS AND HOTELS	1. Trade and tourism
C60T64 TRANSPORT, STORAGE AND COMMUNICATIONS	2. Transport and communications
C65T74 FINANCE, INSURANCE, REAL ESTATE AND BUSINESS SERVICES	3. Finance and business services
C75T99 COMMUNITY, SOCIAL AND PERSONAL SERVICES	Social services
C50T99 TOTAL SERVICES	Total services

Annex 2: Breakdown of real value-added growth (RVA) into productivity and employment growth

Average annual growth rates, percent

		Total business sector			Manufacturing			Utilities			Construction			Market Services		
		RVA	Prod.	Emp.	RVA	Prod.	Emp.	RVA	Prod.	Emp.	RVA	Prod.	Emp.	RVA	Prod.	Emp.
US	1980-1995	3.0	1.4	1.6	3.2	3.8	-0.6	3.8	3.7	0.0	1.1	-0.2	1.3	3.4	1.0	2.4
	1995-2008	2.9	1.9	1.0	3.3	5.1	-1.8	0.6	1.9	-1.3	-0.1	-2.2	2.1	3.8	2.4	1.4
	1995-2001	3.8	2.1	1.6	3.6	4.2	-0.6	-1.5	0.2	-1.6	2.9	-0.7	3.6	5.3	3.0	2.3
	2001-2008	2.2	1.7	0.5	3.0	6.0	-2.8	2.3	3.4	-1.0	-2.7	-3.5	0.8	2.5	1.9	0.6
Japan	1980-1995	3.2	2.3	0.9	3.2	3.1	0.1	2.9	1.8	1.1	0.8	-0.2	1.0	4.3	2.5	1.8
	1995-2006	1.2	1.6	-0.3	1.7	3.7	-1.9	2.4	2.9	-0.4	-2.1	-0.1	-2.0	1.4	1.1	0.2
	1995-2001	0.9	1.4	-0.5	0.0	2.2	-2.1	2.7	2.5	0.2	-2.4	-0.6	-1.8	1.5	1.2	0.4
	2001-2006	1.6	1.8	-0.2	3.8	5.6	-1.7	2.1	3.3	-1.2	-1.9	0.4	-2.2	1.2	1.1	0.1
EU-15	1980-1995	2.2	1.8	0.4	1.4	3.1	-1.7	2.7	3.4	-0.6	0.7	1.3	-0.6	3.0	1.4	1.6
	1995-2008	2.2	1.0	1.2	1.5	2.3	-0.8	2.2	3.4	-1.1	0.8	-0.1	0.9	3.1	1.0	2.1
	1995-2001	2.7	1.2	1.5	2.3	2.4	-0.1	2.7	4.9	-2.1	0.7	0.1	0.6	3.7	0.9	2.8
	2001-2008	1.8	0.9	0.9	0.8	2.2	-1.4	1.8	2.2	-0.3	0.8	-0.3	1.2	2.5	1.0	1.5
UK	1980-1995	2.4	2.2	0.2	1.4	4.2	-2.7	2.5	6.6	-3.9	2.3	2.6	-0.4	3.2	1.8	1.4
	1995-2008	2.8	1.8	0.9	0.3	3.1	-2.7	1.6	3.4	-1.8	2.2	0.5	1.7	4.5	2.9	1.6
	1995-2001	3.3	2.1	1.2	0.8	2.3	-1.5	3.0	5.8	-2.7	1.8	1.1	0.7	5.5	3.2	2.2
	2001-2008	2.3	1.6	0.8	-0.1	3.8	-3.8	0.4	1.5	-1.0	2.5	0.0	2.5	3.7	2.7	1.0
France	1980-1995	2.0	1.9	0.1	0.7	2.9	-2.1	4.9	4.4	0.5	0.4	2.4	-2.0	2.6	1.4	1.2
	1995-2008	2.1	1.1	1.0	1.5	2.8	-1.2	2.8	3.2	-0.4	0.9	-0.8	1.7	2.9	1.0	1.8
	1995-2001	2.6	1.1	1.5	3.0	3.2	-0.3	3.8	3.4	0.4	0.4	0.0	0.4	3.5	0.7	2.8
	2001-2008	1.7	1.0	0.6	0.3	2.5	-2.1	1.9	3.1	-1.1	1.3	-1.5	2.8	2.4	1.3	1.0
Germany	1980-1995	2.3	1.6	0.7	0.8	2.2	-1.4	1.9	2.2	-0.3	0.2	-0.3	0.6	3.7	1.7	2.0
	1995-2008	1.7	1.2	0.5	1.8	2.6	-0.7	2.2	4.4	-2.0	-3.0	-0.1	-2.9	2.5	0.8	1.7
	1995-2001	2.1	1.3	0.7	2.1	2.7	-0.6	2.5	6.0	-3.4	-3.4	0.2	-3.6	3.1	0.6	2.4
	2001-2008	1.5	1.1	0.3	1.5	2.4	-0.9	2.0	2.9	-0.9	-2.7	-0.3	-2.4	2.0	1.0	1.0
Italy	1980-1995	2.1	1.9	0.1	2.0	3.4	-1.4	1.8	1.4	0.4	-0.1	0.8	-1.0	2.6	0.8	1.8
	1995-2008	1.2	0.1	1.1	0.2	0.2	-0.1	1.7	3.5	-1.7	1.4	-0.7	2.1	1.7	-0.4	2.1
	1995-2001	1.8	0.6	1.2	0.9	1.2	-0.2	0.6	3.4	-2.8	1.8	-0.1	1.9	2.5	-0.2	2.7
	2001-2008	0.7	-0.4	1.1	-0.4	-0.5	0.1	2.8	3.6	-0.9	1.2	-1.2	2.3	1.0	-0.6	1.7

		Total business sector			Manufacturing			Utilities			Construction			Market Services		
		RVA	Prod.	Emp.	RVA	Prod.	Emp.	RVA	Prod.	Emp.	RVA	Prod.	Emp.	RVA	Prod.	Emp.
Netherlands	1980-1995	2.3	1.0	1.3	2.3	3.0	-0.7	1.6	2.1	-0.5	0.1	1.2	-1.1	3.6	1.0	2.6
	1995-2008	2.7	1.2	1.5	2.0	2.8	-0.7	2.0	3.4	-1.3	1.5	0.3	1.2	3.9	1.6	2.3
	1995-2001	3.6	1.1	2.5	2.7	2.7	0.0	0.2	3.0	-2.7	2.5	-0.3	2.8	5.4	1.6	3.8
	2001-2008	2.0	1.3	0.8	1.5	2.8	-1.4	3.6	3.8	-0.2	0.6	0.8	-0.2	2.7	1.6	1.0
Belgium	1980-1995	1.9	1.9	0.0	2.1	4.1	-2.0	1.9	3.4	-1.4	-0.1	0.9	-1.0	2.4	1.6	0.8
	1995-2008	2.1	1.0	1.1	1.6	2.8	-1.1	1.9	2.4	-0.5	2.1	1.3	0.8	2.7	0.9	1.8
	1995-2001	2.4	1.2	1.2	2.6	3.0	-0.4	3.7	4.6	-0.9	1.8	1.1	0.6	2.6	0.6	2.0
	2001-2008	1.9	0.9	1.0	0.7	2.5	-1.7	0.3	0.4	-0.2	2.4	1.5	0.9	2.7	1.1	1.5
Austria	1980-1995	2.2	1.9	0.4	2.4	4.0	-1.5	2.7	2.3	0.4	1.6	1.4	0.2	2.9	1.5	1.3
	1995-2008	2.6	1.5	1.0	3.6	3.8	-0.2	2.9	3.7	-0.7	0.7	0.8	-0.1	3.2	1.0	2.1
	1995-2001	2.6	1.5	1.1	3.3	3.7	-0.4	6.0	7.3	-1.2	-0.1	0.5	-0.6	3.6	1.0	2.6
	2001-2008	2.6	1.5	1.0	3.9	3.9	0.0	0.3	0.6	-0.3	1.4	1.0	0.4	2.8	1.1	1.7
Sweden	1980-1995	1.9	2.2	-0.2	2.6	4.4	-1.7	3.0	3.7	-0.7	0.3	2.3	-1.9	2.5	1.6	0.9
	1995-2008	3.0	2.2	0.8	5.4	6.0	-0.6	0.1	-0.3	0.4	1.8	-0.6	2.5	3.4	1.5	1.9
	1995-2001	3.3	2.2	1.0	6.0	5.6	0.4	0.5	1.6	-1.1	1.6	-0.1	1.7	3.8	1.1	2.6
	2001-2008	2.8	2.2	0.6	4.8	6.4	-1.5	-0.2	-1.8	1.7	2.0	-1.0	3.1	3.1	1.9	1.2
Finland	1980-1995	1.9	2.8	-0.9	2.8	5.1	-2.2	2.9	4.9	-1.9	-2.0	0.7	-2.7	2.5	2.7	-0.2
	1995-2008	3.6	2.0	1.6	6.6	6.2	0.4	1.6	3.5	-1.9	3.0	-0.7	3.8	3.7	1.0	2.6
	1995-2001	4.5	2.3	2.1	8.0	6.0	1.9	3.0	5.3	-2.2	2.3	-2.0	4.4	4.7	1.4	3.3
	2001-2008	2.9	1.7	1.2	5.4	6.3	-0.9	0.4	2.0	-1.6	3.6	0.3	3.2	2.8	0.7	2.1
Denmark	1980-1995	2.3	2.2	0.1	1.4	1.9	-0.6	5.9	4.6	1.3	-0.3	1.3	-1.6	2.8	2.2	0.6
	1995-2008	1.8	0.8	1.0	0.9	2.3	-1.3	0.3	1.5	-1.2	1.5	-0.7	2.2	2.9	0.7	2.2
	1995-2001	2.5	1.3	1.2	1.4	2.4	-1.0	1.4	5.1	-3.5	1.9	-0.3	2.2	3.7	1.2	2.4
	2001-2008	1.2	0.3	0.8	0.5	2.2	-1.7	-0.7	-1.5	0.9	1.1	-1.0	2.2	2.3	0.3	2.0
Spain	1980-1995	2.3	1.7	0.6	1.6	2.7	-1.0	2.6	2.1	0.6	2.1	1.7	0.4	2.3	0.6	1.7
	1995-2008	3.4	0.2	3.2	2.2	0.4	1.8	4.3	2.9	1.3	4.6	-0.1	4.7	3.7	-0.5	4.2
	1995-2001	3.9	0.1	3.8	4.2	0.5	3.7	5.2	6.5	-1.2	5.5	-1.1	6.7	3.8	-0.5	4.3
	2001-2008	3.0	0.2	2.8	0.4	0.3	0.1	3.5	0.0	3.5	3.8	0.8	3.0	3.6	-0.6	4.2
Greece	1995-2008	3.6	2.6	1.0	3.4	3.6	-0.2	3.0	4.1	-1.0	0.9	-1.7	2.6	4.7	2.8	1.9
	1995-2001	3.2	2.7	0.5	2.1	2.1	0.0	4.0	5.1	-1.0	7.5	5.4	2.0	4.1	2.5	1.6
	2001-2008	4.0	2.5	1.4	4.6	5.0	-0.4	2.1	3.2	-1.0	-4.4	-7.3	3.1	5.2	3.0	2.1
Portugal	1980-1995	2.6	2.7	0.0	1.3	2.1	-0.8	4.6	5.1	-0.5	1.3	2.2	-0.9	3.4	1.9	1.5
	1995-2006	2.3	1.2	1.1	1.8	2.7	-0.9	4.9	8.0	-2.9	0.5	-1.5	2.0	3.2	0.7	2.4
	1995-2001	3.5	1.4	2.1	3.6	3.5	0.1	5.7	8.6	-2.7	4.3	-0.9	5.3	4.4	1.4	3.0
	2001-2006	0.8	0.8	0.0	-0.3	1.9	-2.1	3.9	7.2	-3.1	-3.9	-2.2	-1.7	1.7	0.0	1.7
Ireland	1995-2007	7.0	2.6	4.2	7.0	6.1	0.8	n.a.	n.a.	-0.3	8.0	-1.3	9.4	8.5	2.6	5.7
	1995-2001	8.7	3.3	5.3	10.4	7.0	3.2	n.a.	n.a.	0.6	10.3	-1.0	11.4	10.7	2.4	8.1
	2001-2007	5.3	2.0	3.2	3.6	5.3	-1.6	n.a.	n.a.	-1.2	5.8	-1.6	7.4	6.3	2.7	3.5
NMS	1995-2008	4.2	3.6	0.5	7.4	7.5	-0.1	-0.4	1.9	-2.3	2.8	1.4	1.4	4.6	2.5	2.1
	1995-2001	3.7	3.9	-0.2	6.1	7.6	-1.3	-1.8	0.2	-2.0	1.9	2.6	-0.6	4.6	3.0	1.6
	2001-2008	4.5	3.3	1.1	8.6	7.5	0.9	1.0	3.6	-2.5	3.6	0.5	3.1	4.6	2.1	2.5
Poland	1995-2008	4.4	3.7	0.7	8.0	8.2	-0.1	0.8	2.6	-1.8	3.4	2.1	1.3	5.1	2.6	2.4
	1995-2001	4.4	4.7	-0.3	6.6	9.5	-2.7	1.6	3.5	-1.8	2.9	4.0	-1.1	5.7	4.0	1.6
	2001-2008	4.4	2.9	1.5	9.3	7.0	2.1	0.0	1.9	-1.8	3.9	0.6	3.3	4.5	1.5	3.0
Czech Rep.	1995-2008	3.2	3.0	0.2	6.6	6.4	0.2	-0.3	2.3	-2.6	-0.9	-0.3	-0.5	3.8	2.8	1.0
	1995-2001	1.5	2.1	-0.6	4.4	4.4	-0.1	-4.5	-2.0	-2.5	-4.5	-1.3	-3.2	2.7	2.2	0.5
	2001-2008	4.7	3.8	0.9	8.6	8.1	0.5	3.4	6.2	-2.6	2.4	0.5	1.8	4.8	3.2	1.5
Slovak Rep.	1995-2008	5.2	4.7	0.5	9.5	10.0	-0.4	-3.7	-2.1	-1.6	4.9	3.2	1.7	4.1	0.9	3.2
	1995-2001	3.6	4.2	-0.6	5.3	7.2	-1.7	-15.2	-15.5	0.3	2.3	4.6	-2.3	2.8	0.0	2.8
	2001-2008	6.5	5.1	1.4	13.3	12.4	0.7	7.3	11.0	-3.3	7.2	1.9	5.2	5.3	1.6	3.6
Hungary	1995-2008	3.6	3.1	0.5	5.9	5.8	0.1	-3.3	0.6	-3.9	2.9	0.3	2.6	4.0	2.0	1.9
	1995-2001	4.1	3.0	1.1	7.1	5.0	2.0	-3.2	-0.1	-3.1	5.4	1.9	3.5	4.2	1.4	2.7
	2001-2008	3.2	3.2	0.0	4.9	6.5	-1.5	-3.4	1.3	-4.6	0.7	-1.1	1.9	3.8	2.5	1.3
Slovenia	1995-2008	4.4	3.8	0.6	5.1	6.6	-1.4	3.0	3.8	-0.8	5.8	2.2	3.5	4.6	2.4	2.2
	1995-2001	4.1	4.2	-0.2	5.3	7.1	-1.7	0.7	2.6	-1.9	4.4	1.7	2.6	4.0	3.0	1.0
	2001-2008	4.6	3.4	1.2	4.9	6.2	-1.2	5.0	4.9	0.1	7.0	2.6	4.3	5.1	1.8	3.3
Estonia	1995-2008	6.5	6.2	0.3	8.0	9.1	-1.0	-0.3	4.0	-4.1	8.4	1.7	6.7	7.7	6.3	1.3
	1995-2001	6.8	8.4	-1.5	8.8	11.7	-2.7	-3.7	1.2	-4.9	7.3	5.0	2.2	8.5	8.4	0.1
	2001-2008	6.3	4.4	1.8	7.4	6.9	0.5	2.7	6.4	-3.5	9.5	-1.1	10.7	7.1	4.6	2.4

Source: OECD STAN Database

Note: EU-15 includes Austria, Belgium, Finland, France, Germany, the Netherlands, Spain, Sweden and the UK. It excludes Ireland, Luxembourg, Portugal and Greece for data availability reasons. NMS includes Poland, the Czech Republic, Hungary, Slovakia, Slovenia and Estonia. It excludes Bulgaria, Cyprus, Latvia, Lithuania, Malta and Romania for data availability reasons.

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ABSTRACT

This paper provides an update of the paper «From R&D to Productivity Growth: Do the Institutional Settings and the Source of Funds of R&D Matter?» (Guellec and van Pottelsberghe 2004). We present estimates of the long-term impact of various sources of knowledge (R&D performed by the business sector, the public sector (higher education and government) and abroad) on the multifactor productivity growth of 17 major OECD countries from 1988 to 2006. The results confirm that business R&D and the R&D performed by the higher education sector significantly contribute to growth. In addition, the extent to which countries rely on triadic patents, as well as their degree of patent friendliness (enforcement mechanism and number of restrictions) affect significantly the extent to which R&D contributes to growth.

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Determinants of productivity growth: Science and technology policies and the contribution of R&D

1. Introduction

The extent to which research and development (R&D) contributes to growth has been increasingly investigated over the past twenty years. Studies at the aggregate level have regularly enriched the empirical approach, by adding new data (longer time periods or more countries), relying on improved panel data models, or introducing new variables such as the level of education or competition policy amongst the explanatory variables. This paper presents an extension of Guellec and van Pottelsberghe's paper «From R&D to Productivity Growth: Do the Institutional Settings and the Source of Funds of R&D Matter?» (GP 2004).

The paper essentially aims at estimating the long-term impact of several sources of knowledge generation on the multifactor productivity growth of 17 major OECD countries from 1988 to 2006. The sources of knowledge are the R&D performed by the business sector, by public labs, by the higher education sector and by foreign institutions. A panel dynamic OLS (DOLS) methodology is used for the econometric analysis. Several science and technology (S&T) policies are used to test whether the return to R&D activities varies across countries. The policies include the socio economic objectives of government support (civilian *versus* defence), the patent policy design related to enforcement provisions and restriction mechanisms, and the extent to which countries file triadic patents.

The results can be summarized as follows. They first confirm that Business R&D, foreign R&D and higher education R&D significantly contribute to growth. These impacts vary across countries according to their S&T policies and the extent to which high value patents are filed. Defence-related support to public R&D reduces the impact of research activities on growth. Policies that increase the power of patent holders (through easier enforcement mechanisms and through reduced provisions for loss of rights) have a negative impact on the return to business R&D at the country level. By contrast, the more high-quality patents a country's industrial sector holds, the higher is the return to its R&D activities.

2. The model and the data

The model aims at estimating the contribution of technical change to productivity growth. The following system of equations is generally referred to in order to evaluate the contribution of research to output growth:

$$\begin{aligned} Y &= MFP \cdot F(L, K) \\ MFP &= G(R, O) \\ R_t &= \sum w_h I_{t-h}^R \end{aligned}$$

where Y is the output, L and K are measures of labour and capital inputs, respectively, and MFP the current state of technology (multi-factor productivity), R the measure of accumulated R&D capital (as a proxy for the knowledge stocks generated by domestic firms, public research institutions and foreign institutions), O stands for the other forces affecting productivity (among which disembodied technical change), I^R measures the gross R&D expenditures in period t , and w_h connects the level of past R&D expenditures to the current state of knowledge.

For estimation purposes, the structure of the production function for country i is generally of the Cobb-Douglas type, which has a useful log-additive form, and O is approximated by an exponential trend (t):



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$$(1) \quad Y_i = \exp(\phi_i \cdot t + u_i) L_i^{\alpha_1} K_i^{\alpha_2} R_i^{\beta} \quad i = 1, \dots, n$$

where u is a random term, ϕ is the rate of disembodied technical change and α_1 , α_2 and β are the output elasticities of labour, capital and the R&D capital stock, respectively.¹ The estimation of these parameters may be carried out by taking the natural logarithm (L) of equation (1), as follows:

$$(2) \quad \ln Y_i = \phi_i \cdot t + \alpha_1 \cdot \ln L_i + \alpha_2 \cdot \ln K_i + \beta \cdot \ln R_i + u_i$$

It is common to derive an index of multi-factor productivity ($\ln MFP$) from equation (2):

$$(3) \quad \ln MFP_i \equiv \ln Y_i - \bar{\alpha}_1 \cdot \ln L_i - (1 - \bar{\alpha}_1) \cdot \ln K_i = \phi_i \cdot t + \beta \cdot \ln R_i + u_i$$

It requires the assumption of constant returns to scale with respect to labour and capital and payment of these traditional inputs (*i.e.* a perfect competition environment). In other words, the output elasticities with respect to labour (capital) are assumed to be equal to the labour (capital) cost share in total output and α_2 is equal to $(1 - \alpha_1)$.

Our model contains the most important sources of technical change: business R&D, higher-education R&D, government R&D and foreign R&D.

The most important sources of technical change are used in the model, namely, business R&D, foreign R&D, R&D performed in public labs and R&D performed in the higher education sector. A country specific deterministic time trend is included in the model to proxy disembodied technical change. Making the time dimension explicit, the model becomes:

$$(4) \quad \ln MFP_{i,t} = \alpha_{0i} + \alpha_{1i} t + \dots + \alpha_{qi} t^q + \beta_i \cdot \ln BRD_{i,t} + \gamma_i \cdot \ln HERD_{i,t} + \delta_i \cdot \ln GOVRD_{i,t} + \varphi_i \cdot \ln FRD_{i,t} + \varepsilon_{i,t}$$

In the previous literature on innovation and growth (*e.g.* Coe and Helpman 1995; Coe *et al.* 2009; Kao *et al.* 1999; GP 2004), those variables are found to be non stationary and cointegrated. The problem with a regression including unit root variables is that OLS estimates could lead to spurious results. An additional problem is related to the endogeneity of the right-hand side variables in the production function (2), since producers most likely decide nearly simultaneously on the levels of outputs and inputs. Kao and Chiang (2001) find that an OLS estimator in a cointegrated regression “has a non-negligible bias in finite sample” due to the endogeneity of variables. GP (2004) estimate an error correction model to deal with this issue and Coe *et al.* (2009) and Kao *et al.* (1999) estimate panel fully modified OLS (FMOLS) and panel dynamic OLS models (DOLS).

This paper relies on the DOLS estimation methodology instead of FMOLS because according to Kao and Chiang (2001), the FMOLS estimator does not improve over the OLS estimator in general and the DOLS estimator may be more promising than the OLS or FMOLS estimators (following the Monte Carlo simulations in Kao and Chiang 2001) in estimating cointegrated panel regressions. Relying on DOLS for homogeneous panel, the following equations, adapted from equation (4), are estimated:

$$(5) \quad \ln MFP_{i,t} = \alpha_{0i} + \alpha_{1i} t + \dots + \alpha_{qi} t^q + \beta_i \cdot \ln BRD_{i,t} + \gamma_i \cdot \ln HERD_{i,t} + \delta_i \cdot \ln GOVRD_{i,t} + \varphi_i \cdot \ln FRD_{i,t} + \sum_{j=-q}^q \eta_{ij} \cdot \Delta x_{i,t+j} + u_{i,t}$$

$$\text{Where } \Delta x_{i,t} = \begin{pmatrix} \Delta \ln BRD_{i,t} \\ \Delta \ln HERD_{i,t} \\ \Delta \ln GOVRD_{i,t} \\ \Delta \ln FRD_{i,t} \end{pmatrix}$$

The variables (for country i and time t) are defined as follows: $\ln MFP$ is an index of multi-factor productivity. MFP growth is computed as the difference between the output’s rate of change and input’s rate of change. The series is derived from the OECD productivity database. The four main sources of knowledge are computed as follows.

¹ In equations (1), (2) and (3), time subscripts are left out for ease of notation.

BRD is the domestic business R&D capital stock. It has been computed using the perpetual inventory method from total intramural business R&D expenditures, in constant 2000 GDP prices and US purchasing power parities (PPPs). The depreciation rate is 15 percent (sensitivity analysis shows that the results of the regressions do not change significantly with the chosen depreciation rate). The main source for the underlying R&D expenditure data is OECD Main Science and Technology Indicators (MSTI).

The higher education R&D capital stock index is HERD. It has been computed using the perpetual inventory method from total intramural higher education expenditures on R&D, in constant 2000 GDP prices and US PPPs. The depreciation rate is 15 percent (again, sensitivity analysis shows that the results of the regressions do not change significantly with the chosen depreciation rate). The basic series is taken from OECD MSTI.

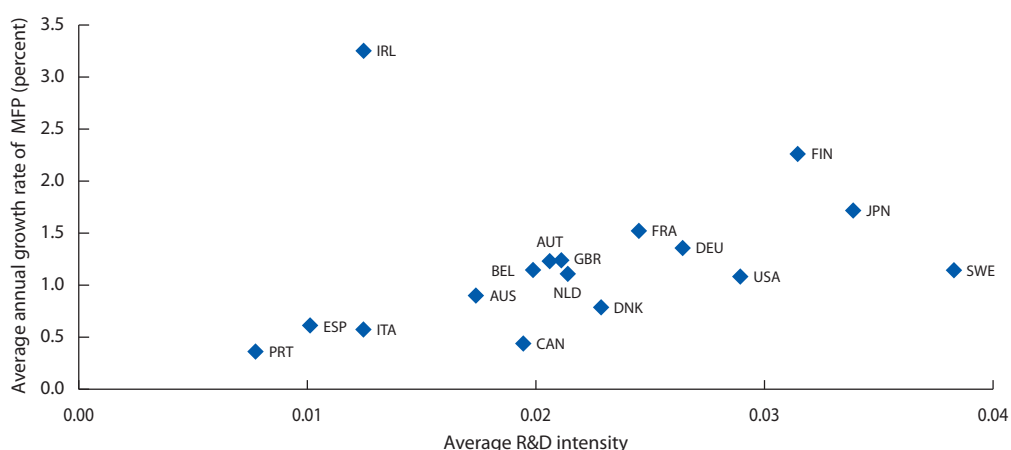
The government R&D capital stock index (GOVRD) has been computed using the perpetual inventory method from total intramural higher education expenditures on R&D, in constant 2000 GDP prices and US PPPs. The depreciation rate is 15 percent (again, sensitivity analysis shows that the results of the regressions do not change significantly with the chosen depreciation rate). The basic series is taken from OECD MSTI.

The foreign R&D capital stock index is denoted by FRD; it is the weighted sum of the domestic business R&D capital stocks of the 16 other countries of the panel. The weights correspond to the bilateral technological proximity between countries (this measure is similar to the one used by Jaffe 1988 and Park 1995). The second assumption is that a country will benefit more from foreign knowledge relating to the same technology fields it works on, than from knowledge in other fields. As we rely on an indicator of technological proximity, the stock of foreign R&D might be considered as a proxy to measure knowledge spillovers instead of rent spillovers (see Griliches 1992). However, it is very difficult to disentangle empirically rent spillovers from knowledge spillovers. Indeed, any measure of rent spillovers always incorporates to some extent knowledge spillovers, and *vice versa*.

The graphical relationship between multifactor productivity growth and business R&D is depicted in Figure 1. It clearly shows that countries with a higher average R&D-to-GDP ratio (R&D intensity) also enjoyed higher average MFP growth. However, the picture gets somewhat blurred when looking at yearly growth rates of MFP and business R&D. This is done in Figure 2. Besides a few outliers, this graph does not allow to draw clear conclusions, hence the need for an empirical model.

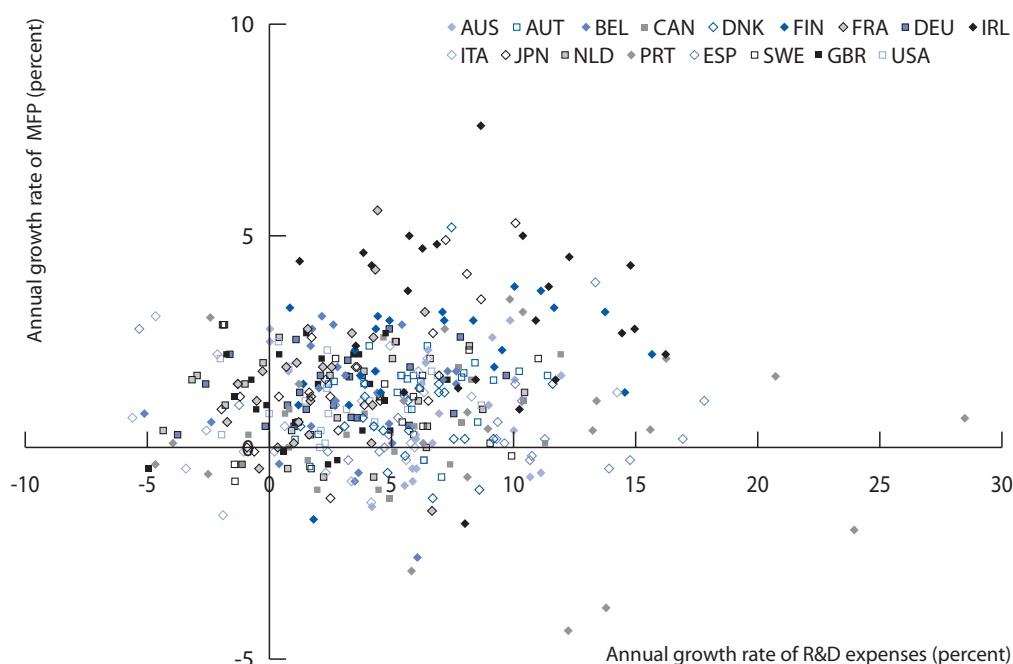
Over longer time periods, countries with higher average R&D intensity enjoy higher average MFP growth.

Figure 1. Average R&D intensity versus average growth rate of MFP (1984-2007)



The R&D-MFP nexus is less clear in year-on-year growth rates, hence the need for an empirical model.

Figure 2. Annual growth rate of R&D expenses versus annual growth rate of MFP (1984-2007)



3. Unit roots and cointegration tests

Before running DOLS estimates of equation (5), the non stationary of variables has to be tested as well as their cointegration rank. Two panel unit root tests have been performed: the one suggested by Hadri (2000) and the one by Im, Pesaran and Shin (IPS 2003). The cointegration of the variables with is investigated through the Pedroni (2004) panel cointegration test.

The Hadri (2000) test assumes that a panel data series is non stationary if the null hypothesis of stationarity is rejected or, in other words, the series is non stationary if a unit root is found for one or more countries (and not necessarily the same for each country). The IPS (2003) test assumes that a panel data series is stationary if the null hypothesis of non stationarity is rejected or, in other words, the series is stationary if at least one country has no unit root and all the other countries have a unit root and not necessarily the same for each country.

Table 1. Panel unit root tests

	IPS	Hadri
LnMFP	1.70	10.66***
LnGOVRD	1.09	9.67***
LnHERD	2.54	11.37***
LnBRD	4.57	11.72***
LnFRD	6.13	11.49***

Notes: Significance levels at the 10-, 5- and 1-percent levels for tests indicated by *, **, and ***, respectively. We reject the null hypothesis explained in the main text if the test statistic is significant.

For each variable, the IPS test does not reject the null hypothesis that the variable is non-stationary (see Table 1). The Hadri test rejects for each variable that the variable is stationary. It can therefore be concluded that the variables are non stationary with unit roots.

The Pedroni (2004) panel cointegration test considers two classes of statistics: the within dimension and the between dimension. For the within dimension, this panel cointegration test assumes, in its null hypothesis, that two or more panel data series are not cointegrated if a common unit root does

not exist for all countries of the panel. For the between-dimension, the test assumes, in its null hypothesis, that panel data series are not cointegrated, meaning that countries do not have a common unit root.

Table 2. Panel cointegration tests

Within-dimension		Between-dimension	
Panel rho-Statistic	2.85	Group rho-Statistic	4.44
Panel PP-Statistic	-6.11***	Group PP-Statistic	-11.27***
Panel ADF-Statistic	-5.41***	Group ADF-Statistic	-5.66***

Notes: Significance levels at the 10-, 5- and 1-percent levels for tests indicated by *, **, and ***, respectively. We reject the null hypothesis explained in the main text if the test statistic is significant.

The Pedroni cointegration test (see Table 2) suggests that the variables are cointegrated or in other words that there exists a linear combination of these variables with a stationary error term. Equation (5) can therefore be estimated with panel DOLS.

4. Estimation results

4.1 The direct effect of R&D performed by different types of institutions

The estimated parameters from equation (5) are presented in Table 3. The long term elasticity of MFP with respect to business R&D (BRD) is 0.14 (column 1), which is in line with the existing estimates in the literature, and very close to GP (2004) estimates. This parameter mainly captures domestic inter-firm and inter-industry spillovers, and the premium associated with business R&D activities (an “excess return” compared with the average return on regular investment).

Table 3. Estimation results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
LnBRD	0.14 2.09 (***)	0.16 3.02 (***)	0.16 2.80 (***)	0.14 2.83 (***)	0.15 3.05 (***)	0.06 1.09	0.15 2.91 (***)	0.04 0.57
LnHERD	0.11 2.85 (**)	0.12 2.23 (**)	0.12 2.24 (**)		0.11 2.19 (**)	0.14 2.75 (***)	0.10 2.07 (**)	0.10 2.01 (**)
LnGOVRD	-0.10 -1.59 (*)	-0.10 -1.68 (**)	-0.10 -1.74 (**)	-0.11 -2.08 (**)		-0.12 -2.17 (**)	-0.03 -0.67 (**)	-0.08 -1.37 (*)
LnFRD	0.08 1.36 (*)	0.08 1.39 (*)	0.08 1.41 (*)	0.08 1.43 (*)	0.06 1.03	0.08 1.45 (*)	0.10 1.91 (**)	0.06 1.07
(Share of public funding of BRD) x LnBRD		-0.32 -0.93						
(Share of public funding of BRD) x (Civil share) x LnBRD			-0.28 -0.64					
(Share of public funding of BRD) x (Defence share) x LnBRD			-0.18 -0.21					
(Defence share) x LnHERD				0.13 0.91				
(Civil share) x LnHERD				0.11 2.05 (**)				
(Defence share) x LnGOVRD					-0.39 -1.12			
(Civil share) x LnGOVRD					-0.06 -1.01			
(Triadic patents per researcher) x LnBRD						3.70 2.98 (***)		
(Enforcement) x LnBRD							-0.10 -2.20 (**)	
(Loss of rights) x LnBRD								0.22 2.78 (***)

Notes: *t*-statistics are indicated in italics and significance levels at the 10%, 5%, and 1% levels for tests are indicated by (*), (**), and (***), respectively. Country-specific intercepts are not reported but are available upon request.

The positive long-term business-R&D elasticity of MFP captures domestic spillovers and the ‘excess return’ on R&D compared to conventional investment.

The research performed in academia (HERD) has a high and positive and significant impact on long term growth. The impact of HERD is even higher than the impact of business R&D, thanks probably to a more pronounced propensity to invest in basic research in academia, which is known to generate more externalities for further research or the market sector. In addition, basic research is explicitly associated with a higher risk or uncertainty, which then leads to higher returns.

Yet, performing research activities does not seem to always directly contribute to economic growth, as suggested by the negative and significant parameters associated with the R&D capital stock of public labs (GOVRD). This negative elasticity can be explained by the fact that government-performed R&D is aimed at public missions with no or little effect on economic growth (environment, defence etc.).

The elasticity of multifactor productivity with respect to Foreign R&D (FRD) is positive and significant, but lower than existing estimates in the literature. Keeping in mind that foreign R&D is accessible at a lower cost than own business R&D (absorptive capability costs *versus* own R&D and absorptive capability costs), the impact can be considered as significant. In other words, for any country, the R&D projects implemented abroad also matter for the country's own productivity growth. This result confirms that the social return to R&D is higher than the private return to R&D.

4.2 The impact of S&T policies on the return to R&D

Each domestic source of knowledge is then interacted with other policy variables in order to test whether the estimated elasticities vary across countries. Column (2) investigates whether a negative premium is associated with the subsidization rate of business R&D. The idea is to test whether subsidies have a negative impact on firms' return to own business R&D. The negative but non-significant parameter suggests that this is not the case. And even if these subsidies are split according to the main objectives of government support, the conclusion does not change (see column 3). However, the socio-economic objective of government support seems to affect the effectiveness of academic research in contributing to economic growth. Whereas defence-related government support has no impact on the social return to academic (higher education) research, civilian objectives seem to improve the social rate of return to R&D.

Productivity effects of business R&D are greater in countries that rely more on high-quality patents and favour patent holders less.

Finally, intellectual property protection is taken into account in two different ways. First, the impact of the stock of business R&D is interacted with that of the number of triadic patents per researcher in a country. Triadic patents are patents filed simultaneously in three countries: the US Patent Office, the Japanese Patent Office and the European Patent Office, which induces high costs and witnesses a clear international strategy of the firm. The idea is to test whether higher-quality intellectual property boosts productivity more. The fixed term of the business R&D capital stock shrinks and ceases to be significant (column 6), but the interaction term is highly positive and significant, suggesting a strong complementarity between R&D and valuable patents.

An alternative method is to rely on the design of patent systems to assess their role on the effectiveness of R&D. Two patent design indicators are used. They are built by Ginarte and Park (1997) and Park (2008) for many countries and every five years. Two subcomponents are used: enforcement mechanisms and loss of rights provisions. The first one increases with the power given to patent holders to enforce their rights, whatever the validity of the patent. The second one increases with the number of provisions that allow reducing the rights of patent holders (*i.e.* compulsory licensing and other policies that are less patent-friendly). The estimated interaction terms show that the social return to R&D drops with patent-friendly policies (columns 7 and 8). In other words, the more a patent system favours patent holders, the smaller the return to R&D. This result is compatible with the triadic-patent numbers, which precisely capture a small number of high value patents that are potentially granted in many countries.

5. Conclusions and policy implications

The objective of this paper has been to provide an update of Guellec and van Pottelsberghe (2004). It presents estimates of the long-term impact of various sources of knowledge (R&D performed by the business sector, the public sector (higher education and government) and foreign sector) on the multifactor productivity growth of 17 major OECD countries over the period 1988-2006. A panel dynamic OLS methodology (Kao and Chiang 2001) is used to estimate the model that includes non-stationary and cointegrated variables.

The results confirm that business R&D and the R&D performed by the higher-education sector significantly contribute to growth. In addition, the extent to which countries rely on triadic patents, as well as their degree of patent friendliness (enforcement mechanism and number of restrictions) affect significantly the extent to which R&D contributes to growth. The more a country files triadic patents (assumed to be high-value patents), the higher is the output elasticity of business R&D. At the opposite, the more a country has a patent-friendly policy (improved enforcement mechanisms and few restrictions on patent holders), the smaller is the impact of business R&D on growth.

The policy implications are the following. First, doing R&D is important for productivity and economic growth; and governments should keep these types of activities as a prime target when designing sustainable policies. Second, public laboratories seem to have a small or negative impact, suggesting that their objective is not to contribute to growth but might have pervasive effects, at the opposite of higher-education research activities. The reason why public labs are less important for economic growth might be related to their weak reactivity to technological evolution, as opposed to university labs that are constantly evolving at the scientific edge. Third, subsidies to R&D do not seem to reduce the return to business R&D, suggesting that policies aiming at providing support to business R&D are working well. Fourth, government funding with civilian objectives (as opposed to defence-related objectives) seem to improve the impact of academic research on economic growth. Fifth, stimulating the filing of high value patents while at the same time adopting less patent-friendly policies (not-so-easy enforcement mechanism, and restrictions when needed) is a balance that policy makers must find in order to secure actual leverage of their intellectual property policies.

Governments should give a central role to R&D in designing sustainable growth policies.

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ABSTRACT

Is international production sharing associated with stronger competitiveness? We address this question from the complementary viewpoints of firms and industries. We show that international production sharing is indeed associated with stronger competitiveness not only at the firm level but also at the industry level. From the viewpoint of firms, stronger competitiveness gives access to a larger number of more complex options when it comes to the design of international operations. From the viewpoint of industries, stronger competitiveness arises from the possibility of reallocating resources from less to more productive firms. For both firms and industries stronger competitiveness arises from the possibility of exploiting a richer set of internationalization strategies to deal with the challenges and the opportunities of globalization.

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The role of international production sharing in EU productivity and competitiveness

1. Introduction

The ability of ‘growing out’ of the crisis is widely recognised nowadays as the only long-term viable option for the sustainability of the EU and its model of social market economy. The latter requires enhanced competitiveness at the EU level, which in turn would allow capturing growth currently taking place mainly in emerging markets.

Given the macroeconomic context, growth and competitiveness are thus strongly linked to the international performance of firms. Indeed, and more generally, a recent economic literature has increasingly underlined and shown empirically that aggregate industrial performance depends strongly on firm-level factors, such as size, organization, technological capacity, as well as on other conditions firms are confronted with in their specific environments, not least their ability to successfully operate on international markets. The punchline of this literature is that it is not countries that produce, sell and export but rather firms within countries, so competitiveness at the country level is determined by the aggregation of individual firms’ ability to compete successfully. It follows that the competitiveness of a country should be defined as the ability of its firms to mobilize and efficiently employ (also outside the country’s borders) the productive resources required to offer the goods and services in exchange for which other goods and services can be obtained, domestically or internationally, at favorable rates of substitution or terms of trade. In this sense, competitiveness is just “a poetic way of saying productivity” (Krugman 1997).

In this paper, we take this ‘bottom-up’ approach and discuss the ways through which international exposure and competitiveness interact both at the industry and at the firm level. In so doing, we capitalize on a dataset that has recently become available thanks to the EFIGE project coordinated by Bruegel and financed by the European Commission and UniCredit within the 7th Framework Program.¹ This dataset is unique in its kind in that it allows for a comparison of firms’ international activities, both across a rich set of internationalization activities and across key EU countries.

In particular, we assess the correlation patterns between the entire range of firms’ international activities (imports, exports, foreign direct investment (FDI), international outsourcing) in the biggest EU economies (France, Germany, Italy, Spain, UK) and their competitiveness measured as total factor productivity (TFP). We also assess the correlation patterns between the same range of international activities and alternative measures of firm-level competitiveness, namely labour productivity and unit labour costs. The latter measure is typically used as the basis for the analysis of competitiveness at the country level. Our analysis is made possible by the fact that the EU-EFIGE/Bruegel-UniCredit dataset can be matched with balance sheet information available from the Amadeus dataset of Bureau van Dijk. The aim is to check whether and to what extent firms involved in the various types of internationalization activities display higher levels of competitiveness compared with firms that are internationally inactive.

Based on aggregate information, we then calculate for each industry an ‘internationalisation intensity’ index and link it to the average productivity levels of its firms.² This allows us to see to what extent countries and industries that are more internationally exposed display higher levels of competitiveness as measured by the average productivity of their firms.

¹ For additional details and updates on the project, see www.efige.org.

² Throughout the paper, ‘industry’ refers to the manufacturing industries of the NACE Rev. 1 classification at two-digit level of aggregation. The terms ‘industry’ and ‘sector’ are used interchangeably.



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We find that international exposure is indeed positively correlated with competitiveness both at the firm and at the industry level. Moreover, competitiveness, when measured by TFP (as economic theory would suggest), is positively correlated with the complexity of firms' internationalization strategies. This is true also when competitiveness is measured by labour productivity whereas it holds to a lesser extent when competitiveness is measured in terms of unit labour costs. The reason is that labour productivity exhibits a strong positive correlation with TFP whereas the correlation between unit labour costs and TFP, though negative as expected, is much weaker. This casts a shadow on the soundness of using unit labour costs as the building block of competitiveness measures at the macro level.

The positive correlation between firm competitiveness and international activity reflects the presence of a positive productivity gap between internationalized firms and purely domestic ones. Higher complexity is associated with higher competitiveness precisely because more complex internationalization strategies entail higher costs. This gap hints at the existence of additional costs that internationalizing firms have to face and only firms that are productive enough can bear. At the same time, international competition has a cleansing effect on industries that forces less productive firms out of the market and reallocates their resources to more productive survivors. This effect may be stronger in expanding industries in which a country has a comparative advantage, thus establishing a dynamic link between international exposure and traditional sources of competitiveness.

We analyze the relationship between competitiveness and international exposure of firms and industries.

Turning to aggregate results, we investigate the correlation between the competitiveness of an industry, measured as the average productivity of its firms, and an index of international exposure, constructed for each industry as the ratio of the value of intermediate goods imported from abroad to the value of total output. We find evidence of a positive correlation in the simplest empirical specification. The correlation holds after controlling for country and industry-specific time invariant characteristics, provided that we also account for the dispersion of productivity across firms. We interpret this finding as showing that international exposure and industry competitiveness go hand in hand as long as there is enough room for reallocating resources from less to more productive firms.

The remainder of the paper is organized as follows. Section 2 provides a selective overview of the existing theoretical and empirical literature on the relation between internationalisation of production and firm- and industry-level costs and productivity. Section 3 presents the original firm-level dataset used for the analyses in the subsequent sections. Section 4 assesses the correlation patterns between the entire range of international activities of firms in the biggest EU economies and their productivity (measured as both labour productivity and TFP). It also discusses the correlation patterns between the range of international activities of firms in those EU economies and their unit labour costs accounting for the country and industry dimensions. Section 5 calculates for each industry an 'internationalisation intensity' index and investigates its relation with industry performance. Section 6 offers a summary of the main results of the paper and discusses their policy implications for the EU.

2. Literature review

This section presents a selective overview of the existing theoretical and empirical literature on the relation between the internationalisation of production and firm- and industry-level costs and productivity. In so doing, it draws on Behrens and Ottaviano (2011), Behrens *et al.* (2011) and Bernard *et al.* (2011).

Behrens *et al.* (2011) discuss the rapid development of 'New trade theory' (henceforth, NTT) since the late 1970s. Its aim was to explain the fact that a large share of world trade takes place between countries with relatively similar technologies and factor endowments (Grubel and Lloyd 1975). This phenomenon

was at odds with in the perfect-competition paradigm of traditional Ricardian and Heckscher-Ohlin trade theories, according to which trade is driven by cross-country differences rather than similarities. While NTT has proposed various theoretical solutions to that conundrum relying on imperfectly competitive market structures, two main strands of models have survived the test of time. In the wake of seminal work by Spence (1976) and Dixit and Stiglitz (1977), the first strand consists of models emphasizing monopolistic competition, firm-level scale economies, and product differentiation (Krugman 1979 and 1980; Lawrence and Spiller 1983). These models assume that, due to scale economies, each firm produces a single variety of a horizontally differentiated good in one location only. Trade takes place because consumers in each location 'love variety' and thus buy diversified consumption baskets. The second strand of NTT focuses on oligopolistic competition. It highlights the key role of firms' strategic interdependence in generating trade even in homogeneous goods between identical countries (Markusen 1981; Brander 1981; Brander and Krugman 1983). This happens because, when there are trade barriers, firms face a higher price elasticity of demand abroad, which makes it worthwhile to 'dump' their products into the export markets.

Unlike traditional Ricardian and Heckscher-Ohlin theories, NTT assigns centre stage to firms rather than industries. In so doing, it emphasizes a number of strategic decisions firms have to make. First of all, firms decide on prices, which explains why the early NTT literature has focused on the fundamental problem of market structure (Helpman and Krugman 1985). More recently, the interest of NTT has moved to two additional decisions: the location choice (Fujita *et al.* 1999; Baldwin *et al.* 2003) and the organizational choice of multinationals (Markusen 2002; Barba Navaretti and Venables 2004).

Key strategic choices by firms include: which price to set, where to locate production, and how to serve foreign markets.

Just like the conundrum of intra-industry trade ignited NTT in the 1970s, starting with the 1990s new empirical evidence has pushed the limit one step further. As discussed by Bernard *et al.* (2011), the focus of research in international trade has moved from industries and countries to firms and products as increasingly rich micro datasets emerged revealing great within-industry heterogeneity in firm characteristics and performance indicators. Theoretical models have risen to the challenge of explaining such heterogeneity, thereby unveiling new channels through which economies react to international openness.

A hallmark of recent analyses based on micro data is that only a very small fraction of firms are active in international markets and that international activity is highly correlated with exceptional economic performance. Internationally active firms are larger, more productive, more skill- and capital-intensive, and pay higher wages prior to their entry into international markets than non-trading firms. These facts suggest that some kind of self-selection is at work. The performance of internationalized firms is better not so much because they are active in international markets. Rather, better performing firms become active in international markets because they are better able to generate the resources needed to overcome the costs of internationalization. Mayer and Ottaviano (2007) provide an overview of these findings for a sample of European countries showing that internationalised firms are indeed "the happy few".

The practical importance of the implications of self-selection cannot be overstated. Theories that neglect firm heterogeneity highlight several sources of gains from trade: enhanced specialization according to comparative advantage; richer product variety; weaker firm market power; and enhanced exploitation of scale economies. Among these sources, only the last one points at a mechanism through which trade liberalization and an individual firm's efficiency can directly interact.

In his seminal contribution, Melitz (2003) shows that, if one considers that firms are heterogeneous, trade liberalization has an additional positive impact on aggregate productivity through the selection of the most productive firms. This is due to a combination of import competition and export market access.

International trade integration fosters aggregate productivity by suppressing the least productive firms and reallocating resources from less to more efficient firms.

Lower trade costs allow foreign producers to target the domestic markets, squeezing the operating profits of domestic firms in those markets whatever their productivities. At the same time, it also offers domestic firms the opportunity of gaining access to foreign markets and of earning additional profits from them. This opportunity, however, is open only to the firms that are productive enough to bear the additional costs of foreign operations arising from transportation, administrative duties, institutional and cultural barriers. As a result, the initially active domestic firms end up being partitioned into three groups. The least productive firms start making losses in their home markets without gaining access to foreign markets and have to exit. The most productive firms compensate lost profits on domestic sales with new profits on foreign sales. They are, therefore, able to survive and expand their market shares abroad. Firms with intermediate productivity also survive but are not productive enough to gain access to foreign markets. They are thus relegated to serving only domestic customers and their market shares shrink. In this framework, international trade integration suppresses the least productive firms and aggregate productivity rises thanks to the reallocation of productive resources from less to more efficient firms.

This mechanism has found supportive evidence in firm-level studies that try to pin down the direction of causation behind the positive correlation between a firm's export status and its productivity ("exceptional exporter performance" in the words of Bernard and Jensen 1999). This is of paramount importance for trade policy. Causation going from export status to firm performance would reveal the existence of 'learning by exporting', which in turn would call for export promotion. However, apart from specific cases typically confined to some developing countries, the bulk of the existing evidence supports the opposite direction of causation already discussed above and known as 'selection into export status': firms with better initial performance have a stronger propensity to export than those with lower initial performance (Tybout 2003).

Two additional effects are consistent with the theoretical arguments discussed above. For one, exposure to trade causes the exit of the least productive firms (Clerides *et al.* 1998; Bernard and Jensen 1999; Aw *et al.* 2000). For another, trade liberalization also causes market share reallocations towards the most productive firms (Pavcnik 2002; Bernard *et al.* 2006). For both reasons, aggregate productivity rises in the liberalizing countries. Another source of aggregate productivity growth following trade liberalization is productivity improvements within plants or firms (Pavcnik 2002; Trefler 2004). Improved plant or firm productivity may be the outcome of reallocations across heterogeneous economic activities within plants or firms. These reallocations operate much like those across heterogeneous firms of an industry.³

In the last few years a burgeoning empirical literature has confirmed and enriched those early results while much of the theoretical research has informed the new empirical findings by extending the basic model of selection put forth by Melitz (2003). Studies have explored various issues. Among them, the self-selection of multinationals (Helpman *et al.* 2004), the interaction between comparative advantage and firm heterogeneity (Bernard *et al.* 2007), variable mark-ups and market size (Melitz and Ottaviano 2008), country asymmetries (Arkolakis *et al.* 2008), multi-product firms (Bernard *et al.* 2011; Eckel and Neary 2010; Mayer *et al.* 2011), the decision whether to organize production activities within or beyond the boundaries of the firm (Antràs and Helpman 2004 and 2008), managerial hierarchies within firms (Caliendo and Rossi-Hansberg 2011), labour market frictions (Amiti and Davis 2011; Egger and Kreickemeier 2009; Helpman and Itzhoki 2010; Helpman *et al.* 2011), financial constraints (Chaney 2005; Manova 2011), product market regulation and unemployment (Felbermayr and Prat 2011).

³ Productivity within plants and firms improves because trade liberalization makes competition tougher, forcing firms to rationalize their product lines and innovate. These effects of international competition are consistent with the overall finding that trade liberalization fosters selection. They are distinct from the kind of 'learning-by-exporting' effects that have been so hard to identify in the data.

Our unique firm-level dataset includes close to 15,000 firms from seven EU countries.

As pointed out by Bernard *et al.* (2011), a general issue that remains ahead is further consideration of the relationship between findings from disaggregated data and the economy's aggregate response to trade. The present paper contributes to this line of research by investigating the relation between the international exposure of an industry in a given country and the distribution of the productivity of its firms, thus combining the traditional industry-level view with the new firm-level view of internationalization.

3. The EU-EFIGE/Bruegel-UniCredit dataset

Our analysis is based on the EU-EFIGE/Bruegel-UniCredit dataset, a unique firm-level dataset collected within the project EFIGE - European Firms in a Global Economy: internal policies for external competitiveness - supported by the Directorate General Research of the European Commission through its 7th Framework Programme. The dataset has been constructed in order to obtain representative samples of manufacturing firms across European countries. In particular the dataset includes around 3,000 firms for Germany, France, Italy and Spain, more than 2,200 firms for the UK, and some 500 firms for Austria and Hungary (Table 1). Firms with less than 10 employees have been excluded from the survey. As a result, internationally active firms should be over-represented in our sample compared with the actual distribution of firms in a country, typically characterized by a large number of relatively small, domestically-oriented firms. Tables A1 and A2 in the Annex provide the distribution of the sample by industry and size class for each country.⁴

Variables of interest have been collected for each firm through a survey questionnaire. In particular, the questionnaire contains both qualitative and quantitative data on firms' characteristics and activities, for a total of around 150 different variables split into six different sections: Proprietary structure of the firm; Structure of the workforce; Investment, technological innovation and R&D; Internationalization; Finance; Market and pricing. All questions mainly concern the year 2008, with some questions asking information for 2009 and for earlier years in order to have a picture of the effects of the crisis as well as the dynamic evolution of firms' activities.⁵

Table 1. The EU-EFIGE/Bruegel-UniCredit dataset by country

Country	Number of firms
Austria	443
France	2,973
Germany	2,935
Hungary	488
Italy	3,021
Spain	2,832
UK	2,067
Total	14,759

Source: EFIGE Survey dataset

Note: Industry codes are not available for 316 firms.

⁴ The representativeness of the sample with respect to the actual population of firms is discussed in Barba Navaretti *et al.* (2011). The sampling design has been structured following a stratification by industry and firm size, with an oversampling of large firms. Throughout the analysis, we have applied a weighting procedure in order to guarantee the representativeness of our results.

⁵ The questionnaire has been administered between January and April 2010 via either CATI (Computer-assisted telephone interview) or CAWI (Computer-assisted web interview) procedures. The complete questionnaire is available on the EFIGE web page, see www.efige.org. A discussion of the dataset as well as preliminary evidence on the internationalization modalities of firms is available in the second EFIGE Policy Report by Barba Navaretti *et al.* (2011). The third EFIGE Policy Report (Békés *et al.* 2011) discusses explicitly the reaction of firms to the crisis.

An interesting characteristic of the EU-EFIGE/Bruegel-UniCredit dataset is that, on top of the unique and extensive cross-country firm information contained in the survey, data can be matched with balance sheet information. In particular, the EFIGE data have been integrated with balance sheet data drawn from the Amadeus database managed by Bureau van Dijk, retrieving nine years of usable balance sheet information for each surveyed firm, from 2001 to 2009. These data can be used to further improve on the characterization of firms included in the survey, in particular by enabling the calculation of firm-specific measures of productivity.

We distinguish different types of international activities such as exporting, importing, international outsourcing and FDI.

Given the aim of this paper, the EFIGE data can be used to identify and compare firms across countries in terms of their different modes of internationalization. In particular, we have classified firms along seven, non-mutually-exclusive, internationalization categories, using the following information from the survey. Firms are considered exporters if they reply “yes, directly from the home country” to a question asking whether the firm has sold abroad some or all of its own products / services in 2008.⁶ Concerning imports, we follow the same procedure, distinguishing between materials and service imports. With respect to FDI and international outsourcing, we have exploited a question asking whether firms were running at least part of their production activity in another country: firms replying “yes, through direct investment (i.e. foreign affiliates/controlled firms)” are considered as undertaking FDI, while firms replying “yes, through contracts and arm’s length agreements with local firms” are considered as pursuing an active international outsourcing strategy.⁷ We have then looked at firms involved in international value chains, although not actively pursuing an internationalization strategy, through a question asking whether part of the firm’s turnover was made up by sales produced according to a specific order coming from a customer (produced-to-order goods): firms replying positively, and indicating that their main customers for the production-to-order activity are other firms located abroad, are considered as pursuing a passive outsourcing strategy. Hence, a passive outsourcer is the counterpart of an active outsourcer in an arm’s length transaction. Finally, thanks to a question that allows identifying the main geographical areas of the exporting activity, we have identified ‘global exporters’, i.e. firms that export to countries outside the EU.

Table 2 provides some descriptive statistics for the seven categories of firms active abroad as well as for the residual category of local firms not active abroad. Figures A1 and A2 in the Annex provide additional information on the various international activities of firms across countries, displaying the average share of firms in each category (extensive margin), and how much each international activity represents, on average, as a percentage of firms’ total turnover (intensive margin). Table A3 in the Annex summarizes the relevant questions in the EFIGE survey associated with each internationalization category as well as the data used in the analysis.

As can be seen, we can identify a clear ranking of firm characteristics with respect to the degree of involvement in international activities, in line with an enriched theory of self-selection of heterogeneous firms into international activities à la Helpman *et al.* (2004). In particular, Table 2 shows that internationally active firms tend to be larger, have higher sales and are more capital intensive. The position along the turnover ranking tends to increase with the degree of complexity of international activities, from exporter, to importer of material / active outsourcing, to importer of services and FDI. Local firms

6 In order to encompass the phenomenon of temporary traders, we have considered as exporter also a firm replying “regularly/always” or “sometimes” to the question “Before 2008, has the firm exported any of its products?”. For importing firms, we combine the following questions: firms replying “yes, from abroad” to “In 2008 has the firm purchased any materials (services) for its domestic production?” and firms replying “regularly/always” or “sometimes” to “Before 2008, did the firm purchase any materials (services) from abroad?”.

7 These firms are attributed to the country in which they are located and thus surveyed, although the ‘nationality’ of the group they possibly belong to may be different. In this paper we do not control for foreign ownership, that is, whether a firm is controlled by a foreign entity. We do control for foreign investment undertaken by the same firm.

involved in international value chains ('passive outsourcers') are somewhat smaller than the average of all internationally active firms, but larger than purely local firms.

Table 2. International categories of firms – Descriptive statistics (full sample), 2008

	Number of firms	Average turnover per firm (1,000 EUR)	Average number of employees	Average capital stock per employee (1,000 EUR)
Non Active abroad	3,402	4,443.33	31.44	152.16
Active abroad	11,357	19,273.46	139.85	196.40
<i>of which</i>				
Exporter	9,849	20,494.21	151.42	199.03
Importer of services	3,449	38,659.98	332.12	223.57
Importer of materials	7,298	24,976.44	191.17	200.36
FDI	719	77,637.20	334.13	239.55
Passive outsourcer	5,799	17,052.42	83.96	204.98
Active outsourcer	590	24,657.11	119.55	225.28
Global exporter	4,016	24,777.71	103.43	222.93
Whole sample	14,759	15,589.29	114.52	186.59

Source: EU-EFIGE/Bruegel-UniCredit dataset

4. Internationalization and firm competitiveness

We can now assess the correlation patterns between the degree of involvement in international activities and firm competitiveness. From a theoretical point of view, firm competitiveness is best captured by the concept of Total Factor Productivity. TFP measures productive efficiency: how much output a firm can produce for any given amounts of inputs. In other words, a firm has higher TFP than a competitor if it is able to produce more output with the same amounts of inputs.

Exploiting the merger between the EFIGE and Amadeus data, it is possible to calculate TFP for around 50 percent of the firms present in the dataset. To that end, we first assign our observational units to industries, and then we run for each industry the Levinsohn and Petrin (2003) semi-parametric production function estimation algorithm. This allows solving the simultaneity bias affecting standard estimates of firm level productivity, as well as to derive TFP estimates from heterogeneous, industry-specific production functions.⁸

More specifically, following standard practice in the literature, output is proxied in the estimations by value-added, deflated using industry-specific price indices retrieved from Eurostat. The labour input is measured by the number of employees. Capital is proxied by the value of tangible fixed assets deflated using the GDP deflator.

⁸ Using ordinary least squares when estimating productivity implies treating labour and other inputs as exogenous variables. However, profit-maximizing firms adjust their inputs each time they observe a productivity shock, which makes input levels correlated with the same shocks. Since the latter are unobserved to the econometrician, inputs turn out to be correlated with the error, biasing the OLS estimates of production functions. Olley and Pakes (1996) and Levinsohn and Petrin (2003) have developed two similar semi-parametric estimation procedures to overcome this problem, using investment and material costs, respectively, as proxies for these unobservable shocks.

Firm competitiveness is best measured by total factor productivity: a firm has higher TFP if it produces more output with the same amounts of inputs.

4.1 Descriptive statistics

Table 3 reports the average TFP of firms in the different international activities alongside the other firm characteristics already shown in Table 2, with the sample now limited to those firms for which it is possible to retrieve TFP. As can be seen, the resulting restricted sample does not show any particular bias in terms of representation by category of firms, nor in terms of overall ranking.

Table 3. International categories of firms – Descriptive statistics (restricted sample), 2008

	Number of firms	Average turnover per firm (1,000 EUR)	Average number of employees	Average capital stock per employee (1,000 EUR)	TFP	Unit labour cost (EUR per unit of value added)	Labour productivity (value added per employee in 1,000 EUR)
Non Active abroad	1,514	5,298.51	31.67	156.14	0.872	0.77	50.71
Active abroad	5,921	24,623.51	152.00	200.01	1.024	0.78	57.55
<i>of which</i>							
Exporter	5,201	26,104.12	164.41	203.19	1.033	0.77	58.09
Importer of services	1,900	50,004.76	372.81	230.61	1.159	0.84	61.81
Importer of materials	3,939	31,647.82	208.25	203.31	1.058	0.79	58.43
FDI	387	98,554.23	359.70	238.08	1.293	1.05	63.35
Passive outsourcer	2,965	20,763.66	84.31	208.06	1.060	0.79	59.86
Active outsourcer	306	32,991.62	127.39	224.94	1.066	0.76	56.03
Global exporter	2,211	28,345.27	104.42	224.77	1.094	0.79	62.56
Whole sample	7,435	20,303.82	125.60	190.39	0.991	0.78	56.05

Source: EU-EFIGE/Bruegel-UniCredit dataset

Notes: Numbers are weighted sample averages. TFP is the Solow residual of the production function.

We also look at two alternative measures of firm competitiveness: labour productivity and unit labour cost.

Table 3 also reports two additional measures of firm level competitiveness, namely labour productivity (value added per employee) and unit labour costs (total wage bill per unit of output). These are commonly used measures of competitiveness. In particular, unit labour costs at the firm level constitute the building block of aggregate measures of competitiveness such as the real exchange rate, and are thus interesting to compare with our estimated TFP.

The relative correlations between the retrieved measures of TFP, labour productivity and unit labour costs are reported in Table 4. As can be seen, TFP and labour productivity are positively and significantly correlated at 70 percent, in line with the findings of the literature. More surprising, however, are the relatively small (albeit correctly signed and significant) correlation coefficients between the two productivity measures and unit labour costs, which are below 30 percent. Such a low correlation casts some doubt on the actual meaning of aggregate measures of competitiveness based on unit labour costs.

Table 4. Correlations between measures of firm competitiveness

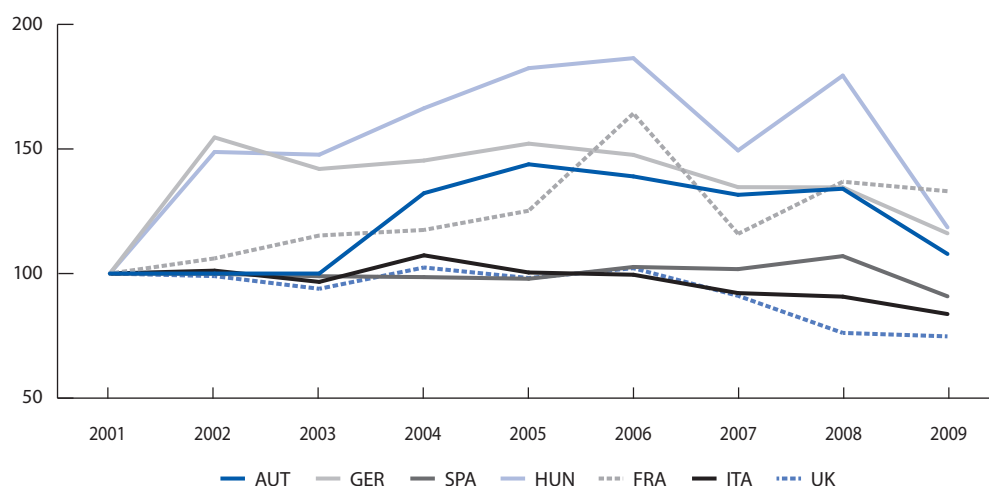
	TFP	Labour productivity
Labour productivity	0.695***	
Unit labour cost	-0.277***	-0.267***

Source: Authors' calculations based on the EU-EFIGE/Bruegel-UniCredit dataset and on the Amadeus dataset

Note: ***denotes statistical significance at the 1-percent level.

Based on the findings in Table 4, we stick to TFP as our ‘preferred’ measure of firm level competitiveness and, to test its aggregation properties in terms of country representativeness, we aggregate the firm-specific information in order to obtain a country-specific TFP index. Specifically, we first compute year/country/sector-specific weighted averages of firm level productivity measures. Then we create an index setting the year-2001 TFP level equal to 100 for each country and sector. Finally, we retrieve the country/year-specific aggregate TFP as the mean across sectors of these indexed TFP measures. The results are depicted in Figure 1.

Figure 1. Aggregate TFP dynamics by country, 2001-2009



Source: Authors’ calculations based on the EU-EFIGE/Bruegel-UniCredit and Amadeus datasets

The dynamics of productivity aggregated from firm-level information are comparable to well-known results on aggregate country competitiveness, with Hungary, a transition economy under convergence, displaying the highest gains of productivity in the early 2000s, followed by Germany, France and Austria. The stagnating productivity trends of Spain and Italy are also evident. Somehow surprising at first glance is the dismal performance of the United Kingdom, but this might be explained by the fact that we are looking at the manufacturing sector of an economy with a growing competitive advantage in services. Finally, all countries display a marked decrease in productivity in 2009.

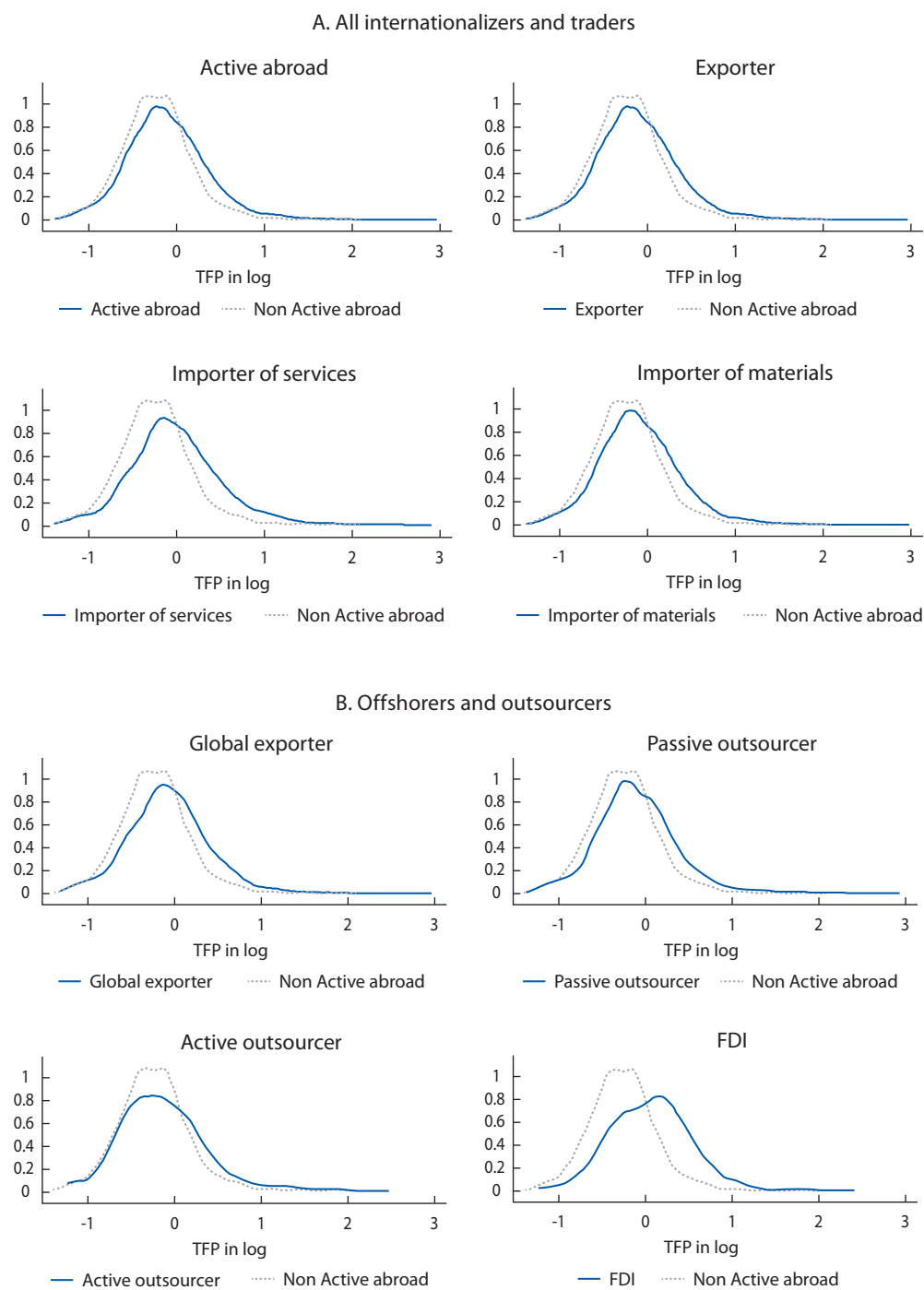
A standard way of showing selection into different internationalization activities is to draw the kernel density estimates of the productivity distribution for firms involved in each of these activities, and compare it with those of firms that are inactive at the international level. A kernel density shows the shares of firms (‘density’) that attain each productivity level, that is, the probability of picking a firm with a certain productivity level when the firm is randomly drawn from each category of activities. The comparisons are depicted in Figure 2 (panels A and B), where it has to be kept in mind that internationalization categories are not mutually exclusive as firms can be engaged in more than one international activity at a time. Thus, the sample sizes might vary and overlap (see Table 2 for details).

An internationally active firm is likely to be more productive than an internationally inactive firm.

Both panels of Figure 2 send the same message: a randomly drawn firm that is active internationally is likely to be more productive than a randomly drawn firm that is inactive internationally.

The fact that the productivity densities vary across internationalization categories suggests that the costs associated with international operations might vary across the different activities. To deepen the investigation of this point, we analyze next how the probability that a firm is active in each international activity is associated with the observed level of productivity. In particular, Figure 3 shows the ‘extensive margin’ (number of active firms over total number of firms) of each internationalization activity for each decile of the productivity distribution.

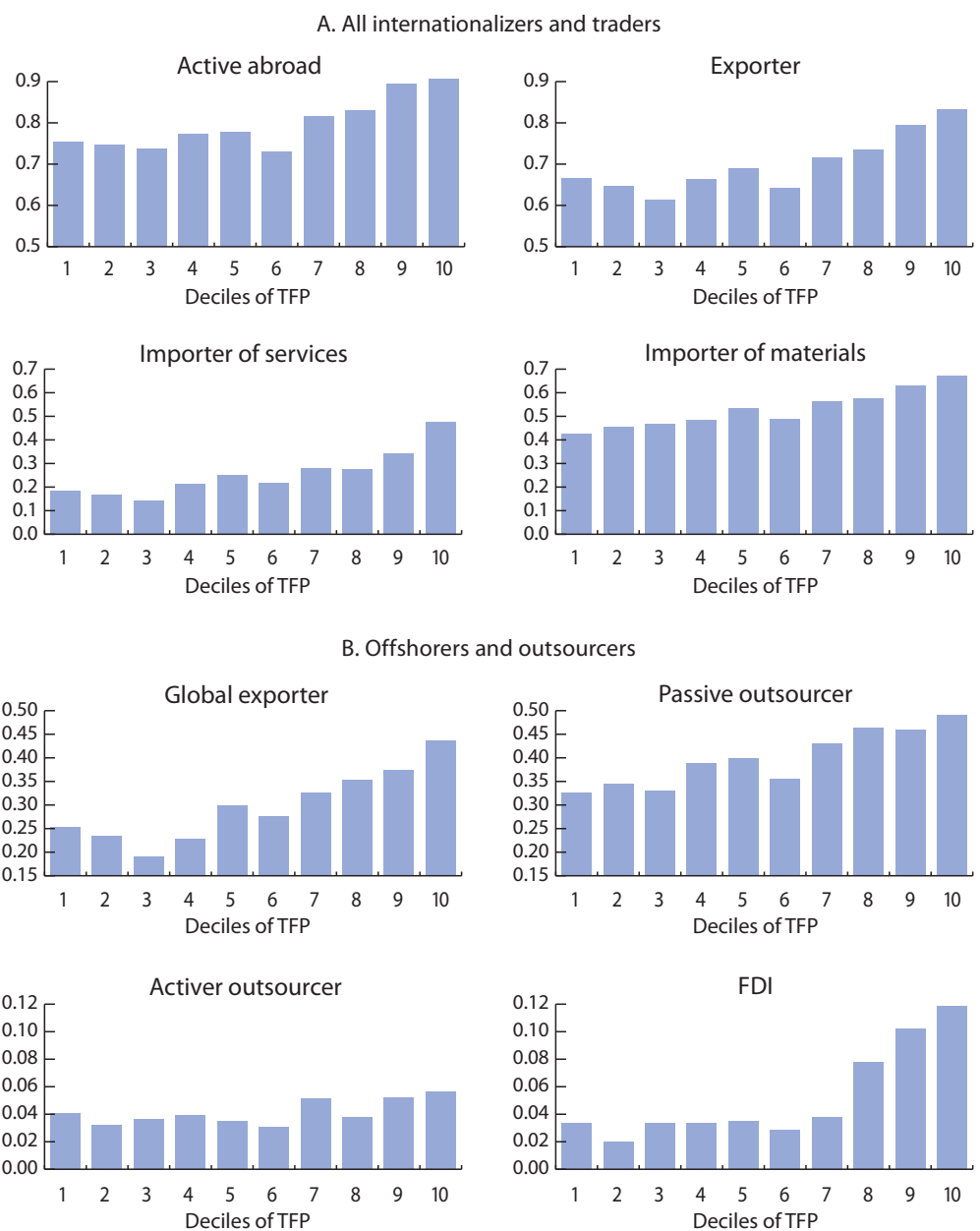
Figure 2. TFP and internationalization



The more productive a firm is, the more likely it is to be involved in some international activity.

The first thing to notice is the overall upward slope of the histograms when moving from left to right, that is from low- to high-productivity deciles. In line with the literature, this points out that the higher the productivity decile, the more likely it is for firms to be involved in some international activity. In other words, more productive firms self-select into internationalization status. However, the richness of information in our dataset allows us to go further than that, distinguishing the various internationalization activities in terms of selectivity.

Figure 3. TFP and internationalization: Share of firms active in each international activity by level of TFP



To see this, let us focus on the top decile (10), *i.e.* on the most productive 10 percent of all firms. The top left graph in panel A of Figure 3 reveals that among the firms in that decile, slightly more than 90 percent are internationally active one way or another. Nonetheless, the categories of internationalization activities differ a lot in terms of popularity: slightly less than 85 percent of firms are exporters; two thirds of them are importers of materials; almost 50 percent of firms are importers of services or passive outsourcers; just below 45 percent of firms are global exporters; less than 15 percent are involved in FDI; and just above 5 percent are active outsourcers.

Focusing on the top 10 percent of firms in terms of productivity, almost 85 percent of them are exporters while just above 5 percent are active outsourcers.

These findings reveal a clear ranking of internationalization activities from low selectivity (exporting) to high selectivity (active outsourcing) that hint at a growing degree of complexity when moving from exporting to FDI and active outsourcing. Thus, firms with stronger competitiveness have access to a

larger number of more complex options in designing their international operations. Stronger competitiveness implies having the possibility of exploiting a richer toolbox to deal with the challenges and seize the opportunities of globalization.

4.2 Econometric evidence

The relationship between firm competitiveness and internationalization activities can be further investigated by a cross-sectional econometric exercise, in which we regress the TFP of each firm, as measured in 2008, on the different categories of internationalization activities, controlling for country and industry fixed effects.

The 'productivity premium' increases with the complexity of internationalization activities and is highest for FDI and the import of services.

The results obtained through OLS are reported in Column 1 of Table 5. As expected, all coefficients are positive and significant. The 'productivity premium' increases with the complexity of internationalization activities. FDI and the import of services are associated with the largest TFP premia, followed by outsourcing activities and finally simple import and export strategies. Not surprisingly, however, 'complex' export strategies, as proxied by the ability of firms to export beyond the EU, are associated with higher premia, comparable to the ones derived from outsourcing activities. Indeed, this ranking is already visible in Figure 2 above, where the more complex internationalization categories exhibit thicker density at higher TFP levels.

Table 5. International status and TFP premium

	(1)	(2)	(3)	
Dependent variable: TFP	OLS	OLS	Ordered Probit	Observations
Active abroad	0.0906*** (0.0132)	0.0353*** (0.0128)	0.261*** (0.0290)	7,259
Exporter	0.0999*** (0.0136)	0.0399*** (0.0131)	0.272*** (0.0298)	6,563
Importer of services	0.171*** (0.0171)	0.0626*** (0.0171)	0.620*** (0.0531)	3,334
Importer of materials	0.118*** (0.0142)	0.0449*** (0.0138)	0.394*** (0.0332)	5,320
FDI	0.257*** (0.0329)	0.0980*** (0.0357)	0.750*** (0.0750)	1,862
Passive outsourcer	0.122*** (0.0151)	0.0558*** (0.0150)	0.329*** (0.0342)	4,372
Active outsourcer	0.134*** (0.0309)	0.0477 (0.0306)	0.364*** (0.0755)	1,777
Global exporter	0.156*** (0.0168)	0.0699*** (0.0167)	0.425*** (0.0368)	3,652
Country fixed effects	Included	Included	Included	–
Industry fixed effects	Included	Included	Included	–
Firm size	Excluded	Included	Excluded	–

Notes: Standard errors in parentheses. *** denotes statistical significance at the 1-percent level. One cross-sectional regression for each internationalization characteristic, with sector and country dummies. Column 2 controls also for the size class of firms (10-19; 20-49; 50-249; >=250 employees). The number of observations is given by the number of inactive firms plus the number of firms active in the selected international activity. All regressions control for country and industry fixed effects. Coefficients of the firm size effects included in Column 2 are reported in Table 6.

Competitiveness and size go hand in hand, as more productive firms grow larger than less productive ones.

In Column 2 of Table 5, in addition to country and industry fixed effects, we also control for firm-specific characteristics, in particular the size class of firms measured in terms of employment. While the TFP premia associated with the various internationalization activities are significantly reduced, their ranking is confirmed. The inclusion of firm size shows that competitiveness and size go hand in hand, as more productive firms manage to grow larger than less productive ones (not reported in Table 5).

The role of firm size is further investigated in Table 6, which reports the magnitude of the fixed effects associated with each size class for the different internationalization statuses in the regression of Table 5, Column 2. As can be seen, coefficients tend to grow larger with firm size, although, for a given class of firms, the size premium tends to be smaller in more ‘complex’ international activities such as FDI or outsourcing. This is evidence of tougher selectivity at the top as more complex activities are chosen by firms whose TFPs are above already high thresholds. In other words, size seems to give a bigger boost to productivity within less complex international activities.

Table 6. Firm size effects on TFP across internationalization activities

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable: TFP	Active abroad	Exporter	Importer of services	Importer of materials	FDI	Passive outsourcer	Active outsourcer	Global exporter
Small firms (20-49 employees)	0.162*** (0.0118)	0.156*** (0.0124)	0.168*** (0.0179)	0.160*** (0.0140)	0.144*** (0.0228)	0.154*** (0.0150)	0.137*** (0.0209)	0.180*** (0.0170)
Medium-sized firms (50-249 employees)	0.343*** (0.0157)	0.346*** (0.0165)	0.376*** (0.0240)	0.336*** (0.0182)	0.253*** (0.0363)	0.309*** (0.0199)	0.341*** (0.0344)	0.332*** (0.0227)
Large firms (over 250 employees)	0.639*** (0.0271)	0.635*** (0.0283)	0.647*** (0.0365)	0.634*** (0.0302)	0.572*** (0.0562)	0.553*** (0.0352)	0.576*** (0.0671)	0.644*** (0.0374)

Notes: Standard errors in parentheses. *** denotes statistical significance at the 1-percent level. The coefficients of the internationalisation variables are reported in Column 2 of Table 5 and are not repeated here.

The foregoing OLS results can also be checked for robustness by estimating an ordered probit model, in which the internationalization status is regressed across the decile categories (from the 1st to the 10th) of TFP analyzed in Figure 3. The results are reported in Column 3 of Table 5. The interpretation of the coefficient is slightly different here, but the results are perfectly consistent: the higher the productivity decile, the more likely it is to observe a firm being involved in some internationalization activity. While this is true for all activities, the effect is strongest for FDI, followed by importers of services; it is weakest for exporters only active within Europe.

Although these rankings are broadly consistent with previous results in the literature for individual countries and specific internationalization activities, the EU-EFIGE/Bruegel-UniCredit dataset is the only one that allows comparing, within a homogeneous framework, the productivity premia of firms across a wide range of international activities. The analysis confirms the well-known strongest self-selection induced by FDI. That is, the productivity ‘threshold’ above which firms tend to be active internationally is highest for FDI. It stresses the recently assessed fact that self-selection is stronger for importing than for exporting activities (see e.g. Altomonte and Békés, 2010). It also reveals the previously unnoticed high TFP premium of firms involved in the import of services, possibly due to the complementarity between complex internationalization strategies and sophisticated services exported by selected providers.

Moreover, the EU-EFIGE/Bruegel-UniCredit dataset not only makes it possible to make comparisons across a wide range of internationalization activities. Uniquely, it also allows comparing the performance of international firms across countries. To that extent, we run the same OLS specification as the one reported in Table 5 adding an interaction term (on top of country fixed effects) between a given country and the international status of the firms. The aim is to understand whether firms from a particular country are more productive in a given international status. We consider here Italy, Germany and France.

The productivity difference between internationally active and inactive firms is larger in France than in other countries.

The coefficients of the interaction terms for the three countries are reported in the first three columns of Table 7. The average patterns are confirmed in the case of Italy and Germany as most coefficients are not statistically significant. The only exception concerns importers of materials, whose productivity difference with respect to internationally inactive (domestic) firms is larger in Italy and France than in other countries. France seems to be different with respect to other international activities, too. In particular, the productivity difference of internationally active firms is larger in France than in other countries. This feature holds for traders in all categories (exporters, importers of materials or services, global exporters).

Table 7. Productivity and internationalization: country and industry effects

Dependent variable: TFP	ITA	FRA	GER	Low-wage sector
Active abroad	0.0209 (0.0290)	0.0818** (0.0410)	0.0681 (0.0591)	-0.00581 (0.0264)
Exporter	0.0128 (0.0295)	0.0971** (0.0422)	0.0450 (0.0596)	-0.00688 (0.0270)
Importer of services	0.0405 (0.0374)	0.101** (0.0499)	0.0371 (0.0669)	-0.0612* (0.0336)
Importer of materials	0.0642** (0.0306)	0.0928** (0.0419)	0.0877 (0.0613)	-0.0178 (0.0281)
FDI	-0.0281 (0.0808)	0.0918 (0.0987)	-0.113 (0.0934)	-0.227*** (0.0600)
Passive outsourcer	-0.00690 (0.0334)	0.0698 (0.0450)	0.0373 (0.0628)	0.00487 (0.0295)
Active outsourcer	0.0620 (0.0784)	0.151 (0.0929)	-0.00996 (0.111)	0.0616 (0.0608)
Global exporter	0.0406 (0.0364)	0.169*** (0.0513)	0.0738 (0.0668)	-0.0233 (0.0330)

Notes: Standard errors in parentheses. ***, ** and * denote statistical significance at the 1-, 5- and 10-percent levels, respectively. The table reports the coefficients of interaction terms between internationalization status and country dummy (or low-wage-sector dummy). The results are obtained by including these interaction terms into the OLS model of Table 5, Column 1.

Turning from a country perspective to an industry perspective, in the fourth column of Table 7 the internationalization status is interacted with an industry-specific dummy taking a value of 1 if the industry is characterized by competition from low-wage countries.⁹ The negative coefficients in the

⁹ Following Bugamelli *et al.* (2010) we consider as being affected from low-wage competition those industries in which the world market share of Chinese exports is above the median world market share of Chinese exports.

fourth column show that the productivity difference between internationally active and inactive firms (shown in Table 5) tends to be smaller in low-wage industries, in particular when they undertake FDI or import services. This is striking as we have seen that, in general, these two are the most selective international activities being associated with the highest productivity premia. The negative and significant coefficients may therefore signal the use of these types of complementary international activities as a defensive strategy by European firms in industries subject to tough competition from low-wage countries. Such difference is indeed not present for other internationalization categories, where firms operating in low-wage industries do not display a significantly different TFP premium on international activity compared to firms from other industries.

In low-wage industries, the productivity difference between internationally active and inactive firms tends to be smaller.

Finally, as a further check, we replicate the initial exercise of Table 5 on TFP for the two alternative measures of firm competitiveness: labour productivity and unit labour costs. The results are described in Table 8, together with the number of observations available for each measure across internationalization statuses. For ease of comparison, the first two columns of Table 8 repeat the results on TFP already listed in Column 1 of Table 5.

Table 8. International status and alternative measures of competitiveness

Dependent variables	TFP		Labour productivity		Unit labour cost	
	OLS	N	OLS	N	OLS	N
Active abroad	0.0906*** (0.0132)	7,259	0.135*** (0.0145)	7,260	-0.0570*** (0.00960)	9,230
Exporter	0.0999*** (0.0136)	6,563	0.141*** (0.0149)	6,564	-0.0545*** (0.00991)	8,281
Importer of services	0.171*** (0.0171)	3,334	0.202*** (0.0188)	3,334	-0.0682*** (0.0121)	4,246
Importer of materials	0.118*** (0.0142)	5,320	0.162*** (0.0155)	5,321	-0.0703*** (0.0101)	6,800
FDI	0.257*** (0.0329)	1,862	0.226*** (0.0373)	1,862	-0.0927*** (0.0253)	2,392
Passive outsourcer	0.122*** (0.0151)	4,372	0.158*** (0.0169)	4,372	-0.0630*** (0.0111)	5,672
Active outsourcer	0.134*** (0.0309)	1,777	0.182*** (0.0359)	1,777	-0.0666*** (0.0212)	2,330
Global exporter	0.156*** (0.0168)	3,652	0.198*** (0.0184)	3,652	-0.0631*** (0.0122)	4,588
Country fixed effects	Included		Included		Included	
Industry fixed effects	Included		Included		Included	
Firm size	Excluded		Excluded		Excluded	

Notes: Standard errors in parentheses. *** denotes statistical significance at the 1-percent level. One cross-sectional regression for each internationalization characteristic, with sector and country dummies. The number of observations is given by the number of inactive firms plus the number of firms active in the selected international activity.

Table 8 shows that the premia in terms of TFP and labour productivity are fully comparable across international statuses. This is so both in terms of magnitude (with premia ranging between 10 and

25 percent relative to internationally inactive firms) and in terms of ranking (with FDI always being associated with the most productive category of firms, followed by importers of services, outsourcers, importers of materials and simple exporters). These findings are in line with the relatively high correlation previously detected between the two productivity measures.

Not surprisingly given the low correlation with TFP, unit labour costs convey a slightly different message. Internationalization premia are still there and significant with the right sign, showing that internationally active firms have lower unit labour costs compared to local firms. However, magnitudes are smaller as premia range between 5 and 9 percent vis-à-vis internationally inactive firms. The ranking also changes. While firms undertaking FDI are still the most competitive, firms importing materials now stand close to them. Once again, unit labour costs seem to capture something different from productivity. Nonetheless, the fact that all coefficients are significantly negative sends a message of overall consistency across measures of competitiveness.

5. International exposure and industry competitiveness

So far we have taken the point of view of the firm showing that firms with stronger competitiveness have access to a richer variety of more complex options when in designing their international operations. We now move to a higher level of aggregation and ask whether the same can be said for industries: Is higher productivity at the industry level associated with more complex internationalization patterns?

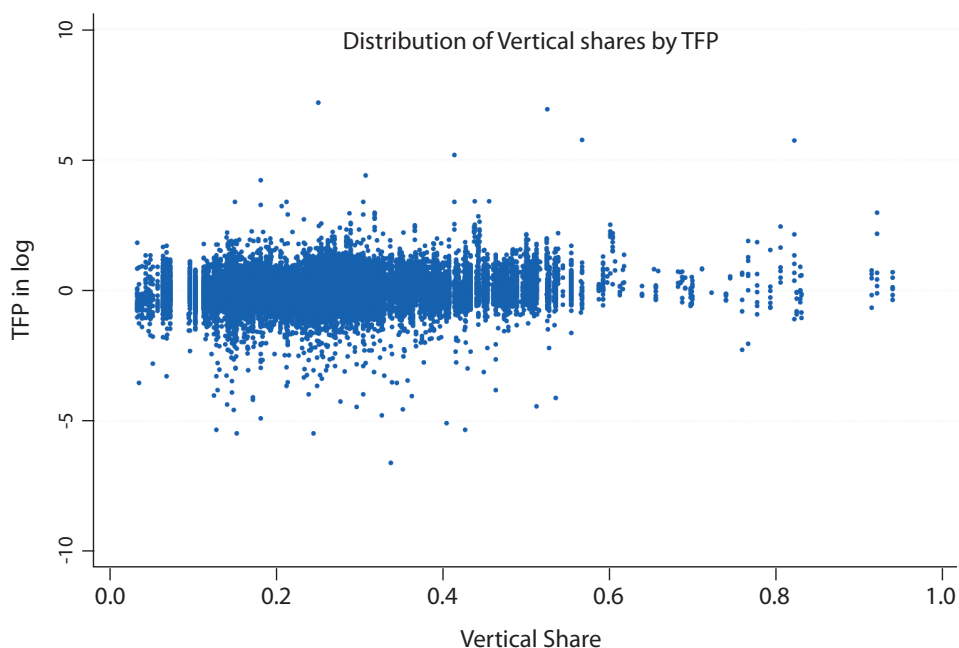
The ‘vertical share’ is the ratio of imported intermediate goods to total output and measures the internationalisation intensity of an industry.

To address this question, we exploit once more the EU-EFIGE/Bruegel-UniCredit dataset that allows operating with a representative sample of firms. We use the associated balance sheet data in a panel format to calculate for each industry a distribution of firm-specific TFP measures from 2002 to 2008. At the same time, we also exploit industry level data to construct for each industry an index of ‘internationalisation intensity’, aimed at capturing both the extent and the complexity of its international exposure. Following Hummels *et al.* (2001), this index measures how much a given industry is vertically integrated with international markets in a country at a certain point in time. For each industry this index of vertical integration (henceforth, ‘vertical share’) is computed as the ratio of the value of intermediate goods imported from abroad over the value of total output. It is based on year- and country-specific Input-Output tables available for each country in our sample for the period 2001-2007. These tables are provided by Eurostat (Economy and finance statistics, ESA 95 Input-Output tables). They are two-way tables that cross data on backward and forward linkages by industry in each country for each year.

The idea is to study the pattern of correlation across industries between the distribution of firm level TFPs and international exposure as captured by the vertical share. The fact that we link the vertical shares for 2001-2007 to TFP distributions for 2002-2008 suggests some kind of causality from the former to the latter. Short of a proper test of causality, such causal interpretation should of course not be pushed too far.

Prima facie evidence on correlation can be gauged from Figure 4, which plots the vertical share for every ‘cell’ (industry/country/year) against the (weighted) average TFP of the firms operating in the same cell. The figure reveals the presence of some mildly positive correlation between vertical shares and average levels of productivity. More interestingly, Figure 4 also shows that the heterogeneity of TFP levels is not constant across internationalisation intensities: larger vertical shares are associated with smaller heterogeneity of firm-level TFP. Hence, both the first and the second moments of the TFP distribution appear to be correlated with international exposure.

Figure 4. Vertical shares and average TFP



Note: Vertical shares are computed as the ratio of the value of intermediate goods imported from abroad over the value of total output for each industry. TFP is the (log) total factor productivity of each firm.

Table 9 further explores the correlations across industries between international exposure and the two moments of the TFP distribution. The table reports the results of a panel regression of the vertical share against the mean and the variance of the TFP distributions.

Column 1 shows that, as long as we do not control for country- and industry-specific fixed effects, we find a positive and significant, albeit small, correlation between the vertical share and average TFP. This is in line with what emerges from Figure 4. Adding country fixed effects alone maintains the significance of that correlation (result not reported). Column 2 highlights, however, that, when including both country and industry fixed effects in the regression, the positive correlation between international exposure and average TFP vanishes as the corresponding coefficient loses statistical significance.

Building on the pattern of TFP heterogeneity spotted in Figure 4, Column 3 of Table 9 adds the variance of TFP to the regressors of Column 2, as well as its interaction with average TFP. This is our preferred specification. It reinstates the sign and significance of the correlation between vertical share and average TFP. At the same time, the interaction term bears a negative and significant coefficient. Hence, after controlling for time-invariant country- and industry-specific characteristics, a larger vertical share is associated with higher average TFP but this association is weaker when the variance of TFP is larger. Likewise, if resources are reallocated from less productive to more productive firms, average TFP increases and the variance of TFP decreases, and both are associated with an increasing vertical share according to our empirical results.

The reallocation of resources from less to more productive firms increases average TFP, while decreasing the variance of TFP, and is associated with an increasing vertical share.

Interpreted through the lens of selection effects, these findings suggest that, within industries and countries, international exposure induces a reallocation of resources towards better-performing firms. There is more scope for such reallocation when there is more heterogeneity in performance across firms.

As selection into international activity takes place, heterogeneity is reduced, the scope for reallocation shrinks, and the positive impact of additional international exposure on industry competitiveness weakens. This is consistent with the fact that a higher average and smaller variance of TFP go hand in hand in Figure 4.

Table 9. Vertical share and industry productivity (GLS)

Dependent variable: Vertical share			
Explanatory variables			
TFP mean	0.00177*** (0.000529)	-0.000732 (0.000521)	0.00355* (0.00182)
TFP variance			-0.00810 (0.0137)
(TFP mean)			-0.0191** (0.00883)
* (TFP variance)			
Constant	0.253*** (0.000936)	0.135*** (0.000973)	0.136*** (0.00266)
Industry fixed effects	No	Yes	Yes
Country fixed effects	No	Yes	Yes
Observations	51,427	51,427	51,427
Number of firms	9,036	9,036	9,036

Notes: ***, ** and * denote statistical significance at the 1-, 5- and 10-percent levels, respectively. Generalized-least-squares (GLS) panel estimation. Robust standard errors clustered at the firm level in parentheses.

6. Conclusions and policy implications

Is international production sharing associated with stronger competitiveness? We have addressed this question from the complementary viewpoints of firms and industries. In so doing, we have exploited the unique features of the EU-EFIGE/Bruegel-UniCredit dataset, which offers detailed, statistically representative and comparable information on the international operations of manufacturing firms from key EU countries.

Aggregate competitiveness measures based on unit labour costs are questionable given the poor correlation between firm level unit labour costs and TFP.

We have started by checking the correlations between common alternative measures of firm competitiveness: total factor productivity (TFP), labour productivity, and unit labour costs. The first measure is the one dictated by economic theory as it captures the ability of firms to efficiently use all factors of production. The second measure is highly correlated with the first and, therefore, can be used as a reasonable proxy whenever the computation of TFP is too demanding. By contrast, the third measure is poorly correlated with the others, which casts a shadow on aggregate measures of competitiveness that are typically founded on it. This implies that productivity and unit labour costs measure different things.

Focusing on TFP as the theoretically sound indicator of competitiveness, we have first investigated its relation with internationalization at the firm level. We have found strong evidence of self-selection in the involvement in international activities. The clear positive correlation between the competitiveness of a firm and the complexity of its internationalization strategies reveals the presence of internationalization costs that are increasing in the degree of complexity.

International production sharing is associated with stronger competitiveness not only at the firm level but also at the industry level. This is revealed by the positive correlation across industries between average productivity and international exposure. The correlation holds after controlling for country and industry time-invariant characteristics, provided that one accounts for the dispersion of firm productivity across industries. Hence, at the industry level international exposure goes hand in hand with competitiveness as long as there is enough room to reallocate resources from less to more productive firms.

International production sharing is associated with stronger competitiveness also at the industry level.

From a policy point of view, self-selection into the various internationalization statuses implies that international production sharing is a signal of stronger competitiveness both at the firm and at the industry levels. From the viewpoint of firms, stronger competitiveness gives access to a larger number of more complex options when it comes to the design of international operations. From the viewpoint of industries, stronger competitiveness arises from the possibility of reallocating resources from less to more productive firms. For both firms and industries, stronger competitiveness arises from the possibility of exploiting a richer set of internationalization strategies to deal with the challenges and the opportunities of globalization.

As competitiveness is the cause rather than the consequence of internationalization, EU policies promoting internationalization per se would hardly affect competitiveness. Vice versa, policies that artificially reduce the ability of competitive firms to trade, outsource and invest abroad would also reduce their ability to exploit their full potential. Rather than focusing on firms' internationalization, successful policies should promote healthy industry dynamics, thereby favouring the reallocation of resources from less to more competitive firms. International competition would then guide this reallocation process.

Annex

Descriptive statistics and definitions of variables constructed with the EU-EFIGE/Bruegel- UniCredit dataset

Table A1. Distribution of firms by country and size class

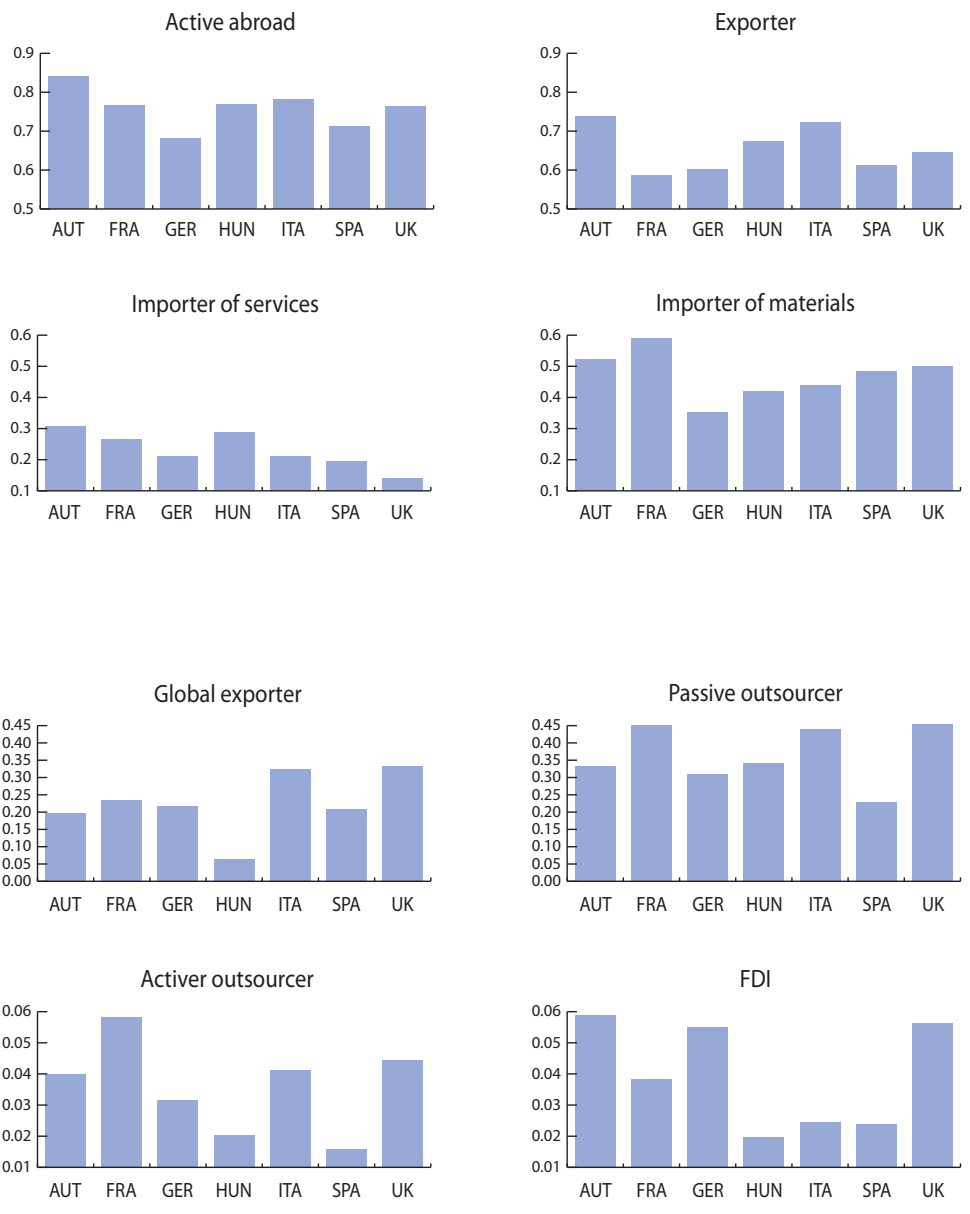
Class size	AUT	FRA	GER	HUN	ITA	SPA	UK	Total
Employees (10-19)	132	1,001	701	149	1,040	1,036	635	4,694
Employees (20-49)	168	1,150	1,135	176	1,407	1,244	805	6,085
Employees (50-249)	97	608	793	118	429	406	519	2,970
Employees(over250)	46	214	306	45	145	146	108	1,010
Total	443	2,973	2,935	488	3,021	2,832	2,067	14,759

Table A2. Distribution of firms by country and sector

Sector	AUT	FRA	GER	HUN	ITA	SPA	UK	Total
15	32	212	350	62	238	463	147	1,504
17	8	118	77	7	196	46	52	504
18	5	55	17	17	109	50	42	295
19	0	32	13	4	115	47	10	221
20	21	93	103	17	88	212	89	623
21	10	83	62	16	71	27	47	316
22	34	148	215	27	105	100	208	837
24	5	102	95	20	108	121	104	555
25	22	226	192	40	169	148	122	919
26	18	153	94	30	167	163	56	681
27	13	68	58	7	76	68	54	344
28	70	839	510	101	611	580	301	3,012
29	48	249	503	68	381	305	208	1,762
31	20	121	134	19	152	66	124	636
32	5	94	56	9	49	25	101	339
33	15	58	192	6	71	25	80	447
34	6	73	41	11	47	64	33	275
35	2	16	20	3	33	42	21	137
36	5	16	172	18	211	258	258	938
Total	339	2,756	2,904	482	2,997	2,810	2,057	14,345

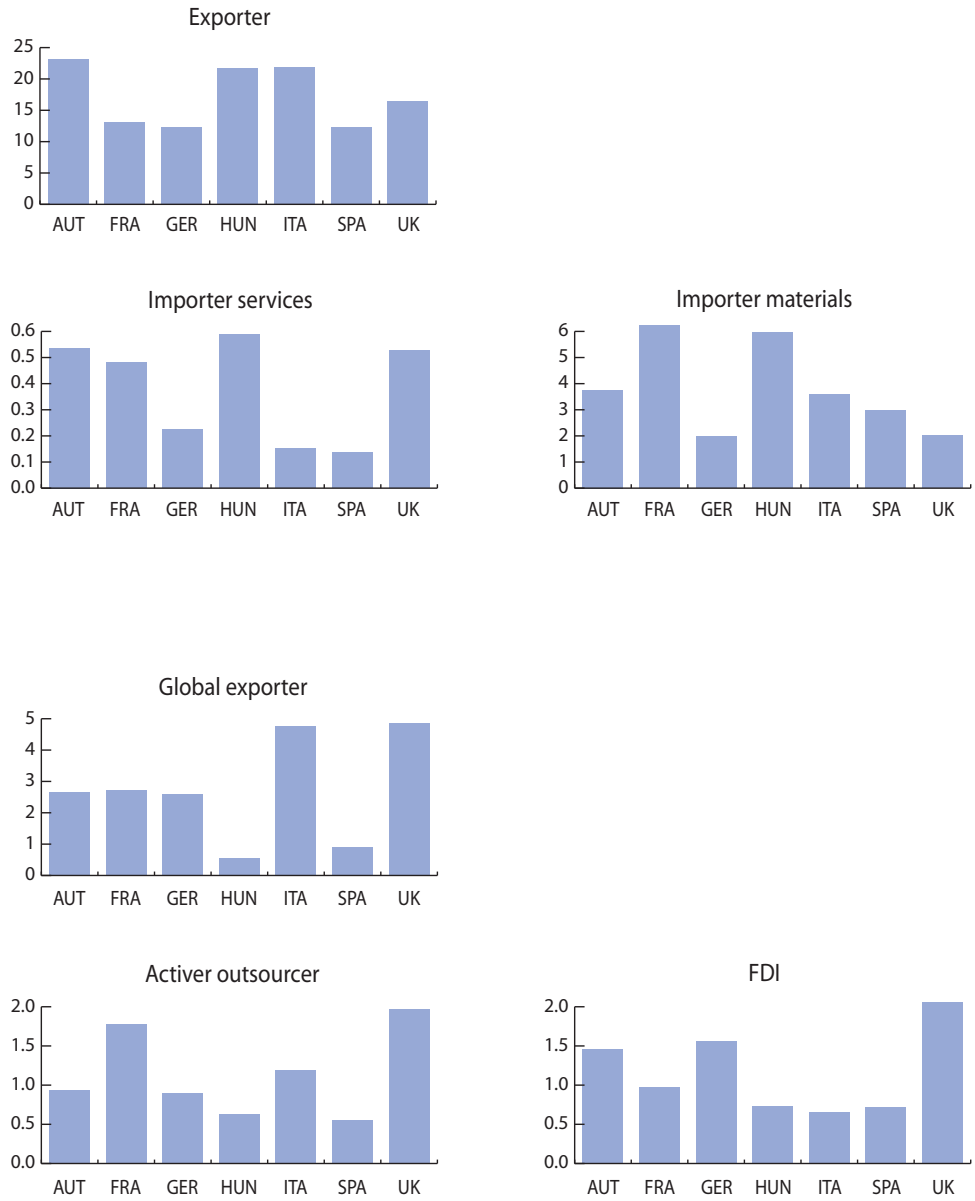
Note: Sector 15 is merged with sector 16 and sector 31 is merged with sector 30.

Figure A1. Extensive margin of trade by international activity and country



Note: The extensive margin is the share of firms active in a given international activity.

Figure A2. Intensive margin of trade by international activity and country (percent)



Note: The intensive margin is the percentage of turnover that firms active in a given international activity derive from that activity.

Table A3. Definition of variables used in the regressions

Variable used	Definition
Exporter	Dummy for exporter - wide definition: firm is direct exporter in 2008 or has been actively exporting in years before 2008.
Importer of materials	Dummy for importer of intermediate goods in 2008 or before
Importer of services	Dummy for importer of services in 2008 or before
Active outsourcer	Dummy for the firm that has production activity contracts and agreements abroad
Passive outsourcer	Dummy for the firm that has sold some produced-to-order goods to foreign clients
Foreign Direct Investor (FDI)	Dummy for firm running at least part of its production activity in another country via direct investments
Global exporter	Dummy for firm exporting to China or India or other Asian countries or to the US or Canada or Central or South America
Active abroad	At least one of the above variables takes value 1.
Total Factor Productivity (TFP)	Solow residual of a Cobb-Douglas production function estimated following the semi-parametric algorithm proposed by Levinsohn and Petrin (2003), at the firm level, 2002-2008
Labour productivity	Value added per employee, at the firm level, 2002-2008 (Amadeus)
Unit labour cost	Labour compensation over value added, at the firm level, 2002-2008 (Amadeus)
Vertical share	Ratio of the value of intermediate goods imported from abroad over the value of total output for each industry, based on country-specific I/O tables, 2001-2007 (Eurostat)

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ABSTRACT

In this paper, we review theory and evidence on the links between product market regulations that curb competitive pressures, the efficiency of resource allocation and productivity growth. We show that product market regulations differ across countries and industries and have evolved differently over time. We argue that differences in regulation have played an important role in driving resource allocation and productivity outcomes. Countries and industries where direct and indirect regulatory burdens are lighter have generally experienced the highest GDP per capita and productivity growth rates. Moreover, where regulatory burdens are lighter, the reallocation of resources towards the highest-productivity firms is stronger. The impacts of inappropriate regulations on aggregate and firm-level productivity performance are estimated to be quantitatively important and thus, reforming such regulations can provide a significant boost to potential growth in OECD economies.

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Regulation, resource reallocation and productivity growth

1. Introduction

The analysis of differences in economic performance across countries largely deals with the role played by market rigidities in curbing incentives to innovate and in preventing resources from flowing to the most productive uses. In some cases, rigidities can be directly related to the nature of some economic activities, but they are often induced by inappropriate policies or institutions. This paper focuses on the role of one particular set of policy-induced rigidities, those that are related to regulations that curb product market competition, where competitive forces would be advantageous for society. There is widespread anecdotal evidence that, in countries where policies unduly curb competition, performance is subpar. As an example, Figure 1 suggests a negative and significant correlation between GDP per capita and the OECD summary indicator of anticompetitive product market regulations across a number of OECD and emerging economies. Indeed, countries with more stringent and anticompetitive product market regulations (according to the OECD synthetic indicator) were also those with a relatively lower GDP per capita, and *vice versa*. Needless to say, this is only illustrative because there are many other factors beyond regulations that determine a country's economic performance. Figure 2, however, also shows a negative correlation between multi-factor productivity (MFP) growth and the stringency of product market regulations: countries that had procompetitive regulations seem to have been more able than others to accelerate productivity growth over the past quarter century. Furthermore, differences in productivity and productivity growth are the main determinant of cross-country gaps in levels and growth rates of GDP per capita. These simple correlations are sufficiently tight to merit further investigation: To what extent are they driven by the adverse effect of anticompetitive regulations on the ability to efficiently allocate resources and on the incentives to continuously improve efficiency (e.g. via innovation), which are at the heart of the growth process in market economies?



Jens Arnold

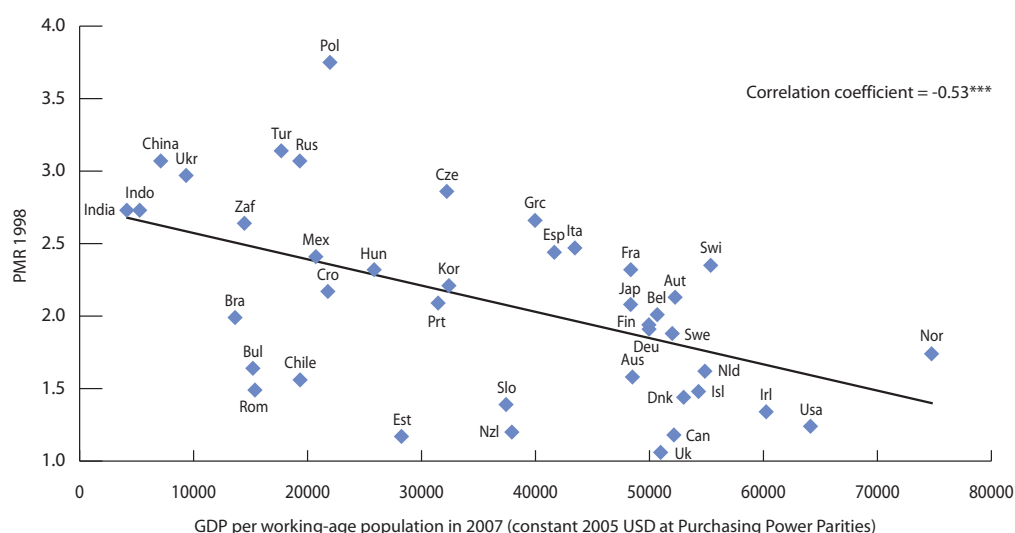


Giuseppe Nicoletti



Stefano Scarpetta

Figure 1. Anticompetitive product market regulation and GDP per capita



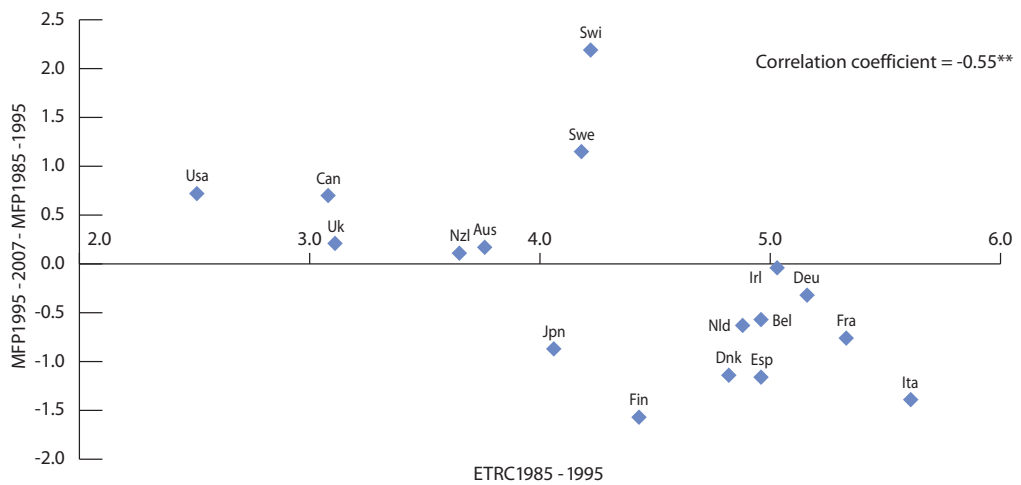
Source: Woelfl *et al.* (2010)

Note: The values on the vertical axis are based on a "simplified" OECD Product Market Regulation (PMR) indicator (see Woelfl *et al.* 2010). PMR measured in 1998 for OECD countries; 2008 for Chile, Estonia, Israel, Slovenia, Brazil, Russia and China; 2007 for Croatia, Indonesia, South Africa and Ukraine; 2006 for Bulgaria, India and Romania. "****" denotes significance at the 1-percent level.

We provide estimates of the extent to which regulations affect productivity, taking into account the heterogeneity of countries, sectors and firms.

In this paper, we address these issues by looking at the link between regulations, resource reallocation and productivity from different angles, *i.e.* aggregate, sectoral and firm-level. We survey some theory and evidence and, based on existing empirical research, we provide estimates of the extent to which regulations can affect productivity, checking whether this effect is economically relevant. Whenever possible, we discuss how the estimated effects of regulation on performance differ depending on the levels of development, industry characteristics and the relative efficiency of firms in terms of their dynamism or distance from the technological frontier. Indeed, heterogeneous performance (across countries, industries and firms) is a key feature of market economies and the influence of regulation on productivity is likely to differ across countries, industries and firms with different characteristics.

Figure 2. Productivity acceleration and regulation



Source: OECD Productivity Database and OECD International Regulation Database
 Note: MFP is a multifactor productivity index. The vertical axis shows the acceleration in average annual MFP growth from the period 1985-95 to the period 1995-2007 (in percentage points). The horizontal axis shows the 1985-95 average of the ETCR, the OECD regulation indicator of anticompetitive provisions and industry settings in electricity, transport and communication industries. ** denotes significance at the 5-percent level.

Throughout the paper, we focus on measures of product market policies provided by the OECD for consistency. These measures are based on laws and regulations that unduly curb competition and cover both general-purpose and sector-specific areas, such as administrative burdens on start ups and access to networks, respectively. They point to differences in the stringency of regulation that could potentially provide an explanation for differences in productivity developments. We also take into account intersectoral linkages, namely the possibility that sector-specific anticompetitive regulations can have an impact on performance beyond the regulated sector itself, due to the fact that regulated sectors are often important providers of intermediate inputs to other sectors.

The paper is organized as follows. First, we provide a short review of the main channels through which anticompetitive regulations can be expected to affect performance, focusing on their effect on technology adoption, innovation and the allocation of resources to the most productive firms as well as on intersectoral linkages. Second, we illustrate how regulations differ across countries and how they have changed over the past quarter century, pointing out the pervasive regulatory burdens that inappropriate sectoral regulations can impose on the economy as a whole. Third, we look at the cross-country evidence on the regulation-performance nexus, drawing on aggregate, industry-level and firm-level data. We start the analysis with a look at some recent evidence on the correlation between growth in GDP per capita and regulation. Then, we turn to industry-level evidence. We show how

cross-country productivity growth dispersion and average productivity growth performance can be related to regulation, with a focus on the divide between relatively “deregulated” English-speaking countries and relatively more regulated continental European countries. Finally, we report results relating the efficiency of resource allocation across firms and, in particular, the ability of the most dynamic firms to sustain high productivity growth rates, to the underlying regulatory environment.

2. How does regulation affect productivity?

Product market regulations, like other regulations, generally address public-interest concerns about market failures, including monopoly conditions, externalities and asymmetric information. In this context, product market regulation can promote competition in certain industries by ensuring that market power in natural-monopoly segments is not used abusively and by providing the correct incentives to market participants. However, regulatory frameworks may be flawed by several (possibly concurring) factors. Some regulations may drift away from their original public interest aims, resulting in the protection of special interest groups. Second, regulations (and their implementation) sometimes involve costs that exceed their expected benefits, leading to so-called “government failure”. Third, technical progress, the evolution of demand and progress in regulatory techniques can make the design of regulations obsolete.

Product market regulations address public-interest concerns but they may result in protecting special interests; have costs in excess of their benefits; or become obsolete.

Inappropriate regulations can affect the productivity performance of an economy in many ways. Given the multiple channels and the potentially conflicting effects, it is hard to provide a single and exhaustive taxonomy of the regulation-productivity linkages.¹ The focus in this paper is on regulations that curb market competition (henceforth “anticompetitive regulations”). In other words, we concentrate on ways in which ill-designed regulations can harm productivity. We do not discuss the potential benefits of appropriate regulations for productivity. Our analysis is therefore related to the large and growing literature on the effects of competition on growth (see Aghion and Griffith 2005 for a survey). Recent models of endogenous growth often include the feature that, with technology flows unfettered across countries, productivity growth in follower countries or industries depends on both the ability to catch up by adopting leading technologies available on the market and the ability to innovate, with the importance of innovation increasing as the country or industry gets closer to the world technology frontier (Aghion and Howitt 1998; Acemoglu *et al.* 2006).

According to this line of research, anticompetitive regulations influence the productivity of existing firms by altering the incentives for technology adoption and investment in innovation. They can do so by reducing the rivalry among incumbents and by making the entry of new innovative firms difficult.² Conversely, the opening up of markets and increased competitive pressures provide both opportunities and incentives for firms to upgrade their capital stocks, adopt new technologies and innovate to reach, and possibly push out, frontier production techniques. While the empirical evidence is mixed, recent cross-country and micro-economic studies suggest that these effects are significant, especially where the absorptive capacity is high.³

1 For two recent attempts, see Griffith and Harrison (2004) and Crafts (2006).

2 The role of regulatory barriers and monopoly rights in curbing or preventing technology adoption has been illustrated by Parente and Prescott (*e.g.* 1994, 1999). Other models have focused on the role of new technologically advanced entrants. These may give incumbents the incentives to upgrade their capital through imitation. Aside from pure imitation, affiliates of foreign multinationals may also provide incumbents with positive externalities, such as exposure to foreign high-technology intermediate inputs (Rodríguez-Clare 1996), learning spillovers from multinationals to their domestic suppliers (Javorcik 2004) and skill spillovers for the host-country labour force (Fosfuri *et al.* 2001).

3 For instance, evidence suggests that an increase in the presence of foreign affiliates is likely to be associated with higher levels of multifactor productivity. This evidence was surveyed by Keller (2004) and Görg and Greenaway (2002). For studies finding positive spillovers, see, for instance, Haskel *et al.* (2007), Griffith *et al.* (2006), Javorcik (2004) and Arnold *et al.* (2011a). Recently, the attention has focused on the precise channels through which these spillovers occur (see, for instance, Crespi *et al.* 2007).

The links between anticompetitive regulations and productivity are likely to be influenced by the level of economic development of each country and by the characteristics of both firms and industries within each country. One strand of research has highlighted that the effects of regulations on productivity differ across countries, firms and industries depending on their proximity to, or their distance from, best-practice production techniques. Another strand of research emphasizes the importance of anticompetitive regulations for the process of reallocation of resources from less to more efficient firms, which underpins the aggregate growth of market economies.

2.1 Regulation, productivity and distance to best practice

At the aggregate level, the potentially different effect of anticompetitive regulations on growth depending on the stage of a country's development is just one element of the debate around "appropriate institutions" for growth (Acemoglu *et al.* 2006; Aghion and Howitt 2006). The idea here is that regulations that encourage market openness and entry of new firms (domestic or foreign) can have differential effects on performance depending on whether growth is mainly fuelled by innovation or by capital accumulation and technology adoption (*e.g.* via imitation), with the latter partly determined by the ability of a country to absorb, and adapt to, foreign technology. If the absorption and innovation capacity is low, as would happen in many developing countries, openness and entry may not have the same positive incentive effects that they usually have in more advanced countries. Thus, the adverse effect of anticompetitive regulations on growth would be expected to be stronger for countries that have higher levels of productivity and GDP per capita.

Anticompetitive regulations may slow down the take-up of new general-purpose technologies such as ICT.

At the industry level, the effects of anticompetitive regulations can also differ depending on the industry's propensity to use certain types of technologies. For instance, anticompetitive regulations may slow down the take-up of new general-purpose technologies, such as information and communication technologies (ICT). This is because with low competitive pressures, the incentives to invest in such technologies so as to increase productivity and retain market shares may be lower than in more competitive markets. Poschke (2010) shows that the reduction in such incentives due to regulatory barriers to entry can explain a good deal of the productivity differences between the United States and Europe, once technology choice at entry of new firms is accounted for. Moreover, regulatory burdens can make the necessary within- and cross-firm adjustments to new production techniques more costly than where such regulations are lighter (for instance, by protecting the rents of providers of high-technology intermediate inputs). Anticompetitive regulations, including border barriers, can also hinder the diffusion process, not least by preventing the prices of new general-purpose technologies from falling as rapidly as in the global market.

Most importantly, at the firm level, the impact of anticompetitive regulations on productivity can depend on the characteristics of incumbents, new entrants and exiting firms, particularly their position relative to frontier production techniques (Askenazy *et al.* 2008). In the aggregate, this can imply a non-linear link between regulation and productivity that depends on the overall degree of firm heterogeneity in regulated markets. In some cases, the relationship between aggregate innovation (and productivity) and competitive pressures can be hump-shaped, with too little or too much competition being harmful for innovative efforts (Aghion *et al.* 2005). For instance, the incentive effect of competition on incumbents' innovative activities is likely to be stronger for firms whose cost structure is close to that of their innovating rivals than for firms that have a large technological gap to fill (Aghion *et al.* 2004; Aghion *et al.* 2006). For firms that are far enough from the world frontier, the "Schumpeterian" discouragement effect due to an increase in entry (which can reflect competition in a market) can be strong enough to deter any innovation activity.

2.2 Regulation, productivity and resource reallocation

Regulation can also affect aggregate productivity growth by making reallocation of resources across heterogeneous firms less efficiency-enhancing. There is a sizeable heterogeneity in firms' characteristics and productivity performance even in narrowly-defined industries, and a larger heterogeneity in relatively newer industries characterised by faster technological progress (see e.g. Caves 1998; Bartelsman and Doms 2000; Bartelsman *et al.* 2004). These heterogeneity patterns are often associated with the idea that firms, whether new entrants or incumbents, are continuously evolving and experimenting with new ideas and technologies (broadly defined to include the use of advanced technologies but also organizational structures) in order to gain market shares or simply survive.⁴ Research based on firm-level data suggests that all market economies are characterized by a continuous process of reallocation of resources across such heterogeneous firms and that this process plays a major role for aggregate productivity and output growth (e.g. Olley and Pakes 1996; Foster *et al.* 2002; Griliches and Regev 1995; Bartelsman *et al.* 2004, 2009a). Resource reallocation is driven by incumbent firms adapting to market and technological changes, but also by firm dynamics – the entry of new firms, their expansion in the initial years of life and the exit of obsolete units. Firm turnover is a particularly important vehicle for the implementation of innovations in industries characterised by faster technological progress,⁵ where technology adoption often requires (more than in other industries) significant changes in the organization of production and skill composition.⁶ Many of the new firms that enter the market fail in the initial years of life, but those that survive tend to grow, often at a higher pace than incumbent firms (see e.g. Geroski 1995; Sutton 1997; Bartelsman *et al.* 2004, 2009a). Interestingly, while the magnitude of firm turnover is fairly similar across countries, the characteristics of entrants and exiters, their growth performance and overall contributions to technological adoption and, ultimately, to productivity growth vary considerably (Foster *et al.* 2002; Bartelsman *et al.* 2004, 2009a; Griffith *et al.* 2006).

Firm turnover – the entry of new and exit of obsolete firms – is particularly important for the implementation of innovations in sectors with rapid technological progress.

A growing body of empirical research has been relating differences in the contribution of resource reallocation to productivity growth to differences in policies and institutions that shape the business environment. The list of policy and institutional factors that are likely to promote experimentation and efficient resource allocation across sectors and firms is long. A substantial literature has examined the impact of credit constraints on firm dynamics and technology adoption (e.g. Rajan and Zingales 1998; Beck *et al.* 2004; Klapper *et al.* 2006; Aghion *et al.* 2007). A more limited number of studies have looked at the role of labour market regulations in influencing labour reallocation and the adaptability of firms to technological shocks (Haltiwanger *et al.* 2006; Micco and Pagés 2006). More recently, the focus has increasingly been on regulations in the product market, especially those that affect the intensity of competitive pressures.

Anticompetitive regulations are likely to influence the incentives for new firms to enter a given market, as well as for incumbents to engage in experimentation and the associated reallocation of resources. Such regulations can hinder the reallocation of resources across firms with different productivities.

4 Different theoretical models and growing empirical evidence support the idea that firms – both incumbents and new firms – are engaged in a continuous process of “experimentation” in which they choose whether to enter, or to stay in, the market, and whether or not to expand and adopt new technologies that may have higher potentials but also run greater risks (see e.g. Sutton 1997, Pakes and Ericson 1998 and Geroski 1995 for surveys). Indeed, entering a new market always involves significant uncertainties, especially if this is associated with the adoption of a new, potentially more productive but also more uncertain, technology.

5 Bartelsman *et al.* (2004) as well as Bartelsman *et al.* (2005) indeed find that the entry of new firms plays a stronger role in boosting aggregate productivity in high-tech industries as compared to medium and low-tech industries.

6 Newcomers may have a comparative advantage over existing firms in implementing new technologies in as much as they do not have to incur any adjustment costs. The wider range of technology options available to entrant firms, but also the greater uncertainty concerning business plans explains the observed greater variance in the performance of young businesses compared to older incumbents.

The exit of low-productivity firms and the expansion in domestic and foreign markets of more productive firms result in higher aggregate productivity growth.

A number of theoretical studies have tried to account for firm heterogeneity and modelled distortions to entry and exit as well as reallocation. For example, Bernard *et al.* (2003) and Melitz (2003) highlight the role of border barriers affecting the degree of competition in the product market. Building on models by Melitz and Ottaviano (2008) and Del Gatto *et al.* (2006), Corcos *et al.* (2007) find that lifting behind-the-border barriers may be even more important for productivity. In their models with heterogeneous firms, easing trade barriers generates a reallocation of resources in favour of more productive firms. The exit of low-productivity firms and the expansion in the domestic and foreign markets of more productive firms lead to an increase in aggregate productivity growth. Bergoening *et al.* (2002) also allow for idiosyncratic differences in firm productivity and focus on the effect of a productivity shock on aggregate productivity when there are government-induced frictions in the reallocation of resources. Their simulations suggest that such frictions lengthen the period in which output is below potential. A few additional studies have further developed models with adjustment frictions that prevent resources from immediately being allocated to the most productive firms (see *e.g.* Restuccia and Rogerson 2007; Hsieh and Klenow 2007; Bartelsman *et al.* 2009b). Static and dynamic frictions partly depend on market characteristics and technological factors but are also clearly related to inappropriate product market regulations. In particular, frictions may represent the costs of adjustment – either in the form of entry and exit costs, or adjustment costs to reallocate factors of production such as capital and labour.⁷ In these models as well, both policy-induced entry costs and regulations that raise the adjustment costs to technological shocks reduce aggregate productivity.

As stressed by Bartelsman *et al.* (2009b), inappropriate regulations may affect the reallocation dynamics on different margins in a variety of ways. For example, high start-up costs are likely to reduce firm turnover and potentially lead to a less efficient allocation of resources, but those firms that finally enter the market may have higher productivity than otherwise due to a tighter selection at entry. In turn, the average productivity of incumbents and exiting businesses will be lower. Similarly, certain market distortions might weaken the selection process at entry and exit leading to less systematic differences between entering, exiting and incumbent businesses. There is also an important time dimension: market conditions that promote experimentation and trial and error processes may be associated with more risk and uncertainty in the short run, leading to a lower immediate contribution from entry to productivity, but a higher long-run contribution once the trial and error process of experimenting firms has worked its way out through learning and selection effects.

2.3 Intersectoral linkages

Regulations that hinder competition via the channels highlighted above can affect productivity not only in each regulated industry but also in other industries through intersectoral linkages. Lack of competitive pressures in a sector can generate trickle-down effects on other sectors by raising the costs, lowering the quality or reducing the availability of intermediate inputs, particularly in the case of service inputs where import competition is limited. Recent research has explored the indirect effects that barriers to competition in (upstream) sectors may have on the efficiency of resource allocation and the productivity performance in other (downstream) sectors (Bourlès *et al.* 2010; Barone and Cingano 2011, Arnold *et al.* 2011a).

The main idea is that upstream regulation generates market power for intermediate-good providers. This power is used to extract rents from downstream firms and restrict their access to key markets, which reduces their opportunities and incentives for productivity improvements. Based on a variant of the innovation model by Aghion *et al.* (1997), Bourlès *et al.* (2010) show that anticompetitive upstream

⁷ Labour reallocation might involve a range of costs including the search and matching frictions that have been the focus of much of the recent literature on the dynamics of the labour market (see *e.g.* Davis *et al.* 1996; Restuccia and Rogerson 2007; Hsieh and Klenow 2006).

Regulations can reduce competitive pressures and incentives to improve efficiency also in client ('downstream') sectors.

regulations can reduce competitive pressures in downstream markets by increasing the cost of finding an intermediate supplier, thereby reducing the number of downstream firms. For instance, lack of competition in an upstream sector can generate barriers to entry that also curb competition in downstream sectors: tight licensing requirements in retail trade or transport can narrow the distribution channels for downstream firms and overly restrictive regulation in banking can reduce the range of available sources of financing for client firms, thereby curbing new entry and firm growth. Moreover, the incentives to improve efficiency downstream are reduced by the ability of upstream firms to appropriate a share of the rents that downstream firms would earn from such improvements. This is because, if the markets for intermediate inputs are imperfect, downstream firms may have to negotiate with (and can be held up by) suppliers. In a similar vein, but based on a model of industry interdependence and international specialization, Barone and Cingano (2011) show that regulations restricting competition in upstream sectors for which import competition is weak (e.g. services) affect the cost and/or quality of products used as intermediate inputs in downstream industries or firms. This imposes unnecessary costs of adjustment to downstream firms wishing to improve efficiency and biases industry specialization away from industries that are intensive in the regulated inputs.⁸ Resource allocation across industries and aggregate productivity growth are obviously also affected.

3. Tracking differences in regulation across countries, industries and over time

3.1 Measuring regulation

Studying the quantitative effects of regulation on productivity requires measuring regulation in a relevant, consistent and comparable way across countries, industries and time. In the context of this study, relevance means only considering regulations that have an impact on competitive outcomes in markets, industries and countries. Consistency and comparability can be reached in a variety of ways. For instance, Griffith *et al.* (2004) and Aghion *et al.* (2006) have recently used EU data on anti-monopoly cases and the implementation of the Single Market Programme to address the potential policy determinants of competition, while Buccirosi *et al.* (2009) have used variability in competition law provisions and enforcement rules in a subset of OECD countries. In this paper, we focus on indicators of anticompetitive product market regulations drawn from the OECD international product market regulation database.⁹ These indicators measure to what extent competition and firm choices are restricted where there are no *a priori* reasons for government interference, or where regulatory goals could plausibly be achieved by less coercive means. They are based on detailed information on laws, rules and industry settings (e.g. the extent of vertical integration or monopoly power), and cover both general-purpose regulations (such as administrative burdens on start-ups) and sector regulations in energy (gas and electricity), transport (rail, road and air), communication (post, fixed and cellular telecommunication), retail distribution, professional services and banking, with country and time coverage varying across industries. This information covers both domestic anticompetitive regulations and industry-specific FDI restrictions in all OECD countries as well as in the BRIICS (Brazil, Russia, India, Indonesia, China and South Africa).¹⁰

8 Indeed, in theoretical models of industry interdependence, the underdevelopment of markets for non-tradeable inputs has been shown to constrain (or even prevent) the diffusion of input-intensive technologies, thus affecting the patterns of resource allocation and international specialization (Rodríguez-Clare 1996; Okuno-Fujiwara 1988). Barone and Cingano's work is related to the growing literature on the relevance of institutions for resource allocation and comparative advantages (see e.g. the references in Barone and Cingano 2011).

9 The data and underlying documentation are publicly available at www.oecd.org/eco/pmr. The most recent observations are currently for 2007/2008.

10 The basic regulatory data include: economy-wide indicators for all OECD countries and several non-OECD ones for 1998, 2003 and 2007; indicators for energy, transport and communication that cover most OECD countries over the 1975-2007 period (several non-OECD countries are also covered for the most recent period); indicators for retail distribution and professional services that cover most OECD countries and several non-OECD countries for 1998, 2003 and 2007; the

The main advantages of using these indicators in empirical analysis are that they can be held to be exogenous to productivity developments and that they are directly related to underlying policies, a feature that business survey data do not have.¹¹ Another advantage is that, since they are composite constructs based on detailed information on specific policies, they address multicollinearity problems in estimation. At the same time, they make it possible to focus on the specific aspects of policies that are considered to be relevant for productivity. For instance, most of the analysis reported below deals with barriers to entry (including administrative burdens), sometimes explicitly distinguishing between border and non-border policies that affect these barriers. Yet another advantage of the OECD indicators is that they vary over countries, industries and time, though full time variability is limited to a subset of non-manufacturing industries.¹²

The OECD regulation indicators are used to summarize the potential burden of non-manufacturing regulations imposed on all business sectors via intersectoral linkages.

The OECD indicators are also used to summarize the potential burden of non-manufacturing regulations imposed on all business sectors via intersectoral linkages. This is particularly important because the non-manufacturing sector is undoubtedly the most regulated and sheltered part of the economy, while few explicit barriers to competition remain in markets for manufactured goods of OECD economies. However, as discussed above, even low-regulated industries may suffer from regulation-induced inefficiencies in non-manufacturing because all industries are heavy intermediate consumers of non-manufacturing inputs. Sectoral "Regulation impact" (RI) indicators of the indirect burden of anti-competitive regulation in upstream non-manufacturing industries for downstream industries (including the regulated non-manufacturing industries themselves) are calculated for each country using information from input-output tables:¹³

$$(1) \quad RI_{kt} = \sum_j (NMR_{jt} + FDI_{jt}) \cdot w_{jk} \quad 0 < w_{jk} < 1$$

where the variable NMR_{jt} is an indicator of domestic anticompetitive regulation in non-manufacturing sector j at time t , FDI_{jt} is an indicator of FDI restrictions in non-manufacturing sector j at time t , and weight w_{jk} is the total input requirement of sector k for intermediate inputs from non-manufacturing sector j . These Regulation impact indicators allow tracking the "trickle-down" effects of inappropriate regulations in non-manufacturing industries on productivity in all sectors of the economy.¹⁴

indicator for banking that covers 30 OECD countries for 2003. The indicator of FDI restrictions covers a larger set of sectors over the 1981-2007 period.

- 11 Naturally, endogeneity cannot be completely ruled out if, for instance, policies are affected by productivity outcomes through political-economy channels. On the relative advantages of policy-based and survey-based composite indicators, see Nicoletti and Pryor (2006).
- 12 Griffith *et al.* (2006) formulate a number of criticisms concerning the OECD indicators, the most compelling being that their time dimension is limited to a subset of non-manufacturing sectors that they do not think are sufficiently representative of economy-wide regulatory developments. Conway and Nicoletti (2006) show that the OECD indicator of non-manufacturing regulation is closely correlated, both across countries and over time, with a popular time-series indicator of economy-wide business regulation, the Economic Freedom of the World index by Gwartney and Lawson (2003). This is not surprising since most OECD product market reforms have been implemented in the non-manufacturing industries over the past decades.
- 13 The resulting Regulation impact indicator covers 39 sectors that use the outputs of these non-manufacturing industries as intermediate inputs for the 1975-2007 period. Given that some sectoral indicators (retail, professional services and banking) have a limited time coverage, we use their 2003 value to compute the regulation impact indicators. But the empirical results reported in the next section do not change if values for 1998, 2003 and 2007 are used instead, with interpolation between periods. This technique for calculating the regulation impact indicators has also been used by Faini *et al.* (2006) and Barone and Cingano (2011).
- 14 All OECD indicators take continuous values on a scale going from least to most restrictive of competition. A detailed description of the indicators of economy-wide regulation can be found in Woelfl *et al.* (2009, 2010) while a detailed description of domestic non-manufacturing regulation and the trickle-down indicators of "regulation impact" is provided in Conway and Nicoletti (2006). Indicators of FDI restrictions are described in Golub (2003) and Golub and Koyama (2006). The indicator of domestic anticompetitive regulations in banking is described in de Serres *et al.* (2006).

3.2 Regulation: Cross-country patterns and historical developments

Figure 3 shows cross-country patterns and the evolution of economy-wide product market regulation and FDI restrictions across non-manufacturing sectors. It suggests that, overall, regulatory approaches have converged across OECD countries over the past two decades towards a more procompetitive stance. Looking at specific non-manufacturing sectors, convergence has taken place in particular in energy, transport and communication as well as in border barriers to FDI (for the latter see Figure 3b), while the available time-series data for retail trade and business services point to persistent differences in the regulatory stance across countries in these sectors. Despite convergence in many areas and sectors, differences in regulation persisted at the end of the period, suggesting that competitive pressures still differ considerably across both countries and sectors.

While regulations have converged towards a more procompetitive stance in many areas of OECD economies, differences persist in retail trade and business services.

Figure 3a. Economy-wide product market regulation
OECD indicator, scale 0-6 from least to most restrictive

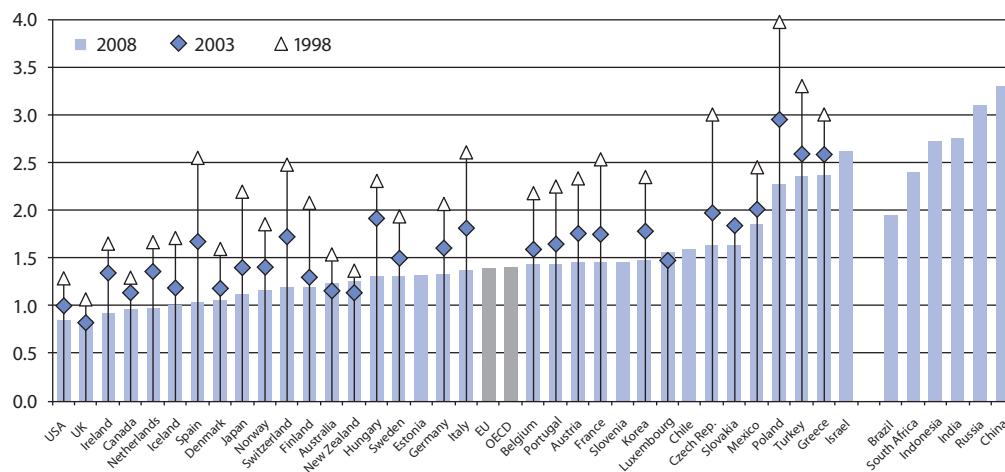
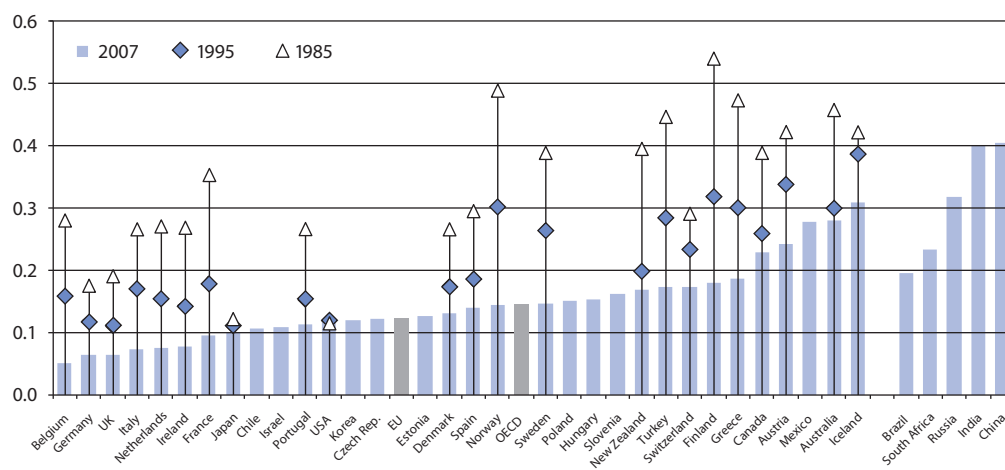


Figure 3b. FDI restrictions in the business sector
OECD indicator, scale 0-1 from least to most restrictive



Source: OECD International Regulation Database

The figure also suggests that, in the most recent period for which data are available, regulations often tended to remain more adverse to competition in emerging economies than in OECD countries, though not necessarily in all sectors. Unfortunately, historical data are lacking and it is not possible to

use the OECD indicators for tracking whether emerging economies have been converging in regulatory practices towards more advanced economies.

These patterns raise a number of issues that are relevant from both a research and policy point of view. First, to what extent is the more restrictive stance in a number of countries, including the emerging economies, slowing down their GDP per capita and productivity growth rates? Second, can differences in competitive pressures across industries that are induced by different regulatory approaches explain the wide cross-country and cross-industry dispersion of productivity growth rates observed in the OECD area? Third, to what extent can regulations that curb competitive pressures and generate unnecessary burdens for businesses hinder reallocation towards the most efficient firms? Fourth, do these regulations affect all countries, industries and firms equally, irrespective of their technological characteristics, dynamism and distance to best practice? We now turn to the cross-country empirical evidence on these issues.

4. Evidence on regulation and productivity

A growing number of recent empirical studies have focused on the effects of product market conditions on growth in productivity and GDP per capita. Some studies have focused on the impact of product market conditions on capital accumulation (Alesina *et al.* 2005) and its asset composition (Gust and Marquez 2004; Conway *et al.* 2006; Bloom *et al.* 2010) as well as on their effects on innovation (Aghion *et al.* 2005; Aghion and Griffith 2005). Here we focus on those cross-country studies that have directly related measures of anticompetitive regulation to GDP per capita and productivity growth. The review does not have the ambition to be exhaustive.

4.1 Some aggregate evidence

Country-level evidence confirms the negative effects of anticompetitive regulations on GDP per capita and MFP growth but the results are somewhat fragile.

Empirical research linking anticompetitive regulations to aggregate growth has found negative effects on GDP per capita, GDP per worker or multifactor productivity (MFP) growth, but the results are not always robust and consistent across studies. These studies have taken empirical approaches based either on static cross-country growth regressions *à la* Barro and Sala-i-Martin or on dynamic panel regressions. Static models have been estimated with either a fixed number of explanatory variables (in addition to regulation) or with methods that allow identifying the variables that are most likely to affect growth among a vast number of possible factors, including regulation (so-called Bayesian Model Averaging – BMA). Studies also differ in terms of the sample of countries used. As shown in Babetskii and Campos (2007), differences in methodology and sample coverage can significantly affect the size (and sometimes the sign) of the growth effects of changes in institutional variables.

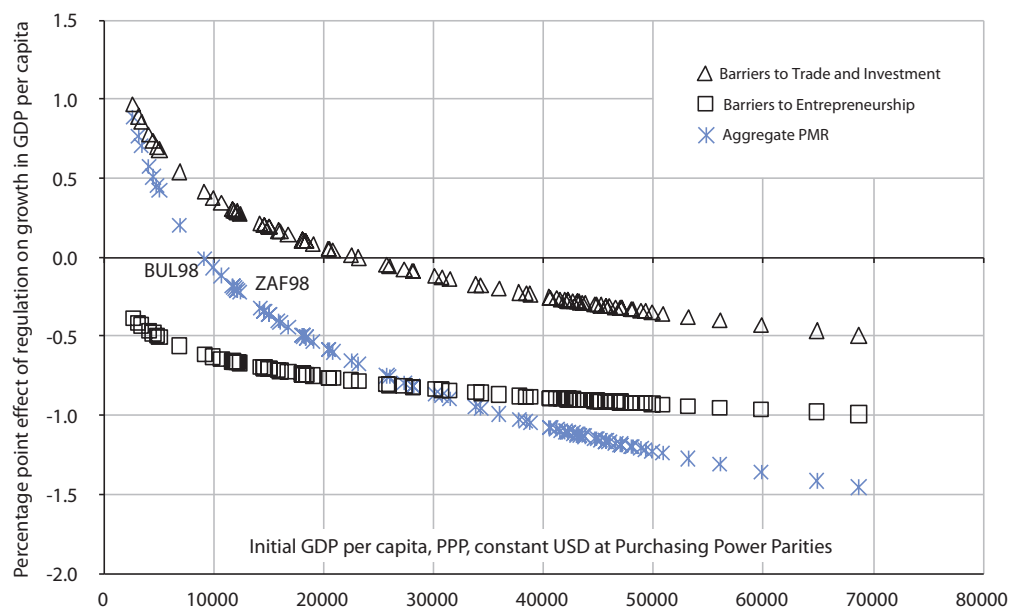
A few recent studies illustrate well the fragility of aggregate findings. Using a BMA methodology and focusing on GDP per capita, Woelfl *et al.* (2010) find that easing anticompetitive regulations by an amount equivalent to moving from the regulatory stance of Brazil to that of the average OECD country could yield a 0.3 percent higher average annual rate of growth in per capita GDP. Boulhol *et al.* (2008) previously found similar results based on simple dynamic panel regressions. However, the statistical significance of results from both these studies is relatively weak. Using a more complex dynamic approach based on Bloom *et al.* (2002), Bouis *et al.* (2011) also find that anticompetitive regulations curb GDP per capita via their effect on MFP, but they are unable to sharply distinguish the influence of regulation from that of other institutional variables within their estimation framework. Finally, specifically focusing on MFP in the context of static cross-country growth regressions, Aghion *et al.* (2009) also find adverse effects of market rigidities (expressed as a combination of labour and product

market regulation) on aggregate performance. A common feature of all these studies is that, among the various kinds of regulations that were tested, barriers to entry and entrepreneurship are found to be those having the most significant and damaging effects on performance.

One possible reason for the lack of robustness of results from aggregate studies is that the effects of regulation, and of different kinds of regulations, may vary with levels of development (Aghion and Howitt 2006). This implies a “composition” effect that blurs the link between regulation and performance when this non-linearity is not accounted for in estimation. Some estimates from dynamic panels with thresholds (or simple dummies) differentiating among effects of regulations across income levels suggest that anticompetitive regulations may have particularly adverse effects on more advanced countries, while having lesser negative effects and even positive ones at low levels of development. For instance, Figure 4 shows how the effects of different kinds of regulations vary across countries with different initial GDP per capita levels according to the panel estimates of Woelfl *et al.* (2010). Negative effects of overall anticompetitive regulations (PMR) begin to be observed at GDP per capita levels just above those of Bulgaria (BUL) or South Africa (ZAF) in 1998, with certain barriers to trade and investment still having positive effects even at higher income levels. Nonetheless, as already mentioned, barriers to entrepreneurship have uniformly negative effects on growth in all countries independent of GDP per capita. But the effects of all types of regulations on growth become increasingly adverse as income levels rise, and particularly steeply so for those regulations that affect international openness. Aghion *et al.* (2009) find similar threshold effects of market rigidities on aggregate MFP growth, with rigidities decreasing growth only in countries with income close to the level of the United States. No such threshold effects were found, however, in the dynamic panel estimated by Bouis *et al.* (2011), suggesting that the jury is still out concerning the relevance of such effects for policy analysis and recommendations.

Some studies suggest that anticompetitive regulations have more harmful effects on more advanced countries than on countries at low levels of development.

Figure 4. The impact of regulation on growth at different levels of initial GDP per capita



Source: Woelfl *et al.* (2010)

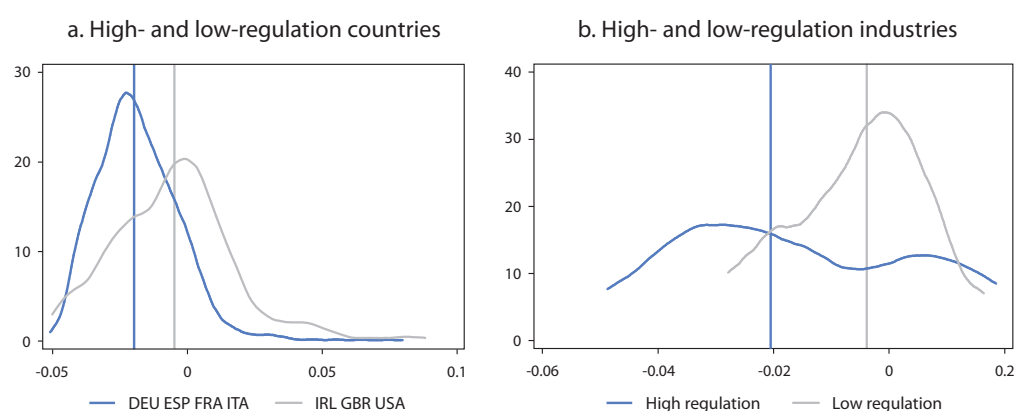
4.2 Regulation and industry-level productivity

To begin exploring the link between regulation and industry-level productivity, Figure 5a shows the cross-industry distribution of labour productivity growth rates over the 1995-2005 period in two groups of countries for which we have consistent data: three relatively “deregulated” English-speaking countries

– the United States, the United Kingdom and Ireland – and four relatively “restrictive” large European countries – Germany, France, Italy and Spain. The figures focus on trend productivity growth rates to abstract from short-term fluctuations. Moreover, the growth rates have been purged of idiosyncratic effects across countries and industries to make it possible to pool the productivity data in a meaningful way.¹⁵ Therefore, the values on the horizontal axis are not directly interpretable, while their dispersion (overall and across industries) is.

In Figure 5b, observations are classified into low or high regulation if they fall into the first and last quintiles, respectively, of the distribution of the regulation impact indicator. This indicator reflects the trickle-down effects of anticompetitive regulation in non-manufacturing sectors on industries that use the output of these sectors as intermediate inputs into the production process.

Figure 5. Labour productivity growth distributions across countries, industries and time, 1995-2005



Source: Authors' calculations based on EU-KLEMS, March 2007, and OECD International Regulation Database
 Notes: The horizontal axis shows trend productivity growth, Hodrick-Prescott (HP) filtered (to eliminate the cyclical component) and purged of country and industry means. Agriculture, forestry, fishing, mining and construction are excluded, as are public administration, education and health sectors. The vertical bars represent sub-sample medians.

English-speaking countries have a higher concentration of fast-growing sectors than continental EU countries.

Several features emerge from Figure 5. For both groups of countries, the overall distribution is skewed to the left, indicating prevalence of weak productivity growth rates, but has a long right tail, suggesting cases of high productivity growth. Interestingly, the right tail of fast growing industries is longer and thicker in English-speaking countries than in continental EU countries that have a higher concentration among relatively more slowly-growing industries. As a consequence, English-speaking countries tend to have a higher median productivity growth than continental EU countries (as shown by the distance between the vertical lines).

In the light of our previous discussion, it is natural to relate these differences in the distribution of productivity growth to underlying product market regulations that are more or less prone to help sustain efficiency improvements within each industry. As a first check on this conjecture, Figure 5b replicates the productivity growth distributions pooling together all countries, but now distinguishing between high- and low-regulated cases (each observation being for a country/sector/year, again purged of idiosyncratic factors). Low- and high-regulated cases are defined as those falling within the first and fifth quintiles, respectively, of the distribution of the OECD regulation impact indicator. As explained above, using these indicators makes it possible to account for both the direct effects of anticompetitive regulations in each industry and the indirect effects via intersectoral linkages.

¹⁵ In other words, the figure shows the distribution of the residual of a regression of productivity growth rates on country and sector dummies after applying a Hodrick-Prescott filter and eliminating outliers (top and bottom percentile of the distribution). The resulting distributions are based on country-industry-year observations.

The figure suggests that regulation plays a role in shaping the distribution of productivity growth rates. Where regulation encourages competition and does not impose any excessive costs to businesses, both the density of high productivity growth rates and median productivity growth are higher than where regulations are restrictive and costly. Moreover, the dispersion of productivity growth rates is much higher in highly-regulated situations and low productivity growth is much more frequent.

The wide industry-level dispersion of productivity growth rates is a potentially important source of identification for econometric studies of the regulation-productivity link. A large number of such industry-level studies have been implemented over the past decade, mostly relying on dynamic panel data analyses (e.g. Scarpetta and Tressel 2002; Nicoletti and Scarpetta 2003; Conway *et al.* 2006; Griffith *et al.* 2006; Inklaar *et al.* 2008; Buccirossi *et al.* 2009; Bourlès *et al.* 2010) within the general framework proposed by Aghion and Howitt (2006). In this framework, sectoral productivity growth in a given country depends on the ability to keep pace with growth in the country with the highest level of productivity (the leader) by either innovating or taking advantage of the best technology available. Productivity growth depends on both knowledge spillovers from the leader's innovation drive and the speed at which the productivity gap is closing due to, for instance, technology diffusion and adoption. In turn, the effect of anticompetitive regulation on productivity growth in follower countries is assumed to depend on the size of the sectoral productivity gap.¹⁶

While the basic estimation framework is similar, the various studies differ in data and coverage, control variables and, especially, in the measurement of product market policies, with the most recent studies focusing on the indirect burdens imposed by (upstream) non-manufacturing regulations on all (downstream) business sectors (see Arnold *et al.* 2008 for a survey). The match between the industry productivity dimension and the industry-level regulation impact indicators constructed by the OECD, as well as their time-series variability, has proved to be particularly useful for the estimation.

Given the differences in data and specification, the results from industry-level studies are not easily comparable. However, a number of common conclusions emerge:

- In all studies, regulations that restrict competition are found to curb labour productivity or MFP growth significantly, even though the point estimates vary.
- Studies that obtain separate estimates for different sectors (Conway *et al.* 2006; Inklaar *et al.* 2008) tend to find stronger negative effects in ICT-intensive industries.
- Regulations that appear to be most damaging for sectoral productivity growth are barriers to entry, consistent with the results found in aggregate growth regressions (see above).
- Studies that account for regulatory burdens implied by intersectoral linkages (Conway *et al.* 2006; Inklaar *et al.* 2008; Bourlès *et al.* 2010) find these burdens to provide an important explanation of the dispersion in productivity growth rates across countries, industries and over time.

Focusing on labour productivity, Conway *et al.* (2006) show that regulatory burdens have been particularly harmful to productivity improvements in ICT-intensive sectors, largely because they slowed down the catch-up process to best practice productivity. Conway and Nicoletti (2007) estimate the productivity growth "deficit" that would be suffered by countries whose anticompetitive regulations would hinder the catching-up following a global positive productivity shock such as that experienced in the OECD area during the diffusion of ICT. In all countries, the detrimental effect of anticompetitive regulation, again expressed by the regulation impact indicator, is larger in ICT-intensive sectors given

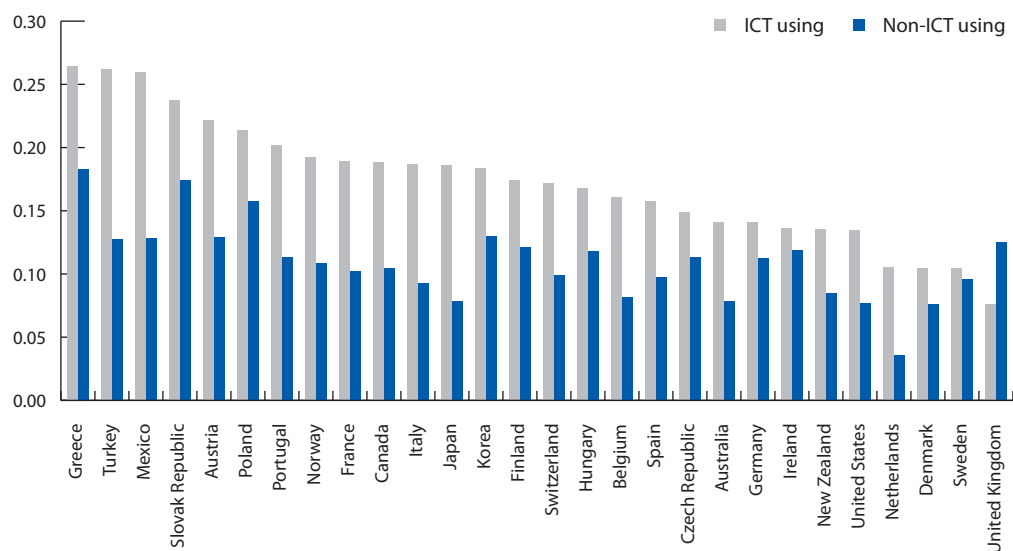
Regulations are most harmful when they affect ICT-intensive sectors; come as barriers to entry; or concern sectors providing key inputs for other sectors.

¹⁶ All these studies include country- and sector-fixed effects. However, due to the presence of the interaction term between the productivity gap and regulation, the source of identification of the regulation effects is variability across all dimensions of the panel: time, industries and countries.

that the regulatory burden is estimated to be higher in these sectors in comparison to non-ICT intensive sectors (Figure 6). The estimated gap in productivity catch-up in ICT-intensive sectors is particularly sizeable in Austria, Greece, Italy, Germany, Norway and Belgium, all of which remain 30 to 40 percent below potential five years after the initial shock.

Figure 6. The burden of non-manufacturing regulation on ICT-using and non-ICT using sectors, 2003

Scale normalised to 0-1 from least to most burdensome



Source: OECD International Regulation Database

Notes: The figure shows the regulation impact indicator, which reflects the burden of anticompetitive regulation in non-manufacturing sectors on industries that use the output of these sectors as intermediate inputs into the production process.

The strength of the adverse growth effects may depend on the distance from the technological frontier, but whether close followers or laggards are more affected is under debate.

While virtually all industry-level studies of the regulation-productivity link, on average, find adverse effects of anticompetitive policies on growth, there is less agreement on whether these effects are uniform across countries (or sectors) independent of their distance to the technological frontier. Among the studies that have conditioned the effects of regulation on distance to frontier, Conway *et al.* (2006) and Nicoletti and Scarpetta (2003) find that regulation tends to slow down productivity growth more strongly in countries (or sectors) that are further away from global best-practice productivity. They ascribe this result to the tendency of weak competitive pressures and burdens implied by regulation to lower incentives and opportunities and increase the costs of adopting best-practice production technologies and methods. Average developments in industry productivity would thereby suffer from weak growth in the most efficient firms and a low contribution of firm turnover to efficiency improvements.¹⁷

Recent studies (Bourlès *et al.* 2010) suggest, however, that anticompetitive regulations in up-stream industries tend to have a more damaging effect on the multifactor productivity growth of sectors sufficiently close to the global productivity frontier. This is consistent with the neo-Schumpeterian view that lack of competition is particularly harmful where the “escape-competition” effect benefiting an innovating firm is the strongest – that is in a situation of neck-and-neck rivalry among firms

¹⁷ Since Conway *et al.* (2006) focus on labour productivity, the greater harm to productivity growth caused by anticompetitive regulations for countries and sectors that are further away from the global frontier can also be ascribed to the tendency of such regulations to curb capital formation (Alesina *et al.* 2005) and ICT investment (Gust and Marquez 2004).

(Aghion *et al.* 1997; Aghion and Howitt 2006). Nevertheless, Broulès *et al.* also find that this closeness-to-frontier effect vanishes in the most recent period (1995-2007) characterised by increased integration of global markets and the widest diffusion of ICT technologies. In other words, countries (and sectors) uniformly suffered from anticompetitive regulations in the more recent past independent of whether they are close to or well behind the frontier. Over the whole estimation period, regulation is found to curb productivity for more than 85 percent of the observations while significantly increasing it only for a small share of them (3 percent), namely for firms whose MFP levels are less than half of those of the global technology leader. Using the average level of regulation and the average level of the productivity gap, regulation is estimated to curb annual MFP growth by around 1 percentage point over the whole period and by around 1.7 percentage points more recently.

4.3 Regulation, firm-level reallocation and productivity

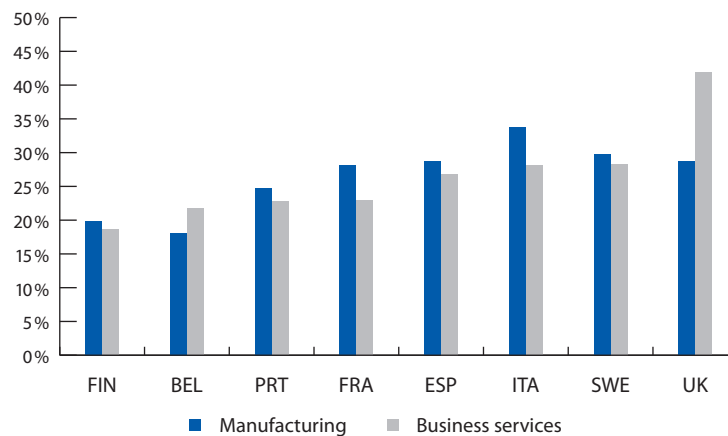
As discussed above, industry-level productivity growth hides a widespread heterogeneity in firms' performance within each industry and a continuous process of reallocation across them, through the entry of new firms, the exit of obsolete ones and the reallocation of factor inputs among continuers. All industries display persistent productivity dispersion, pointing to a (more or less) wide heterogeneity in the performance of firms. In this context, a natural question is whether market forces tend to reallocate resources towards firms with higher efficiency levels. A simple way of assessing the importance of reallocation for productivity is to ask the question – are resources efficiently allocated in a sector/country in the cross-section of firms at a given point in time? To answer this question, we focus on multi-factor productivity, which is the appropriate measure of firm-level efficiency in the use of inputs, and we use the simple cross-sectional decomposition of MFP levels for a sector at a point in time developed by Olley and Pakes (1996). Aggregate MFP is decomposed into two terms involving the un-weighted average of firm-level MFP plus a cross term that captures allocative efficiency since it reflects the extent to which firms with greater efficiency have a greater market share.¹⁸

To see whether the resource allocation across firms in a sector is efficient, we check to what extent firms with greater efficiency have greater market shares.

This decomposition essentially involves comparing the un-weighted average MFP to the weighted average MFP. To minimise the measurement problems involved in comparing these MFP levels across sectors or countries, we focus on the relative contribution of allocative efficiency to the observed aggregate productivity level. This requires comparing productivity levels of firms in the same industry and country, thus ensuring that most measurement problems are controlled for. Specifically, we estimate a production function in logarithmic form for each sector and country and take the residual, *i.e.* the part of output that is not explained by factor inputs, as a measure of MFP. Figure 7 presents the estimated indicator of efficiency ($OP=WP/(AP+WP)$) in the allocation of resources in a sample of EU countries for which we have consistent firm-level data from the Amadeus database over the early 2000s. It focuses on manufacturing and business services separately and for each of the two broad sectors, a weighted average of 2-digit industry level OP cross terms is used.

18 Formally, the decomposition is given by: $P_t = (1/N_t) \sum_i P_{it} + \sum_i \Delta \theta_{it} \Delta P_{it} = AP_t + WP_t$ where N is the number of businesses in the sector and Δ is the operator that represents the deviation of, respectively, the firm-level measure of productivity (P) and the business market share (θ) from their respective industry simple average in a given year.

Figure 7. Contribution of resource allocation to sectoral MFP levels (early 2000s)
Based on Olley-Pakes productivity decomposition



Source: Authors' calculations based on Amadeus database

Notes: The data reported in the figure represent the share of the total MFP level that is due to an efficient allocation of resources. The degree of efficiency in resource allocation is measured by the cross-term of the Olley and Pakes decomposition (see the main text), which is defined as the log difference between the weighted (P_i) and un-weighted averages (AP_i) of firm-level productivity.

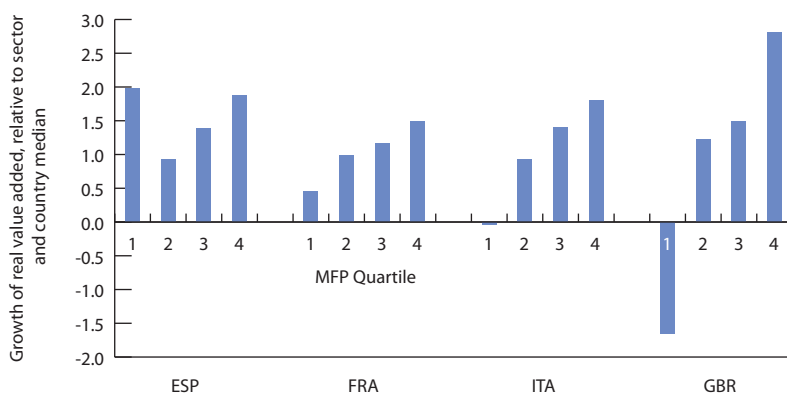
The OP decomposition suggests that, in all countries, allocative efficiency accounts for a significant fraction of the overall observed MFP levels: between 20-40 percent of the observed productivity levels can be ascribed to the actual allocation of resources compared to a situation in which resources would be randomly allocated across firms in each sector. However, there are also differences across the two broad sectors and across countries. The United Kingdom stands out with the highest degree of allocative efficiency in services, almost 15 percentage points above that of the second-highest country in the service sector (Sweden).

More productive firms generally grow faster than less productive ones, but some countries do better than others in channelling resources to high performers.

To shed some further light on the allocative efficiency, Figure 8 plots average firm growth by the quartile of the firm-level MFP distribution. The quartiles divide firms according to their MFP relative to the median of the sector and country for which the production function was estimated, on average over 1998-2004). Thus, the top quartile represents the 25 percent most productive firms in each industry. Firm growth is measured in terms of real value added, averaged over 1998-2004, and normalised by the country/sector average (which is set equal to 1 in the figure). In other words, a value of 3 for the highest quartile in the United Kingdom means that these firms grew on average three times as fast as their peers in the same country and sector. Naturally, this is a partial analysis that does not consider dynamic processes – for example, some of the low-productivity firms may be new ventures that are involved in a learning-by-doing process and catching up with the efficiency of more mature businesses, while some of the highly productive businesses may have less scope for further expansion. Bearing this caveat in mind, the figure suggests that in all countries but one (Spain), more productive firms indeed experience higher growth than their lower-productivity counterparts. However, the growth differences between low- and high-productivity firms vary significantly across countries. This confirms our finding based on the cross-sectional OP productivity decomposition, namely that some countries are better able to channel resources towards high-productivity firms, thereby encouraging them to grow rapidly and strongly contributing to the overall productivity performance.

Figure 8. Do better firms grow faster?

Value-added growth by quartiles of the MFP distribution of firms



Source: Authors' calculations based on the Amadeus database

Notes: The figure presents the average real value added growth of the four quartiles of the MFP (relative to the median of the sector and country for which it was estimated) distribution of firms in each country. Firm level real value added growth is normalised by country/sector average to improve the comparability.

Two questions emerge at this point: Why have some countries been more able than others to reallocate resources towards fast-growing firms, especially in industries with a high potential for exploiting new general-purpose technologies? What are the mechanisms through which inappropriate regulations might affect reallocation across sectors and firms? A first step towards answering these questions is to correlate our OP indicator of allocative efficiency across countries, sectors and time with the OECD indicators of the regulatory burden imposed by non-manufacturing regulation on all sectors of the economy. In other words, we investigate whether there is an association between anticompetitive regulations (in both upstream and downstream sectors) and the efficiency of the reallocation process within each industry.¹⁹

The results are shown in Table 1. For the overall business sector, they point to a negative effect of regulatory burdens on the efficiency of resource allocation. However, breaking down the sample into manufacturing and services suggests that the negative effect of regulation originates from services. This is not surprising, since cross-country differences in the regulatory environment and regulatory reforms over the past decade mostly concerned the service sector. Interestingly, if we split the industry sample between ICT-intensive and non-ICT intensive sectors, we find that regulatory burdens affect the ICT-intensive sectors more strongly, where such burdens are often higher (see Figure 6 above). In other words, in those sectors where there was more heterogeneity in firm performance because of greater experimentation and learning by doing around this new general-purpose technology, regulations that restricted competition and entry of new firms have had a strong negative effect on the ability of the market to channel resources towards firms with the best performance. This illustrates one channel through which restrictive regulations that impinge on ICT-intensive sectors may have curbed the ability of some countries to fully benefit from the diffusion of new technologies over the past decade, as suggested by Conway *et al.* (2006) based on industry-level data.

Regulatory burdens affect the efficiency of resource allocation, especially in services and ICT-using sectors with their greater need for experimentation and learning-by-doing.

¹⁹ We use a fixed-effect specification where, in addition to our regulation impact indicator, we include a full set of time-varying country-specific and sector-specific effects. The sample includes a set of OECD countries for which the Amadeus database has a good coverage of firms: Austria, Belgium, Finland, France, Germany, Italy, Portugal, Spain, Sweden, United Kingdom; the period is 1998-2004.

Table 1. Product market regulation and allocative efficiency

Dependent variable: Olley-Pakes indicator	Business sector	Manufacturing only	Services only	ICT-using sectors	Non-ICT using sectors
Regulation impact indicator	-0.33*** (0.10)	0.54 (1.44)	-0.37** (0.16)	-0.30** (0.14)	-0.26 (0.17)
Country-year fixed effect	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes
Observations	894	703	191	417	477
R2	0.20	0.21	0.19	0.21	0.20

Source: Updated from Arnold *et al.* (2008)

Note: Standard Errors in parentheses. *, **, *** indicate statistical significance at the 10, 5 and 1 percent levels, respectively. Agriculture, forestry, fishing, mining and construction are excluded, as are public administration, education and health sectors. ICT-intensive sectors include both ICT-producing and ICT-using sectors.

Further light on the link between regulation, reallocation and productivity growth can be provided by formal econometric analysis using firm-level data. This makes it possible to explore the effects of inappropriate regulations on firm-level productivity while accounting for heterogeneity in firm characteristics. Limits in the availability of comparable firm-level data have so far restricted the number of cross-country empirical studies of this kind. Most available studies have therefore focused on firm-level panels in individual countries. Moreover, most firm-level studies of the competition-performance nexus have used measures of competition based on market outcomes, such as entry rates, mark-ups, market shares or concentration indices (Nickell 1996; Blundell *et al.* 1999; Aghion *et al.* 2004, 2005, 2006; Forlani 2011). Here we report results from three recent multi-country firm-level studies that have explicitly focused on the role of barriers to entry imposed by regulation.

Depending on their design, entry regulations play the roles of screening the best entrants or protecting inefficient incumbents.

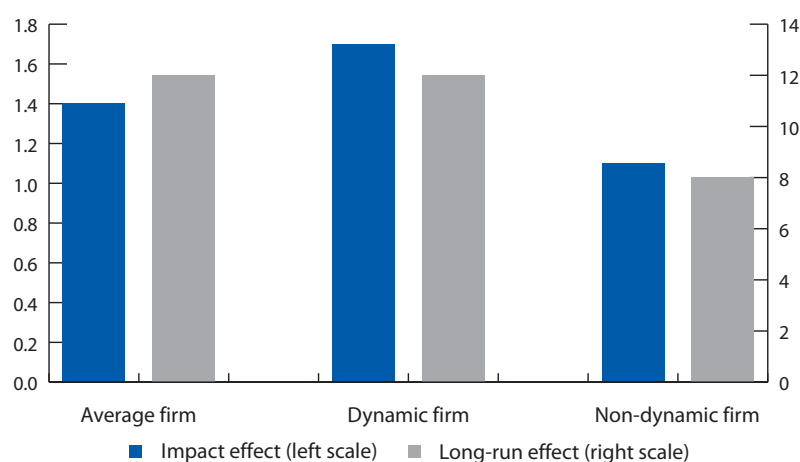
Klapper *et al.* (2006) look at the effect of entry regulations, as measured by the World Bank Doing Business indicators (World Bank 2004), on entry rates, the size of entrants and their labour productivity growth rates in a two-year (1998-1999) panel of European firms covered by the Amadeus database. They note that depending on their design, entry regulations can play the alternative roles of screening the most efficient firms or protecting inefficient incumbents. They test which of these roles has been predominant using a difference-in-difference approach. They find evidence that regulations curb entry, increase the average size of firms at entry and lower the labour productivity growth of incumbents, strongly suggesting that these regulations are sheltering them from competitive pressures. The implications for resource reallocation are clear: inappropriate entry regulations tend to hamper the efficiency-enhancing role of firm demographics, distort the size distribution of firms and negatively affect aggregate productivity by lowering the incentives to improve efficiency in existing firms.

Daveri *et al.* (2010) focus on the direct effects of entry regulations on MFP growth of service sector firms in Italy and France over the 1995-2007 period. They measure regulations with detailed service sector information provided by the OECD for retail distribution, transport, communication and professional services. They proceed in two steps: First they estimate the impact of entry restrictions on the market power of incumbents in these regulated sectors (as measured by mark-ups), and then they relate this indicator of market power to the MFP growth of incumbents in the same sectors. They find indeed that regulations curb firm-level productivity growth in regulated industries via a higher mark-up, that is, regulations weaken competitive pressures and weaker competitive pressures slow down efficiency improvements.

Arnold *et al.* (2011b) take a broader approach to investigate the impact of entry regulations on MFP growth. They take into account both the direct effects of regulations on firms' productivity in regulated non-manufacturing sectors and the indirect effects of such regulations on firms in other ("downstream") sectors via intersectoral linkages, using the OECD indicators of regulation impact. They also account for firm heterogeneity by distinguishing between "dynamic" firms that catch up rapidly to the global frontier (for their sector) and firms that do not (the "non-dynamic" firms).²⁰ Their main results are summarised in Figure 9. Anticompetitive regulations are found to curb the productivity growth of all firms, dynamic and non-dynamic in both upstream and downstream sectors. On average, a substantial easing of such regulations is estimated to increase the productivity growth by over 1 percent, implying an increase of more than 10 percent in the level of multifactor productivity in the long run. Interestingly, the estimated increase is significantly stronger for dynamic firms. Hence, regulation may have negative effects on the efficiency of resource reallocation by disproportionately hitting those firms that are driving improvements in aggregate productivity.

Substantially easing regulations could boost productivity growth by over 1 percent on average, raising the level of MFP by more than 10 percent in the long run.

Figure 9. Percentage increase in MFP from easing anticompetitive regulation
Reduction by one standard deviation in domestic and border entry barriers



Source: Table 1, columns 1 and 3 in Arnold *et al.* (2011b)

Notes: Dynamic firms are defined as firms that catch up to the global frontier in their respective sector. A One-standard-deviation change is equivalent to moving from the level of regulation prevailing in Greece (one of the most regulated countries according to the OECD regulation impact indicators) to a situation of best-practice regulation corresponding to adopting the least anticompetitive regulations observed in the OECD area in all sectors.

5. Concluding remarks

In this paper, we discuss theory and evidence that relate differences in the efficiency of resource reallocation and productivity performance across countries to anticompetitive product market regulations. We provide evidence that such regulations differ across countries and industries and have changed over time. Drawing on recent empirical studies, we find that regulations are of importance for performance.

²⁰ Arnold *et al.* (2011b) also distinguish between two sources of entry restrictions, domestic and border barriers (proxied by FDI restrictions). They find that these barriers are more harmful for dynamic firms that approach the global frontier more rapidly.

***Reforming
anticompetitive
regulations would
provide a significant
boost to potential
growth in OECD
economies.***

We highlight three main sets of results:

- There is solid evidence that the pace and depth of product market reforms are important for understanding both productivity and resource allocation outcomes. Countries and industries where direct and indirect regulatory burdens are lighter have generally experienced the highest GDP per capita and productivity growth rates in the studies we have surveyed.
- Evidence at the firm level suggests that, where regulatory burdens are lighter, the reallocation of resources towards the highest-productivity firms is stronger. Moreover, firm-level productivity growth is also curbed by anticompetitive regulations.
- The implications of inappropriate regulations for productivity performance are estimated to be quantitatively important. Therefore, reforming such regulations can provide a significant boost to potential growth in OECD economies.

The adverse effects of anticompetitive regulation on performance are often found to be non-linear, with their intensity depending on the characteristics of countries, industries and firms. Some studies find the effects to be more severe for industries closer to international best practice and/or using more intensively new information technologies and for firms that are more dynamic. However, there is no consensus on the extent and direction of such differential effects and further research is needed to elucidate the interaction of regulation with levels of development and the heterogeneity of industries and firms.

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ABSTRACT

Countries differ substantially in the extent to which more productive firms are large and/or are becoming larger and less productive firms are small and/or becoming smaller. A challenge for both emerging and advanced economies is that achieving such static and dynamic allocative efficiency requires an ongoing process of restructuring and reallocation. Such restructuring and reallocation is by its very nature costly. Market structure and institutions that promote well-functioning business dynamism are, accordingly, critical for economic performance. In the 1980s and 1990s, the US exhibited a robust pace of business dynamism that contributed substantially to US productivity and job growth. There are, however, some disturbing trends in the nature of US business dynamism – for example, the pace of business start-ups has declined secularly especially over the last decade. The decline in the pace of business dynamism may be contributing to the anaemic US recovery from the recent recession.

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Firm dynamics and productivity growth

1. Introduction

A ubiquitous feature of market economies is that there are large differences in productivity across businesses even within narrowly defined sectors.¹ These differences in productivity exhibit considerable persistence. An obvious question is how low-productivity firms persist in a well-functioning, market economy. To help answer this question, it is instructive to note two key features of well-functioning, market economies. First, in these economies the lowest-productivity businesses are more likely to exit. Second, among surviving businesses, the most productive businesses are the largest businesses. These features imply that while low-productivity businesses do exist in equilibrium due to a variety of frictions, market forces in a well-functioning, market economy allocate more outputs and inputs to the more productive businesses. That is, well-functioning market economies exhibit a high degree of allocative efficiency.

There is increasing evidence that the success of an economy depends critically on the extent to which the market structure, business climate and institutions promote such allocative efficiency. Allocative efficiency means that resources are allocated to their highest valued use. Achieving high allocative efficiency is not just a static problem but a dynamic one. The reason is that the economic environment is constantly changing, requiring an ongoing process of restructuring and reallocation. One manifestation of such change is that while the differences in productivity across businesses are persistent, there is a process of continuous change in the distribution of productivity. As such, in well-functioning market economies there is a high pace of ongoing reallocation of outputs and inputs across businesses wherein resources are shifted away from less productive to more productive producers. The empirical evidence shows that in well-functioning economies the ongoing pace of reallocation is productivity enhancing. One needs to be careful about making causal inferences here – it is not reallocation per se that yields productivity growth but rather the process of productivity growth requires ongoing productivity-enhancing reallocation. The reason is that there is need for experimentation and trial and error in both developing new products and processes and in adapting to changes in the economic environment.

Allocative efficiency thus involves both static and dynamic dimensions. Static allocative efficiency is associated with more productive businesses being larger. Dynamic allocative efficiency is associated with businesses that have become more (less) productive expanding (contracting). In addition, achieving allocative efficiency also inherently involves keeping the costs of such business dynamism low.

By its very nature the reallocation of outputs and inputs across firms is costly – it is costly to businesses in terms of adjustment frictions and it is costly to households as workers are caught up in this reallocation and also because households own the businesses incurring costs. Workers impacted by reallocation often spend time in unemployment and if unemployment is prolonged, it is often accompanied by substantial and persistent earnings losses. Substantial costs are born by businesses in terms of the time and resources associated with changing activity, whether via firm entry and exit or contraction and expansion. Some of these time and resource costs are an inherent component of the process of reallocation but market structure and the regulatory and institutional framework play a critical role in determining the extent to which the reallocation is productivity enhancing.

¹ The evidence suggests this partly reflects idiosyncratic choices of product quality and mix, location of the business, organizational practices and the like. It likely also reflects differences in entrepreneurial and managerial ability. In addition, it likely reflects a form of luck – being in the right place at the right time with a product and process that is of high value and can be produced in a cost-effective manner. In what follows, as a short-hand we mostly refer to all these factors as differences in productivity (broadly defined) across businesses.



John Haltiwanger

The extent to which a country exhibits allocative efficiency depends critically on market structure and the institutions that govern economic activity.

A key theme of the paper is that the extent to which a country exhibits static and dynamic allocative efficiency without incurring high costs depends critically on market structure and the institutions that govern economic activity. While distortions to allocative efficiency are present in all economies, countries with strongly distorted product, capital and labour markets and poorly functioning institutions exhibit worse outcomes in terms of allocative efficiency. In turn, highly distorted economies have lower output per capita.

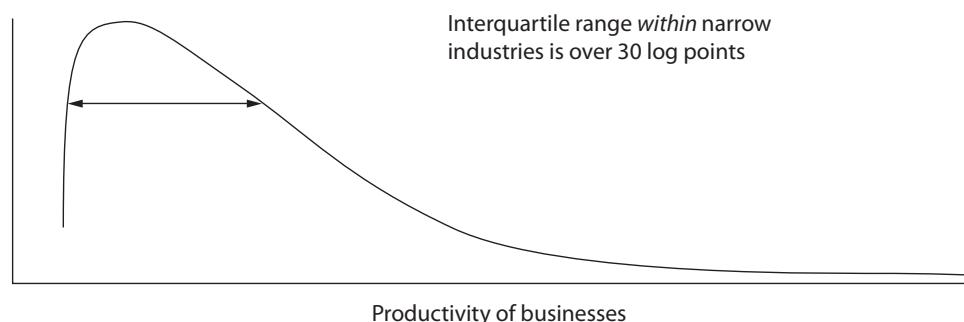
In this paper, I summarize the theoretical and empirical literature underlying the challenges of promoting allocative efficiency on the one hand and minimizing the disruption costs of ongoing reallocation. Section 2 provides an overview of the basic facts on firm dynamics. Section 3 presents conceptual underpinnings. Section 4 discusses policy challenges. Section 5 provides some concluding remarks.

2. The relationship between productivity and reallocation

2.1 Basic facts

It is useful to start with basic facts about the distribution of productivity and size across businesses.² There is much evidence that even within narrowly defined sectors there is substantial dispersion in both productivity and size of businesses.

Figure 1. The distribution of productivity across businesses in the same industry



Note: The above is a hypothetical depiction of the shape of the productivity distribution reflecting the empirical finding that productivity is approximately log normally distributed. The reported interquartile range is based on the distribution of US manufacturing establishments (see Syverson 2004).

Figure 1 illustrates a hypothetical productivity distribution within industries that reflects the patterns that have been observed in the data. For example, Syverson (2004) shows that the inter-quartile range of measures of within-industry establishment-level total factor productivity (TFP) is about 30 log points. This implies that if the firm at the 75th percentile has productivity equal to 100 then the firm at the 25th percentile has productivity equal to 74. Foster *et al.* (2008) show that the dispersion of establishment-level total factor productivity within detailed product classes that abstracts from variation in plant-level prices is at least as large.³ Similarly, there is substantial dispersion in business size. For example, Bartelsman

2 In what follows, some of the evidence is about establishments and some is about firms. By establishments, we mean specific physical locations of production activity. By firms, we mean all activity under common operational control. As an example, an individual Wal-Mart store is an establishment while the firm is the activity of all Wal-Mart stores as well as other establishments owned and controlled by Wal-Mart (e.g. distribution facilities). Both establishment and firm-level evidence is relevant. For job reallocation, the establishment level is likely preferred since the frictions in the labour market are very much about moving workers away from one location to another. In addition, most establishment-level job reallocation is between-firm reallocation. For other purposes, analyzing activity at the firm level is preferable. For example, when discussing financial-market frictions, the relevant level of activity is the firm not the establishment. The discussion in this paper specifies whether results refer to the establishment level or the firm level. Note that theoretical models often do not make this distinction – that is they don't formally model multi-establishment firms.

3 Foster *et al.* (2008) examine 11 detailed product classes for the US where direct measurement of physical output and prices

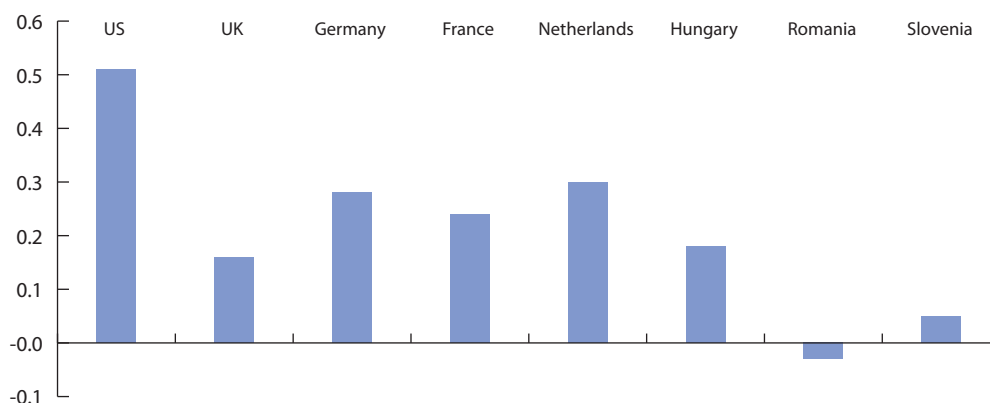
et al. (2009, 2011) show that within US industries, firms in the top quartile of the size distribution are on average 80 times larger than firms in the first quartile of the within-industry size distribution.

The large dispersion in productivity and size provide ample scope for there to be differences across countries, time periods within countries and industries within countries in “static” allocative efficiency. By the latter, we mean the extent to which in the cross section resources are allocated to their highest-valued use which in this case implies that the most productive firms should be the largest firms. Figure 2a based on Bartelsman *et al.* (2009, 2011) shows there are large differences in the within-industry covariance of size and productivity across countries. For example, the covariance in firm size and firm productivity in the US is high and positive while it is lower in Western Europe and still lower in Eastern Europe. Interestingly, while the covariance between size and productivity is low in Eastern Europe, Figure 2b shows that the covariance has been increasing substantially over the last couple of decades. Bartelsman *et al.* (2009, 2011) also show that these differences in the size/productivity covariances are potentially quite important in accounting for differences in output per capita across countries.

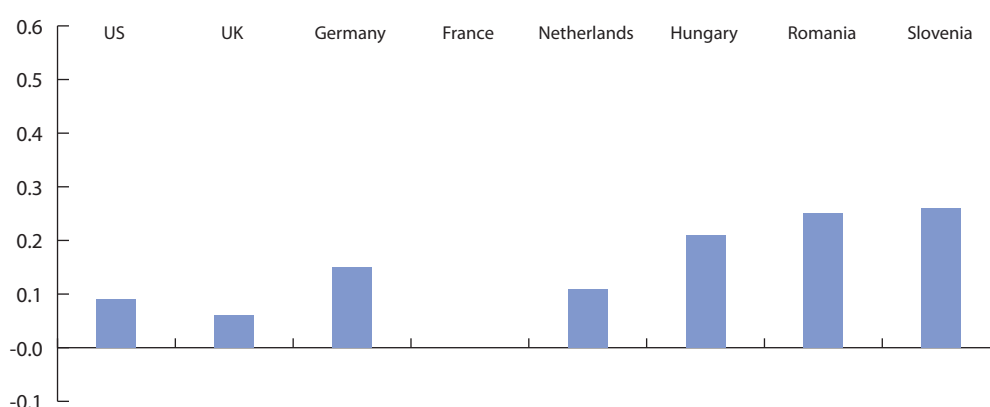
Static allocative efficiency implies that the most productive firms should be the largest firms.

Figure 2. The relationship between size and productivity

2a. Average within-industry covariance between size and productivity, 1992-2001



2b. Change in within-industry covariance between size and productivity, from 1992-1996 to 1997-2001



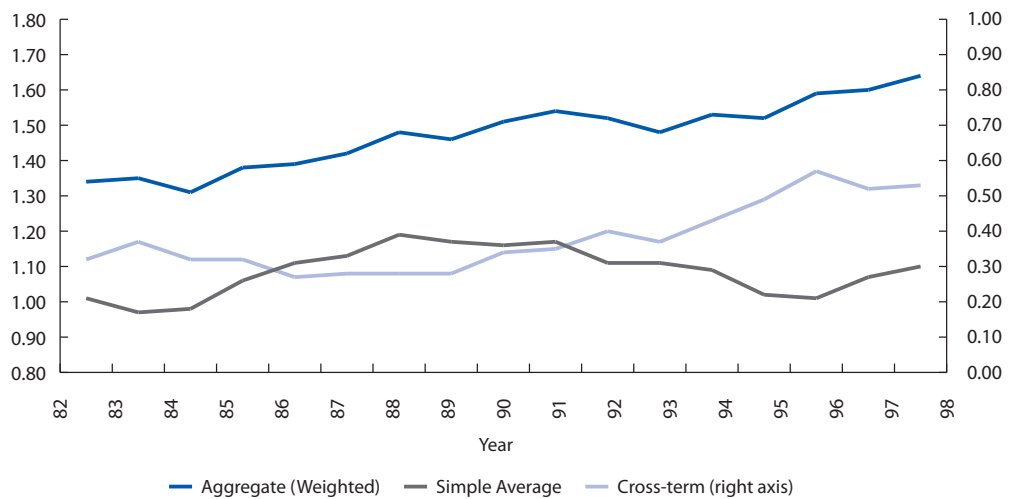
Source: Bartelsman *et al.* (2011), see Tables 1 and 2

is feasible. They find that the dispersion of physical productivity is slightly larger than the dispersion of revenue productivity (essentially price times physical productivity). Interestingly, the reason is that physical productivity and price are inversely correlated at the establishment level. This latter pattern is consistent with models of product differentiation such as those in Melitz (2003) and Melitz and Ottaviano (2008).

China and Colombia underwent market reform and have seen the covariance between size and productivity of their firms rise substantially.

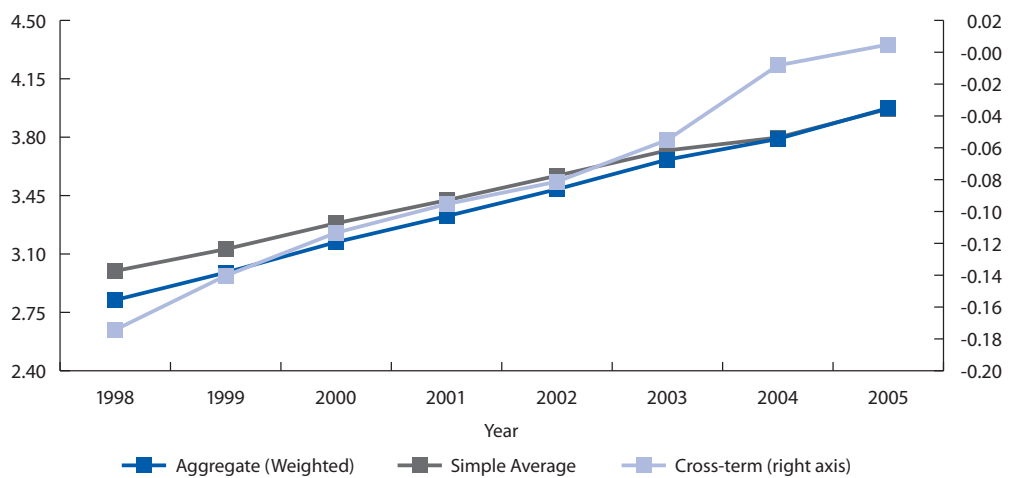
The covariance measures depicted in Figures 2a and 2b are a component of a productivity decomposition developed by Olley and Pakes (1996). The Olley-Pakes decomposition decomposes an index of industry level productivity into an unweighted mean of productivity at the firm level and the covariance of size and productivity. Figures 3 and 4 show Olley-Pakes decompositions of within-industry productivity for Colombia (using TFP as the measure of productivity) based on a study by Eslava *et al.* (2004) and for China (using labour productivity) based on a study by Deng and Haltiwanger (2008). Both countries underwent substantial market reform in the sample periods for these analyses. It is striking that in both countries the covariance between size and productivity rose substantially. Moreover, it is especially striking that in 1998 the covariance between size and productivity in China was negative. The interpretation is that at that point the largest firms were relatively low productivity firms. Figure 4 suggests that an important part of China's rapidly growing productivity is a movement of the covariance from negative to slightly above zero. A covariance at or around zero is still quite low relative to say the US, leaving considerable opportunities in China to improve allocative efficiency.

Figure 3. Olley-Pakes decompositions of productivity for Colombian manufacturing, 1982-1998



Source: Eslava *et al.* (2004)
 Note: This is a decomposition of within-industry TFP growth.

Figure 4. Olley-Pakes decomposition of labour productivity for China, 1998-2005



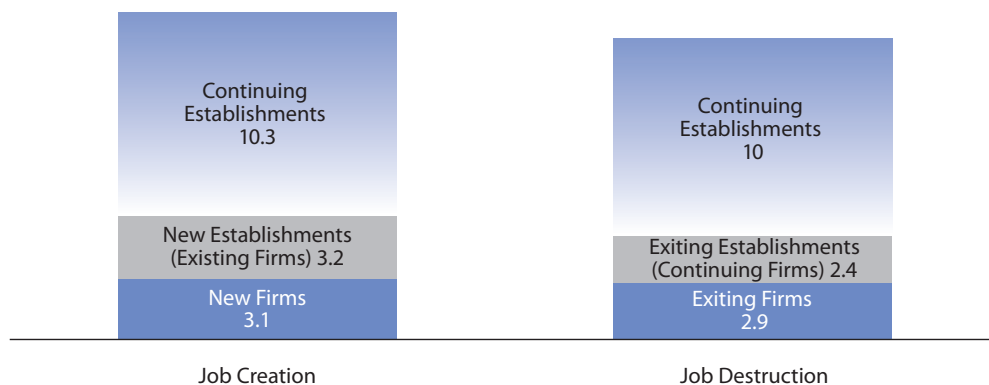
Source: Deng and Haltiwanger (2008)

The within-industry cross-sectional patterns of productivity and size across countries are of critical interest and importance but offer an incomplete picture. That is, on the basis of the cross sectional evidence alone one might conclude that there is relatively stable within-industry size and productivity distribution in the sense that high-productivity firms remain high-productivity firms and large firms remain large firms and so on. While there is persistence in both firm size and firm productivity, there also is considerable reallocation and movements within the distributions. Estimates of the persistence of idiosyncratic or productivity shocks suggest first order yearly autocorrelation of about 0.8 (see e.g. Foster *et al.* 2008). Along with estimates of dispersion, this estimate of persistence implies estimates of the standard deviation of innovations to productivity shocks of about 0.20 (in terms of log total factor productivity).⁴

Complementing the high variance of innovations to productivity shocks is a high pace of reallocation of outputs and inputs. Figure 5 based on Haltiwanger *et al.* (2010) shows an annual establishment-level gross job creation rate of about 17 percent (as a percentage of employment) and an annual establishment-level gross job destruction rate of 15 percent in the US. This implies in any given year a gross job reallocation rate of about 32 percent – that is about 32 percent of jobs are reallocated each year in the US. Figure 5 also shows that entry and exit of firms as well as entry and exit of establishments of existing firms play an important role in this reallocation. Bartelsman *et al.* (2009, 2011) show that such patterns are present in a range of advanced and emerging economies. In addition, Davis and Haltiwanger (1999) and Haltiwanger *et al.* (2010) show that much of this reallocation is within industries (about 90 percent of job reallocation in the US is within 6-digit NAICS or 4-digit SIC industries). Thus, reallocation largely reflects the contribution of business entry, exit, expansion and contraction within industries.

In the US, about 32 percent of jobs are reallocated each year.

Figure 5. Annual job creation and destruction in the US private sector, 1980-2009 (percent of employment)

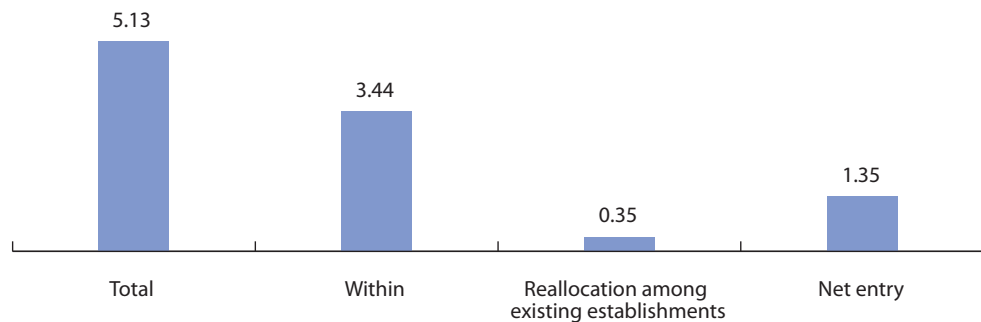


Source: Tabulations from the BDS combined with tabulations from Haltiwanger *et al.* (2010)

Just as there is a relationship in the cross-sectional distribution of size and productivity, there is a relationship between the pace of reallocation and productivity shocks. In well-functioning economies, outputs and inputs are being reallocated away from the lower-productivity to higher-productivity businesses. Figure 6 shows that about a third of the productivity growth within a manufacturing industry over a five-year period of time is accounted for by such reallocation in the US (this is captured by summing the middle and right bars in Figure 6). Foster *et al.* (2001) show that over longer horizons (ten years) the contribution is even larger (about 50 percent).

⁴ This statistic is consistent with the evidence in Foster *et al.* (2008).

Figure 6. Components of TFP growth over five-year horizons in selected US manufacturing industries, 1977-1997

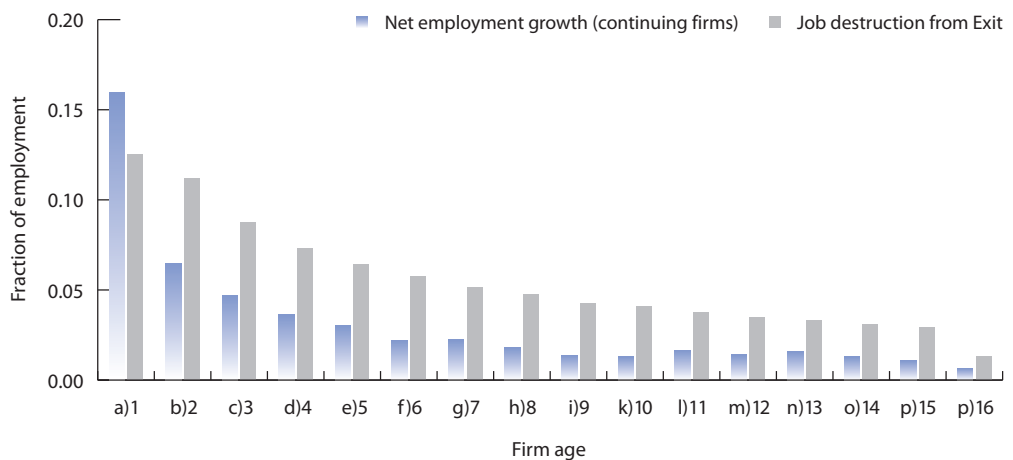


Source: Foster *et al.* (2008)

Young firms exhibit an up-or-out dynamic – they either grow fast on average or they exit.

An important component of this reallocation is entry and exit of establishments and firms. Given the importance of entry, it is instructive to characterize the post-entry dynamics of young firms. Figure 7 based on Haltiwanger *et al.* (2010) shows how job destruction and net employment growth at the firm level vary with age of the parent firm.⁵ Among surviving firms, young firms grow very fast in absolute terms and relative to their more mature counterparts. However, the job destruction rate from firm exit is also much higher for young firms. Taken together, the implication is that young firms exhibit an “up or out” dynamic – they either grow fast on average or they exit.⁶

Figure 7. Up-or-out dynamics of young US firms



Source: Haltiwanger *et al.* (2010)

Note: Firm age is defined as the age of the oldest establishment. For example, firm age category “1” is based on firms where the oldest establishments entered in the prior year (start-ups are categorized as firm age equal to “0”).

How do these “up or out” dynamics relate to productivity? Figure 8 (based on Foster *et al.* 2006) shows the relationship between productivity and continuing and exiting for all and single-unit establishment firms in retail trade. Exiting young establishments and firms have very low productivity while surviving

⁵ These patterns show dynamics at the firm not establishment level.

⁶ A related key message of Haltiwanger *et al.* (2010) is that firm age rather than firm size is the more theoretically and empirically relevant characteristic of businesses for job creation. That is, the conventional wisdom that small businesses create most jobs is better understood in terms of the job creation prowess of business start-ups and the rapidly growing survivors in Figure 7. Business start-ups and young firms are small so the conventional wisdom is picking up the role of start-ups and young firms. On the flip side, small, mature firms are not disproportionate creators of jobs.

young firms and establishments have above average productivity. As such, the “up or out” dynamic in Figure 7 contributes to productivity growth through moving resources towards the more productive and away from the less productive young businesses.

Figure 8. Productivity of young businesses relative to mature surviving incumbents, US retail trade (percentage difference)



Source: Tabulations from Census of Retail Trade taken from Foster *et al.* (Table 5, 2006)
 Note: Young establishments are those that are under five years old.

In short, in well-functioning economies there is evidence of not only static allocative efficiency (more productive businesses are larger) but dynamic allocative efficiency (resources are being moved from less to more productive businesses). A key theme in the remainder of the paper is that the extent to which a country exhibits patterns of both static and dynamic efficiency will depend on market structure and institutions.

In well-functioning economies, there is not only static but also dynamic allocative efficiency: resources are moved from less to more productive businesses.

Another theme emphasized in this paper is that accommodating the micro volatility as evidenced by the ongoing need to reallocate workers to more efficient producers becomes disrupted in economic slumps. The nature of this disruption will be elaborated on below. In addition, micro volatility can change the nature of macro volatility. For example, periods of intense restructuring in the economy can dampen aggregate activity as resources are being used for restructuring and reallocation rather than current production. In a related fashion, periods of intense restructuring are often associated with periods of heightened uncertainty, which can slow down the adjustment dynamics from both aggregate and micro shocks. These relationships are also discussed below.

2.2 The impact on workers

As noted in the introduction, the ongoing reallocation is not costless, with workers and businesses bearing substantial time and resource costs in accommodating the reallocation, even if it is productivity enhancing. Both types of resource costs need to be taken into account in evaluating the extent to which a country is achieving static and dynamic allocative efficiency.

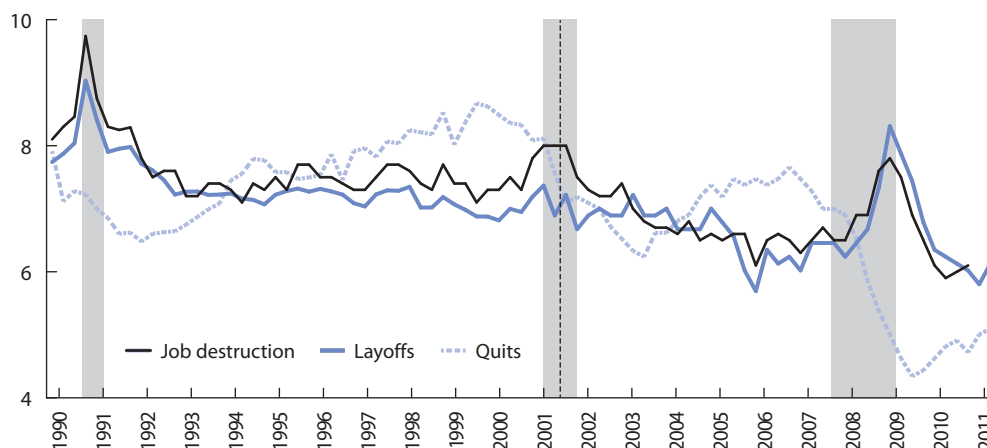
In good times in well-functioning economies, the impact on workers is not too adverse in terms of employment and earnings outcomes. For this purpose, we focus on the evidence in the US.⁷ Figures 9 and 10 (based on Davis *et al.* 2011) help highlight several key patterns. These figures show that in good economic times, much of the job destruction in the US takes the form of worker quits instead of layoffs.

⁷ See Davis *et al.* (2010) and references therein.

In good economic times, job destruction mostly takes the form of worker quits whereas layoffs prevail in downturns.

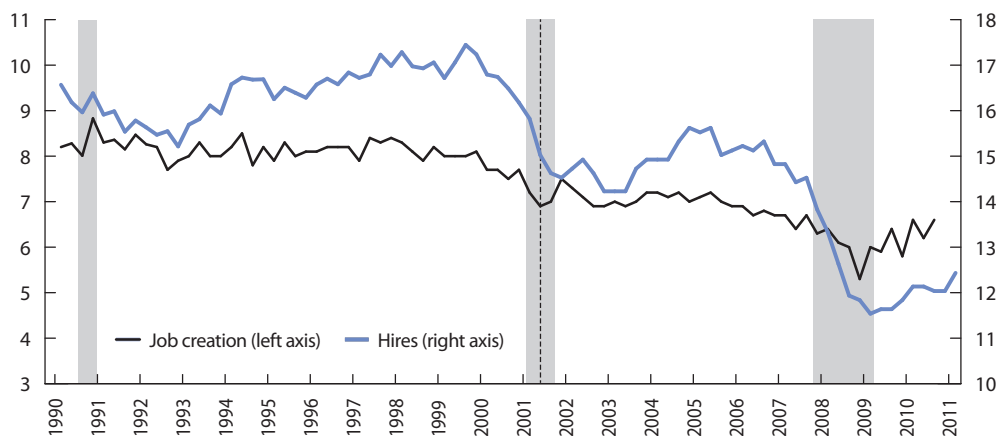
This pattern is consistent with related evidence that shows that in good economic times, many separations of workers are associated with either no spell of joblessness or a short spell of joblessness and often result in an increase in earnings relative to the prior job. The latter is consistent with the perspective that the workers are reallocating away from lower-productivity firms or low-quality matches to higher-productivity firms or matches. In good times, the typical worker switching jobs experiences an increase in earnings (see e.g. Fallick *et al.* 2011).

Figure 9. Quits, layoffs, and job destruction in the US private sector, 1990-2010 (annual rate, percent of employment)



Source: Figure 1 from Davis *et al.* (2011)

Figure 10. Hiring and job creation in the US private sector (percent of employment)

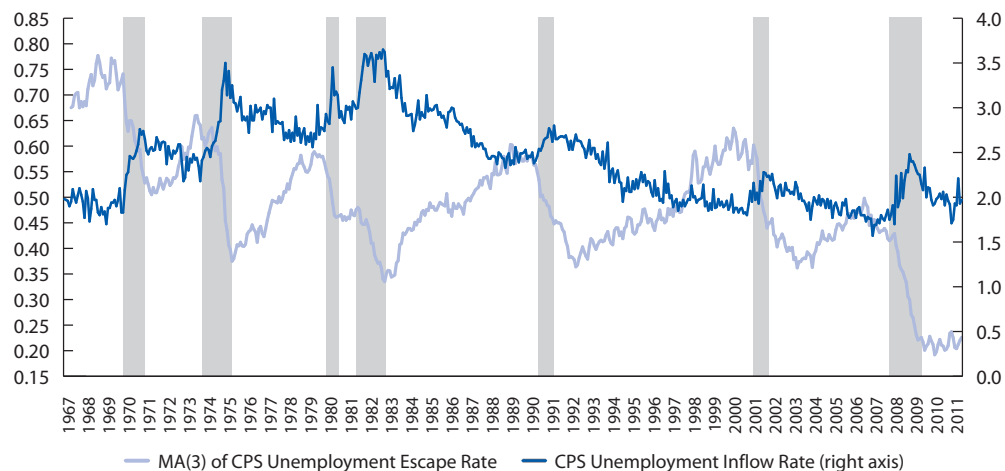


Source: Figure 2 from Davis *et al.* (2011)

All the potential problems with the dislocation of workers are significantly exacerbated in economic downturns even in otherwise well-functioning economies. Not surprisingly, as seen in Figure 9, job destruction increases and job creation decreases in an economic downturn. Job destruction in downturns is accommodated mostly through layoffs, yielding spells of unemployment that are often protracted. The current economic downturn in the US offers ample evidence of these challenges. Figure 11 shows unemployment inflow rates and escape rates from unemployment. In normal times, the average duration of unemployment in the US is about two months (this is roughly 1 over the escape rate). In the current economic downturn, it is closer to ten months. Empirical evidence also shows that the persistent earnings losses that displaced workers experience are worse in recessions.⁸

⁸ See Jacobson *et al.* (1993), Dardia and Schoeni (1996), Fallick *et al.* (2011), and Davis and von Wachter (2011).

Figure 11. Unemployment inflow and escape rates, US, 1967-2011 (percent)



Source: Tabulations from Current Population Survey

Notes: The quarterly inflow rate is depicted on the right axis. The escape rate is a three-month moving average and is depicted on the left axis.

The above discussion pertains to well-functioning economies. In highly distorted economies, reallocation is generally not well accommodated, regardless of whether we focus on expansions or contractions. One often observes an effort to stifle reallocation in these economies. This is rationalized with concerns about long-term unemployment and the impact of displacement on earnings. However, as we discuss below, stifling such reallocation has adverse effects on static and dynamic allocative efficiency.

In distorted economies, reallocation is stifled in good and bad times, with adverse effects on allocative efficiency.

3. Guidance from economic theory on allocative efficiency

3.1 Core models of firm dynamics

We begin with considering why firms of different sizes and productivity co-exist within an industry. One reason is that even though more productive firms have an incentive to become larger, there may be some form of decreasing returns due to economies of scope and control (e.g. Lucas 1978). Another reason is that firms produce and provide somewhat different products even in the same industry. Models of product differentiation such as those in Melitz (2003) and many antecedents have this feature. Such product variation need not be differences in physical products but can also include differences in the bundling and the way of providing the goods and services in question (including the location of delivery). For example, it may be that firms differ in their reliability and timeliness of delivery.

With such models as a backdrop, there is a rich set of models that help us understand the observed industry and firm dynamics. Jovanovic (1982) posits that, at entry, firms don't fully know their productivity (or other aspects of profitability). Thus, an important part of firm dynamics, especially for growing industries, is the selection and learning dynamics of young firms. For example, those firms that learn they have a good location, good product or process, survive and grow. Those that learn they are not profitable contract and exit. Since the evidence on firm dynamics shows that reallocation and restructuring is not confined to young firms, additional theories need to be used to understand such dynamics. Ericson and Pakes (1995) and a variety of other papers (see Syverson 2011 for a recent survey) develop models that help account for the ongoing reallocation and productivity dynamics. Ericson and Pakes (1995) postulate that every time a firm makes a major change in its way of doing business

(either by adopting a new technology or in responding to some major change in economic conditions like higher energy costs), the firm begins the learning and selection dynamics anew. That is, they need to learn about their profitability with the new product or process.

The more general notion as illustrated in models such as Hopenhayn (1992) and Hopenhayn and Rogerson (1993) is that the productivity shocks firms face are persistent but that firms are constantly subject to new productivity and profitability shocks. Viewed from this richer perspective, firms are constantly forced to adjust and adapt to changing economic circumstances and while their past successes can help in forecasting their ability to adjust and adapt, firms are constantly required to reinvent themselves. Those that reinvent themselves well survive and grow. Those that adapt and adjust poorly contract and exit.

3.2 Scope for misallocation

Distortions to allocative efficiency include barriers to entry and exit, poor labour, product and capital market regulations, weak rule of law and bad public infrastructure.

Much of the above discussion paints a picture of the potentially important role of productivity-enhancing reallocation for economic growth. More recent work has emphasized many factors that can go wrong as countries try to achieve both static and dynamic allocative efficiency. Banerjee and Duflo (2005), Restuccia and Rogerson (2008), Hsieh and Klenow (2009) and Bartelsman *et al.* (2009, 2011) all emphasize that there are a host of distortions to static and dynamic allocative efficiency. Such distortions include barriers to entry and exit, regulations that deter job destruction, poorly functioning product, capital and labour markets, weak rule of law, poor public infrastructure for communication and transportation, as well as problems with graft and corruption or otherwise arbitrary and capricious behaviour of governments. The consequences of such distortions can be severe. As discussed above, in a well-functioning economy the most productive firms are the largest firms. In a distorted economy with poor institutions, the largest firms may not be the most productive ones but rather the best connected or perhaps the best at navigating the distortions within a country.⁹

This recent literature has shown that the misallocation that results from the type of distortions discussed above can account for a substantial fraction of the observed differences in proxies for allocative efficiency (such as the size/productivity covariance discussed in Section 2) as well as differences in aggregate output and consumption per capita.

Such misallocation distortions have adverse consequences in their own right, but can also potentially yield a variety of second-best problems for economic reforms. For example, consider trade reform. While the Melitz (2003) and related models make a case why trade liberalization can yield productivity-enhancing reallocation, in the presence of these distortions the impact of piecemeal economic reforms is less clear. If it is difficult to start a business, difficult to expand, difficult to avoid having rents extracted from any profits unless one stays sufficiently small, and difficult to contract or exit, the productivity enhancing reallocation highlighted by Melitz (2003) and others can be derailed.

In like fashion, not only might the reallocation be derailed but it may be especially costly. As emphasized by Caballero and Hammour (2000), distortions can be such that creation and destruction get decoupled in time – that is, market reform (including trade reform) might induce downsizing and exit by less productive businesses but the accompanying creation and expansion by the more productive businesses may be delayed or derailed. When there is such decoupling, the cost to workers can be especially high, since in an economy with lots of destruction but not much creation (at least for a period of time) there is by construction an economic downturn with many dislocated workers.

⁹ Bartelsman *et al.* (2009, 2011) provide evidence on differences across countries for a wide range of distortions.

One *caveat* heard regarding the arguments expressed above is that the role of reallocation for productivity growth may be more of an issue for advanced market economies than emerging economies. One argument is that it is economies at the frontier of technology that are inherently engaged in the experimentation and creative destruction process. Following this reasoning, the argument for emerging economies is that, if technology could simply be brought up to levels from the past in advanced economies where methods and business practices are well understood, this would be still be a substantial improvement in emerging economies.

There are several reasons why this line of argument is not persuasive. For one, the evidence shows that in all economies (advanced and emerging) we observe large within-sector differences in productivity across businesses (see *e.g.* Bartelsman *et al.* (2009, 2011), and Hsieh and Klenow 2009). If anything, within-sector dispersion in productivity is larger in emerging economies reflecting, as Hsieh and Klenow (2009) emphasize, the effects of misallocation. The point is there is much scope for productivity-enhancing reallocation in emerging economies. Furthermore, while the sources of within-industry differences in productivity across businesses are still under investigation, it is clear that they don't simply stem from access to different "blueprints" for how to produce specific goods and services. Rather, differences in productivity reflect differences in managerial ability, organizational capital, management practices and other intangible factors (see *e.g.* Corrado *et al.* 2005) along with potentially random factors about choosing the right combination of location, products, and processes. The implication is that productivity differences across businesses reflect idiosyncratic factors that are not simply a matter of blueprints – and that such differences are pervasive not only in high-tech and low-tech sectors but also in advanced and emerging economies.

While this discussion highlights the considerable progress made in our understanding of these issues theoretically and empirically, there remain many open questions on these issues. Identifying the potential benefits from economic reforms in terms of improved allocative efficiency and their costs in terms of transition costs and worker dislocation is an active area of research.

3.3 Different dimensions of volatility

Much of the discussion about volatility has focused on two dimensions of volatility: First, the large dispersion of productivity/profitability across businesses; and second, the ongoing reallocation of outputs and inputs across businesses. In terms of the latter, it is useful to note that such reallocation reflects an important form of dispersion across businesses – specifically, dispersion in output and input growth rates across businesses. That is, reallocation reflects resources flowing from contracting businesses (those with negative growth rates in outputs and inputs) to expanding businesses (those with positive growth rates in outputs and inputs). Entry and exit rates represent the extremes of the output and input growth rate distributions and obviously contribute substantially to volatility.

It is natural to focus on dispersion in profitability/productivity on the one hand and dispersion in output and input growth rates on the other hand. The core models discussed in Section 3.1 largely treat the dispersion in productivity/profitability as exogenous while treating the dispersion of output and input growth rates as endogenous. As highlighted in the discussion of Sections 3.1 and 3.2, a critical factor impacting aggregate outcomes is how well an economy accommodates the idiosyncratic productivity/profitability shocks: Are those businesses with favourable shocks growing and those with less favourable shocks shrinking and is such reallocation accomplished without too much disruption?

There are other closely related dimensions of volatility. An obvious candidate is dispersion in earnings across workers. It is well known that in advanced economies there has been an increase in the dispersion of the *level* of earnings across workers – and the evidence suggests this is associated with changing

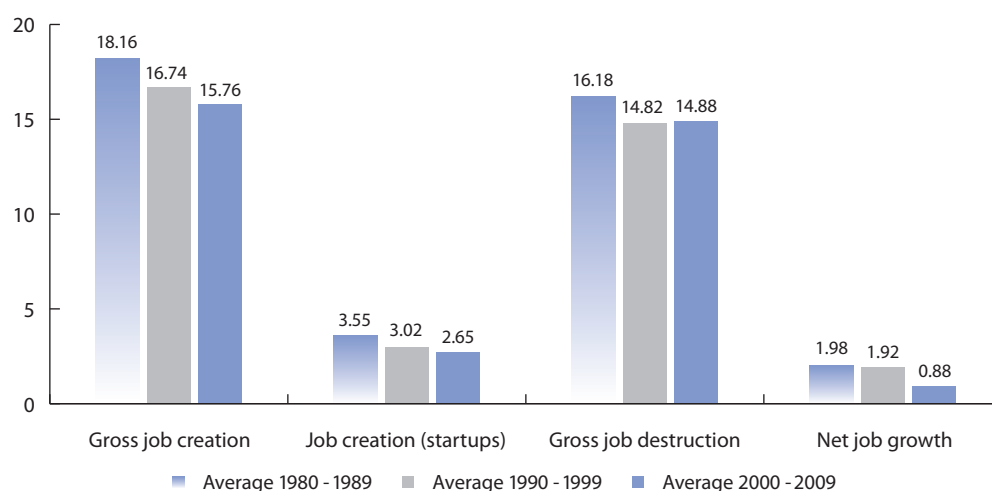
Much of the increase in personal-income inequality in the US reflects increased dispersion in productivity and earnings between establishments.

technology favouring more skilled workers (*i.e.* skill-biased technological change) as well as corresponding changes in trade patterns (the off-shoring of lower-skilled jobs). This rise in earnings inequality is closely related to the discussion on firm dynamics in prior sections. For example, a number of studies (*e.g.* Davis and Haltiwanger, 1991, Dunne *et al.* (2004) and Barth *et al.* (2010)) have found that much of the increase in earnings inequality in the US is associated with an increase in the between-establishment dispersion in earnings. Moreover, these studies show that the establishments with higher earnings are more productive, more highly skilled and more likely to have adopted advanced technology.

What do we know about changes in volatility over time as well as differences in volatility across countries? They may reflect many factors. Variations in volatility may reflect changes in the driving forces of profitability as well as changes in the adjustment dynamics. For the latter, an important issue in the current context is whether the differences in volatility reflect the relative flexibility of an economy. Greater flexibility might take many different forms. It might be that workers in a more flexible economy are more geographically mobile so that there is even more reallocation of labour in response to a given set of shocks. Alternatively, it might be that wages become more flexible (*e.g.* with greater reliance on flexible-pay mechanisms) so that a given set of shocks is reflected more in wages than in the reallocation of employment. These examples highlight the fact that appropriate caution is needed in assessing differences in measures of volatility across time and countries.

The evidence on changes in volatility is primarily for the US which has extensive longitudinal panels of businesses and workers covering many decades. For the US, there is evidence that the volatility of output and employment growth rates of publicly traded firms has increased over the last few decades (see *e.g.* Comin and Phillippon 2006). However, interestingly when the entire economy is considered (in the US, publicly traded firms account for about 30 percent of employment and 40 percent of output), there is actually a pronounced decline in the volatility of employment growth rates (see Davis *et al.* 2007, Davis *et al.* 2010, Davis *et al.* 2011, and Haltiwanger *et al.* 2011). The evidence in Figure 12, drawn from Haltiwanger *et al.* (2011), shows that a decline in the pace of business start-ups accompanies this decline in volatility. On average, start-ups accounted for 3.5 percent of employment annually in the 1980s, 3.0 in the 1990s and declined to 2.6 percent post-2000. This reflects a decline in new jobs from start-ups of more than one million jobs per year. Given that the average net increase in jobs is only a little over two million jobs this is a substantial decline.

Figure 12. Declining business dynamism in the US: Trends in gross flows and net job creation, 1980-2009



Source: Haltiwanger *et al.* (2011)

Does the lower volatility imply the US has become less flexible over time? This is an open research question. There is some evidence that it may reflect in part a different form of flexibility. Lemieux *et al.* (2009) show there has been a pronounced increase in the use of flexible-pay mechanisms (bonus pay, stock options, *etc.*) in the US so this may reflect increased earnings flexibility. However, the evidence in Davis *et al.* (2007) suggests this is unlikely to be the whole story. For example, they find that the lower volatility in part reflects the increasing shift in sectors like retail trade to large, national firms (*e.g.* Wal-Mart) who are much less volatile than Mom-and-Pop retailers. There is evidence that the shift to large, national chains reflects the type of technological change and reallocation discussed in prior sections as large, national chains have been able to take greater advantage of advances in information technology for distribution networks and inventory control. However, it may also be that large, national chains are less nimble in adjusting to changing economic conditions. The more general point is that a decline in volatility in the US may reflect a less dynamic US economy (and thus an economy less able to respond to changing economic conditions).

The findings of a decline in the pace of business start-ups raise related concerns. If start-ups and young businesses are an important source of experimentation and innovation, the fall in volatility associated with the decline in start-ups may bode ill for future US growth. It is an open question why there has been a secular decline in the pace of start-ups. It may be related to an increased fraction of activity being accounted for by large, multi-national firms as discussed above.

There is also evidence that volatility increased dramatically in the 1990s in the transition economies (see *e.g.* Faggio and Konings 1999, Jurajda and Terrell 2002 and Haltiwanger and Vodopivec 2003). When looking at the performance of these economies, it was clear that this was disruptive with adverse aggregate consequences as most transition economies first experienced a downturn in aggregate economic activity. Moreover, the evidence suggests that there was a non-trivial lag between the burst of job destruction and job separations early in the reforms and the subsequent recovery of job creation and hires. The patterns exhibited in these economies were consistent with the discussion and concerns about decoupling of job creation and destruction in Section 3.2. Still, the evidence is that, for the most part, the transition economies weathered this storm and recovered with robust growth. It likely helped that the world economy exhibited robust growth in the second half of the 1990s.

Another important issue in terms of changes in volatility over time within countries is that periods of more intense restructuring are often associated with periods of heightened uncertainty. Bloom (2009) has stressed that recessions differ in the extent of uncertainty, which impacts how fast the economy recovers from the downturn. Bloom *et al.* (2010) have emphasized that the Great Recession of 2007-09 is a period of especially heightened uncertainty due to the collapse of financial markets and the accompanying intense period of restructuring associated with the downturn (*e.g.* shifts away from construction activity and restructuring of financial markets). Such heightened uncertainty contributes to particularly slow recoveries, since even businesses with potential profit opportunities are reluctant to invest and hire new workers under these circumstances.

Heightened uncertainty such as during the Great Recession of 2007-09 contributes to particularly slow recoveries.

Comparing the level of volatility across countries has proven to have substantial measurement and conceptual challenges. The working conjecture is that the US, being a very flexible economy, would have a higher dispersion of growth rates of outputs and inputs than other countries. However, the evidence on this is mixed. Part of the reason for this is measurement difficulties (see Bartelsman *et al.* (2009, 2011)). However, another reason might be flexibility manifesting itself in different dimensions. As Bertola and Rogerson (1997) emphasize, countries with rigid labour regulations also often have centralized wage bargaining. The former should dampen employment volatility while the latter should increase employment volatility, so the final outcome is ambiguous.

This discussion of different dimensions of volatility highlights the difficulties of simply comparing measures of volatility across countries or across time. As discussed earlier, one approach that overcomes the measurement and conceptual challenges of comparing measures of volatility is to focus on whether the volatility (reallocation) is productivity enhancing. Differences across time and across countries on whether reallocation is productivity enhancing are of unambiguous importance. Another approach to making cross-country comparisons is to focus on the impact of the business climate on volatility. For example, Haltiwanger, Scarpetta and Schweiger (2010) use differences in volatility across industries and size classes within countries to show that countries with more rigid labour markets have less employment reallocation. One can identify this effect not with the cross-country variation but with the within-country variation between industries and size classes.

4. Policy lessons and challenges

A well-functioning economy is sufficiently flexible to permit productivity-enhancing reallocation while minimizing the disruption costs from such reallocation.

The policy lessons in broad terms are clear but the actual implementation imposes many challenges. The broad policy lesson is that, in order to function well, the economy needs to be sufficiently flexible to permit productivity-enhancing reallocation while minimizing the disruption costs from such reallocation in a manner that does not stifle the reallocation. Few countries achieve the economic environment that is consistent with this broad lesson. One could argue that the US has the market structure and economic institutions that closely approximate this objective in normal economic times. But the recent Great Recession has reminded us that even in the US, there is fragility in the system and disruptions in key markets (like financial markets) affect the nature and consequences of the natural economic volatility that is part of any ongoing process of technological progress. Thus, one of the policy challenges is how to maintain the market structure and economic institutions that operate in normal economic times while permitting intervention when markets get disrupted. This challenge of countercyclical policy is not the primary focus of this paper but we discuss some issues along these lines below.

For emerging economies, the challenges are potentially enormous. As discussed in Pagés (2010) and Pagés *et al.* (2009), one important challenge evident in many emerging economies is the role of informality, which can often also go hand-in-hand with what they call the “missing middle”. In highly distorted economies where the burden of poor institutions and market distortions weigh down on businesses, there tend to be very small businesses, very large businesses but not as many medium-sized businesses as in well-functioning market economies. The authors argue the reason for this phenomenon is that only the very large businesses have the resources to deal with the highly distorted economic environment (or worse, are large simply because of the existing distortions, which are often associated with crony capitalism and government-private sector connections). They argue that small businesses – even those with great potential in terms of productivity – stay small to fly below the radar. That is, businesses stay small and informal to circumvent the regulatory burden and corruption practices that often characterize countries with weak institutions.¹⁰

Reallocation has little chance of being productivity-enhancing in highly-distorted economic environments. The challenges then are that many components need to be simultaneously in place for economies to successfully grow. This is particularly the case when undertaking market reforms. These challenges are present in both emerging and advanced market economies. The list of components for “success” for any country is long:

¹⁰ There may be an ameliorating effect on the duration of joblessness in economies with large informal sectors to the extent that workers dislocated by restructuring and reallocation can quickly find jobs in the informal sector. It is not clear that this is indeed beneficial to the extent it reflects workers and firms in the informal sector being underemployed for the reasons discussed in the text.

With the right policies in place, opening up to (world) markets is more likely to be productivity enhancing.

- Labour markets need to be sufficiently flexible to permit reallocating workers from less productive to more productive establishments without long spells of unemployment.
- As part of this flexibility, safety nets need to be in place so that workers adversely impacted by reallocation can be assisted in finding new employment without distorting the process of reallocation.
- The infrastructure needs to be of sufficiently high quality to insure that existing and starting-up businesses that seek to grow are not thwarted by factors such as poor transportation and communication infrastructure.
- Product markets need to be sufficiently competitive so that firms are not large for reasons related to market power or due to favourable treatment by the government.
- Financial markets need to be sufficiently developed to provide funding to starting-up and expanding businesses and to be able to deal with the inevitable failure of young and small businesses.
- Regulation has to provide appropriate oversight without imposing onerous time and resource costs on individuals who start or close down a business.
- The legal system has to work sufficiently well so that property rights are well established and bankruptcy and business failure can be accommodated.
- The rule of law and the role of the government need to be such that graft, corruption and other forms of criminal activity don't thwart private sector businesses from starting and growing.

These are just examples of the many components that need to be in place for an economy to operate efficiently. With all of these components in place, opening up to markets and competing in world markets is much more likely to be productivity-enhancing without the costs of reallocation being too high for businesses and workers.

Getting all these pieces in place simultaneously is obviously a challenge on many dimensions. Given such challenges, governments often try to intervene to facilitate growth and/or to protect workers and businesses from some of the adverse effects of volatility. The message of this paper is that policies and institutions that stifle reallocation can yield very poor outcomes. Another related message of the paper is that well-intended industrial policies that try to aid the private sector must confront the facts associated with the large dispersion of productivity across businesses (and the associated productivity-enhancing reallocation that works in well-functioning market economies). Recall that dispersion of productivity in narrowly defined sectors in advanced economies like the US is very large and even larger in less developed economies. Industrial policies that (perhaps inadvertently) support the low-productivity businesses in a sector will lower aggregate productivity and make it difficult for a country to increase its productivity over time if, for example, it is difficult for governments to let go companies they have supported in the past. The government is in no better position than the market to pick winners and, given the evidence on dispersion, the risks of picking and supporting low-productivity businesses is non-trivial. As an alternative to industrial policies, policies that seek to address the distortions and market failures in the country may be more promising.

Another challenge is how to handle crises. Crises tend to distort the dynamics of reallocation and restructuring, regardless of whether we look at advanced or emerging economies. In crises there is lots of job destruction but not much job creation, with accompanying high unemployment. In financial crises, financial markets are not facilitating the reallocation of resources away from less productive to more productive businesses.¹¹ Such productivity-enhancing reallocation requires financial markets

¹¹ A recent paper that explores these issues is Eslava *et al.* (2010). They find that exits are less related to productivity in times of financial crises.

providing funding to start-ups and to young, small businesses which have the potential to grow fast. Such credit channels break down in recessions that are associated with financial crises.

5. Concluding remarks

There is considerable variation across countries in the extent to which size and productivity are correlated and reallocation is productivity enhancing.

The evidence strongly supports the view that static and dynamic allocative efficiency is critical for the aggregate economic performance of a country. In the cross-section, we observe a very dispersed and skewed size distribution of activity in advanced market economies that is accompanied by a very dispersed and skewed distribution of productivity. In a well-functioning economy, these two distributions should be strongly positively correlated – that is, the most productive businesses should be the largest businesses. In addition, in a well functioning economy, resources tend to be reallocated from less productive businesses to more productive businesses. The evidence shows there is considerable variation across countries in the extent to which size and productivity are correlated and reallocation is productivity enhancing.

The evidence shows that countries that undergo market reform improve their static and dynamic allocative efficiency and, in turn, achieve higher productivity. The covariance between size and productivity rises in response to market reform and market selection improves with market reform. By market selection, we mean that less productive businesses are more likely to exit and more productive businesses are more likely to survive. This improved market selection contributes positively and substantially to productivity growth.

Many things can go wrong that either mitigate or potentially limit the gains from market reform. In a highly distorted economy, there are second-best problems so that piecemeal market reform will not be as effective. Distortions may arise in the legal system and the rule of law as well as in regulation and in product, labour and financial markets. A poorly-functioning labour market makes the response to reallocation very costly. Reallocation yields inherent costs on businesses and workers as it induces workers to relocate across businesses. In a poorly-functioning labour market, this can be very costly.

Even in advanced market economies that are normally well-functioning, the reallocation dynamics of workers can become distorted in severe economic downturns. Addressing the difficulties of managing reallocation dynamics during economic downturns without distorting the potential for productivity enhancing reallocation in the long run is a continuing challenge. The recent crisis has highlighted the importance of well-functioning financial markets. In times of financial crises, financial markets are less able to facilitate the selection and growth dynamics of businesses – for large, mature as well as young and small businesses alike. Perhaps ironically, the globalization of financial markets has made the problem more challenging during economic crises given the flight to quality becoming increasingly global during crises.

Financial regulation that helps monitor the health of the financial services industry and provides safeguards against financial collapses is undoubtedly needed. Some caution about how to design such safeguards is provided by the underlying message of this paper. Successful new, young firms need equity investors. The development of venture capital, angel financing, and other markets that target start-ups and young and small businesses has facilitated productivity-enhancing reallocation. Financial-sector reform should avoid increasing the barriers to the financial sector in finding new instruments and creative ways of providing funding to high growth businesses and, more generally, to productivity-enhancing reallocation.

The recent economic crisis has also highlighted the potential importance of heightened uncertainty during economic crises in dampening the pace of economic recovery. The key insight from economic

theory that also enjoys empirical support, especially in the recent crisis, is that heightened uncertainty will slow down recoveries due to caution and waiting effects. That is, even businesses with profit opportunities will delay and/or reduce the amount of investment and hiring due to heightened uncertainty.

Is the discussion in this paper on productivity and firm dynamics related to the slow recovery of the US economy from the recent economic crisis? It may be. There is indeed a potentially disturbing trend in business dynamism in the US: Whilst having achieved rapid productivity and job growth with a high pace of reallocation, the US has been experiencing a secular decline in the pace of business dynamism highlighted by a secular decline in start-ups over the last three decades. The decline has become especially pronounced in the post-2000 period. While understanding this decline is an open research question, it bodes ill for future US growth given that flexibility, business dynamism and a high pace of reallocation contributed so much to US growth over the past several decades. Moreover, the decline in flexibility would also imply the US will struggle to restructure and reinvent itself in the way which it successfully did in previous crises. This may be a contributing factor to the anaemic US recovery from the Great Recession.

The slow recovery of the US economy from the recent economic crisis may be related to the secular decline in the pace of business dynamism.

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