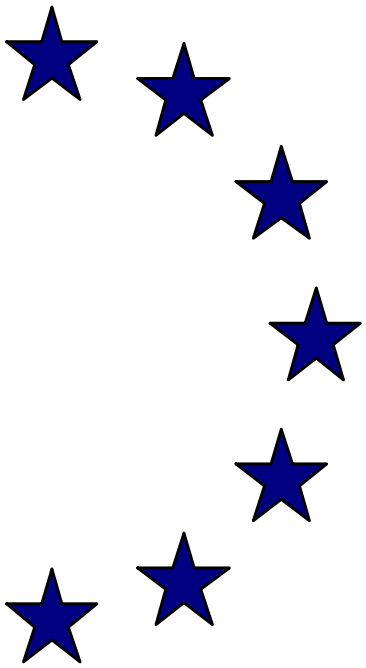
EUROPEAN ECONOMY

EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR ECONOMIC AND FINANCIAL AFFAIRS

ECONOMIC PAPERS



ISSN 1725-3187
http://europa.eu.int/comm/economy_finance

N° 209 August 2004

The link between product market reform and macro-economic performance

by

Rachel Griffith (IFS and CEPR) and Rupert Harrison (IFS)[1]

Economic Papers are written by the Staff of the Directorate-General for Economic and Financial Affairs, or by experts working in association with them. The "Papers" are intended to increase awareness of the technical work being done by the staff and to seek comments and suggestions for further analyses. Views expressed represent exclusively the positions of the author and do not necessarily correspond to those of the European Commission. Comments and enquiries should be addressed to the:

European Commission
Directorate-General for Economic and Financial Affairs
Publications
BU1 - -1/180
B - 1049 Brussels, Belgium

[1] This study was commissioned by the Directorate General Economic and Financial Affairs to the Centre for Economic Policy Research (CEPR) and the Institute for Fiscal Studies (IFS) under the reference ECFIN-E/2002/002. The findings, interpretations and conclusions expressed in this paper are entirely those of the authors and do not necessarily represent those of the European Commission. They should not be attributed to the European Commission.

ECFIN/4971/04-EN

ISBN 92-894-7876-4

KC-AI-04-209-EN-C

Table of Contents

1 Summary

Value-added per capita in EU countries has lagged behind the US. This is despite widespread reforms to product markets across EU countries aimed at increasing growth. This study analyses the macro-economic impact of product market reforms undertaken in the European Union over the 1980s and 1990s. Theory suggests that product market reforms should enhance growth, although the impact may vary across countries and may take time. On the whole empirical work has pointed to a positive impact of more liberal regulation and product market reforms on growth, although this is by no means a robust finding. In addition, many papers have highlighted the fact that there may be distributional consequences with some countries, industries or individuals losing out. The resulting adjustment process, as plants shut down and workers are displaced, may be lengthy. Productivity levels in some countries could fall, although from a world-wide perspective this results in an increase in allocative efficiency. Where the impact of reforms is to increase total employment this may result in a fall in productivity, particularly in the short run, as less productive workers are brought into the labour force.

In this work we consider a large number of regulations and reforms across EU countries. Our main methodology is a two-stage approach. The channel we investigate is one in which the level of rents is a key determinant of factor demands and incentives for efficiency enhancement and innovation. We focus on this channel because we believe that the literature highlights this as the main channel by which product market reforms affect macro-economic outcomes. We first estimate the relationship between product market reforms and the level of economic rents in the economy and in manufacturing and services. We then estimate the relationship between the level of economic rents and aspects of macroeconomic performance, using our indicators of product market reform as instruments for the mark-up. We thus control for possible endogeneity of the mark-up due to shocks that affect rents and macroeconomic outcomes simultaneously.

This method captures the impact of product market reforms on competition and the impact of competition on allocative, productive and dynamic efficiency, and includes the impact of

competition on both innovation and imitation, as measured by R&D expenditure and total factor productivity. We do not capture returns to scale.

We show that product market reforms that ease entry, reduce tariff rates and regulatory barriers kahto trade, remove price controls, and reduce public involvement in production affect the average level of economic rents in the economy in diverse ways. Reforms to labour and credit markets are associated with reductions in the level of economic rents available. Our empirical results show that the level of economic rents is negatively associated with employment and investment, or in other words greater competition is associated with higher levels of employment and investment, particularly in the service sector. These results accord with theoretical predictions. Increases in competition bring prices closer to marginal costs, increasing output demanded and thus leading to increases in factor demands.

We find that regulatory reforms that have reduced the level of economic rents appear to be associated with lower levels of labour and total factor productivity. In addition, while there appears to be a non-linear relationship between the level of economic rents and levels of R&D expenditure and growth rates of labour and total factor productivity, most countries appear to have levels of economic rents where a reduction in rents is associated with a reduction in R&D and growth rates. This is identified by looking at changes over time within countries. When we look at average differences across countries we see the opposite – countries with lower average levels of rents are those that have higher productivity, TFP and R&D investment. Interpreting these results is, however, problematic as we can not identify the impact of the average level of rents across countries from the impact of other characteristics of countries that we do not observe. There are a number of reasons why we would recommend caution in interpretation – some to do with possible measurement issues, others to do with timing and dynamics.

First, this association is obtained from a within-groups estimator, so it is identified from differences in the relative time series variation within countries. When we look at the between, or cross-section, relationship we see that countries with lower levels of markups (higher levels of competition) have higher growth rates of productivity. The problem with the latter result is that

we are not able to control for other differences across countries which may be correlated with product market regulations. For example, it might be that countries which had low levels of product market regulation were also countries that had better education systems, and this was associated with faster productivity growth.

Secondly, there are many challenges in measuring the objects of interest (labour and total factor productivity as well as the degree of competition) correctly both within several sectors of the economy (particularly services) and also obtaining comparable measures across countries. The main problems are the correct measurement of prices to reflect both variation in firms' market position and in the quality of the products produced, and are well recognised in the literature and by most national statistical agencies.[1] In addition, comparing the level of competition across countries is difficult due to differences in data collection and measurement. Some of these difficulties are lessened by looking at changes over time within countries, although this does not alleviate all the problems.

Thirdly, it is also likely that dynamic processes are important here, and with the limited time series of data we have available to us we have not been able to fully investigate these. For example, the literature emphasises the fact that adjustment costs in R&D are high (higher than for general employment or physical capital)[2] and it may take firms and others a long time to adjust to change. In addition, there are a number of difficulties in identifying the impact of such large scale reforms across heterogeneous countries which were experiencing different economic conditions.

In an appendix we also look at the impact of privatization and liberalization in network industries (electricity and telecommunications) and find that reforms were associated with reductions in employment and increases in labour productivity in these industries.

---

[1] The US puts considerable effort into correcting prices indices, e.g. for computers. A discussion of the main issues is contained in an Appendix to this report, and see Griliches (1998) for further discussion

[2] See, inter alia, Hall (1993).

For many of the problems that we encounter micro data would help; micro data would allow us to model some of the dynamic processes, though here longer time series are what is really needed (and here the problem is not only data collection, but the extent and variability of reform across countries). Micro data helps to deal with many aspects of heterogeneity, as well as many, though not all, of the measurement issues. Micro data is certainly needed to capture the complexity of mechanisms for regulating network industries.

The very different experiences of different countries that we document raise the question of whether it is possible to impose a common structure across different countries. Essentially we should ask whether the experience of other EU countries is a suitable counterfactual for estimating the effects of changes in any particular country. An alternative strategy would be to look at firms or industries within a country that were affected by the reforms and compare their performance to those that were not affected, or to pick relevant groups of countries which share similar characteristics to act as controls.

2 Introduction

Value-added per capita in EU countries has lagged behind the US (see Figure 1). This is despite widespread reforms to product markets across EU countries aimed at increasing growth.[3] The purpose of this study is to analyse empirical evidence on the macro-economic impact of product market regulation and reforms undertaken in the European Union over the last decade. We do this using data for twelve EU countries[4] over the period 1985-2000.

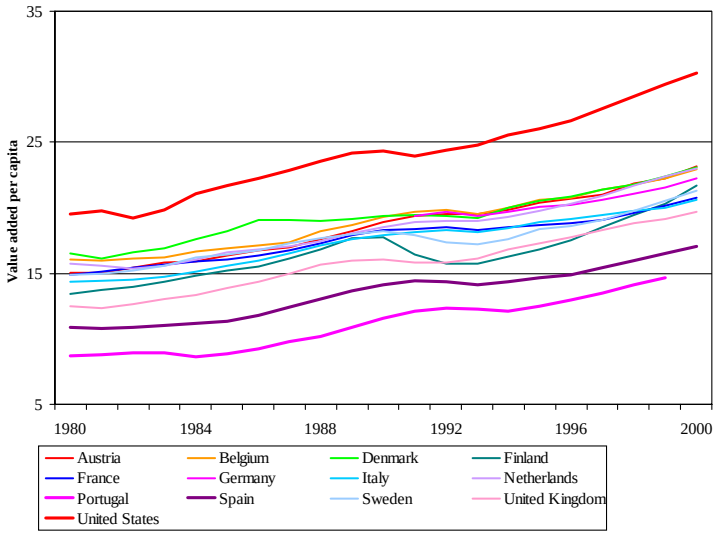


Figure 1: Value-added per capita.

Source: Author's calculations using OECD data. Value-added is in 1995 US dollars using deflators and PPP exchange rates.

Theory suggests that product market reforms should have a positive impact on allocative efficiency by bringing prices more in line with marginal costs and by driving less efficient firms out of the market. Productive efficiency may be improved by reducing slack and encouraging firms to cut fat. Opening up of markets may yield increases in productivity through returns to

[3] See, for example, EU (2003).

[4] Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Portugal, Spain, Sweden and the UK.

scale and also change opportunities for technology transfer and affect the rate of adoption of new technologies. The impact on dynamic efficiency is the hardest to pin down and it is not clear in which direction it will go. One the one hand tougher competition provides incentives for firms to innovate in order to escape competition, on the other hand in less competitive markets rents are higher so the potential returns from innovation are higher. In addition, the impact of product market regulations and reforms is likely to differ across countries and industries depending on a number of factors including the current state of technology and other regulatory institutions.

The empirical literature has not been able to distinguish all of these separate affect. On the whole empirical work has pointed to an overall positive impact of more liberal regulation and product market reforms on growth, although this is by no means a robust finding. In addition, many papers have highlighted the fact that there may be distributional consequences with some countries, industries or individuals losing out, e.g. countries or industries far from the technological frontier. The resulting adjustment process, as plants shut down and workers are displaced, may be lengthy. Productivity levels in some countries could fall (if their comparative advantage is in lower productivity sectors), although from a world-wide perspective this results in an increase in allocative efficiency.

Our approach is motivated by recent theoretical and empirical work.[5] We consider a large number of regulations and reforms across EU countries over the period 1986-2000. The reforms we focus on include changes to public procurement policies, privatizations (moving ownership from public to private sector), legal and administrative barriers to entry, barriers to trade, regulation and liberalisation of network industries.

The theoretical literature points to the level of rents as the main mechanism by which product market regulations and reforms affect performance. Competition enhancing reforms reduce rents. This brings prices more in line with marginal costs, affects managers and workers incentives to

[5] These include Aghion et al (2002), Blanchard and Giavazzi (2002), Alesina et al (2003) and Nicoletti and Scarpetta (2003).

operate efficiently and affects firms' incentives to invest in activities that will increase their ability to capture rents in future.

We therefore begin our analysis by examining the relationship between a large number of reforms and a measure of rents. This is an important first step and one that much of the existing empirical literature omits. The impact of product market reforms is heterogeneous and a priori restrictions imposed by aggregating reforms into a single index can provide misleading results. In addition, this analysis highlights the important identification problem that all empirical work in this area faces (but which not all papers discuss). In order to produce econometric estimates that identify the key parameters of interest from other cross country differences we need to have indicators of product market regulations and reforms that vary differentially over time across countries or industries. These do not always exist – both because many regulations are similar across countries and many reforms happened around the same time. We adopt a strategy to identify the parameters of interest that is valid under certain assumptions (which are spelled out). We find that there is great variation in the impact of different regulations or reforms, pointing to the problems with using a simple single index to capture the range of regulations and reforms.

Macro-economic performance is measured by growth in output per worker. This can be decomposed into total factor productivity (TFP), factor accumulation and changes in the quality of factors. We estimate the impact of product market reforms on these performance indicators both through affecting the level of economic rents available in the economy and, as a robustness check, directly.

The structure of this report is as follows. The next section provides a review of the relevant economics literature. In section 4 we describe our methodology and give a broad picture of macro economic performance in EU countries. In section 5 we consider product market reforms and their relationship to performance, and section 6 concludes and provides some pointers for future work in this area. In the Appendix we consider the process of regulatory change in network industries over the past fifteen years and how these relate to employment, investment and productivity measures.

3 Literature review and discussion of existing empirical work

This section discusses the theoretical and empirical literature on channels through which product market regulations and reforms impact on macroeconomic performance. There are a large number of literatures which are relevant to the topic. It is beyond the scope of this report to review all of them. For example, TFP measurement and growth accounting, business cycles and adjustment processes would all be of interest in a more comprehensive study. We focus on the literature that deals directly with channels through which product market regulations and reforms impact on performance.

Theoretical models suggest that regulations and reforms which liberalise or improve the working of product markets, or which move assets from public to private ownership, can affect macro economic performance in a number of ways. Following the Commission's suggestion, we discuss these under the headings of allocative efficiency, productive efficiency, dynamic efficiency and impact on overall growth. Three empirical papers that we consider as particularly relevant to this study are discussed separately, these are Nicoletti and Scarpetta (2003), Card and Freeman (2003) and Alesina, Ardagna, Nicoletti and Schiantarelli (2003).

3.1 Allocative efficiency

Reforms that lead to more competitive product markets (reduce rents) bring prices more in line with marginal costs and this will mean that the allocation of goods is more efficient. However, in network industries where cost structures create a tendency towards natural monopolies, it is not necessarily lower levels of regulation that will result in prices closer to marginal cost. In these cases the nature and quality of regulation may be more important than its level.

More product market competition can lead to increased allocative efficiency as lower productivity firms exit and market share moves from lower productivity to higher productivity firms. This means that inputs (labour, capital) are allocated more efficiently. Trade liberalisation exposes firms to foreign competition forcing exit of high cost producers and shifting market

share to low cost producers. However, the resulting adjustment process, as plants shut down and workers are displaced, may be lengthy. Low cost producers may be located in other countries so individual countries and industries can gain or lose from this process.

Two recent theoretical papers that focus on reallocation effects of liberalisation are Melitz (2003) and Blanchard and Giavazzi (2001). Melitz (2003) specifies a model with imperfect competition and heterogeneous firms in which opening to trade leads to reallocation of resources within industries towards more productive firms. Low productivity firms exit, high productivity firms expand in the domestic market and some enter the export market. This leads to an increase in aggregate productivity, even when there is no productivity growth within firms.

Blanchard and Giavazzi (2001) consider the impact of product and labour market regulations in the context of a model in which firm and employee productivity is fixed and in which there is only one factor of production (labour). Reforms to product markets reduce and redistribute the economic rents that accrue to economic agents (owners of capital and workers). In their model deregulation of product markets can take the form of increased substitutability between goods or a reduction in entry costs. In the short run, when the number of firms is fixed, increased substitutability between goods leads to lower mark ups, reduced unemployment and higher real wages. In the long run firms exit due to the lower level of rents, and as a result mark ups, unemployment and real wages return towards their original levels. This dimension of product market deregulation is thus eventually self-defeating. Reducing entry barriers has an effect in the long run - it leads to lower mark ups, lower unemployment and higher real wages. There are three things we take from this stylised model. First, even in a model where productivity does not change over time, reforms have different expected effects in the short and the long runs. Second, the impact of increasing product market competition may be muted if entry is not possible. Third, there are likely to be important interactions between product market regulations and other forms of regulation such as in labour and credit markets.

There is a large amount of empirical research on trade liberalisation, and many studies show a positive relationship between openness and growth.[6] Harrison and Revenga (1995) note that in transition economies, where large impacts have been found, trade reforms went hand in hand with big restructuring programmes. This highlights the identification problem, which we discuss in greater detail below. There have also been a large number of studies reviewing the impact of the Single Market Programme which on the whole find a positive impact on productivity and growth.[7]

One recent and carefully done study is Pavcnik (2002) which looks at trade liberalization in Chile, and finds that reallocation from low to high productivity producing plants through exit contributes around 2% to growth in manufacturing (traded sectors). Two other directly relevant papers are Olley and Pakes (1996), which finds that deregulation of the US telecommunications industry led to increases in productivity through restructuring that shifted capital from less to more productive firms and induced the exit of lower productivity firms, and Gagnepain and Uribe (2003) which shows that the 1992 European deregulation package introduced a significant change in the behaviour of airline carriers and led to efficiency improvements.

3.2 Productive efficiency

The impact of reforms to regulation or increasing product market competition on productive efficiency works through changing incentives to organize work more effectively, trim fat and reduce slack, as well as potential benefits that accrue from returns to scale as market size increases.

---

[6] See, inter alia, Levinsohn (1993), Sleuwaegen and Yanawaky (1988), Jaquemin and Sapir (1991), Levinsohn (1993), Pavcnik (2002), Harrison and Revenga (1995), Redding and Proudman (1997).

[7] There are too many to cite here but see, inter alia, Buiges et al (1991) and Mayes and Hart (1994), Jaquemin and Sapir (1991), Bottasso and Sembenelli (1998).

The main impact of better regulation or higher product market competition on productive efficiency that has been emphasized in the theoretical literature has been the incentive effect on managers and workers to reduce slack, trim fat and structure the workplace more efficiently. This strand of the literature motivates Nickell (1996)'s influential empirical paper. The agency cost literature[8] suggests that inefficiencies arise because managers (or workers) slack, there is a conflict of interest between owners and managers, and the owners cannot perfectly monitor the managers' effort. Product market competition can affect the incentives of managers to slack (positively or negatively) and the ability of the owner to monitor the manager (positively). Moving ownership from the public to private sector is one form of deregulation where this effect may be particularly important. The expected gains from privatization are based on the idea that privatization improves the incentives of owners to monitor managers,[9] for any given level of competition a change in ownership would be expected to lead to an increase in productive efficiency. Competition may or may not increase after privatization - this depends on the regulatory and institutional structures and whether they create sufficient market pressure. A lack of competition can thwart the incentives for productivity improvements in privatized industries. In industries where there are natural monopolies (largely high fixed cost or network industries) the impact of privatization depends on the market structure and regulatory regimes that ensues post-privatisation.[10]

Empirically it is difficult to distinguish between effects on productive and dynamic efficiency. Here we consider the impact on productive efficiency to be captured on the level of TFP – it represents a step change in the level of TFP, as firms reduce slack and cut fat – while dynamic efficiency is captured by a change in the growth rate of TFP.

---

[8] See, inter alia, Hart (1983), Scharfstein (1988), Willig (1987), Vickers (1994), Holmstrom (1982), Nalebuff and Stiglitz (1983), Schmidt (1997), Martin (1993).

[9] For a recent ssurvey of the literature see Megginson and Netter (2001).

[10] See Laffont and Tirole (1993) for a survey.

Nickell (1996) finds an impact of changes in product market competition, as captured by firms' market share, on productivity levels of UK firms. However, potential endogeneity in market share is not dealt with properly, so imputing a causal relationship between competition and TFP growth is problematic.[11]

Pavnick (2002), when considering trade liberalization in Chile, finds within plant productivity increases in manufacturing (traded) sectors of 3-10%. These are large increases. In contrast, Olley and Pakes (1996) did not find within firm growth in productivity as a result of the US telecoms deregulation.

A large empirical literature exists on the economic impact of privatization and liberalization, particularly of network industries. Several points are of particular relevance for the present study. First, there is often a failure of competition to develop unaided – "liberalisation" and "privatisation" need not mean the same thing everywhere, and they need not have the same effect. This is well documented in the UK by Green and Haskel (2003). Take the case of British Gas. At privatisation, rival suppliers where given permission to enter the market. However, they would need to buy gas from North Sea operators whose main customer was British Gas and ship it through British Gas' pipes, at charges set by British Gas. No entry occurred. It was not until the early 1990s after intervention by the UK competition authority, when British Gas negotiated specific targets for its market share and took steps to help rival suppliers that there was effective competition in the industry.

Second, there is controversy in the literature as to whether it is the *transfer of ownership* or the *restructuring* associated with privatisation that is of consequence.[12] Haskel and Szymanski (1992) for instance find that privatisation itself was not strongly associated with rises in TFP in

[11] Two empirical papers, Jagannathan and Srinivasan (2000) and Griffith (2001), find support for the idea that increased competition improves performance by affecting managers and workers incentives to slack.

[12] See the survey by Megginson and Netter (2001).

the UK, but that pre-privatisation restructuring was. Bishop and Kay (1988) and Bishop and Thompson (1992), again for the UK, reach the same conclusion on this point.

Boylaud and Nicoletti (2000) try to infer the effects of deregulation on performance by using variation of market outcomes and regulatory regime over time and countries for the OECD. They focus on three measures of performance: labour productivity, prices and quality. The degree of market competition and the time to liberalisation emerge as their two main explanations for the cross-country and time variability in productivity and prices, while the influence of state ownership, time to privatisation and the internationalisation of domestic markets have less clear-cut effects.

Ros (1999) also examines the relative importance of deregulation/liberalisation and privatisation in promoting teledensity, operating efficiency, and the quality and pricing of telecom services in OECD countries, with privatisation notably playing a greater role in the Ros study. On balance empirical studies conclude that deregulation and liberalisation in Telecommunication are associated with significant growth in teledensity and operating efficiency, and significant improvements in price and quality.

With trade liberalization there may be economies of scale gains if output increases (although it is not necessarily the case that output within the region will increase, e.g. if there are lower cost producers outside the region).

3.3 Dynamic efficiency

Gains through allocative and productive efficiency represent one-off changes to the level of productivity and output and accrue relatively quickly. Improvements in dynamic efficiency, through innovation and the introduction of new good and new processes, potentially have a much larger impact but are also likely to take much longer to accrue. In addition, it is not clear that increasing product market competition (reducing rents) leads to increases in firms' incentives to innovation. This is because in more competitive markets the potential gains from innovation are

lower. Increases in market size, e.g. through trade liberalization, could have a positive impact on innovation if they increased the size of potential rents (although if it coincided with an increase in competition the net affect could be positive or negative). Trade liberalisation may also increase the opportunities for technology transfer if it results in new goods or services entering the market or the entry of firms with lower cost technologies.

The early endogenous growth and industrial organisation literatures[13] suggested that increased product market competition led to *reduced* innovative activity, as more competition reduced the monopoly rents that reward successful innovators. Results in these models were driven by the assumption that innovation was made by outsiders (so pre-innovation rents were zero) so the payoff to innovation is just equal to the post innovation rent. Clearly under these assumptions there are larger incentives to innovate when rents are higher. Increasing product market competition reduces the post innovation rents so reduces incentives to innovate.

These models generally exhibit increasing returns to scale driven by the fact that ideas are non-rivalrous (once invented it is relatively costless to use an idea many times over). The size of the economy – as measured by population or the number of researchers – affects either the long run growth rate or the long run level of per capita income.[14]

More recent endogenous growth models,[15] extend the basic Schumpeterian model by allowing incumbent firms to innovate. In these models, innovation incentives depend not so much upon post-innovation rents per se, but more upon the difference between post-innovation and pre-innovation rents (the latter were equal to zero in the basic model where all innovations were made by outsiders). In this case, more product market competition may end up fostering innovation and growth as it may reduce a firm's pre-innovation rents by more than it reduces its

---

[13] See Romer (1990), Aghion and Howitt (1992), Grossman and Helpman (1991) Caballero-Jaffe (1993), Dasgupta and Stiglitz (1980).

[14] Jones (1999) provides a review of these effects.

[15] Aghion-Harris-Vickers (1997), Aghion, Harris, Howitt, Vickers (2001), ABBGH (2002).

post-innovation rents. In other words, competition may increase the incremental profits from innovating, and thereby encourage R&D investments aimed at "escaping competition". In these models product market competition will affect innovation to a larger extent in more "neck-and-neck" industries, that is in industries in which oligopolistic firms face more similar production costs. The firm with lower unit costs is referred to as the technological leader, and the one with higher unit costs the follower, in the corresponding industry, and when both firms have the same unit costs they are referred to as neck-and-neck firms.

In this framework firms innovate in order to reduce production costs, and they do it "step-by-step", in the sense that a laggard firm in any industry must first catch up with the technological leader before becoming itself a leader in the future. In neck-and-neck industries competition is particularly intense and it is also in those industries that the "escape-competition" effect pointed out above is strongest. On the other hand, in less neck-and-neck, or more "unleveled", industries, more competition may also reduce innovation as the laggard's reward to catching up with the technological leader may fall (this is a "Schumpeterian effect" of the kind emphasized in the earlier models). Finally, by increasing innovation incentives relatively more in neck-and-neck industries than in unleveled industries, an increase in product market competition will tend to reduce the fraction of neck-and-neck industries in the economy in equilibrium; this "composition effect" reinforces the Schumpeterian effect in inducing a negative correlation between product market competition and aggregate productivity growth or the aggregate rate of innovations.

Recent work by Aghion, Blundell, Griffith, Howitt and Prantl (2003) introduces entry into such a model. They show that the affect of increasing entry threat depends on the country, industry or firm's distance to the frontier. In countries or industries that are close to the (world) technological frontier, fostering entry or competition will increase incumbents' incentives to innovate in order to escape potential entrants or competitors. However, in countries and industries that lag far behind the frontier, higher entry or higher competition on their own tends to discourage incumbent firms from innovating. This model suggests that the overall impact of

trade liberalisation will depend on the current state of technology in the country or industry.[16] However, in the long run trade liberalization will increase the overall average growth rate because in equilibrium there will be more industries where the affect is positive. Trade liberalization is also likely to increase inequality across regions and/or industries. EU (2003) emphasizes the fact that post-war growth in Europe was largely based on imitation, driven by capital accumulation, while what is needed now is for European countries to shift towards growth based on innovation.

In terms of empirical evidence Nickell (1996) found a positive impact of competition on firm level TFP growth. Blundell, Griffith and Van Reenen (1999) found that firms with higher market shares innovated more but that at the industry level there were more total innovations in more competitive industries. So in aggregate competition leads to more innovation, however, within industries it is the dominant firms that innovate most.

Recent work has suggested that the relationship may be non-linear, with both very high and very low levels of product market competition providing lower incentives to innovation.[17] This lends empirical support to the model in which incumbent firms can innovate (as well as entrants) so that innovation incentives depend on the *difference* between post-innovation and pre-innovation rents.[18]

3.4 Overall growth impact

To summarise:

- allocative efficiency is improved by reducing the level of monopoly rents and bringing prices more in line with marginal costs; in addition output may be shifted towards more

[16] This is based on the model in Acemoglu, Aghion, and Zilibotti (2002).

[17] Aghion et al (2002).

[18] See, for example, Aghion et al (2002), Griffith (2001), Griffith et al (2000,2001).

efficient firms. Reforms such as trade liberalization expose domestic firm to foreign competition, reducing their market power and there may be economies of scale gains if output increases (although this is not necessarily the case). However, there may be distributional consequences, some countries, industries or individuals could lose out, e.g. where a country or industry is far from the technological frontier. The resulting adjustment process, as plants shut down and workers are displaced, may be lengthy. Productivity levels in some countries could fall (if their comparative advantage is in lower productivity sectors), although from a world-wide perspective this results in an increase in allocative efficiency.

- productive efficiency may be improved through economies of scale or scope, or through changing incentives for managers and workers to slack (although this latter affect can, in theory, go in the opposite direction); part of the growth affect of product market liberalization comes through the increasing returns affect implied by the endogenous growth models and the assumption that ideas are non-rivalrous (can be used repeated at low incremental cost); trade liberalization and the opening up of markets may also change opportunities for technology transfer and affect the rate of adoption of new technologies;

- the impact on dynamic efficiency is perhaps the hardest to pin down, product market reforms will affect incentive to engage in innovative activity, but it is not clear in what direction and the impact is likely to differ across countries and industries depending on a number of factors including the current state of technology and other regulatory institutions;

- empirical studies often can not separately identify the impact of product market regulations and reforms on allocative, productive and dynamic efficiency. In terms of the overall growth impact:

- there may be a substantial and lengthy adjustment period, and there are likely to be winners and losers in the adjustment process;

- empirical studies have for the most part pointed to a positive impact of lower product market regulation or higher product market competition on productivity and growth, however, a number of empirical issues remain unresolved; recent empirical work has found an inverted U relationship with both very high and very low level of competition being bad for innovation.

Many studies have not been able to identify a causal relationship. They have shown a simply a correlation or association. This difficulty in identifying a causal relationship is common across studies in this area (and many other fields of economics). In addition, there are many difficulties in measuring the key variables of interest – the extent of product market reforms, the extent of competition and market size, macroeconomic performance – and the validity of any study rest on careful attention to these measurement issues, which are discussed in greater detail below.

Three empirical papers merit more extended discussion of their direct relevance. These are Nicoletti and Scarpetta (2003), Card and Freeman (2003) and Alesina et al (2003).

3.5 Nicoletti and Scarpetta (2003)

Nicoletti and Scarpetta (2003) (henceforth N&S) relate a large number of reforms to growth in total (multi) factor productivity in one of the most comprehensive empirical studies in this field. In their paper the impact of product market reforms affects the rate of TFP convergence across countries and industries. Those countries and industries experiencing the greatest reform experience temporarily faster growth rates while they catch up to the international steady-state growth rate. The specific question they address is whether the different patterns of reform across countries can help explain the differences in growth rates across countries and industries. They highlight two main affects of reform: lowering entry barriers and state control are associated with faster catch-up to the frontier in manufacturing industries, with industries furthest behind the frontier getting greatest rewards; the process of privatization is associated with productivity gains.

It is worth examining their empirical methods and results in some detail because they highlight many of the difficulties involved in using cross-country data on regulations to examine the effects of product market reforms. The general approach follows Griffith, Redding and Van Reenen (2000, 2002), who explicitly derive a model of productivity growth and catch-up from an endogenous growth framework. N&S replace the role of R&D in this approach with their measures of product market regulation. Thus product market regulation affects an industry's TFP growth both directly and when interacted with the industry's distance to the world technological frontier, or "technology gap". The general model is thus as follows

$$\Delta \ln TFP = \alpha(\Delta \ln TFPLeader) + \beta(techgap) + \gamma(PMR) + \delta(PMR * techgap)$$

where PMR is an index of various indicators of product market regulation, and the coefficients are usually allowed to vary between manufacturing and service industries. Many of N&S's results stem from the interaction between PMR and the technology gap, which the authors interpret as indicating that stricter product market regulation delays the process of technology adoption in countries that lag behind the frontier. However, the assumption that product market regulations act in the same way as R&D expenditures do in the original Griffith et al model is rather ad hoc. In the case of R&D there is clear theoretical and empirical support for the idea that in order to imitate you need to be doing some R&D yourself. It is not so clear that the primary impact of product market reforms and regulations should be on the rate of technology transfer.

N&S use a panel of 17 manufacturing and 6 business services industries in 18 OECD countries over the period 1984-1998. The baseline specification (Table 5 in their paper), which does not include any measures of product market reforms, finds a positive direct effect of the leader's TFP growth only in service industries (coefficient α in the above equation) and a stronger effect of the technology gap in service industries than manufacturing (coefficient β). The coefficients have the expected sign, and the greater evidence of catch-up in service industries accords with results in Bernard and Jones (1996) who suggest that service industries may be more homogeneous across countries than manufacturing industries.

The first set of product market regulation regressions include a country-level, non-time-varying summary measure of regulation (combining state control and barriers to entry), as well as a country-level, time-varying measure of overall privatization (their Table 6). Several issues arise with the use of these PMR indicators. First, the fact that the regulation indicators do not vary across industries or over time means that country fixed effect, which would control for unobservable country characteristics on growth, cannot be included in the regressions. Identification of the coefficients therefore comes from cross-section variation across countries in the average growth rate of TFP. No significant results are found until the regulation indicators are interacted with the technology gap measure. Given that the regulation measures are not significant on their own, it would be possible to re-introduce country dummies to check that the interaction result is robust to unobservable persistent differences across countries. However, this is not done.

Secondly, the regulation measures used in N&S capture the situation in 1998, which is at the end of the sample. The underlying assumption is that end-of-period values are representative of the cross-country patterns of regulation over the entire 1984-1998 period. This will not be true if some countries have liberalized their markets faster than others. This makes causal interpretations of the results extremely problematic.

Finally, the information on product market regulations has been aggregated into a single summary measure. This imposes strong and possibly arbitrary restrictions on the way in which individual regulations can affect productivity growth. It also mean that it is not possible to deduce from the results which specific regulations have the largest effects, and how economically important those effects are. To some extent this may be inherently difficult due to high levels of correlation between different regulations, but a more flexible approach using greater numbers of individual indicators could be both more robust and more informative. This criticism applies to almost all of the regulatory indicators used by N&S.

In contrast to the country measure of regulation, the time-varying measure of overall privatization appears to have a consistently positive effect on TFP growth, although these are not

interacted with the technology gap. However, the privatization effect is no longer significant in a specification that includes a time-varying measure of regulation. This time varying measure is constructed by interacting the non-time-varying measures described above with a time-varying indicator of regulatory reforms in seven service sector network industries. The underlying assumption is that developments in these network industries are representative of regulatory changes in the economy as a whole. This is very unlikely to hold due to the special nature of the network industries considered, and the significant result should be interpreted extremely cautiously. The fact that the indicator of overall privatization is no longer significant suggests a positive correlation between privatization and regulatory reform over time within countries. As mentioned above, this problem is likely to be true of many indicators of product market reform and again this makes causal interpretations of the results difficult.

The second set of results use time-varying measures of entry liberalization in manufacturing and services, where the former is constructed using data on trade liberalization, and the latter using regulatory reforms in network industries. None of the results are significant, except for a positive effect of entry liberalization in services on TFP growth in manufacturing. The authors suggest that this may reflect changes in the scope for efficiency enhancements related to the use of service inputs, but the result is difficult to interpret with confidence. Another possibility is that it reflects cheaper or higher quality service inputs. A time-varying indicator of privatization that varies between services and manufacturing also has a significantly positive effect on TFP growth in all of these regressions.

The final set of results uses non-time-varying industry-specific measures of barriers to entry, as well as the time-varying measures of entry-liberalization used previously. The coefficients on the measures of barriers to entry are either insignificant or suggest a slightly positive effect of barriers to entry on TFP growth. The only exception is when barriers to entry in manufacturing are interacted with the technology gap, suggesting that increased barriers to entry may reduce the positive ‘catch up’ effect. Entry liberalization in services again appears to have a significantly positive effect on TFP growth in the whole economy, as does overall privatization.

Overall, results that appear relatively robust are the positive effect of overall privatization and entry liberalization in services on economy-wide TFP growth. The latter of these is problematic due to the summary nature of the measure of entry liberalization as discussed above.[19] The interactions of PMR measures with the technology gap suggest that the negative effects of higher product market regulations on TFP growth may be greater in countries that lie furthest behind the technological frontier. This appears to contrast with the theoretical and empirical work by Aghion, Burgess, Redding and Zilibotti (2003). ABRZ study the impact of trade reform in India over the 1990s. They find that the impact of liberalization varies across sates, and in particular depends on the state of technology and labour market institutions before reform. States that were near the technological frontier and had liberalized labour markets experienced increased growth in response to trade liberalization (though increasing competition). Industries that were either far behind the frontier and/or had rigid labour market institutions suffered from increased trade liberalization. ABRZ interpret these results as reflected increased rates of technology transfer from frontier countries to India. An alternative interpretation might be that the measures of regulation underestimate the true extent of product market regulation in countries furthest from the frontier.

A further difficulty in the interpretation of Nicoletti and Scarpetta's results is that they do not relate product market reforms to actual measures of product market competition, and the channels by which product market reforms may affect productivity growth are not made clear. Thus they do not show that the product market reforms considered led to an increase in product market competition or entry, or how these factors are related to TFP growth at the industry level.

[19] In an appendix not published in the final Economic Policy version of the paper they appeared to show that these results were not robust to the inclusion of outlying observations.

3.6 Alesina, Ardagna, Nicoletti and Schiantarelli (2003)

A recent OECD working paper by Alesina, Ardagna, Nicoletti and Schiantarelli investigates the relationship between product market regulation and investment in OECD countries over the 1975-1998 period. The paper provides a theoretical framework and then uses the same OECD time-varying regulation indices as Nicoletti and Scarpetta (2003) to investigate the empirical relationship between regulation and investment. This paper provides a strong link between theory and the empirical investigation.

The theoretical framework is similar to that in Blanchard and Giavazzi (2002), except that labour markets are assumed to be competitive, in order to abstract from labour market regulation, a second factor (capital) is added to the model, and the capital stock is endogenised in order to generate predictions about investment.[20] The product market is characterized by monopolistic competition, where the elasticity of demand is assumed to depend negatively on the degree of product market regulation. One possible interpretation is that the elasticity of demand is an increasing function of the number of firms, which is in turn determined by the cost of entry. Thus less restrictive entry regulations increase the number of firms, which increases the elasticity of demand and thus lowers the level of rents in the economy.

In this context, firms choose capital and labour to maximize the present discounted value of future cash flow, subject to standard quadratic adjustment costs associated with investment. The authors assume that these adjustment costs can also be affected by product market regulation. For reasonable parameter values, the solution to the model generates predictions about the relationship between product market regulation, the mark-up (or the level of rents) and the level of investment and employment. Deregulation, by reducing the mark-up, leads to an increase in investment and a higher demand for labour. This kind of theoretical framework lies behind the analytical approach used in our study.

---

[20] Blanchard and Giavazzi only have one factor – labour.

The empirical section of the paper looks at the effect on investment of time varying summary indexes of barriers to entry and public ownership provided by the OECD in three network industries (Electricity, Gas and Water, ISIC 40-41; Communications and Post, ISIC 64; and Transport and Storage, ISIC 60-63). The empirical specification takes the form of a dynamic model of investment with country, industry and year effects. The authors find that barriers to entry have a significant negative effect on investment, but that public ownership has no significant effect. They suggest that public ownership may provide firms with incentives to over-invest that cancel out any negative effect. The scale of the effect they find is large: the reduction in the regulation index in the UK communications sector over the 1984-1994 period generates a predicted increase in the investment rate of 3.27 percentage points. The actual increase was 3.03 percentage points (from 4.96% to 7.99%).

3.7 Card and Freeman (2003)

Another recent study that is directly relevant is the forthcoming book by Blundell, Card and Freeman and the introductory chapter by Card and Freeman (2003). This book provides an in depth analysis of two decades of reforms to product and factor markets in the UK. Each chapter considers micro evidence for the impact of different types of reform. Card and Freeman conclude,

> *"The evidence shows that the UK made greater market reforms than most other advanced countries and that it arrested the nearly century-long trend in relative economic decline of the UK relative to its historic competitors, Germany and France… It is difficult to link the reforms to the improved economic performance relative to these other countries, but at the minimum our analysis has shown the change in the UK economy cannot be readily explained by standard macroeconomic change in labor or capital. … Absent a unequivocal counterfactual of what would have happened had the UK not proceeded with reforms, we cannot definitively judge the market reforms, though*

weighing the diverse evidence, they do seem to have played a positive role in aggregate economic growth."

Thus, Card and Freeman are saying that there remains a substantial unexplained component of growth (or lack of decline) in the UK, and that this seems to be associated with a number of reforms to product and labour markets. However, even the large number of studies that were undertaken in the individual chapters of their book were not able to conclusively link these reforms to performance, in large part because they were not able to form a clear picture of what would have happened in the absence of these reforms. This ability to identify the counterfactual is essential in any evaluation, without this it is not possible to impute causality to any observed association between reforms and growth. This is the major difficulty with Nicoletti and Scarpetta's paper and in our empirical work reported below.

4 Modelling strategy

We are interested in estimating the effects of reforms to product market regulations on macroeconomic outcomes. The literature in this area suggests that the main way in which regulations and reforms are channeled into macro outcomes is through affecting the level of economic rents available in the market. This in turn affects price levels, the allocation of inputs and outputs and incentives to engage in efficiency enhancing activity and innovation. We capture the level of rents available using an estimate of the markup or price-cost margin.

We examine the relationship between a large number of reforms and a measures of rents in the aggregate economy, as well as in manufacturing and service sectors separately. This is an important step and one that much of the existing empirical literature omits. The impact of different product market reforms on product market competition and rents may vary significantly, and a priori restrictions imposed by combining reforms into a single index can provide misleading results. In addition, this analysis highlights the important identification problem faced by all empirical work in this area (but which not all papers discuss). In order to obtain econometric estimates that identify the key parameters of interest separately from other cross country differences we need to have indicators of product market regulations and reforms that vary differentially over time across countries or industries. These do not always exist – either due to data availability, or because many regulations are similar across countries and many reforms happened around the same time. We adopt a strategy to identify the parameters of interest that is valid under certain assumptions (which are spelled out).

Macro-economic performance is measured by growth in output. This can be decomposed into total factor productivity (TFP), factor accumulation and changes in the quality of factors. We estimate the impact of product market reforms on these performance indicators both through rents and directly. This can be described as a two-stage estimation procedure, or as an instrumental variables approach. We estimate the effects of product market reforms on the level of rents, and then estimate the effect of the mark-up on macroeconomic outcomes using measures of product market reforms as instruments for the mark-up. The ultimate effects of

product market regulations and reforms on macroeconomic outcomes, as mediated via the level of rents, can be evaluated by combining the estimated coefficients from the first and second stages.

Using an instrumental variables estimator is important because it controls for potential endogeneity in the mark up. For example, a positive demand shock would lead both to increases in output and in the level of profitability. These variables would then appear to be correlated, but this would not be because of any causal relationship between them. Using instruments that affect the markup but that do not directly affect performance allows us to identify a causal relationship. However, this relies on the assumption that reforms only affect performance through affecting the level of markup. We use regulatory reforms which affect the level of markups, but which we assume do not affect macro performance directly, as instruments. We test the validity of these assumptions using a test of over-identifying restrictions, which we describe in more details below. In addition, we are explicitly interested in the estimated coefficients in the first stage as these tell us how product market reforms have affected the level of economic rents available.

This approach is an alternative to aggregating various indicators into a summary measure of product market regulation using a priori restrictions as in Nicoletti and Scarpetta (2003). The key advantages of our approach are first that the nature of the aggregation is determined by the data, rather than being imposed a priori, and secondly that we can recover the expected effects of specific regulations from the estimated coefficients in the first stage.

We consider equilibrium output at the country or industry level:

(1) $$Y_{it} = f\left(K_{it}, L_{it}, R_{it}, A_{it}\right)$$

where K is index of tangible capital inputs, L is index of labour inputs, R is index of intangible capital inputs and A is a measure of TFP.

Product market competition is captured by μ, the markup of price over marginal cost, and affects output through the levels (and quality) of the factor demands and growth rates of productivity.

$$
\begin{aligned}
K_{it} &= f_K(\mu_{it}) \\
L_{it} &= f_L(\mu_{it}) \\
R_{it} &= f_R(\mu_{it}) \\
A_{it} &= f_A(\mu_{it})
\end{aligned}
\tag{2}
$$

In the short run we consider the number of firms, tangible and intangible capital as being fixed. Labour inputs adjust through hiring, firing, redundancies and changes to working hours. The extent and speed of adjustment will depend on labour market regulations and the nature of bargaining between employers and workers. In the short term TFP adjusts through reductions in slack. In the longer run firms can enter and exit, tangible and intangible capital investment can occur and TFP can adjust through investment in new technologies, changes in workplace organization, and technological spillovers.

We use only those regulations and reforms which vary differentially over time across countries (or across industries). This is because we believe that it is important to control for differences across countries that we are not able to observe, but which are constant over time and may be correlated with product market reforms and performance. We control for these unobservable characteristics by including country specific effects, which are highly statistically significant in all our regressions. Indicators that only vary across countries, but not over time, cannot be included (because they would be exactly collinear with the country fixed effects) but are controlled for by the country specific effects. The estimates obtained using this "within" estimator, which identifies the impact off of differential time series variation, are preferable to "between" estimates which identify the impact from cross-sectional differences which may be affected by measurement errors and other unobservable differences.

We begin by estimating the first stage, or reduced form, regressions of the mark-up on the indicators of product market reforms

$$\mu_{it} = \beta_{\mu} PMR_{it} + \beta_{\gamma} YGAP_{it} + f_i + t_t + \varepsilon_{it}^{\mu} \quad (3)$$

where PMR_{it} represents a vector of time and country/industry varying indicators of product market regulation, $YGAP_{it}$ is a measure of the output gap that captures country-specific cyclical factors, f is a country fixed effect and t represents year dummies (these capture common macro shocks).

The estimated first stage coefficients $\hat{\beta}_{\mu}$ are of interest in themselves and tell us about how specific regulations or reforms have affected the degree of product market competition, as measured by the mark up. In addition, the explanatory power of the regressors in the reduced form regressions is an indicator of whether they are good instruments for the mark-up in the second-stage regressions. To illustrate this we present the R^2 statistics for the reduced form regressions.

We then estimate the effects of the predicted level of rents from the first stage on factor demands, labour productivity and TFP.[21] For factor demands we are interested in the impact of product market competition on the levels:

$$\begin{aligned} \ln I_{it} &= f_I(\hat{\mu}_{it}) + \beta_{\gamma} YGAP_{it} + f_i + t_t + \varepsilon_{it}^{I} \\ \ln L_{it} &= f_L(\hat{\mu}_{it}) + \beta_{\gamma} YGAP_{it} + f_i + t_t + \varepsilon_{it}^{L} \\ \ln R_{it} &= f_R(\hat{\mu}_{it}) + \beta_{\gamma} YGAP_{it} + f_i + t_t + \varepsilon_{it}^{R} \end{aligned} \quad (4)$$

Where $f(\hat{\mu}_{it})$ is some function of $\hat{\mu}_{it}$, for example a linear function such as $\beta_0 + \beta_1 \hat{\mu}_{it}$. For labour productivity and TFP we are interested in both the level and growth rate, for example:

[21] In practice we actually do this in one step, using the regressors from the reduced form as instruments for the mark-up to ensure that the standard errors are correct.

(5) $$\ln TFP_{it} = f_{TFP}(\hat{\mu}_{it}) + \beta_{\gamma} YGAP_{it} + f_i + t_t + \varepsilon_{it}^{TFP}$$

$$\Delta \ln TFP_{it} = f_{\Delta TFP}(\hat{\mu}_{it}) + \beta_{\gamma} YGAP_{it} + f_i + t_t + \varepsilon_{it}^{\Delta TFP}.$$

Recent papers in the endogenous growth literature have suggested that the relationship between product market competition and productivity growth may be non-linear, with both very high and very low levels of competition being bad for growth.[22] We investigate the possibility that the function $f(\hat{\mu}_{it})$ may be non-linear by including both a linear and a squared term in the mark-up.

In the two stage or instrumental variables framework described above the ultimate effect of individual reforms on macroeconomic outcomes can be calculated by multiplying the estimated first and second stage coefficients. If the relationship in the second stage is non-linear then the effects of product market reforms will depend on the initial level of product market competition as measured by the mark-up.

The key assumption we are making is that the impact of product market reforms on macro economic performance only acts through the level of economic rents available in the economy, and that these reforms to do not affect performance in any other way. We test this assumption using a Sargan test of over-identifying restrictions. If we consider the factor demand equations numbered (4) above, the vector of indicators of product market reforms, PMR_{it}, is excluded from the regression, and acts only as a group of instruments for the mark-up. If the assumption that all the elements of PMR_{it} should be excluded from the regression is not valid then the estimated coefficient on the mark-up may be biased. Because there are more elements of the

[22] See Aghion et al (2002).

vector PMR_{it} than variables being instrumented, the equation is said to be over-identified. It is possible to test the over-identifying exclusion restrictions using a Sargan test.[23]

If the Sargan test rejects the over-identifying restrictions, this does not provide any guidance on which elements of PMR_{it} should be included in the regression. In order to investigate this we use a procedure that is equivalent to a Lagrange Multiplier test of over-identifying restrictions.[24] This involves estimating an equation of type (4), taking the estimated residuals and regressing these on all of the exogenous variables in the model. Consider employment as an example. We estimate:

$$\ln L_{it} = f_L(\hat{\mu}_{it}) + \beta_\gamma YGAP_{it} + f_i + t_t + \varepsilon_{it}^L \tag{6}$$

which gives us the estimated residuals $\hat{\varepsilon}_{it}^L$. We then estimate the residuals regression by OLS:

$$\hat{\varepsilon}_{it}^L = \delta_L PMR_{it} + \delta_\gamma YGAP_{it} + f_i + t_t + u_{it}^L \tag{7}$$

If any of the estimated $\hat{\delta}_L$ coefficients on the product market reform indicators in this equation are statistically different from zero this suggests that the relevant indicator should not have been excluded from the employment regression (6). The intuition behind this is as follows: if the indicator is correlated with the remaining unexplained variation in employment from the main regression then it contains relevant information about changes in employment that are not mediated through the mark-up, and it should have been included directly in the employment regression in the first place. When this happens we re-estimate equation (6) with the relevant indicator included directly. We repeat the exercise until the Sargan test does not reject the remaining over-identifying restrictions.

---

[23] See Sargan (1958, 1988) Anderson and Rubin (1949), Hansen (1982) Arellano and Bond (1991).

[24] The Lagrange Multiplier test is asymptotically equivalent to the Sargan test in large samples.

The econometric approach described above allows us to identify the impact of product market reforms on a range of performance measures. However, it relies on several functional form assumptions in both the theory and in the econometric application. Including all of the PMR indicators directly in explaining macroeconomic performance is equivalent to difference-in-difference methods from the evaluation (natural experiment) literature. We do this to consider the robustness of our results. This method highlights the fact that what we are doing is comparing an affect (or "treated") group of countries with an unaffected (or "control") group, and that it may be hard to identify an unaffected group, especially for large scale reforms which are likely to affect most industries and countries. This is the same identification problem as was highlighted above – and is dealt with inadequately in much of the literature. As emphasized by Card and Freeman (2002) it is hard to tell what the counterfactual growth rate would have been. Thus it is not clear that those countries/industries that did not undergo reforms provide a good representation of what would have happened in those countries that did, if they had not undergone the reforms. The other drawback, as discussed above, of this approach is that it does not allow us to say anything about the magnitude of the impact of future reforms or alternative reforms (unless we make further functional form assumptions). It may also be difficult to specify the timing of reforms across countries and industries and this may make evaluation difficult.

4.1 Measuring the markup

Our main intermediate indicator of interest is the mark-up. This most closely corresponds to the parameter specified in theoretical models which is the level of rents available to firms. We use this to capture the impact that changes in regulatory regimes over time have on product market competition. Other measures of product market competition such as a concentration index or a Herfindahl index have a number of well-documented problems associated with them. First, in order to measure them we need to have firm level data and we need to be able to define and measure the extent of the relevant markets (in terms of both which products are in the market and which geographic areas are covered by the same market). This is a problem that plagues policy makers and academics alike. Secondly, even if we are able to define markets, these indices are

not necessarily good indicators of the level of competition. Industries with high concentration or Herfindahl values can still be fiercely competitive, if for instance, the threat of entry is high.

The mark-up, which is an approximation of the Lerner Index, can be shown to be a more robust measure of competition.[25] We construct a mark-up over value added (profitability measure) as follows:

$$markup = \frac{ValueAdded}{LabourCosts + CapitalCosts},$$

where all variables are in nominal prices. This simple measure of the mark-up can be shown to be equivalent to that proposed by Roeger (1995),[26] and contains an implicit assumption of constant returns to scale, such that marginal cost is equal to average cost. Capital costs are calculated using an assumed constant rental cost of capital. The calculated markup for the entire business enterprise sector is shown in Figure 2. It averages 1.26 and increases slightly over the period 1985 to 2000. This measure is clearly cyclical and there is big variation both within and between countries. The highest levels are in Italy, which has a mean of over 1.4 and reaches nearly to 1.5 by the end of the sample period. The lowest mean markups are in Germany and Austria. Finland experiences a rapid decline in the markup over the late 1980s followed by rapid increase after 1990.[27]

[25] See, inter alia, Boone (2000) and Aghion et al (2002).

[26] See Klette (1998) for a discussion.

[27] Overall, our measure are similar to other examples in the literature, for example those calculated for manufacturing industries by Martins, Scarpetta and Pilat (1996).

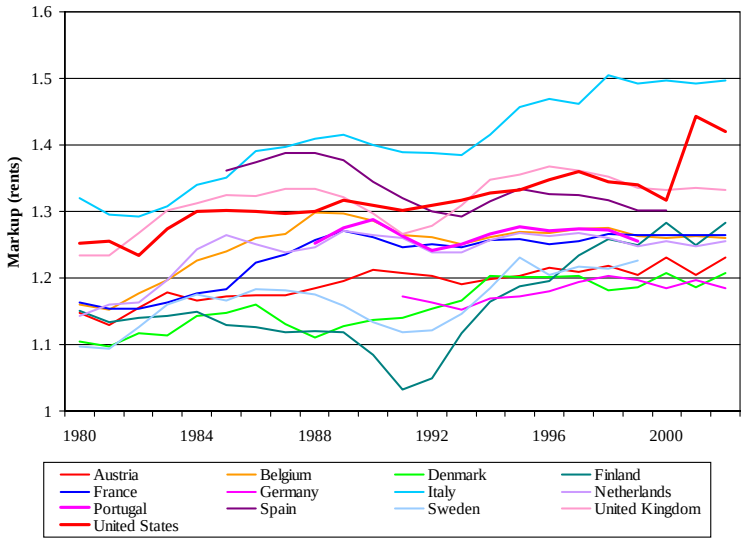


Figure 2: Mark-up over Value-added.

Source: Authors' calculations using OECD data, the assumed rental cost of capital is 10%.

This measure of the mark-up is biased downwards (upwards) in the presence of increasing (decreasing) returns to scale. It is possible to use estimates of average returns to scale at the industry level, combined with industrial structure at the country or sector level, to control for this bias.[28] However, it has not been possible for us to either estimate or find time-varying data on average returns to scale at the industry level. Since industrial structure does not change very quickly over time any bias that might arise due to different levels of increasing returns to scale across countries will be captured by the fixed country effects in our econometric analysis. Similarly, any trends that are common across countries will be captured by year effects.

[28] See, for example, Antweiler and Trefler (2002).

Figure 3: Mark-up with country and year means taken out.

Source: Authors' calculations using OECD data, the assumed rental cost of capital is 10%.

Figure 3 plots the markups after the country mean and common time variation has been taken out.[29] This emphasizes the within country time-series variation, which is what we are relating to product market regulation in our econometric analysis below. There are a group of countries which experienced declining markups from 1990 onwards which include Austria, Belgium, France, Germany, the Netherlands, Portugal, and the UK (from 1995). In contrast, Denmark, Finland, Italy and Sweden experienced increasing markups over the 1990s. Finland is clearly

[29] In a test for non-stationarity of the mark-up we reject the unit-root hypothesis at the 5% level. The autoregressive coefficient is equal to 0.897 with a robust standard error of 0.041.

very different to the other countries, part of which may be due to developments within the telecommunications industry which played a dominant role during the 1990s.

We use the mark-up over value added rather than over output because data is available more often. In Figure 4 we show both. The mark-up over value added is higher than that over output, with the average for the aggregate mark-up over value added in our preferred sample of countries equal to 1.25, and the equivalent average for the mark-up over output equal to 1.11. The linear correlation between the two in the same sample is equal to 0.98, and all our main results are robust to using the mark-up over output where data is available.

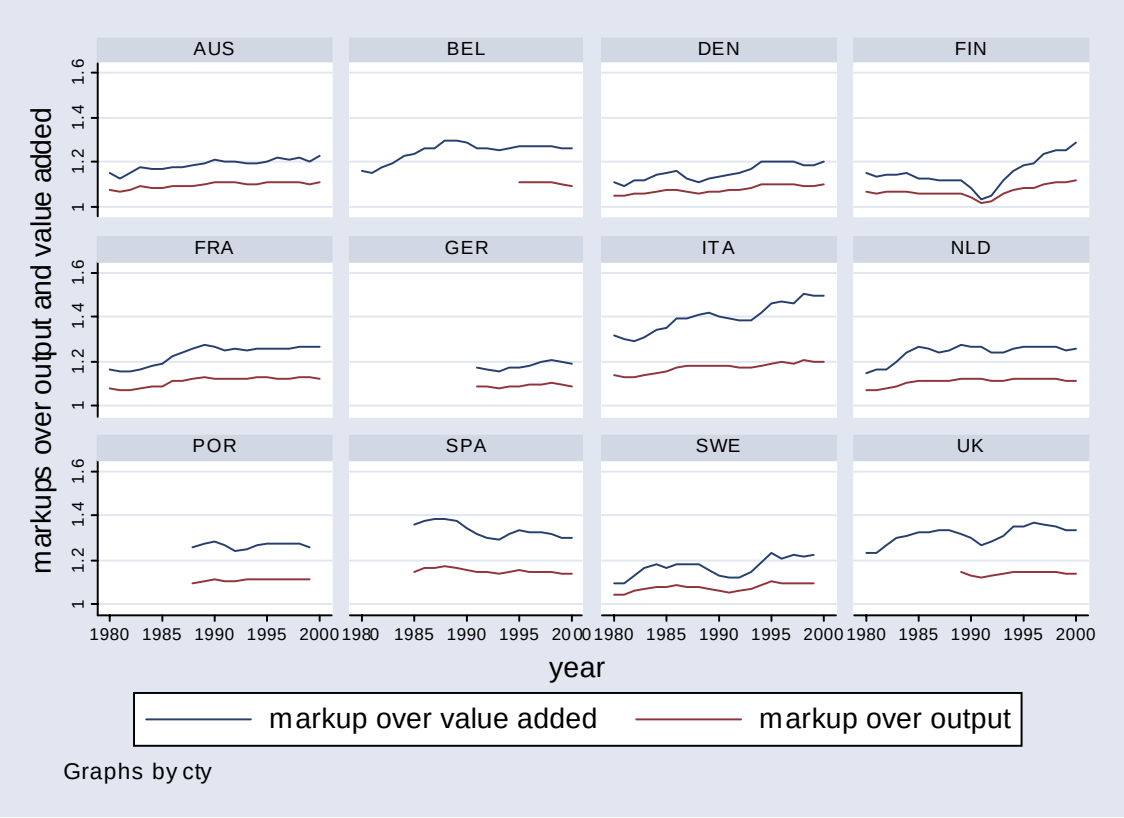


Figure 4: Mark-up using output compared to using value-added.

Source: Authors' calculations using OECD data, the assumed rental cost of capital is 10%.

This measure of the markup, or profitability, is affected not only by the degree of competition in the market but also by the level of costs[30] and the volume of sales. Using the predicted mark-up as described in the methodology section should control for influences on the mark-up that are not related to developments in the product market. However, to check the robustness of our results we will also correlate our measures of product market regulations and reforms directly with the macro economic performance indicators as described above.

In the appendix we look at the relation between regulations and price levels in the only industry where suitable data is available – the electricity industry. We were not able to obtain any suitable data over the relevant time period on price levels for other goods.[31] Comparing price levels across countries and markets can be problematic for a number of reasons (for example the characteristics of seemingly similar products can differ markedly across markets,[32] and non-linear pricing schedules can mask differences) the electricity industry is one where the service provided is fairly homogeneous.

We have also looked at the entry data in the OECD entry database. This contains information on

the number of exiting, entering and continuing firms by year (usually at the two-digit industry level) for the period 1986-1997 for a subset of EU countries (and in some countries only for manufacturing industries). Unfortunately we have not been able to obtain useful results from this data, largely because the available sample sizes were too small once we restricted analysis to the years and countries for which we had data on relevant product market regulations. We would recommend that future work in this area begin by looking at the relationship between product

---

[30] See Demsetz (1982) and Boone (2000).

[31] Our price data comes from the Eurostat structural indicators. Data is also available for the Post and Telecommunications industry but only for the 1997-2002 period.

[32] See, for example, work by Goldberg and Verboven on EU car markets.

market regulation and entry at the micro level in individual countries, before extending it to a cross-country investigation.

4.2 Macroeconomic performance

We measure macroeconomic performance using conventional indicators. These include the level and growth rate of labour productivity and total factor productivity, capital formation, R&D expenditure, numbers employed, and average hours worked.

Information on output, value-added, capital expenditure and numbers employed come from the OECD STAN database. R&D expenditures are taken from the OECD ANBERD database. Hours worked comes from a dataset constructed by researchers at the university of Groningen.[33] Data on the key variables of interest for the period 1985-2000 are available for all EU countries except Greece, Republic of Ireland and Luxembourg. These countries are omitted from this analysis. In addition, Spain and Portugal are excluded from some parts of the analysis due to data availability. We include only current members of the EU in our empirical analysis, and thus exclude other OECD countries such as the USA and Japan. Appendix B gives further details on the data.

Figure 1 shows business enterprise value-added per capita from 1980 to 2000. The US has a higher level and grows at a faster rate than European countries. All countries have higher per capita value added by the end of the period than at the beginning, although the growth rates vary. Finland experienced a substantial dip over the early 1990s followed by a rapid recovery. Portugal and Spain have had persistently lower levels of per capita value added compared to the other countries. There has been relatively little change in the ranking of countries within this group, although Card and Freeman (2003) show that over a longer time period (back to 1960) there has

[33] "University of Groningen and The Conference Board, GGDC Total Economy Database, July 2003, http://www.eco.rug.nl/ggdc"

been more change in the ranking of countries with, for example, the UK falling from 3rd to 12th amongst OECD countries.

Figure 5 plots value added per worker (a measure of labour productivity) from 1980 to 2000.[34] Portugal remains at the bottom of the chart, while Spain moves from the bottom in terms of value-added per capita to around the median in terms of value-added per worker. The US and Belgium remains at the top throughout the period.

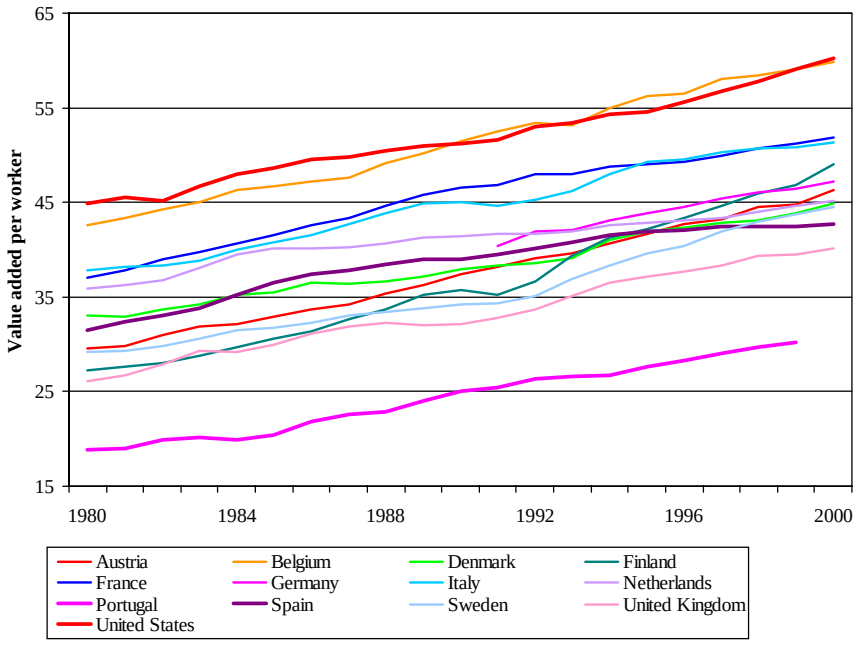


Figure 5: Value-added per worker. Source: Authors' calculations using OECD data. Value-added is in 1995 US dollars using deflators and PPP exchange rates.

The difference between per worker and per capita value added reflects the unemployment rate, the proportion of the population of working age and participation rates. Figure 6 shows the

[34] The number of workers is defined as numbers engaged. Where this is not available we use numbers employed.

unemployment rate from 1980 to 2000. We can see, for example, that Spain has very high unemployment, so this will in part explain the difference in value added per capita and per worker. The US has substantially lower unemployment, particularly over the 1990s.

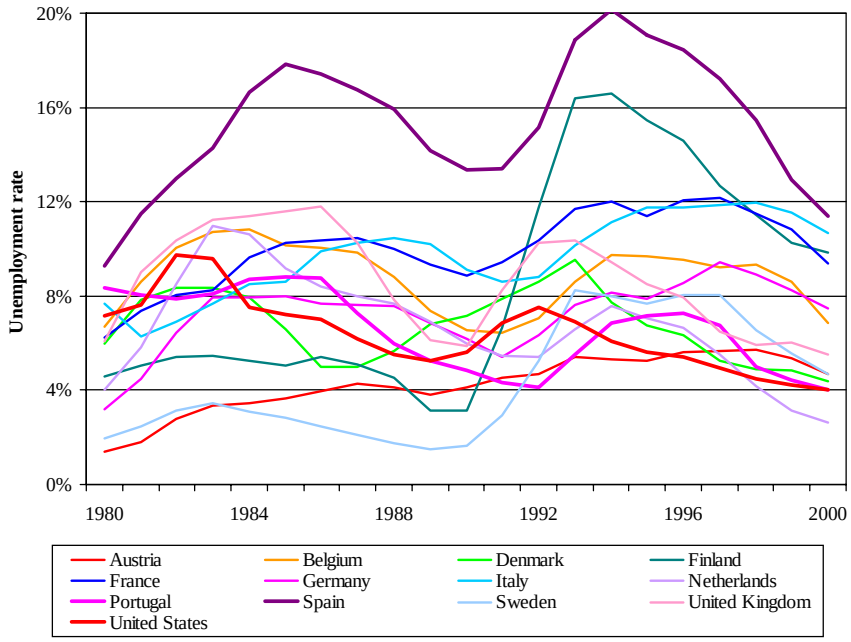


Figure 6: Unemployment rate. Source: OECD.

We use a measure of the output gap to control for country specific business cycles. The measure we use is taken from the OECD Economic Outlook. Figure 7 shows the output gap for the countries in our sample over the 1980-2000 period, measured as the percentage deviation of current output from potential output.

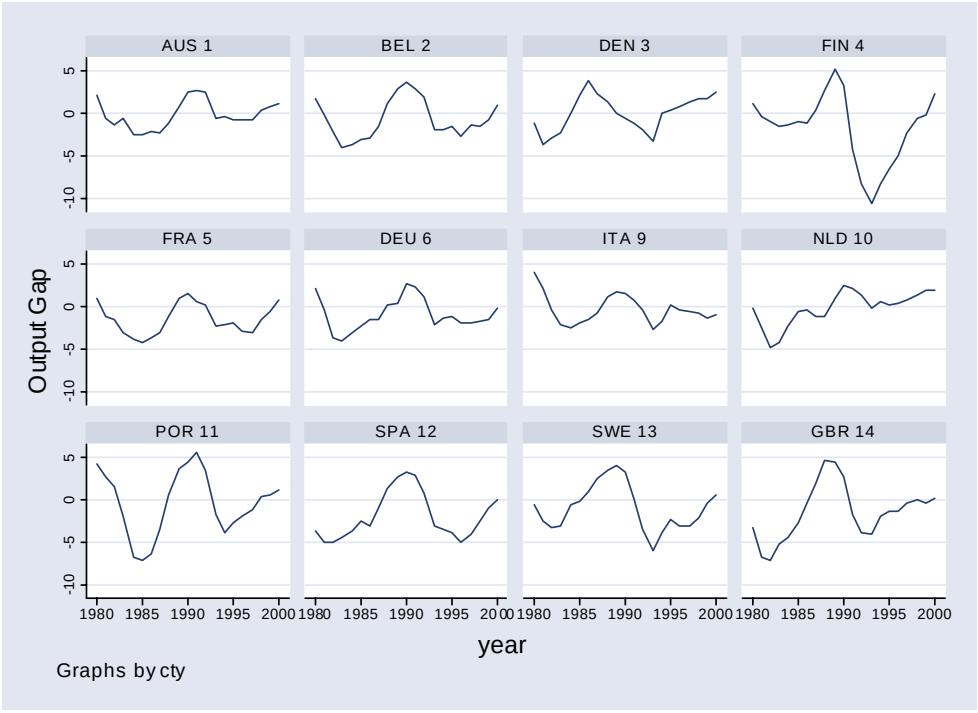


Figure 7: Output gap, measured as the percentage deviation of output from trend. Source: OECD.

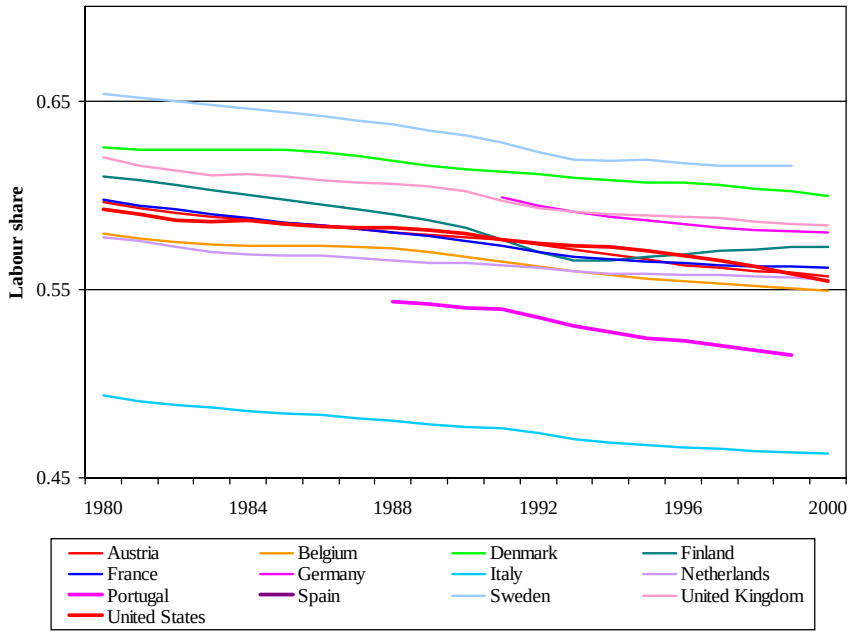


Figure 8: labour share. Source: Authors' calculation using OECD data.

Figure 8 shows the labour share, calculated as the wage bill over value-added.[35] This declines over the period for all countries. The average level of just under 0.6 is low compared to what we normally see with firm level datasets. Italy's labour share below 0.5 seems unrealistically low. For this, as well as other reasons, it is important to allow for country specific effecting the econometric analysis below. If errors of measurement are fairly constant over time within countries then the use of country fixed effects or growth rates in regressions will partially control for them.

Figure 9 shows an index of numbers employed/engaged (normalized to 1 in 1980 so the growth rate is comparable across countries). We see that countries have had very different experiences. Finland and Sweden have experienced big reductions in employment while the Netherlands and the US experienced strong employment growth. Figure 10 shows an index of gross fixed capital formation (again normalized to 1 in 1980). The US and Spain experience rapid growth in capital formation, while Finland lagged behind, particularly over the 1990s.

[35] The labour share has been smoothed by taking the predicted values from a regression of the labour share on country dummies and the capital/labour ratio, following a procedure used by Harrigan (1998?).

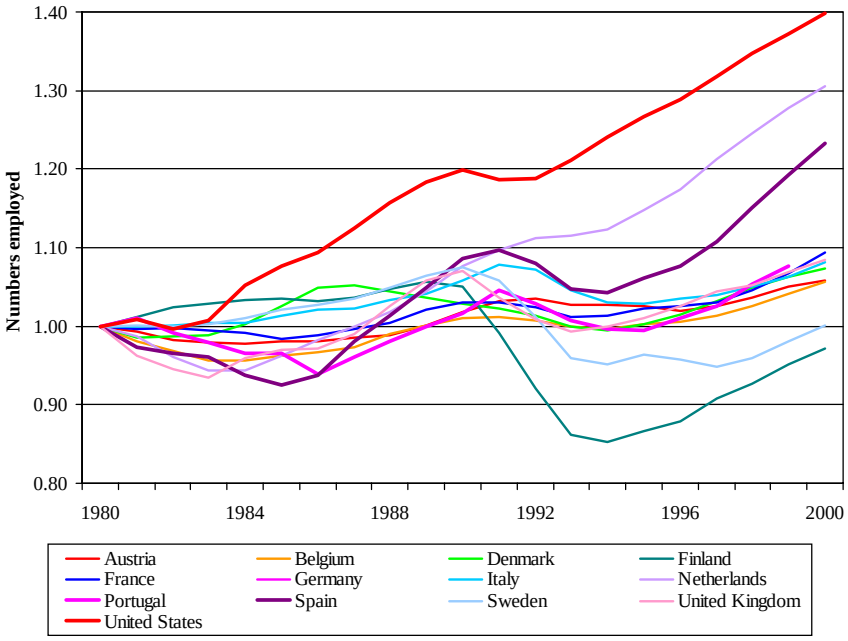


Figure 9: Numbers employed (rebased to 1980=1). Source: Authors' calculations using OECD data

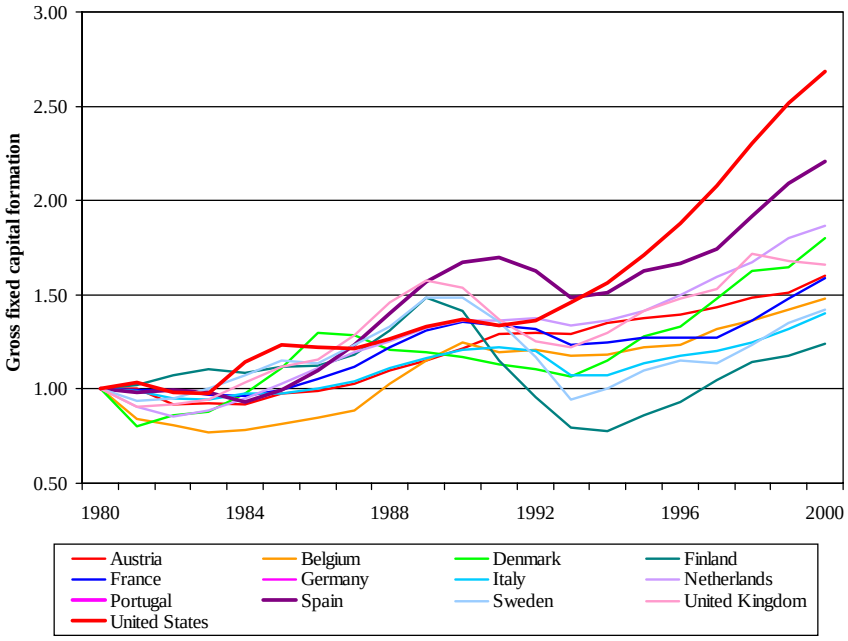


Figure 10: Gross fixed capital formation (rebased to 1980=1). Source: Authors' calculations using OECD data.

Figure 11 shows an index of R&D expenditure (normalized to 1 in 1991, the first year data is available for all countries). Finland's exceptionally fast growth is heavily influenced by Nokia.

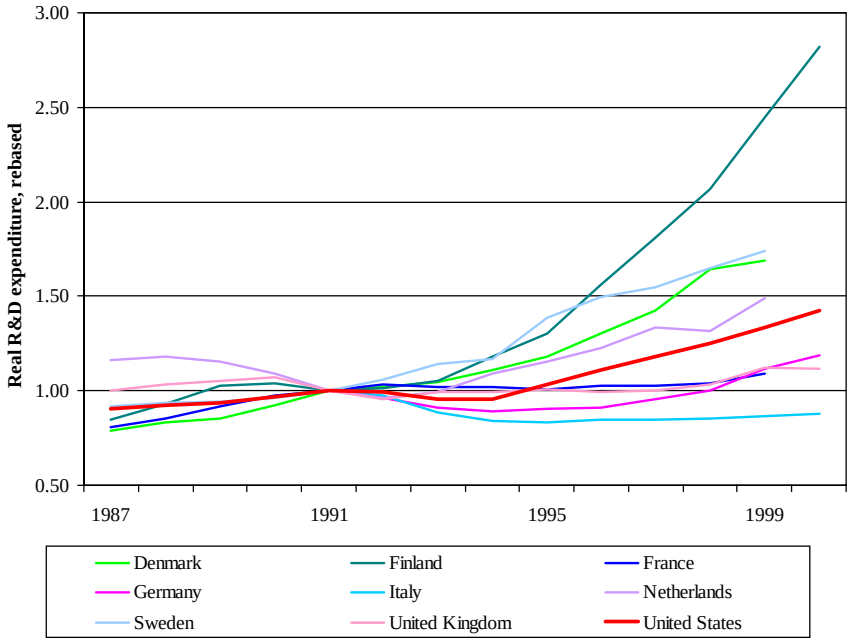


Figure 11: Real R&D expenditure (re-based to 1991=1). Source: Authors' calculations using OECD data.

We calculate the level of TFP using a superlative index following Caves et al (1982). This is consistent with a translog production function. Growth in TFP is also measured with a superlative index. Capital stock is constructed from gross fixed capital formation using a perpetual inventory method. The precise method was calibrated so that the calculated capital stock was similar to the OECD capital stock contained in the STAN data where the latter was available. Using our calculated capital stock, rather than OECD calculated capital stock, greatly extends the coverage of the sample but may raise some concerns about measurement error. Figure 12 shows an index of the relative level of TFP. The level is highest in the US, with Belgium, France and the UK highest in Europe. Again, Finland lags behind, though catches up over the 1990s.

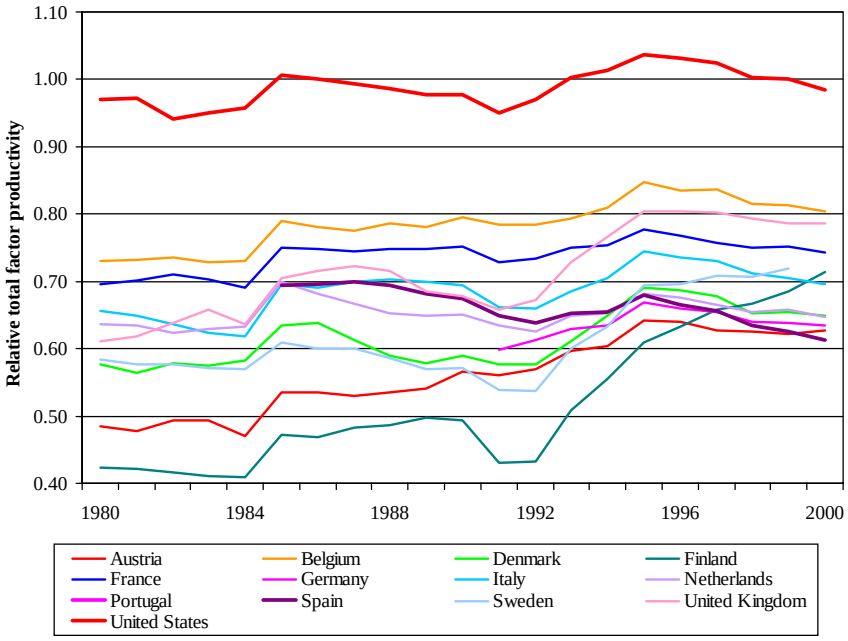


Figure 12: Relative total factor productivity. Source: Authors' calculations using OECD data.

It is well known that conventional measures of TFP are biased when product markets are not perfectly competitive (see Appendix).[36] This means that estimates of the impact of product market reform on TFP could give spurious or misleading results. This is especially true when regressing TFP on the mark up. This is potentially less of problem with growth rates where biases that are constant over time will be differenced out.

Table 1 shows the average growth rate in labour productivity over the 1980s and 1990s, while Table 2 shows the average growth rate in total factor productivity.

[36] See, inter alia, Hall (1988, 1990), Roeger (1995), Klette and Griliches (1996), Klette (1999).

Table 1: Growth in labour productivity

Country	1985-1989	1990-2000	1985-2000
Australia	0.024	0.022	0.023
Belgium	0.016	0.016	0.016
Denmark	0.011	0.017	0.015
Finland	0.034	0.030	0.031
France	0.024	0.011	0.015
Germany	.	0.017	0.017
Italy	0.023	0.012	0.016
Netherlands	0.009	0.008	0.008
Portugal	0.030	0.023	0.024
Spain	0.020	0.008	0.012
Sweden	0.015	0.026	0.022
UK	0.019	0.021	0.020
Average	*0.020*	*0.018*	*0.018*

Note: Authors' calculations using OECD data. Labour productivity is measured as real value-added is in 1995 US dollars using deflators and PPP exchange rates.

Table 2: Growth in total factor productivity

Country	1985-1989	1990-2000	1985-2000
Australia	0.017	0.012	0.014
Belgium	0.013	0.007	0.009
Denmark	0.004	0.011	0.008
Finland	0.021	0.024	0.023
France	0.014	0.004	0.007
Germany	.	0.008	0.008
Italy	0.015	0.004	0.007
Netherlands	0.005	0.004	0.004
Portugal	0.044	0.008	0.012
Spain	0.012	-0.003	0.001
Sweden	0.005	0.018	0.013
UK	0.013	0.012	0.012
Average	*0.012*	*0.009*	*0.010*

Note: Authors' calculations using OECD data. Growth in total factor productivity is measured using a superlative index (Caves et al, 1982), see text for details.

5 Aggregate economy

We now turn to a consideration of product market regulations and reforms at the level of the aggregate economy. We first describe the available data on product market reforms, and justify the choice of indicators that we use in our econometric analysis. We then present results for the aggregate economy and for the manufacturing and services sectors.

5.1 Product market reforms

While a large number of papers and policy documents refer to the extensive reforms that have occurred to product markets over the past two decades there is relatively little direct information available on the scale and scope of these reforms across countries. The major reforms to affect European countries include the range of measures implemented as part of the Single Market Programme, deregulation and regulatory reform of network industries, reductions in state aids, reforms to competition policy, entry requirements, and privatizations.

The most complete descriptions of product market reforms across EU countries are contained in the large number of papers and books that considered the implementation of the Single Market Programme, and a series of recent papers by researchers at the OECD.[37] We have used many of the sources described in the OECD papers where they are available to us.[38] We also use information from the Eurostat Structural Indicators.[39] Composite indicators are available from the Fraser Institute in their indices of economic freedom.[40] The Fraser Institute (FI) indices all range from 1 to 10, with 1 indicating the lowest level of economic freedom (or highest level of regulation) and 10 indicating the highest level of economic freedom (or lowest level of

[37] See, inter alia, Nicoletti and Scarpetta (2003).

[38] It is beyond the scope of this project to engage in collection of new data.

[39] http://europa.eu.int/comm/eurostat/Public/datashop/print-product/EN?catalogue=Eurostat&product=1-structur-EN&mode=download.

[40] All the Fraser Institute data can be found at www.freetheworld.com

regulation). The FI indices refer to areas of regulation rather than specific regulations. However, they are based on a considerable amount of factual information, and in many cases the data underlying the series is also available. The key advantage of the FI indices is that they have been consistently collected over time.[41]

We have assembled and coded a large number of these indicators of regulations and reforms using data from the EU, OECD, Fraser Institute and other sources. We discuss them under the following categories: ease of starting a new business, trade, state involvement in the economy, administrative burden on business, and other controls.

5.1.1 Ease of starting a new business

Empirical work suggests that most of the total variation in entry across industries and over time is within industry rather than between industries.[42] This highlights the importance of obtaining time-varying data to identify the impact of entry on outcomes. In addition, the literature shows that the survival rate of entrants is low, and that significant market penetration is a lengthy process, with even successful entrants taking more than a decade to achieve a size comparable with the incumbent (see, e.g., Dunne et al., 1989). Past research has found only modest effects of entry on average industry price-cost margins (Geroski, 1990).

The Fraser Institute compiles an index of the ease of starting a new business. This is based on data from World Economic Forum's *Global Competitiveness Report* which includes surveys of business decision-makers on issues such as the number of permits to start a firm and the number of days required to start a firm. This survey captures businesses' *perception* of regulation. The Fraser Institute reports this for 1995 and 2000, and we extrapolate the earliest value backwards to allow inclusion of the variable in our regressions while minimizing measurement error. The first two columns of Table 3 show the value of the Fraser Institute measures for 1995 and 2000. In all

[41] Indices that start in 1990 or 1995 have been extrapolated backwards using the earliest available value. Identification of these indices thus comes only from the period over which they are actually collected.

[42] For example, see Geroski (1995).

countries except the UK it became easier to start a new business over the period (i.e. the value of the index increased).

The OECD report a number of indicators that are related to ease of entry. However, their data is only available for the year 1998. This means that we can not use them to explain economic performance over the late 1980s and 1990s. The values of these are shown in the next seven columns of Table 3.

Table 3: Indicators of the ease of starting a new business

	Fraser Institute index of the ease of starting a new business		OECD: minimum no. of procedures for entry	OECD: minimum number of services	OECD: maximum delay (weeks)	OECD: minimum cost (ECU)	OECD: minimum capital requirements (ECU)	OECD admin burdens on startups	OECD Legal barriers to entry
Year:	1995	2000	1998	1998	1998	1998	1998	1998	1998
Austria	3.7	5.4	7	5	8	2200	73000	2.8	4.0
Belgium	4.6	6.4	3	4	6	1000	64000	1.5	1.8
Denmark	6.3	6.5	2	2	1	300	68000	0.5	2.6
Finland	8.5	8.8	7	1	6	1050	80000	1.5	0.8
France	3.4	5.2	21	1	15	2200	40000	3.3	2.0
Germany	5.0	6.4	8	2	24	750	50000	2.5	0.5
Italy	4.1	5.1	21	4	22	7700	100000	5.3	3.0
Netherlands	7.5	7.6	7	1	12	1400	46000	1.8	2.0
Portugal	4.3	5.7	9	1	24	1000	25000	2.5	1.3
Spain	5.3	5.7	12	5	28	330	62000	3.8	0.5
Sweden	5.1	7.9	6	1	4	1130	60000	1.3	1.3
UK	8.1	7.7	4	1	1	900	70000	0.8	1.3
USA	8.4	8.4	5	6	2	200	0	0.8	1.3

Sources: Fraser Institute Index of Economic Freedom (2003); OECD International Regulation Database (1998); Nicoletti, Scarpetta and Boylaud (2000), "Summary indicators of product market regulation", OECD Economics Department Working Paper

The first five are raw data from the OECD International Regulation Database. The final two are composite indicators constructed by economists at the OECD[43]: "Administrative burdens on

[43] See Nicoletti, Scarpetta and Boylaud (2000), "Summary indicators of product market regulation", OECD Economics Department Working Paper

startups (corporations)" is constructed from the raw OECD data on number of procedures, services, delays and costs, and "Legal barriers to entry" is constructed from the OECD Regulation Database question on "Government or regulations restricts number of entrants". These indicators vary between 0 and 6 and are increasing in the restrictiveness of regulation. Other variables that are available in the OECD regulatory database but are not used here are those relating to ease of setting up as a Sole Proprietor. We think that these are not as relevant as Sole Proprietors represent a small part of activity in most countries. Finally we also use cross-country data for 2002 from the European Commission on the time and cost associated with the registration of private limited companies.[44]

The cross-country correlations between the OECD and EU indicators and the 1995 value of the Fraser Institute index are shown in Table 4. We expect a negative correlation with all these indicators because the OECD measures are increasing in the degree of regulation while the Fraser Institute measure is decreasing in the degree of regulation. All the correlations are indeed negative, and there is a significant correlation between the Fraser Institute index for ease of starting a new business and the OECD measure relating to procedures required for starting a new business (-0.511) and the OECD index of "Administrative burden on startups" (-0.596). These suggest that the Fraser Institute variable is indeed measuring a real dimension of the ease of entry. The fact that the Fraser Institute index also has time-series variation makes it particularly valuable for our analysis, as it allows us to control for other unobservable differences that are constant over time.

[44] These are taken from European Commission (2002): Benchmarking the Administration of Business Start-ups, final report, Enterprise Directorate-General, January.

Table 4: Cross-country correlation between Fraser Institute index and other indicators

Indicator	Correlation with Fraser Institute index of the ease of starting a new business
Minimum number of procedures for entry (OECD)	-0.511 *
Minimum number of services (OECD)	-0.457
Maximum delay (weeks) (OECD)	-0.452
Minimum cost (ECU) (OECD)	-0.361
Minimum capital requirements (ECU) (OECD)	-0.188
Administrative burdens on startups (OECD)	-0.596 **
Legal barriers to entry (OECD)	-0.383
Cost of registration (EU)	-0.472
Time for registration (EU)	-0.384

*Notes: 12 observations, 1995; * indicates significance at 10% level,** indicates significance at 5% level*

We experimented with correlating these indicators with data on actual entry from the OECD Entry Database but had little success, largely because of small sample sizes.

Note that we are capturing one facet of entry regulation, the ease of starting a new business. Entry through trade is considered in the next section. There are other forms of entry and entry barriers, such as the degree of entry deterring behaviour by incumbents and the extent to which existing firms enter new markets. These are more difficult to measure and are not as directly related to regulatory reform. We do not capture these aspects of barriers to entry here.

5.1.2 Trade

The theoretical literature suggests that lowering barriers to the inward flow of goods and services will increase the degree of competition and thus lead to reductions in the mark-up.

The Fraser Institute reports an index of the average tariff rate for years from 1975 to 2000. The data on tariff rates come from a large number of sources, including the World Bank, the OECD, UNCTAD and GATT. There is not much differential variation in tariff rates across EU countries as rates were largely harmonized within the European Community prior to our sample period.

Thus, the only differential changes we see in average tariff rates over our 1985-2000 period are in Austria, Finland and Sweden before they joined the EU in 1995. Figure 13 plots the index of the average tariff rate by country. The overall trend is upwards, indicating reductions in the average tariff rate. Finland had fairly similar average tariff rates to the EU countries prior to 1995, while Austria significantly reduced tariff rates prior to joining and Sweden raised tariff rates.

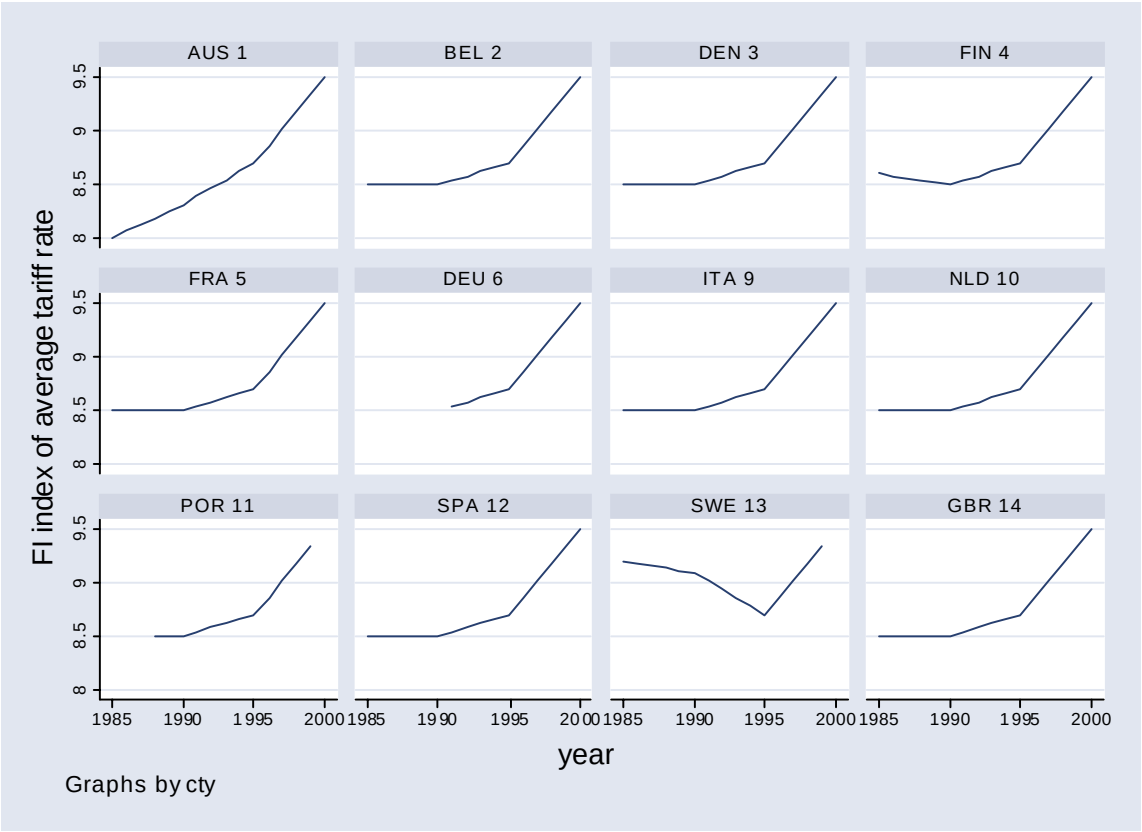


Figure 13: Fraser Institute index of the average tariff rate, 1985-2000.
Source: Fraser Institute Index of Economic Freedom (2003).

The Fraser Institute also reports an index of regulatory trade barriers. This includes information on the number of hidden import barriers (barriers other than published tariffs and quotas). This

information is taken from the World Economic Forum *Global Competitiveness Report* and is available for 1995 and 2000.

In Table 5 we present the cross-country correlations between the Fraser Institute index of regulatory trade barriers[45] (1995) and two OECD indices:[46] one measuring the extent of regulatory barriers to trade, which comes from a number of questions such has whether the country is engaged in mutual recognition agreements (MRAs) and whether the country has sought to internationally harmonise standards and procedures; and another measuring "Discriminatory procedures", constructed from a range of questions about treatment of national versus foreign firms. Again, the OECD indicators are only measured in 1998 and so can not be used to explain economic performance over the 1980s and 1990s. The correlation coefficients in Table 5 are both significantly negative as expected, suggesting that the Fraser Institute index is a good measure of the extent of regulatory barriers to trade. As before, the key advantage of the Fraser Institute index is that it varies over time.

Table 5: Correlation of Fraser Institute index with OECD indicators

OECD indicator	Correlation with Fraser Institute index of regulatory trade barriers
Regulatory trade barriers	-0.612 **
Discriminatory procedures	-0.519 **

*Notes: 12 observations, 1995; * indicates significance at 10% level,** indicates significance at 5% level*

5.1.3 State involvement in the economy

We aim to measure and control for several aspects of government involvement in the economy. Government involvement takes several forms. Governments are active in the production of many goods and services – most noticeably in the network industries (covered in an appendix) but also

[45] All the indicators of tariffs are equal across EU countries after 1995, and so any correlations are all equal to one.

[46] See Nicoletti, Scarpetta and Boylaud (2000), "Summary indicators of product market regulation", OECD Economics Department Working Paper

in others (e.g. cars). This could limit the extent of competition as state monopolies or quasi-monopolies have market power and the ability to deter entry. Government owned establishments may also be less efficient.[47] Another form of government involvement is through transfers and subsidies. These could help relatively inefficient firms to survive. Finally, government investment in public goods, such as infrastructure development and education, could reduce costs of private sector producers and lead to efficiency gains.

A number of the Fraser Institute indices are potentially relevant here: "government transfers and subsidies as a % of GDP", "government enterprises, and government investment as a % of total investment", and "price controls". The first two of these are available for 1975-2000, while "price controls" is available for 1990-2000. The indices are compiled primarily from the World Bank's *World Development Indicators*, the International Monetary Fund's *International Financial Statistics* and *Government Finance Statistics Yearbook*, and the OECD *Economic Surveys*.

We also have data from the European Centre of Enterprises with Public Participation (CEEP) Statistical Review on the importance of enterprises with majority public participation. The measure we use is an average of the share of employees, value added and investment in the non-agricultural business-enterprise sector represented by enterprises with majority public participation. All data concern enterprises with majority public participation in the non-agricultural merchantable economy. This measure is collected in 1991, 1995 and 1998.

We have also used three of the Eurostat Structural Indicators. These are "Sectoral and ad hoc state aids as a % of GDP" (1991-2000), "Public procurement as a % of GDP"[48] (1993-2000), and "Openly advertised public procurement as a % of public procurement" (1993-2000).

---

[47] See Meggison and Netter (2001) for a survey of the empirical evidence in this area.

[48] We have constructed this from data on openly advertised public procurement as a % of GDP and openly advertised public procurement as a % of total public procurement.

Finally we have several indicators from the OECD that are all available for the year 1998 only. The first is a measure of state ownership as a % of non-agricultural business GDP in 1998, taken from the OECD International Regulation Database. The others are indices varying between 0 and 6 constructed by economists at the OECD using various data sources.[49] These are: "Scope of the public enterprise sector", constructed using data from the OECD International Regulation Database on government ownership of firms; "Size of the public enterprise sector", constructed using data from the CEEP and various OECD sources; and "Price controls", constructed using data from the OECD International Regulation Database on price controls in air travel, road freight, retail distribution and telecommunications. All these indices are increasing in the restrictiveness of regulation.

Indicators of state involvement in the economy are listed in Table 6. In this section we compare the information contained in the different indicators and justify the choice of indicators that we use in our analysis.

Table 6: Indicators of state involvement in the economy

Indicator	Source	Years
Government transfers and subsidies as a % of GDP	FI	1975 - 2000
Government enterprises, and government investment as a % of total investment	FI	1975 - 2000
Price controls	FI	1990 - 2000
Share of enterprises with majority public participation in the non-agricultural business sector	CEEP	1991, 1995, 1998
Sectoral and ad hoc state aids as a percentage of GDP	EU	1991 - 2000
Public procurement as a % of GDP	EU	1993 - 2000
Openly advertised public procurement as a % of public procurement	EU	1993 - 2000
State ownership as a % of non-agricultural business GDP	OECD	1998
Scope of the public enterprise sector	OECD	1998
Size of the public enterprise sector	OECD	1998
Price controls	OECD	1998

[49] See Nicoletti, Scarpetta and Boylaud (2000), "Summary indicators of product market regulation", OECD Economics Department Working Paper

The Fraser Institute index of price controls (1995) has a cross-country correlation with the OECD index of price controls of -0.593, which is significant at the 5% level. This is negative as expected (the first is increasing in economic freedom while the second is increasing in the restrictiveness of regulation), which suggests that the two indices are capturing similar aspects of price regulation. We use the Fraser Institute index in our analysis because it varies over time.

In Table 7 we present the cross-country correlations for the year 1995 between the remaining two Fraser Institute indices, the CEEP measure of public enterprises and the other indicators. To aid interpretation of the results, all variables have been coded so that we would expect a positive correlation in each case if the indicators contain comparable information. In addition, correlations between indicators that we particularly expect a priori to contain similar information are shown in bold.

Table 7: Correlations between indicators of state involvement in the economy

Indicator	(1) Correlation with Fraser Institute index of transfers and subsidies	(2) Correlation with Fraser Institute index of government enterprises and investment	(3) Correlation with the CEEP measure of public enterprises
CEEP measure of public enterprises	0.253	**0.699 ****	-
Sectoral and ad hoc state aids as a% of GDP (EU)	**-0.195**	0.386	0.532 *
Public procurement as a % of GDP (EU)	**0.188**	0.402	0.320
Openly advertised public procurement as a % of total (EU)	**0.314**	0.289	0.415
State ownership as a % of GDP (OECD)	0.182	**0.509 ***	**0.875 ****
Scope of the public enterprise sector (OECD)	0.080	**0.572 ***	**0.645 ****
Size of the public enterprise sector (OECD)	0.211	**0.358**	**0.793 ****

*Notes: 12 observations, 1995; correlations between indicators that we particularly expect a priori to contain similar information are shown in bold; * indicates significance at 10% level,** indicates significance at 5% level*

In the first column, the correlations with the Fraser Institute index of transfers and subsidies are generally low and insignificant, and the correlation between the index and the Eurostat indicator of state aids is in fact negative (-0.195). These results suggest that the index may not be capturing relevant information. One possibility is that variation in the Fraser Institute index is mostly dominated by government transfers in the form of unemployment insurance and other welfare payments, which are not directly relevant to product markets. For these reasons we do not use this index in our analysis.

In the second column the correlations with the Fraser Institute index of government enterprises and investment are generally significant and positive where expected, particularly the correlation with the CEEP measure (0.699). However, the correlations in column (3) between the CEEP measure of public enterprises and the OECD indicators are even higher, suggesting that this is a better measure of the importance of public enterprises in the economy. For this reason we do not use the Fraser Institute index in our analysis, but we do use the CEEP indicator.

In conclusion, the indicators of state involvement in the economy that we use in our analysis are the Fraser Institute index of price controls, the CEEP measure of the importance of public enterprises, and the Eurostat indicators. We do not use any of the OECD indicators because they have no time-series variation and are measured only at the end of our sample period (1998). This means that they cannot be used to explain changes in macroeconomic performance over the previous period.

5.1.4 Administrative burden on business

Our final indicator is a Fraser Institute index of "Time senior management spends with government bureaucracy". This is based on survey responses from the World Economic Forum's "Global Competitiveness Report 2001-2002" and is available for the years 1995 and 2000. A large amount of time spent with government bureaucracy may constitute a barrier to entry, hinder firms' expansion, or may indicate a significant amount of government involvement in business decision-making. We have very little other data to compare with this index. The most comparable indicator is a variable from the OECD International Regulation Database called

"Percentage of SMEs for which administrative burdens are a problem", which is based on survey data available for 1998. The values for this and the Fraser Institute index are shown in Table 8. The fact that the OECD indicator refers only to SMEs (Small and Medium-sized Enterprises) may mean that it is not exactly comparable with the Fraser Institute Index, but the two nevertheless have a cross-country correlation coefficient of -0.484, although this is not quite significant at the 10% level. The correlation is expected to be negative because the OECD indicator is increasing in the burden of regulation.

Table 8: Indicators of administrative burden

	Fraser Institute index of time spent with government bureaucracy		% of SMEs for which administrative burdens are a problem
Year:	1995	2000	1998
Austria	6.5	7.4	34
Belgium	6.5	8.9	33
Denmark	8.9	8.2	23
Finland	8.5	8.5	20
France	6.3	8.1	36
Germany	6.5	8.5	31
Italy	4.7	6.1	35
Netherlands	7.4	9.1	24
Portugal	5.5	7.2	38
Spain	6.4	7.9	13
Sweden	8.3	8.3	28
UK	7.8	8.0	35
USA	7.5	8.2	-

Sources: Fraser Institute Index of Economic Freedom (2003); OECD International Regulation Database

5.1.5 Other controls

In our econometric analysis below we also control for changes in labour market and credit market regulations. We use Fraser Institute indices of both these areas of regulation, which are collected for the years 1985, 1990, 1995 and 2000. The index of labour market regulations is constructed from information in the World Economic Forum's *Global Competitiveness Report 2001-2002* on the impact of minimum wage legislation, hiring and firing practices, collective

bargaining, and unemployment insurance. The index of credit market regulation is constructed from information on bank ownership, the extent of competition from foreign banks, the percentage of credit extended to the private sector, and interest rate controls. Sources include the World Bank, Price Waterhouse, the Global Competitiveness Report, and the IMF's *International Financial Statistics*. The indices are presented in Figures 14 and 15.

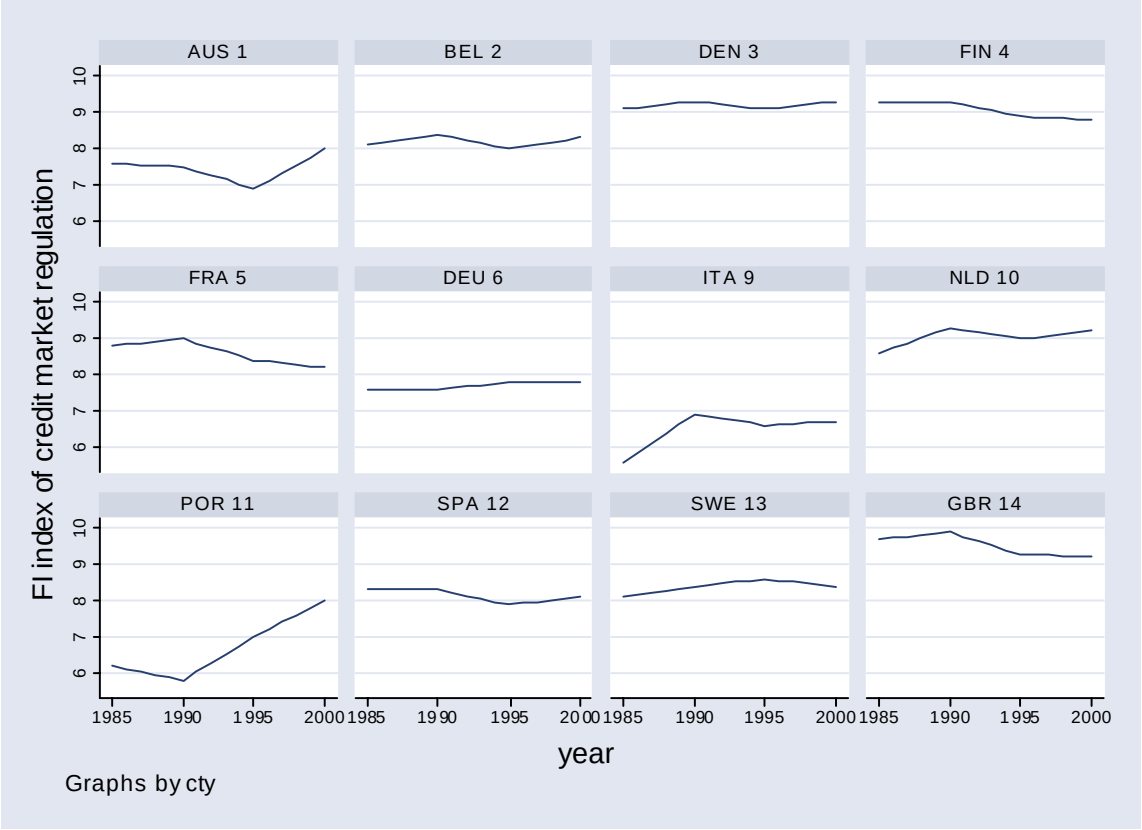


Figure 14: Fraser Institute index of credit market regulation, 1985-2000.
Source: Fraser Institute Index of Economic Freedom (2003).

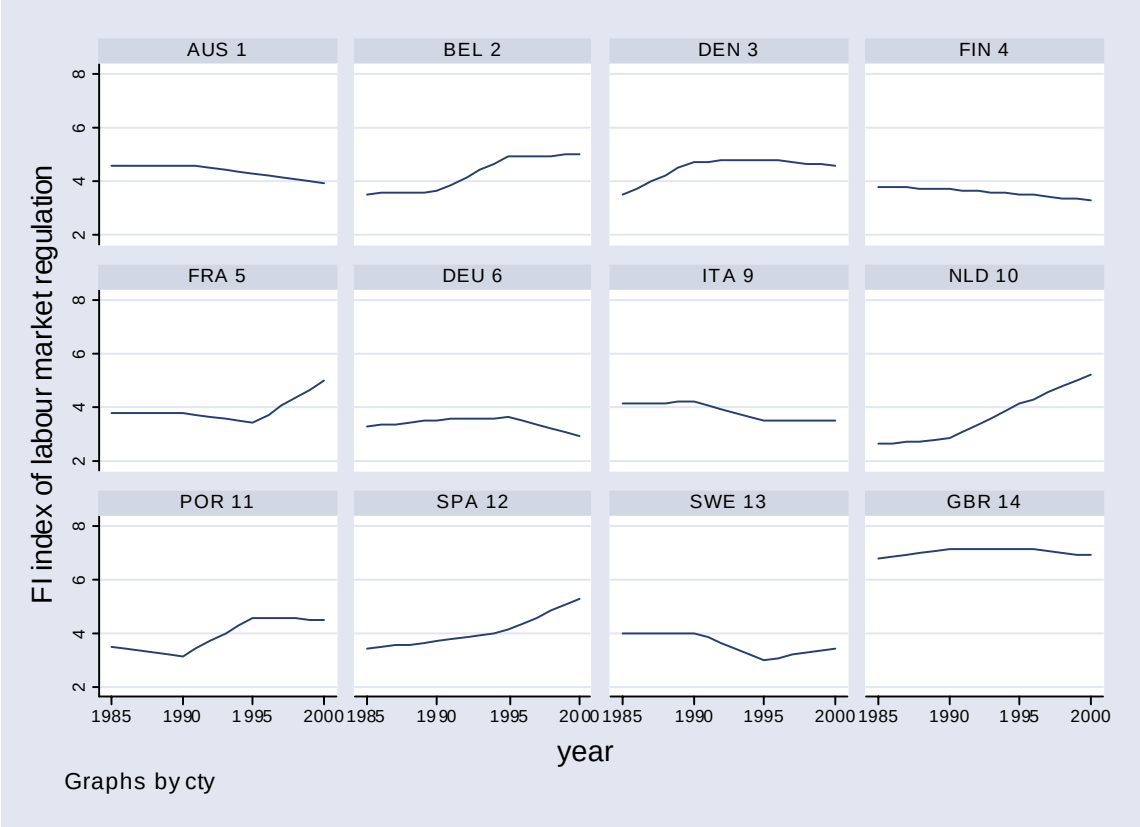


Figure 15: Fraser Institute index of labour market regulation, 1985-2000.

Source: Fraser Institute Index of Economic Freedom (2003).

5.1.6 Relationship between these indicators and Single Market Program.

Since our investigations span the years 1985-2000, they will most notably reflect the impact of the Single Market Program (SMP) on the European economy. The measures taken under this initiative are detailed in the Commission's 1985 White Paper, and aim to guarantee the "four freedoms" to move capital, labour, goods and services. Several of the SMP measures will be picked up by our regulation variables. Most obviously, the abolition of all protective national measures will be picked up by the Fraser Institute's tariff index.

Public procurement data is available from Eurostat for the years following 1993, which might still capture the effects of opening up public procurement procedures and extending them to previously sheltered markets.

Finally, the ease of starting up a business and the regulatory burden on business have been improved by the SMP program, notably through fiscal simplification.

As additional controls we use credit market regulations. The credit market has been an area of much activity for the SMP, with the coordination of national credit institutions and important legal harmonisation.

5.2 Impact of product market reforms on performance

As discussed in Section 4, our main methodology is a two-stage approach. The approach is motivated by theoretical models that highlight the available level of rents as a key determinant of factor demands and incentives for efficiency enhancement and innovation. We first estimate the relationship between our chosen indicators of product market reforms and the mark-up. In the second stage we then estimate the relationship between the mark-up and aspects of macroeconomic performance, using our indicators of product market reform as instruments for the mark-up. We thus control for possible endogeneity of the mark-up due to shocks that affect rents and macroeconomic outcomes simultaneously. In the following sections we first present results for the aggregate economy and then for the manufacturing and service sectors. We then present results from regressions of macroeconomic performance directly on the indicators of product market reforms. These serve as a robustness check for our main two-stage results.

5.2.1 Product market reforms and the mark-up in the total business sector

We start by considering the relationship between the product market reforms described above and the markup in the aggregate business enterprise sector (ISIC 01-99). These results are shown in Table 9, where numbers in parenthesis are robust standard errors. All the explanatory variables are scaled so that a higher number means less regulation or government involvement. If less regulation was associated with lower markups this would be reflected in a negative coefficient.

These measures reflect different features of the economic environment, and the results point to the problems that can arise if regulatory measures are combined into a single aggregate index, as

is done in much empirical work. As shown by the widely varying coefficients, imposing a priori that they all have the same impact on competition (markups) would be seriously misleading. We now turn to a discussion of the relation between each of the indicators of product market regulation and the mark-up to highlight these points.

In the first column we include indicators of the main reforms discussed above, as well as country and year effects to control for unobservable characteristics that differ across countries but are constant over time (including measurement error) as well as to control for common macro variation. In column (2) we control for labour and credit market regulations, as these may also affect markups, and in column (3) we also control for country specific business cycles (measured as deviations from trend output).[50] Columns (4) to (6) repeat this exercise for the 1990s only, where our data is more complete. In the final column we include only those variables where we have complete information, in other words where we have not extrapolated backwards the earliest available value. The coefficients in column (7) are very similar to those in column (6), indicating that the presence of extrapolated data is not seriously affecting the other coefficients.

Focusing on our preferred specifications in columns (3) and (6) we see that the mark-up is lower when entry is easier and the average tariff is lower. Regulatory trade barriers are only significantly related to mark-ups over the 1990s, and only when we do not allow for country specific business cycles. Time with government bureaucracy is only significantly related to mark-ups when we do not control for country specific business cycles (in this case mark-ups are lower when firms report spending less time with government bureaucracy). The mark-up is higher when there are less price controls and when there is less involvement of government via the public enterprise sector.

The R^2 is high in all specifications, indicating that these variables explain a substantial share of the variation in the mark-up. This suggests that they are strong instruments. The country effects are jointly significant in all specifications.

[50] Our measure of the output gap is taken from the OECD's *Economic Outlook* (2002)

These coefficients generally make economic sense. Price controls often act to keep prices, and thus mark-ups, down artificially. When they are loosened it is likely that prices will rise. Similarly, for the CEEP measure of the scale of the public enterprise sector, government producers do not seek to maximize profits, and may thus set prices lower or have higher costs than private sector producers. We also see that lower levels of labour market regulation and easier access to credit are associated with lower mark-ups. Both these types of regulation may in part capture ease of entry. The output gap is positively associated with mark-ups – our measured mark-ups tend to be pro-cyclical.

What about the economic importance of these results? Consider the coefficient on "ease of starting a new business", which is –0.021 in column (3). This suggests that regulations or reforms that increase the index by 1 would reduce the markup by about 2.1 percentage points, which would represent about an 8% fall in the average mark up over value added.[51] Reforms that increased the index by around 1 between 1995 and 2000 took place in Germany, Italy and Portugal.

We now use all the variables included in column (3) as instruments for the markup when we correlate the markup with macro economic performance and factor demands. This is equivalent to using the coefficients in column (3) to calculate a predicted markup and including that in the second-stage regression. We have experimented with using different groups of product market reforms as instruments, and the results in the second stage are robust to different combinations of instruments. Standard errors in the second stage regressions have been adjusted to account for the use of instrumental variables.

[51] This is 0.02/0.25, where 0.25 is the average mark-up in the sample.

Table 9: Product market reforms and mark-up, aggregate business sector

Dependent variable: markup	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Ease of starting a new business	-0.009 (0.008)	-0.022 ** (0.008)	-0.021 ** (0.007)	-0.011 (0.009)	-0.021 ** (0.008)	-0.016 * (0.008)	
Price controls	0.017 ** (0.004)	0.014 ** (0.003)	0.014 ** (0.003)	0.014 ** (0.006)	0.010 ** (0.004)	0.009 * (0.005)	0.006 * (0.004)
Average tariff rate	-0.031 * (0.018)	-0.022 (0.020)	-0.046 ** (0.020)	-0.123 ** (0.031)	-0.151 ** (0.036)	-0.148 ** (0.033)	-0.136 ** (0.031)
Regulatory trade barriers	0.018 (0.020)	-0.019 (0.022)	-0.009 (0.021)	0.019 (0.020)	-0.042 ** (0.020)	-0.024 (0.022)	
Time with government bureaucracy	-0.036 ** (0.007)	-0.012 * (0.007)	-0.009 (0.007)	-0.029 ** (0.007)	0.004 (0.006)	0.007 (0.006)	
CEEP measure of public enterprises	0.003 ** (0.001)	0.004 ** (0.002)	0.003 ** (0.002)	0.002 (0.002)	0.008 ** (0.002)	0.006 ** (0.002)	0.005 ** (0.001)
Labour market regulation		-0.024 ** (0.004)	-0.024 ** (0.004)		-0.029 ** (0.005)	-0.028 ** (0.005)	-0.024 ** (0.005)
Credit market regulation		-0.009 (0.011)	-0.005 (0.010)		-0.050 ** (0.013)	-0.038 ** (0.014)	-0.032 ** (0.010)
Output gap			0.004 ** (0.001)			0.004 * (0.002)	0.005 ** (0.002)
R squared	0.930	0.940	0.946	0.931	0.953	0.957	0.955
Test of country effects	20.62 **	25.46 **	28.89 **	20.77 **	34.16 **	36.44 **	85.14 **
Observations:	181	181	181	129	129	129	129
Countries:	12	12	12	12	12	12	12
Years:	1985-2000	1985-2000	1985-2000	1990-2000	1990-2000	1990-2000	1990-2000

Note: Numbers in () are robust standard errors. All regression include country and year dummies.
** indicates significance at 10% level,** indicates significance at 5% level*

5.2.2 Employment

We look at the relationship between the markup and levels of employment in Table 10. In column (1) we show the relationship between the markup and the log level of employment, including year and country effects. In column (2) we include the output gap to control for cyclical variations in employment. In columns (3) and (4) we use our preferred instrumental variables estimator, where the instruments are as shown in column (3) of Table 9. We instrument

because we are concerned about the likely endogeneity of the markup with respect to employment. Industries that are growing will experience shocks that lead to changes in both employment and profitability. If the effects of shocks on profitability and employment are positively correlated we would see a spurious positive correlation between employment and the mark-up. This means we would expect an upward bias in the coefficient on the markup. When we control for endogeneity in columns (3) and (4) we see that the coefficient becomes more negative as expected. In a test of endogeneity bias we find that the bias is significant at the 1% level.[52]

Table 10: Markup and employment, aggregate business sector

Dependent variable: ln(employment)	(1)	(2)	(3) instrumental variables	(4) instrumental variables
Mark up	-0.706 **	-0.993 **	-1.627 **	-1.632 **
	(0.112)	(0.078)	(0.177)	(0.159)
Output gap		0.015 **	0.018 **	0.018 **
		(0.001)	(0.002)	(0.002)
Ease of starting a new business				-0.032 **
				(0.009)
No. of overidentifying restrictions			7	6
Sargan test (p-value)			21.97 **	9.90
			(0.003)	(0.129)
Observations:	181	181	181	181
Countries:	12	12	12	12
Years:	1985-2000	1985-2000	1985-2000	1985-2000

Note: Numbers in () are robust standard errors. All regression include country and year dummies. Instruments in columns (3) and (4) are shown in column (3) of Table 9.
** indicates significance at 10% level,** indicates significance at 5% level*

[52] The test follows the "control function" approach. We include the estimated residual from the first stage regression as a regressor in the second stage. In a linear regression this is exactly equivalent to two-stage instrumental variables and the coefficient on the estimated first-stage residual acts as a test of endogeneity. In the specification in column (3) the coefficient on the first-stage residual is 1.07 with a robust t-statistic of more than 5.

For the instrumental variables estimates we present the results of a Sargan test of the over-identifying restrictions. In column (3) all eight PMR instruments are excluded from the main employment regression; in other words we assume that they are not correlated with the unexplained variation in the dependent variable, the log of employment. Since the mark-up is the only variable being instrumented, this results in 7 over-identifying restrictions. If the assumptions underlying the exclusion of these variables from the employment regression are not valid then the estimated coefficient on the mark-up may be biased.

The Sargan test in column (3) strongly rejects the assumptions underlying the exclusion restrictions. However, the test on its own does not provide any guidance on which of the excluded instruments should be included directly in the employment regression. In order to investigate this we use the technique described in Section 4. We took the residuals from the regression in column (3) and regressed them on all of the exogenous variables in the model – these are all the policy indicators, the output gap, and the country and year dummies. We will call this the "residuals regression". In this case the only policy indicator with a statistically significant coefficient in the residuals regression was the indicator of "ease of starting a new business", which had a negative coefficient. This suggests that this indicator should be included directly in the main employment regression. We do this in column (4) and, as expected, the coefficient is negative and significant. The Sargan test now does not reject the remaining six over-identifying exclusion restrictions, even at the 10% level. The main coefficient of interest is the one on the mark-up, which is very similar to that in column (3). This suggests that, while the exclusion of the "ease of starting a new business" indicator from the employment regression was not supported by the data, it did not seriously bias the estimate of the coefficient on the mark-up. Nevertheless, the preferred specification is the one in column (4).

The negative coefficient on the "ease of starting a new business" indicator in column (4) suggests that reforms that make it easier to start a new business are associated with lower levels of employment in a way that is not channeled through the mark-up, or level of rents. At first sight this a counterintuitive result. However, to obtain the overall effect of this indicator we need to combine this direct effect with the indirect effect that works through the mark-up. We can

calculate the indirect effect by combining the effect of the indicator on the mark-up from column (3) of Table 9 with the effect of the mark-up on employment from column (4) of Table 10. Thus we multiply the coefficient on the "ease of starting a new business" indicator from column (3) of Table 9, which is -0.021, with the coefficient on the mark-up in column (4) of Table 10, which is –1.632. This gives a positive indirect effect of 0.034. This indirect effect works in exactly the opposite direction to the direct effect, so that reforms that make it easier to start a new business are associated with lower mark-ups and thus higher levels of employment. In this case it turns out that the direct and indirect effects of the indicator almost exactly cancel each other out (-0.032 and +0.034 respectively), and the overall effect is not statistically significantly different from zero.

In all specifications, the relationship between the markup and the log level of employment is negative and significant suggesting that lower mark-ups are associated with higher levels of employment. This corresponds well with the theoretical predictions discussed above.

We can combine the coefficients on the product market reform indicators from the first stage in Table 9 with those on the mark-up from the second stage to determine the ultimate effect of product market regulations on macro-economic outcomes as mediated through the mark-up, or level of rents. For the indicators that are excluded from the employment regression in the final specification (in other words all except the "ease of starting a new business" indicator) this indirect effect is the only relevant channel.

Consider the coefficient on "average tariff rate" in column (3) of Table 9, which is –0.046. As discussed earlier, this suggests that regulations or reforms that increase the index by 1 would reduce the markup by about 4.6 percentage points. This is a very large change: for example Austria experienced an increase in the index of 0.4 points between 1990 and 1995. This corresponded to a reduction in the average tariff rate from 8.5% to 6.5%, where the average tariff rate is defined as "revenue from taxes on trade as a share of the trade sector". This is about a 25% reduction in the average tariff rate.

We can combine this coefficient with that on the instrumented mark-up in column (4) of Table 10, which is equal to -1.632 . Thus an increase of 0.4 points in the "average tariff rate" index (a reduction in the average tariff rate) is associated with a 1.8 percentage point reduction in the mark-up, which is in turn associated with about a 3% increase in the level of employment.[53] This is a large change in the mark-up, which thus leads to a correspondingly large effect on employment. Given that the average mark-up in our sample is 0.25, this corresponds to an elasticity of employment with respect to the mark-up of about -0.4 %.[54]

5.2.3 Investment

In Table 11 we look at the relationship between the markup and the log level of gross fixed capital formation. Again, we first show the relationship between them with year and country effects included in column (1), then condition on the output gap in column (2) and then use an instrument variables estimator in columns (3) and (4). Here we also find a negative and significant relationship, with the instrumental variables estimates being significantly more negative as before. A test for endogeneity again rejects the hypothesis of no endogeneity bias at the 1% level.[55] Overall, these results correspond well with the theoretical predictions and empirical results in the paper by Alesina at al (2003) discussed above.

[53] An increase of +0.03 in the log level is approximately equal to a 3% increase in the level.

[54] A 1% change in the mark-up is about 0.0025 percentage points, which leads to a change of about 0.4% in the level of employment (0.0025 times 1.632 is equal to about 0.004).

[55] In a control function specification, the coefficient on the first stage residual in the specification of column (3) is 1.17 with a robust t-statistic of more than 3.

Table 11: Markup and gross fixed capital formation, aggregate business sector

Dependent variable: ln(gross fixed capital formation)	(1)	(2)	(3)	(4)
			instrumental variables	instrumental variables
mark up	-1.285 **	-2.077 **	-2.770 **	-2.877 **
	(0.252)	(0.151)	(0.265)	(0.332)
output gap		0.043 **	0.046 **	0.044 **
		(0.003)	(0.003)	(0.003)
Credit market regulation				0.106 **
				(0.016)
Average tariff rate				0.189 **
				(0.045)
Time with government bureaucracy				-0.053 **
				(0.016)
No. of overidentifying restrictions			7	4
Sargan test (p-value)			46.45 **	2.20
			(0.000)	(0.699)
Observations:	181	181	181	181
Countries:	12	12	12	12
Years:	1985-2000	1985-2000	1985-2000	1985-2000

Note: Numbers in () are robust standard errors. All regression include country and year dummies. Instruments in columns (3) and (4) are shown in column (3) of Table 9.
** indicates significance at 10% level,** indicates significance at 5% level*

As was the case with employment, the Sargan test of over-identifying restrictions strongly rejects in Column (3). Using the same technique as above, the results of the "residuals regression" from this specification suggested that three of the policy instruments should be included directly in the investment regression. These were the indicators of "credit market regulation", "average tariff rate", and "time with government bureaucracy". When we include these three variables in Column (4) they all enter significantly and the Sargan test does not reject the remaining over-identifying restrictions. As before, the coefficients on the mark-up and the output gap are not significantly different from Column (3).

The positive direct effect of the "credit market regulation" indicator on investment acts in the expected direction: lower levels of regulation are associated with higher levels of investment.

The indicator did not have a significant effect on the mark-up in Column (3) of Table 9, suggesting that there is no evidence for an indirect effect through the level of rents.

The positive direct effect of the "average tariff rate" indicator suggests that lower average tariffs are associated with higher levels of investment. In this case the direct effect acts in the same direction as the indirect effect that acts through the level of rents. The "average tariff rate" has a significant negative coefficient of -0.046 in Column (3) of Table 9, which combines with the estimated negative coefficient on the mark-up in Column (4) of Table 11 to give a positive indirect effect of the indicator on investment of 0.132. This is of the same order as the direct effect, which is 0.189.

The significant negative effect of the "time with government bureaucracy" indicator suggests that less time spent with bureaucracy is associated with lower levels of investment. However, when combined with the small positive indirect effect via the mark-up the overall effect of the indicator is not significantly different from zero even at the 10% level.[56]

The scale of the negative relationship between the mark-up and gross fixed capital formation is again large. For example the results in column (4) suggest that a reduction of 1 percentage point in the mark-up is associated with about a 2.9% higher level of fixed capital investment. Given that the average mark-up in our sample is 0.25, this corresponds to an elasticity of gross fixed capital formation with respect to the mark-up of about –0.7 %.

5.2.4 Comparison with QUEST

We can compare these estimated results for the mark-up, employment and gross fixed capital formation with predictions generated by the QUEST general equilibrium model. In Tables 12 and 13 we present the results of two QUEST simulations and compare the results to the

[56] The indirect effect is calculated as –0.009 * -2.877 = 0.026, where the first number is taken from Column (3) of Table 9, and the second is the coefficient on the mark-up in Column (4) of Table 11. This makes an overall effect of –0.027.

predictions generated by our estimated coefficients in column (4) of Table 10 and Table 11. The first simulation is a 0.5% reduction in the mark-up in Germany from 17% to 16.5%. The second simulation is a 0.5% reduction in the mark-up for all the EU15 countries. In both cases we present the resulting percentage change in employment and investment in Germany after 5 years, and in the second simulation we also present the change in the EU15 countries overall. In both cases most of the impact has occurred after 2 or 3 years, so the effects presented can be viewed as long-run effects. The predicted effect using our estimated coefficients is the same in both cases, whether the change is only in Germany or in the EU15 countries.

Table 12: QUEST simulation (1) : 0.5% reduction in the mark-up in Germany

Predicted effect after 5 years in Germany from:	% change in employment	% change in investment
Our estimated coefficients	0.81 %	1.44 %
QUEST	0.66 %	1.06 %

Notes: the estimated coefficients are taken from column (4) of Table 10 and Table 11

Table 13: QUEST simulation (2) : 0.5% reduction in the mark-up in EU15

Predicted effect after 5 years:	% change in employment	% change in investment
Our estimated coefficients	0.81 %	1.44 %
QUEST (Germany)	0.69 %	1.25 %
QUEST (EU15)	0.65 %	1.08 %

Notes: the estimated coefficients are taken from column (4) of Table 10 and Table 11

Encouragingly, the predictions from QUEST are very similar to those generated by our estimated coefficients, although our predicted effects are always slightly larger. These results lend support to our analytical approach. If we believe that our second stage results are the correct order of magnitude, this suggests that our first stage estimates of the effects of product market reforms on

the mark-up can be combined with the second stage results to estimate the ultimate effect of the reforms on macroeconomic outcomes.

5.2.5 R&D

We next look at the relationship between the mark-up and investment in research and development (R&D) in Table 14. Columns (1) and (2) are OLS, while columns (3), (4) and (5) use our instrumental variables approach. In columns (1) and (3) the mark-up is positively associated with R&D expenditure, suggesting that when there are more economic rents in an economy there is also more investment in R&D. In other words more competition is associated with less R&D. In columns (2) and (4) we include a squared term to investigate whether the impact is non-linear, as has been suggested in the literature.[57] We see something of a non-linear affect, but this only turns downwards at high levels of economic rents that are observed only in one country – Italy.

The Sargan test of over-identifying restrictions strongly rejects the exclusion restrictions in Columns (3) and (4). Using the same technique as before we include four of the policy indicators directly in Column (5). All four enter significantly and the Sargan test no longer rejects the remaining two over-identifying restrictions. Neither the coefficient on the mark-up nor that on the squared term are significantly different from those in Column (4), although the joint hypothesis that both coefficients are the same as in Column (4) is rejected at the 5% level. The overall shape of the inverted-U relationship is slightly shallower than in Column (4), and the relationship becomes downwards-sloping at a slightly lower level of the mark-up. Nevertheless, Italy remains the only country with levels of the mark-up where reducing the level of rents is associated with higher levels of R&D.

Figure 16 shows the predicted relationship between log R&D expenditure and the mark-up based on the estimated coefficients in column (5). Every point represents a country-year observation in

[57] See for example Aghion et al (2002).

our sample, so it is clear that most countries are in the upwards sloping range. Below we explore how this relationship varies across manufacturing and service sectors and find a larger downwards sloping section in manufacturing where most R&D expenditure is observed.

Table 14: Markup and R&D, aggregate business sector

Dependent variable: ln(R&D)	(1)	(2)	(3) instrumental variables	(4) instrumental variables	(5) instrumental variables
mark-up	2.630 **	24.409 **	4.470 **	34.353 **	27.157 **
	(0.515)	(3.334)	(0.792)	(4.523)	(6.057)
mark-up squared		-9.076 **		-12.583 **	-10.438 **
		(1.279)		(1.770)	(2.610)
output gap	0.007	0.002	0.001	-0.006	-0.008
	(0.007)	(0.006)	(0.008)	(0.008)	(0.006)
Ease of starting a new business					-0.089 **
					(0.022)
Average tariff rate					-0.462 **
					(0.085)
Regulatory trade barriers					-0.390 **
					(0.079)
CEEP measure of public enterprises					0.045 **
					(0.012)
No. of overidentifying restrictions			7	6	2
Sargan test (p-value)			41.99 **	21.35 **	0.62
			(0.000)	(0.002)	(0.734)
Observations:	100	100	100	100	100
Countries:	8	8	8	8	8
Years:	1987-2000	1987-2000	1987-2000	1987-2000	1987-2000

Note: Numbers in () are robust standard errors. All regression include country and year dummies. Instruments in columns (3) and (4) are shown in column (3) of Table 9.
** indicates significance at 10% level,** indicates significance at 5% level*

The direct effect of three of the indicators in Column (5) is negative, suggesting that fewer barriers to starting a new business, a lower average tariff rate and lower regulatory trade barriers are all associated with lower levels of R&D in ways that are not mediated through the level of

rents. Meanwhile, a smaller public enterprise sector is associated with higher levels of R&D. All these direct effects are much larger than the associated indirect effects.

5.2.6 Labour productivity

We now look at the relationship between the mark-up and value-added per hour worked in the business enterprise sector (a measure of labour productivity). As above, numbers in () are standard errors and all regressions include country and year dummies and the output gap.[58] In column (1) of Table 15 we see that there is a positive linear relationship between the mark-up and labour productivity. In column (2) we include a squared term and see that this effect lessens at higher levels of the markup. However the relationship remains positive for all observed values of the mark-up. In columns (3) and (4) we use an instrumental variables estimator, where the instruments are as above. The overall positive relationship remains in Column (3), but the coefficients on the mark-up and its square are no longer significant in Column (4), although they are jointly significant.

The Sargan test of over-identifying restrictions strongly rejects in Columns (3) and (4). Using the same technique as above we include three policy indicators directly in Column (5). All three enter significantly and the Sargan test of the remaining three over-identifying restrictions no longer rejects. The coefficients on the mark-up and its square are both larger than in Column (4), although neither is significantly different from before. The joint hypothesis that the two coefficients are as in Column (4) is not rejected at the 5% level. Both coefficients are significantly different from zero, but as before the relationship between the mark-up and the level of labour productivity never becomes downwards sloping.

The direct effects of the three included policy indicators are all positive as expected. Thus lower barriers to starting a new business, a lower average tariff rate, and less restrictive credit market regulations are all associated with higher levels of labour productivity in ways that are not

[58] The results in this section are not significantly different if the output gap is not included.

mediated through the level of rents. Calculating the associated indirect effects is complicated by the non-linear relationship between the mark-up and the level of labour productivity. For simplicity, we calculate the indirect effect at the average level of the mark-up in the sample, which is 1.25. On this basis, the small positive direct effect of the "ease of starting a new business" indicator is almost exactly offset by the negative indirect effect which is equal to –0.027.[59] The positive direct effects of the "average tariff rate" and "credit market regulation" indicators are only partially offset by their indirect effects which are –0.059 and –0.006 respectively.

The predicted relationship between the log level of labour productivity and the mark-up based on column (5) of Table 15 is shown in Figure 17. We see that the positive relationship between the mark-up and the level of labour productivity is lower at higher levels of the markup, but it is never decreasing. This positive relationship with the level of labour productivity is interesting. There are several possible explanations. One is suggested by the negative relationship between the level of employment and the mark-up that we found above. If new workers absorbed into the workforce have lower levels of skills, or work with less capital, than those already in work, then an expansion of employment associated with a lower mark-up will be associated with a lower overall level of labour productivity. The same effect would be seen if the new jobs are more concentrated in lower productivity sectors than existing jobs.[60] We show below that the estimated negative relationship between employment and the mark-up is much larger in the service sector than in manufacturing.

[59] This is calculated as –0.021 * {5.667 – (2*1.755*1.25)}, where the first number is taken from Column (3) of Table 9, and the expression in brackets is the marginal effect of the mark-up on the level of labour productivity, calculated at the average value of the mark-up, which is 1.25.

[60] Equally, if workers who leave the workforce worked in lower productivity jobs than those who remain employed, then a reduction in employment associated with a higher mark-up will be associated with a higher overall level of labour productivity.

Table 15: Mark-up and labour productivity, aggregate business sector

dependent variable: ln (value-added per hour worked)	(1)	(2)	(3) instrumental variables	(4) instrumental variables	(5) instrumental variables
mark up	0.509 **	2.360 **	0.984 **	2.387	5.667 **
	(0.111)	(0.796)	(0.166)	(2.419)	(2.377)
mark up squared		-0.744 **		-0.566	-1.755 *
		(0.318)		(0.990)	(0.952)
output gap	-0.001	-0.002	-0.003 **	-0.004 **	-0.008 **
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Ease of starting a new business					0.026 **
					(0.011)
Average tariff rate					0.194 **
					(0.026)
Credit market regulation					0.021 *
					(0.013)
No. of overidentifying restrictions			7	6	3
Sargan test (p-value)			43.96 **	44.17 **	3.22
			(0.000)	(0.000)	(0.359)
Observations:	181	181	181	181	181
Countries:	12	12	12	12	12
Years:	1985-2000	1985-2000	1985-2000	1985-2000	1985-2000

*Note: Numbers in () are robust standard errors. All regression include country and year dummies. Instruments in columns (3) and (4) are shown in column (3) of Table 9. * indicates significance at 10% level,** indicates significance at 5% level.*

A second, and possibly related, potential explanation is that issues of timing and dynamics are crucial for understanding the true relationship between the level of rents and labour productivity. For example, Olley and Pakes (1996) do not find any effect of regulatory changes on within-firm productivity, but suggest that such an effect might be observed in a longer time-series of data. We return to this issue below. Finally it is possible that the positive coefficient is capturing mis-measurement in true labour productivity in the presence of markups. As with TFP (see Appendix) labour productivity will be overestimated when markets are less competitive.

Figures 16 to 23 investigate the relationship in some depth. In Figure 16 we plot the average markup for each country over the period on the x-axis and the average level of productivity for

each country on the y-axis. We see that there is no obvious relationship between the two, especially if we exclude Italy, which is an outlier. We do not use this cross-country variation in our econometric analysis because we want to control for measurement and other unobservable differences across countries that are constant over time.

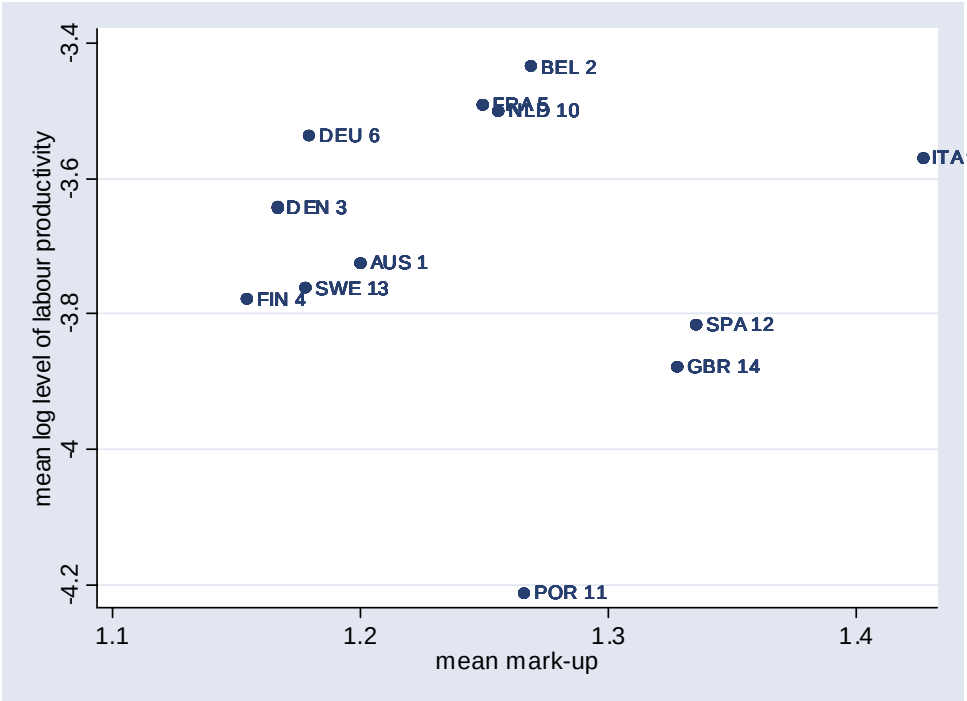


Figure 16: Mean log level of labour productivity and mark-up, aggregate economy, 1985-2000.

Source: Authors' calculations using OECD data.

In Figure 17 we plot the markup (x-axis) against the level of labour productivity (y-axis) for each country year observation, after we have removed country fixed effects, common year effects and the country specific business cycle (as measured by the output gap). Here we see a clear positive relationship, and it is this within-country relationship that is picked up in our econometric results.

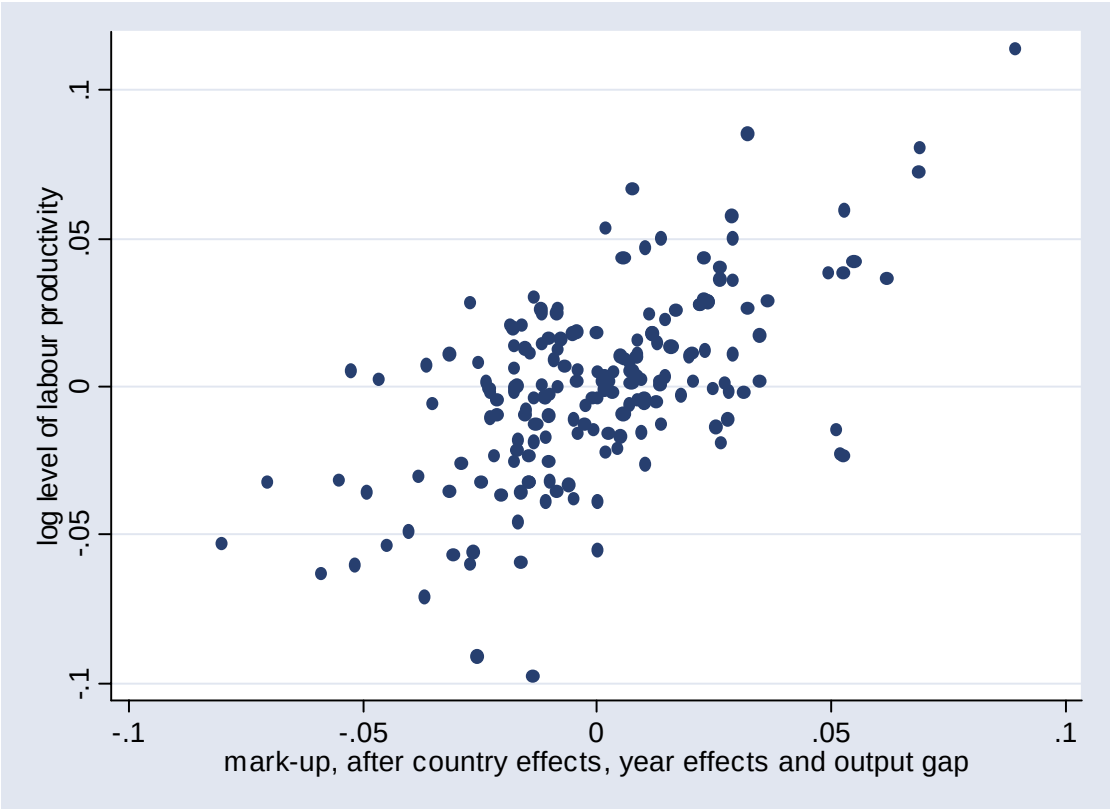


Figure 17: Log level of labour productivity and mark-up after removing country effects, year effects and output gap, aggregate economy, 1985-2000. Source: Authors' calculations using OECD data.

In Figure 18 we plot the same variables by country. Several aspects of this figure suggest that the relationship between our measured mark-up and the level of labour productivity is far from simple. First, the within-country relationship is not homogeneous across countries. Some countries such as Finland, Spain and Sweden show a clear positive relationship, others such as Austria and Denmark show no clear relationship at all, and countries such as Italy and Portugal suggest a negative relationship.

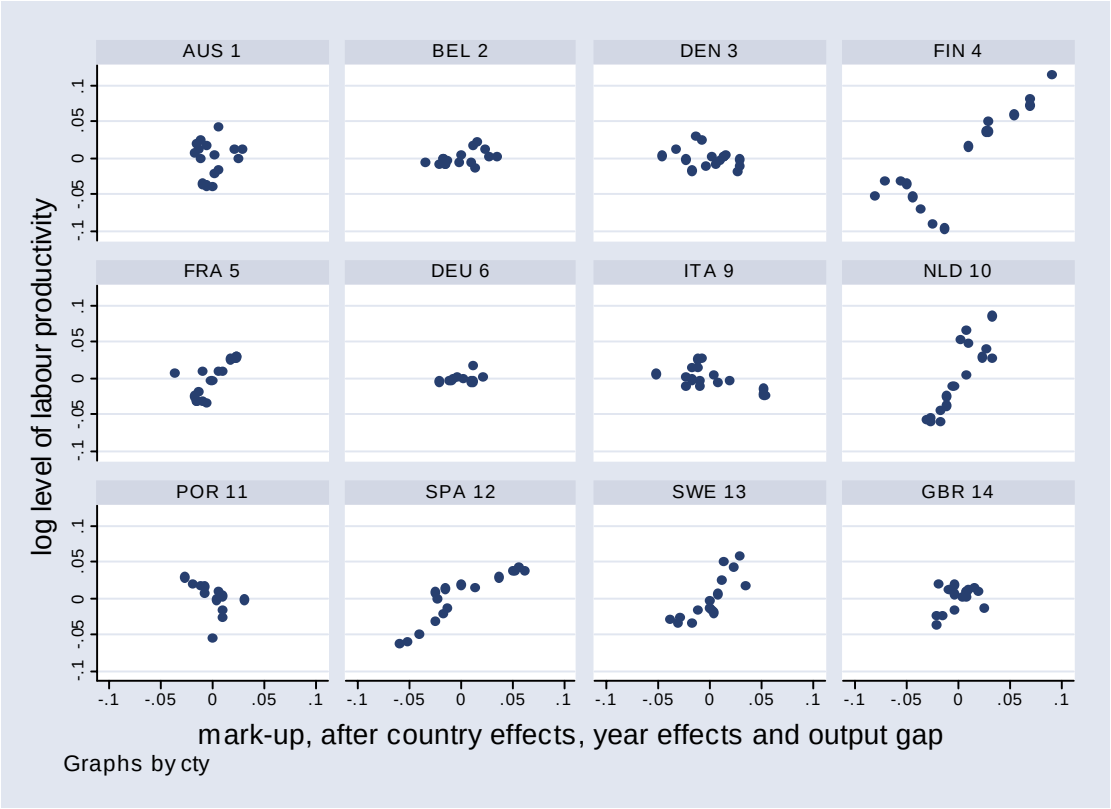


Figure 18: log level of labour productivity and mark-up after removing country effects, year effects and output gap, aggregate economy, 1985-2000, by country. Source: Authors' calculations using OECD data.

Even in this description, however, there are further subtleties. Figure 19 shows the relationship in Finland with the year of each observation marked. Labour productivity is rising over time once we have controlled for the cycle, a fixed country effect and common year effects. This means that labour productivity was rising faster in Finland than the average for the sample. However, the relationship between labour productivity and the mark-up shows two distinct parts. From 1985 to 1989 there is a clear negative relationship between the two after controlling for the cycle, a country fixed effect and common year effects. Then during the severe recession between 1989 and 1991 the mark-up and labour productivity both fall, and from 1991 to 2000 there is a strong positive relationship as both are rising. This suggests that there may have been a structural break in the relationship between labour productivity and the mark-up around the time of the recession. Whether this is due to measurement issues or real changes in the structure of the economy is very

hard to say without further analysis, possibly with more disaggregated data. Alternatively, a more homogenous relationship might be observed over a much longer time period that was not so dominated by a severe recession.

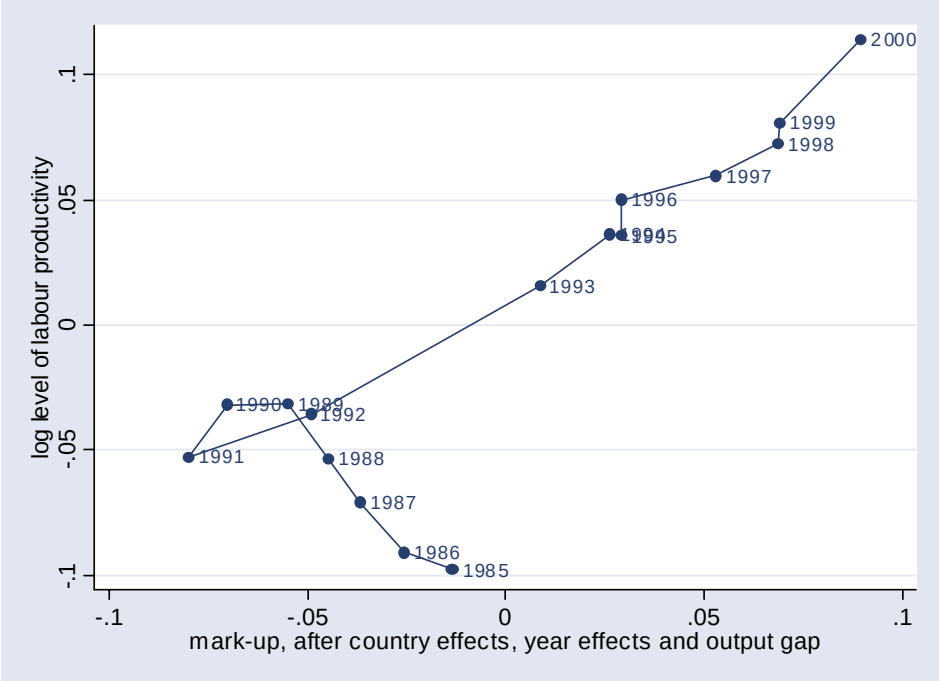


Figure 19: Finland. Log level of labour productivity and mark-up after removing country effects, year effects and output gap, aggregate economy, 1985-2000. Source: Authors' calculations using OECD data.

Figures 20 to 23 show the same graph for France, Germany, Italy and Spain. All four show very different stories. France and Germany show a positive relationship only between 1992 and 1995, with very little obvious relationship either before or afterwards. Italy shows a negative relationship as labour productivity falls and the mark-up rises relative to the sample average (i.e. after controlling for common year effects), although between 1986 and 1993 there is little change in the mark-up. Spain shows a positive relationship similar to Finland in the 1990s, except that both labour productivity and the mark-up fall relative to the sample average instead of rise. These very different experiences raise the question of whether it is possible to impose a common structure across different countries. Essentially we should ask whether the experience of other EU countries is a suitable counterfactual for estimating the effects of changes in any particular

country. An alternative strategy would be to look at firms or industries within a country that were affected by the reforms and compare their performance to those that were not affected, or to pick relevant groups of countries which share similar characteristics to act as controls (this is what is known as a matching estimator and can be formalised econometrically).

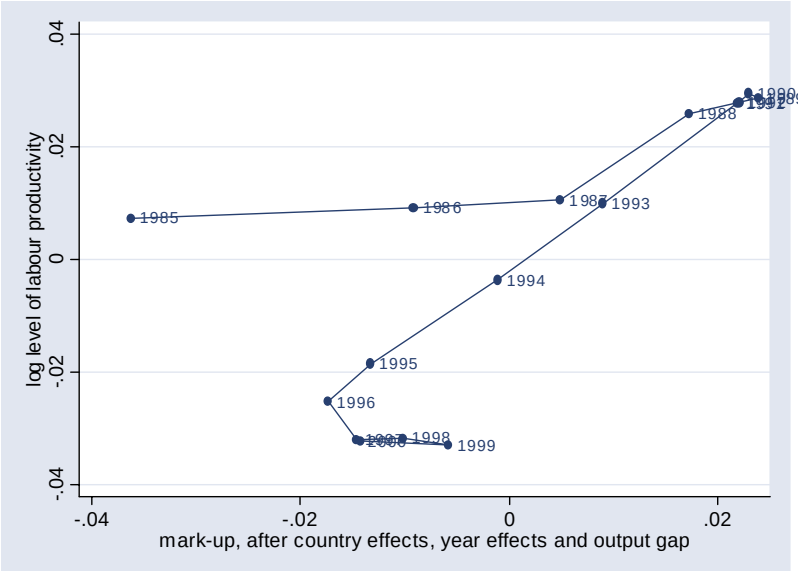


Figure 20: France. Log level of labour productivity and mark-up after removing country effects, year effects and output gap, aggregate economy, 1985-2000. Source: Authors' calculations using OECD data.

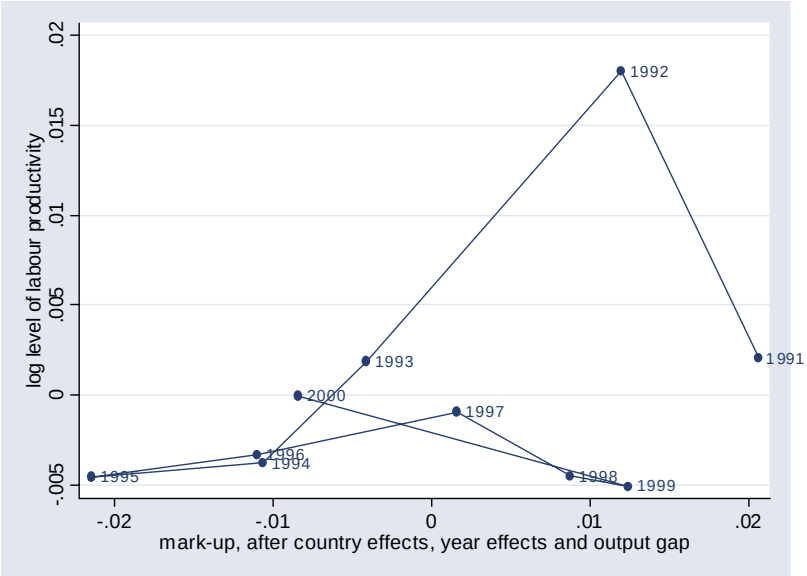


Figure 21: Germany. Log level of labour productivity and mark-up after removing country effects, year effects and output gap, aggregate economy, 1985-2000. Source: Authors' calculations using OECD data.

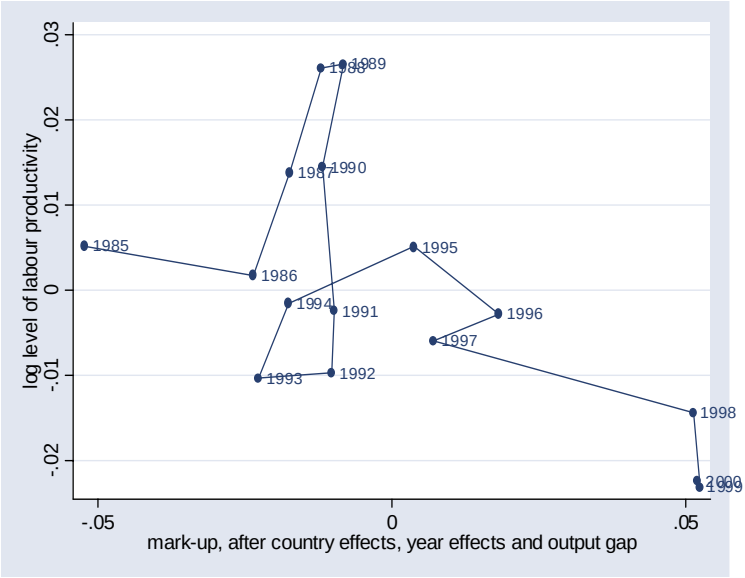


Figure 22: Italy. Log level of labour productivity and mark-up after removing country effects, year effects and output gap, aggregate economy, 1985-2000. Source: Authors' calculations using OECD data.

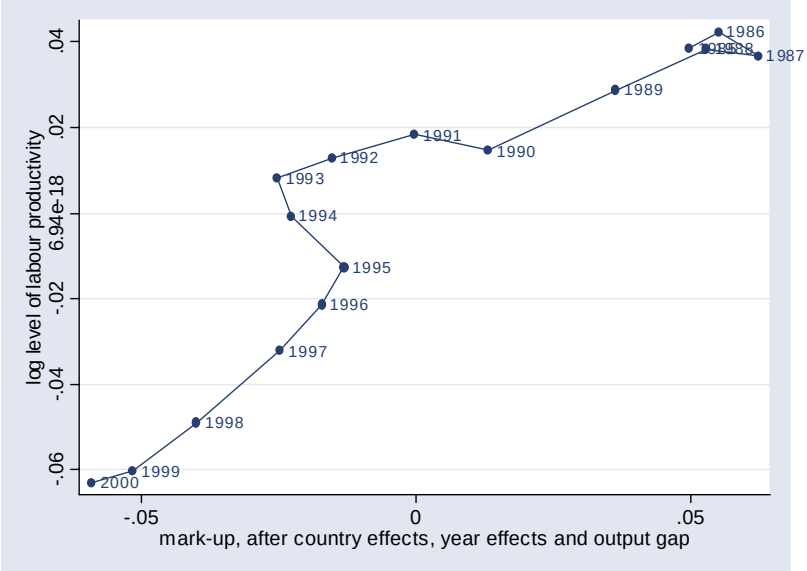


Figure 23: Spain. Log level of labour productivity and mark-up after removing country effects, year effects and output gap, aggregate economy, 1985-2000. Source: Authors' calculations using OECD data.

5.2.7 Growth of Labour Productivity

Several of the potential explanations presented above for a positive relationship between the mark-up and the level of labour productivity might have different implications if we consider the effect of mark-ups on the *growth* of labour productivity. For example, if newly created jobs have lower labour productivity on average than existing jobs, then an expansion of employment associated with a lower mark-up will be associated with a reduction in labour productivity growth, but only while employment is growing. Once employment has reached a new level, the *growth rate* of labour productivity may rise again, even though the *level* of labour productivity may remain lower for some time. However, the ability to capture these dynamics is very dependent on observing a long enough time-series of data, especially since many of the product market reforms we are considering took place in the middle and towards the end of our sample period.

The relationship between the growth in labour productivity and the markup is presented in Table 16. In column (1) we see that there is a positive and significant linear relationship using OLS. In column (2) we allow for non-linearities, but the quadratic term is not significant. In columns (3)

and (4) we use our instrumental variables estimator. In this case the Sargan test does not reject the over-identifying restrictions. The linear relationship in Column (3) is positive as before, but only significant at the 10% level. The squared term enters negatively and significantly in Column (4), but the relationship is again only downwards sloping for high values of the mark-up - values that are observed only in Italy. Figure 24 shows the predicted relationship between the growth of labour productivity and the mark-up using the coefficients from column (4). Interestingly, the curve is extremely similar to that for R&D in Figure 25, peaking at a mark-up of about 1.3, and with most observations in the upwards sloping range.

Table 16: Markup and growth in labour productivity, aggregate business sector.

dependent variable: ln (growth in value-added per hour worked)	(1)	(2)	(3)	(4)
			instrumental variables	instrumental variables
mark up	0.085 **	0.586 *	0.106 *	1.289 **
	(0.042)	(0.333)	(0.059)	(0.630)
mark up squared		-0.202		-0.477 *
		(0.127)		(0.250)
output gap	-0.001	-0.000	-0.000	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
No. of overidentifying restrictions			7	6
Observations:	180	180	180	180
Countries:	12	12	12	12
Years:	1985-2000	1985-2000	1985-2000	1985-2000

*Note: Numbers in () are robust standard errors. All regressions include country and year dummies. Instruments in columns (3) and (4) are shown in column (3) of Table 9. * indicates significance at 10% level, ** indicates significance at 5% level.*

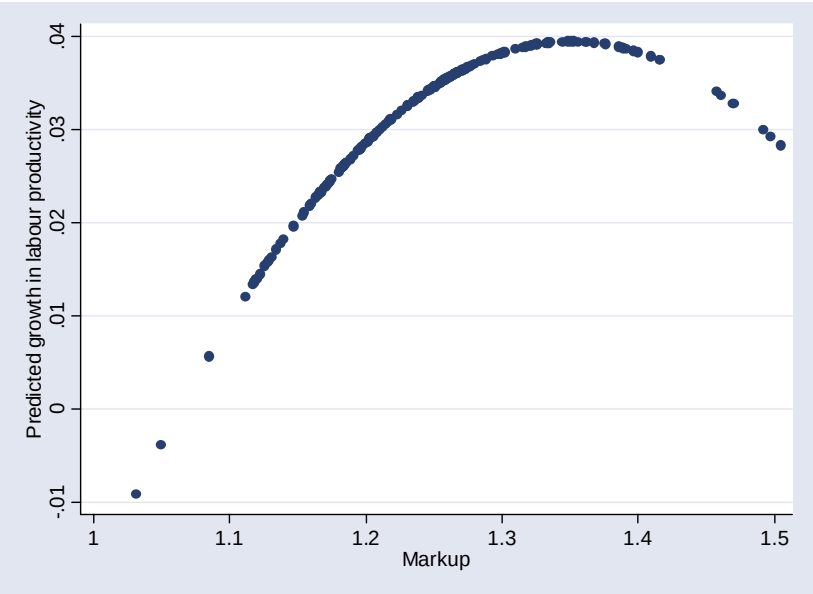


Figure 24: Predicted relationship between growth of labour productivity and the mark-up, aggregate economy. Source: Authors calculations; based on Column (4) of Table 16.

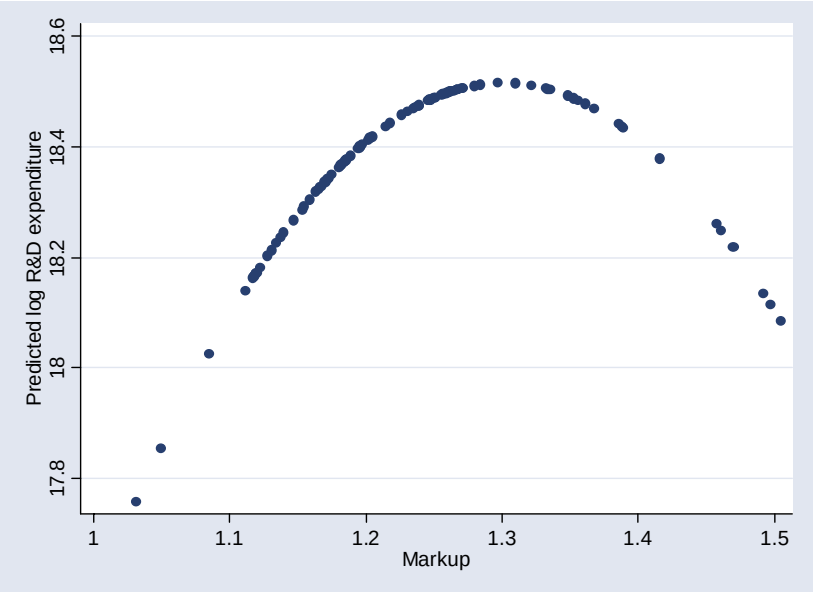


Figure 25: Predicted relationship between log R&D expenditure and the mark-up, aggregate economy. Source: Authors calculations; based on Column (5) of Table 14.

The fact that we observe a weak positive relationship between the mark-up and the growth rate of labour productivity is consistent with our earlier potential explanation for the levels

relationship. While it is happening, an expansion in employment associated with a lower mark-up will be associated with lower labour productivity growth if the new jobs have below-average labour productivity. In a relatively short panel like the one we are using we may mostly observe this transition phase, and not the subsequent phase where the levels of the mark-up and employment have stopped changing. It may that this later phase will be characterized by faster productivity growth, but we would not observe it in our sample.

In Figure 26 we plot the average markup for each country over the period on the x-axis and the average growth rate of labour productivity for each country on the y-axis. There is clearly a *negative* relationship on average, so that a lower average mark-up is associated with a higher average growth rate of productivity. However, as before, our econometric analysis does not use this cross-country variation because we want to control for measurement and other unobservable differences across countries that are constant over time. If we repeat the specification in column (3) of Table 16 but exclude the country effects, thus allowing the "between" variation to be picked up by the results as well as "within" variation, then the estimated relationship is significantly *negative*, with a coefficient on the mark-up of -0.027 and a robust standard error of 0.013. In this case there is no evidence of a non-linear relationship.

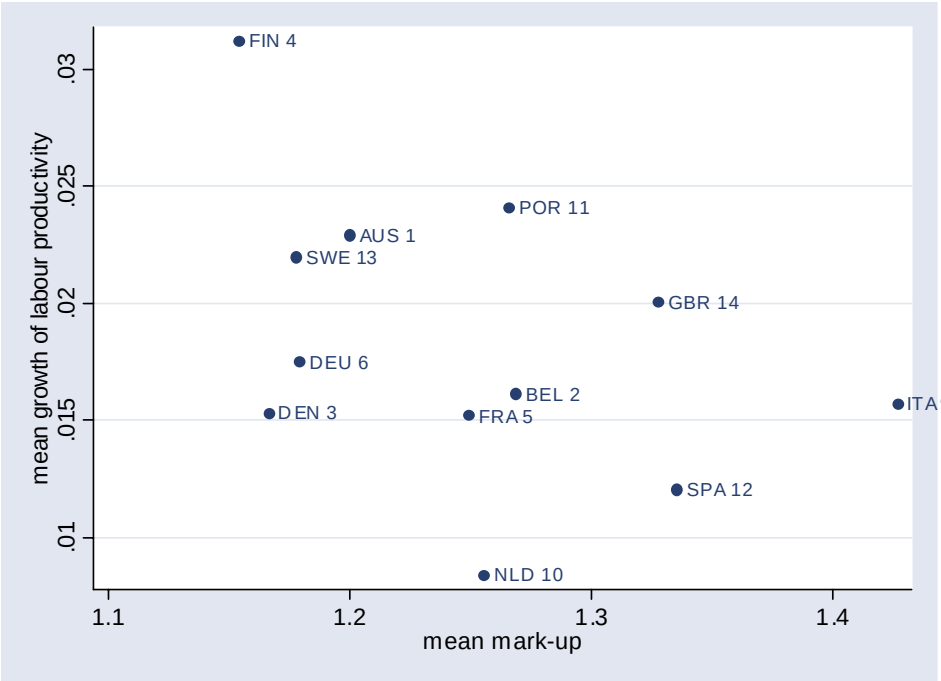


Figure 26: Mean growth of labour productivity against the mark-up, aggregate economy, 1985-2000.

Source: Author's calculations using OECD data.

In Figure 27 we plot the markup (x-axis) against the growth rate of labour productivity (y-axis) for each country year observation, after we have removed country fixed effects, common year effects and the country specific business cycle (as measured by the output gap). As suggested by our econometric results in Table 16, there appears to be a weak positive relationship on average, but Figure 28 shows that this is again heterogeneous across countries.

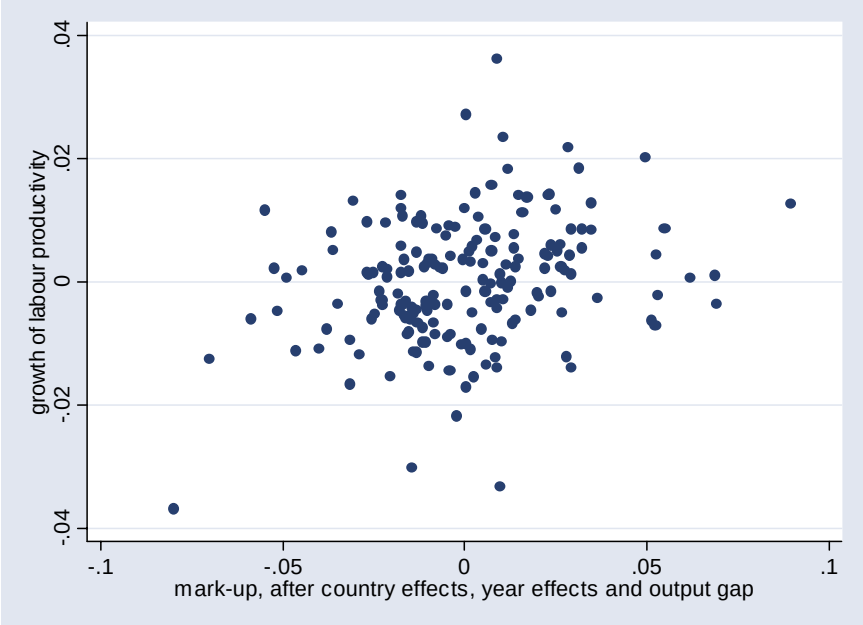


Figure 27: Growth of labour productivity and level of the mark-up after removing country effects, year effects and output gap, aggregate economy, 1985-2000. Source: Author's calculations using OECD data.

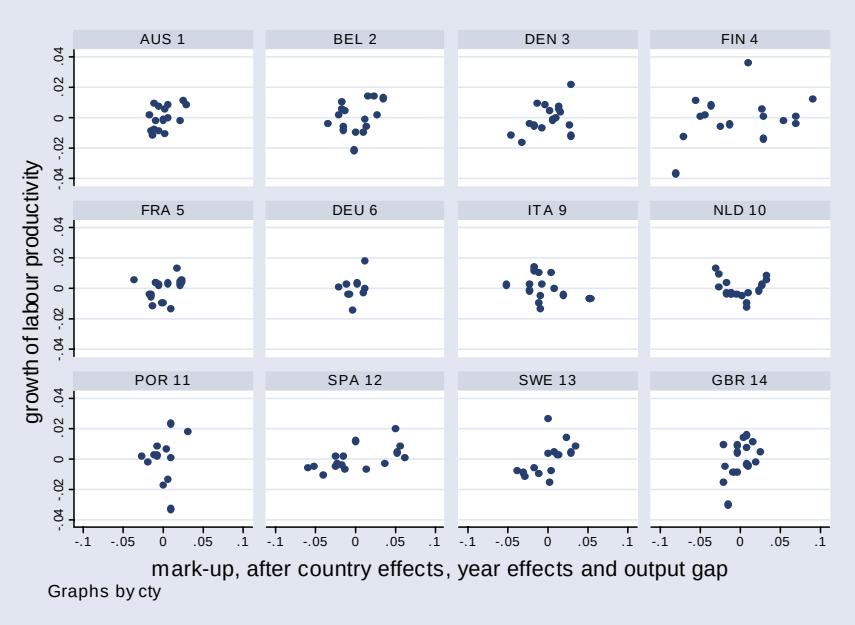


Figure 28: Growth of labour productivity and level of the mark-up after removing country effects, year effects and output gap, aggregate economy, 1985-2000, by country. Source: Author's calculations using OECD data.

The fact that we observe a negative relationship between growth in labour productivity and the mark-up between countries but a positive relationship within countries could be interpreted in several ways. The "between" result is less robust in the sense that it does not control for unobservable differences across countries that are constant over time, and in particular differences in the measurement of the mark-up. However, the difference between the results is also consistent with our earlier potential explanation based on the creation of new jobs that are below average labour productivity. If in our panel we mainly observe a transitional phase where a lower mark-up is associated with higher employment at the expense of labour productivity growth, then the within-country variation will be dominated by a negative relationship between the mark-up and labour productivity growth.[61]

5.2.8 Total Factor Productivity

We now look at the relationship between the predicted markup and total factor productivity levels and growth rates. Again with the *level* of total factor productivity (Table 17) we find a positive linear relationship using OLS in column (1). The quadratic term in column (2) is significant but never results in a downward sloping relationship. In columns (3), (4) and (5) we use our preferred instrumental variables estimator. The results in columns (3) and (4) are qualitatively similar to those in the first two columns, although the size of the coefficients is larger. However, the Sargan test rejects the over-identifying restrictions in both cases. Using the same technique as above we include two policy indicators directly in column (5). Both are significant and the Sargan test does not reject the remaining four over-identifying restrictions. The coefficients on the mark-up and its square are smaller than in column (4) and are not significant, although they are jointly significant at the 5% level. However, they are not significantly different from those in column (4). The positive overall relationship remains.

[61] The same effect within countries would be observed if there was a transitional phase where a higher mark-up is associated with lower employment and thus higher labour productivity growth.

Table 17: Markup and level of total factor productivity, aggregate business sector

dependent variable: ln (level of total factor productivity)	(1)	(2)	(3)	(4)	(5)
			instrumental variables	instrumental variables	instrumental variables
mark up	0.676 **	3.431 **	1.213 **	5.660 **	3.978
	(0.104)	(0.799)	(0.137)	(1.829)	(2.649)
mark up squared		-1.107 **		-1.793 **	-0.923
		(0.317)		(0.746)	(1.082)
output gap	-0.002	-0.002 *	-0.004 **	-0.005 **	-0.008 **
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
Average tariff rate					0.145 **
					(0.029)
CEEP measure of public enterprises					-0.008 **
					(0.003)
No. of over-identifying restrictions			7	6	4
Sargan test (p-value)			36.47 **	29.30 **	4.49
			(0.000)	(0.000)	(0.343)
Observations:	181	181	181	181	181
Countries:	12	12	12	12	12
Years:	1985-2000	1985-2000	1985-2000	1985-2000	1985-2000

*Note: Numbers in () are robust standard errors. All regression include country and year dummies. Instruments in columns (3) and (4) are shown in column (3) of Table 9. * indicates significance at 10% level,** indicates significance at 5% level*

As was the case with labour productivity there are a number of possible explanations of this result, particularly involving the importance of timing and dynamics. The problem of mis-measurement of TFP in the presence of positive mark-ups is also of concern, as higher markups will result in higher measured TFP (see Appendix for technical discussion).

In Table 18 we consider the relationship between the markup and the *growth* in total factor productivity. Again when we simply include the linear term we see a positive relationship with both the OLS and instrumental variables estimators.[62] The quadratic term is significant in both

[62] The Sargan test rejects the over-identifying retrictions in Column (3). However, once we allow for a non-linear relationship between the mark-up and the growth of TFP the Sargan test does not reject the over-identifying restrictions in Column (4).

cases and again suggests an inverted U shape that is sloping downwards only at high levels of the mark-up. As was the case with the growth of labour productivity, if we re-estimate the specification in Column (3) excluding the country effects, and thus allowing cross-country variation to picked up by the results, the estimated relationship is significantly negative, and there is no evidence of a non-linear relationship.[63] Thus we again find a mainly positive relationship between the mark-up and productivity growth using only within-country variation, but a negative relationship when we include cross-country variation. The same discussion and caveats apply as were described above for the case of labour productivity.

Table 18: Markup and growth of total factor productivity, aggregate business sector

dependent variable: ln (growth of total factor productivity)	(1)	(2)	(3)	(4)
			instrumental variables	instrumental variables
mark up	0.188 **	1.271 **	0.173 **	1.418 **
	(0.039)	(0.292)	(0.045)	(0.384)
mark up squared		-0.436 **		-0.503 **
		(0.110)		(0.153)
output gap	-0.001	-0.001 *	-0.001	-0.001 *
	(0.001)	(0.001)	(0.001)	(0.001)
No. of over-identifying restrictions			7	6
Sargan test (p-value)			14.92 **	9.93
			(0.037)	(0.128)
Observations:	178	178	178	178
Countries:	12	12	12	12
Years:	1985-2000	1985-2000	1985-2000	1985-2000

Note: Numbers in () are robust standard errors. All regression include country and year dummies. Instruments in columns (3) and (4) are shown in column (3) of Table 9.
** indicates significance at 10% level,** indicates significance at 5% level*

[63] The coefficient on the mark-up in the linear case is –0.026 with a robust standard error of 0.011.

5.2.9 Manufacturing and services

We now consider how the impact of product market reforms may differ between manufacturing (traded) and service (non-traded) sectors and how this is related to performance. In Table 19 we show the same regression as in Columns (3) and (6) of Table 9 but separately for manufacturing (ISIC 15-37) and services (ISIC 50-74), allowing the relationship to differ across the two sectors. Data constraints mean that we drop Portugal from the sample for manufacturing, and drop Portugal and Spain for services. The main differences from the aggregate results are: ease of starting a new business and time spent with government bureaucracy are related to the markup in services but not in manufacturing, and labour and credit market regulations have a greater impact in services than manufacturing.

One surprising result is that the coefficient on mean tariff rate is high in services, which are generally not traded. This result seems to be driven mainly by Austria, and disappears if we drop Austria from the sample. This is not the case in manufacturing. One possibility is that Austria implemented other pro-competitive product market reforms in preparation for joining the EU that reduced the mark-up in services and whose effect is being picked up by the average tariff rate index.

Table 19: Product market reform and markup - manufacturing and service sectors

Dependent variable: markup	(1)	(2)	(3)	(4)
Sector:	Manufacturing		Services	
Ease of starting a new business	0.005	-0.007	-0.051 **	-0.033 **
	(0.016)	(0.016)	(0.018)	(0.017)
Price controls	0.011 **	0.017 *	0.014 **	0.014
	(0.006)	(0.009)	(0.006)	(0.010)
Average tariff rate	-0.098 **	-0.265 **	-0.176 **	-0.308 **
	(0.048)	(0.059)	(0.049)	(0.072)
Regulatory trade barriers	-0.060	-0.061	-0.016	-0.022
	(0.040)	(0.043)	(0.041)	(0.046)
Time with government bureaucracy	-0.017	-0.002	0.032 **	0.043 **
	(0.019)	(0.017)	(0.015)	(0.013)
CEEP measure of public enterprises	0.012 **	0.015 **	0.008 **	0.009 **
	(0.003)	(0.004)	(0.003)	(0.004)
Labour market regulation	-0.001	0.002	-0.042 **	-0.053 **
	(0.010)	(0.012)	(0.008)	(0.011)
Credit market regulation	-0.025	0.000	-0.045	-0.135 **
	(0.020)	(0.041)	(0.028)	(0.045)
Output gap	0.003	0.002	0.006 *	0.008
	(0.003)	(0.004)	(0.003)	(0.007)
R squared	0.829	0.855	0.950	0.961
Test of country effects	23.51 **	23.35 **	42.66 **	55.69 **
Observations:	159	114	143	105
Countries:	11	11	10	10
Years:	1985-2000	1990-2000	1985-2000	1990-2000

Note: Numbers in () are robust standard errors. All regression include country and year dummies.
** indicates significance at 10% level,** indicates significance at 5% level*

In Table 20 we relate the markup to the log level of employment as before, but now looking separately at the relationship in manufacturing and services. We see that increasing competition (lowering the markup) is associated with higher levels of employment, although this result is not significant after using instrumental variables in manufacturing. The impact in the service sector is similar to that seen in the aggregate.

Table 20: Employment in manufacturing and services

Dependent variable: ln(employment)	(1)	(2)	(3)	(4)	(5)	(6)
Sector:		Manufacturing			Services	
		instrumental variables	instrumental variables		instrumental variables	instrumental variables
mark up	-0.108 (0.076)	-0.335 * (0.194)	0.181 (0.190)	-0.571 ** (0.070)	-0.938 ** (0.127)	-1.457 ** (0.258)
output gap	0.016 ** (0.002)	0.017 ** (0.002)	0.012 ** (0.002)	0.016 ** (0.002)	0.017 ** (0.002)	0.020 ** (0.003)
Labour market regulation			0.042 ** (0.009)			
CEEP measure of public enterprises			0.007 ** (0.003)			0.009 * (0.005)
Price controls			-0.021 ** (0.005)			
Ease of starting a new business						-0.078 ** (0.019)
Time with government bureaucracy						0.053 ** (0.022)
Average tariff rate						-0.199 ** (0.053)
No. of over-identifying restrictions		7	4		7	3
Sargan test (p-value)		46.16 ** (0.000)	6.58 (0.160)		42.42 ** (0.000)	2.67 (0.445)
Observations:	159	159	159	143	143	143
Countries:	11	11	11	10	10	10
Years:	1985-2000	1985-2000	1985-2000	1985-2000	1985-2000	1985-2000

Note: Numbers in () are robust standard errors. All regression include country and year dummies. Instruments in columns (2), (3), (5) and (6) are shown in Table 19.
** indicates significance at 10% level,** indicates significance at 5% level*

The Sargan tests of the over-identifying restrictions in column (2) and (5), where all eight policy indicators are excluded from the main employment regression, rejects these restrictions. By looking at the "residuals regression" we find three product market reforms which enter the employment equation in manufacturing – labour market regulations, the CEEP measure of public

enterprises and price controls. In the case of services four product market reforms enter – the CEEP measure of public enterprises, ease of starting a new business, time with government bureaucracy and the average tariff rate. After these have been included the Sargan test does not reject the remaining over-identifying exclusion restrictions.

As before, the main coefficient of interest is the one on the mark-up. This now changes substantially after including the reforms directly. In manufacturing the coefficient on the markup becomes insignificant. A move towards less restrictive labour market regulations and towards less public ownership of manufacturing capacity are associated with higher levels of employment, which accords with our expectations. Somewhat less intuitively, the direct effect of a relaxation of price controls is associated with reductions in employment. This does however accord with our findings above for the aggregate economy and for the markup in manufacturing - remember that relaxation of price controls were associated with an *increase* in the markup (i.e. higher prices) and this could lead to lower output and thus lower employment.

In services a reduction in public enterprise and less time spent with government bureaucracy are associated with increased employment, while ease of starting a new business and lower tariffs are associated with less employment. But again, remember that these are only the partial effect, these product market reforms also entry through the markup. When we account for this we find that reductions in public enterprise have effectively no impact[64] and time spent with government bureaucracy is negatively associated.[65] Increasing the ease of entry overall has a positive association with employment,[66] as does the average tariff rate.[67]

In Table 21 we investigate the relationship with fixed capital formation and find that there is no significant impact in manufacturing but in services there is a very large impact – reductions in

[64] The total effect of public enterprise is -0.005 = 0.0009 – 1.457*0.008.

[65] The total effect of time spent with government bureaucracy is -0.045 = 0.053 - 1.457*0.032.

[66] The total effect of ease of entry is 0.063 = 1.457*0.051 - 0.078.

[67] The total effect of the tariff rate is 0.114 = 1.457*0.176 - 0.199.

the mark-up are associated with increases in the level of gross fixed capital accumulation. This is the same relationship that we found in the aggregate economy, and is consistent with the theoretical predictions and empirical results contained in the paper by Alesina et al (2003) discussed earlier.

In column (2) all of the instrumental variables (from Table 19) are excluded from the investment equation for manufacturing and the Sargan test clearly rejects this restriction. The "residuals regression" suggests that credit market regulations and price controls should enter the investment equation, as shown in column (3). As expected, and as we saw in the aggregate results, relaxing credit market regulations is associated with higher level of investment. Lower levels of price control are associated with lower investment, again, as we saw before this may be because lower price controls are associated with price rises and thus reductions in output.

In column (5) all of the product market reforms are excluded from the investment equation and the Sargan test clearly rejects this restriction. The "residuals regression" suggests that three of the regulations should be included directly in the investment equation, as shown in column (6). The coefficient on the markup, our main variable of interest, remains effectively unchanged.

The direct effect of increasing the ease of entry is negative – easier entry is associated with lower levels of investment. However, the indirect effect is positive and of about the same size (combining the negative coefficient of –0.051 in column (3) of Table 19 with the coefficient of –2.226 on the mark-up in column (6) of Table 21 gives a positive indirect effect of 0.11).

The positive direct effect of the "average tariff rate" indicator suggests that lower average tariffs are associated with higher levels of investment. In this case the direct effect acts in the same direction as the indirect effect that acts through the level of rents. The "average tariff rate" has a significant negative coefficient of -0.176 in Column (3) of Table 19, which combines with the estimated negative coefficient on the mark-up in Column (6) of Table 21 to give a positive indirect effect of the indicator on investment of 0.39, which, together with the direct effect gives a total effect of 0.56.

Reductions in regulatory trade barriers to not enter significantly in the markup equation so the direct positive effect is the total effect – reducing regulatory barriers to trade is associated with increases in investment in services. These results accord with the aggregate results and show that most of the impact on investment is coming through the service sector.

Table 21: Fixed capital formation in manufacturing and services

Dependent variable: ln(gross fixed capital formation)	(1)	(2)	(3)	(4)	(5)	(6)
Sector:		Manufacturing			Services	
		instrumental variables	instrumental variables		instrumental variables	instrumental variables
mark up	-0.326 (0.281)	-0.596 (0.536)	-0.137 (0.568)	-1.529 ** (0.122)	-2.294 ** (0.337)	-2.226 ** (0.357)
output gap	0.031 ** (0.005)	0.032 ** (0.005)	0.031 ** (0.006)	0.053 ** (0.004)	0.054 ** (0.005)	0.049 ** (0.005)
Credit market regulation			0.093 * (0.048)			
Price controls			-0.030 * (0.017)			
Ease of starting a new business						-0.084 ** (0.025)
Average tariff rate						0.167 * (0.087)
Regulatory trade barriers						0.095 * (0.056)
No. of over-identifying restrictions		7	5		7	4
Sargan test (p-value)		13.88 * (0.053)	7.99 (0.157)		29.23 ** (0.000)	6.49 (0.166)
Observations:	159	159	159	143	143	143
Countries:	11	11	11	10	10	10
Years:	1985-2000	1985-2000	1985-2000	1985-2000	1985-2000	1985-2000

Note: Numbers in () are robust standard errors. All regression include country and year dummies. Instruments in columns (2), (3), (5) and (6) are shown in Table 19.
** indicates significance at 10% level,** indicates significance at 5% level*

In Tables 22 and 23 we look at R&D, allowing for non-linearities in all specifications as we saw above in the aggregate results that this was important. In the manufacturing sector (Table 22) we

find no statistically significant relationship between the markup and R&D investment after we use an instrumental variables estimator (column 2). The manufacturing sector results are, however, sensitive to the inclusion of Finland, where real R&D expenditure in manufacturing more than tripled between 1993 and 2000, largely because of one firm (Nokia).[68] In column (3) we drop Finland from the sample and the results show a strong inverted-U relationship. The predicted relationship between log R&D and the mark-up based on these coefficients is shown in Figure 30. The relationship is negative at levels of the mark-up above about 1.2, and Italy, France and the Netherlands are all mostly on the downwards sloping section. The Sargan test in column (3) rejects the over-identifying restrictions and the "residuals regression" suggests including ease of starting a new business, price controls and regulatory trade barriers. Ease of starting a new business is negatively associated with R&D expenditure (as it was with investment in physical capital). The indirect effect is in the opposite direction. Because of the non-linearity we have to evaluate the total effect at a specific level of the markup, we use the mean level. The indirect effects are very small relative to the direct effects (for three controls) so the direct effects dominate.

[68] See Figure 11.

Table 22: R&D expenditure in manufacturing

Dependent variable: ln(R&D)	(1)	(2)	(3)	(4)
		instrumental variables	instrumental variables (excluding Finland)	instrumental variables (excluding Finland
mark-up	-5.921 *	-3.884	37.202 **	25.331 **
	(3.373)	(8.456)	(10.744)	(8.792)
mark-up squared	3.258 **	3.590	-14.956 **	-10.331 **
	(1.379)	(3.494)	(4.492)	(3.730)
output gap	-0.010	-0.033 **	-0.026 *	-0.024 **
	(0.010)	(0.014)	(0.014)	(0.009)
Ease of starting a new business				-0.134 **
				(0.058)
Price controls				0.111 **
				(0.029)
Regulatory trade barriers				-0.427 **
				(0.102)
No. of over-identifying restrictions		6	6	3
Sargan test (p-value)		27.56 **	16.85 **	6.10
		(0.000)	(0.010)	(0.107)
Observations:	93	93	79	79
Countries:	8	8	7	7
Years:	1987-2000	1987-2000	1987-2000	1987-2000

Note: Numbers in () are robust standard errors. All regression include country and year dummies.
Instruments in columns (2), (3) and (4) are shown in column (x) of Table 19.
** indicates significance at 10% level,** indicates significance at 5% level*

In Table 23 we look at the relationship between the markup and R&D expenditure in the service sector. We find an inverted U relationship. In column (2) the Sargan test rejects the overidentifying restrictions and the "residuals regression" suggests including regulatory trade barriers, time with government bureaucracy and credit market regulations. Again the direct effects dominate. More lax regulatory trade barriers are associated with lower levels of R&D expenditure while less time with government bureaucracy and lower levels of credit market regulation are associated with higher levels of R&D expenditure.

Table 23: R&D expenditure in services

Dependent variable: ln(gross fixed capital formation)	(1)	(2)	(3)
		instrumental variables	instrumental variables
mark-up	4.076 **	4.817 **	5.735 **
	(1.975)	(2.229)	(2.812)
mark-up squared	-1.514 *	-1.547 *	-1.640
	(0.829)	(0.910)	(1.093)
output gap	0.024 *	0.024 *	0.027 **
	(0.013)	(0.014)	(0.013)
Regulatory trade barriers			-0.477 **
			(0.152)
Time with government bureaucracy			0.442 **
			(0.074)
Credit market regulation			0.398 **
			(0.146)
No. of over-identifying restrictions		6	3
Sargan test (p-value)		33.15 **	5.90
		(0.000)	(0.117)
Observations:	90	90	90
Countries:	8	8	8
Years:	1987-2000	1987-2000	1987-2000

Note: Numbers in () are robust standard errors. All regression include country and year dummies.
Instruments in columns (2) and (4) are shown in column (x) of Table 19.
** indicates significance at 10% level,** indicates significance at 5% level*

The results for the levels and growth rates of labour productivity and TFP were generally similar to those in the aggregate economy, although the results for the growth rates appear to be driven mostly by the manufacturing sector. Due to the difficulties with these results discussed above the specific results for manufacturing and service sectors are not presented here.

6 Summary and conclusions

In this study we have analysed the macro-economic impact of product market reforms undertaken in the European Union over the 1980s and 1990s. We considered a large number of regulations and reforms across EU countries. Our main methodology was a two-stage approach that highlighted the level of rents as a key determinant of factor demands and incentives for efficiency enhancement and innovation. We first estimated the relationship between product market reforms and the level of economic rents. We then estimated the relationship between the level of economic rents and aspects of macroeconomic performance, using our indicators of product market reform as instruments for the mark-up. We thus controlled for possible endogeneity of the mark-up due to shocks that affect rents and macroeconomic outcomes simultaneously.

This method captures the impact of product market reforms on competition and the impact of competition on allocative, productive and dynamic efficiency – this includes the impact of competition on both innovation (as measured by R&D expenditure and total factor productivity) and of imitation (as measured by total factor productivity). It does not capture returns to scale.

We showed that product market reforms that ease entry, reduce tariff rates and regulatory barriers to trade, remove price controls, and reduce public involvement in production affect the average level of economic rents in the economy in diverse ways. Reforms to labour and credit markets are associated with reductions in the level of economic rents available. Our empirical results showed that the level of economic rents is negatively associated with employment and investment, or in other words greater competition is associated with higher levels of employment and investment, particularly in the service sector. These results accord with theoretical predictions. Increases in competition bring prices closer to marginal costs, increasing output demanded and thus leading to increases in factor demands.

We found that regulatory reforms that have reduced the level of economic rents appear to be associated with lower levels of labour and total factor productivity. In addition, while there appears to be a non-linear relationship between the level of economic rents and levels of R&D

expenditure and growth rates of labour and total factor productivity, most countries appear to have levels of economic rents where a reduction in rents is associated with a reduction in R&D and growth rates. These results are contrary to most of the existing empirical literature and there are a number of reasons why we would recommend caution in interpretation – some to do with possible measurement issues, others to do with timing and dynamics.

First, this association is obtained from a within-groups estimator, so it is identified from differences in the relative time series variation within countries. When we look at the between, or cross-section, relationship we see that countries with lower levels of markups (higher levels of competition) have higher growth rates of productivity. The problem with the latter result is that we are not able to control for other differences across countries which may be correlated with product market regulations. For example, it might be that countries which had low levels of product market regulation were also countries that had better education systems, and this was associated with faster productivity growth.

Secondly, there are many challenges in measuring the objects of interest (labour and total factor productivity as well as the degree of competition) correctly both within several sectors of the economy (particularly services) and also obtaining comparable measures across countries. The main problems are the correct measurement of prices to reflect both variation in firms' market position and in the quality of the products produced, and are well recognised in the literature and by most national statistical agencies.[69] In addition, comparing the level of competition across countries is difficult due to differences in data collection and measurement. Some of these difficulties are lessened by looking at changes over time within countries, although this does not alleviate all the problems.

Thirdly, it is also likely that dynamic processes are important here, and with the limited time series of data we have available to us we have not been able to fully investigate these. For

[69] The US puts considerable effort into correcting prices indices, e.g. for computers. A discussion of the main issues is contained in an Appendix to this report, and see Griliches (1998) for further discussion

example, the literature emphasises the fact that adjustment costs in R&D are high (higher than for general employment or physical capital)[70] and it may take firms and others a long time to adjust to change. In addition, there are a number of difficulties in identifying the impact of such large scale reforms across heterogeneous countries which were experiencing different economic conditions.

For many of the problems that we encounter micro data would help; micro data would allow us to model some of the dynamic processes, though here longer time series are what is really needed (and here the problem is not only data collection, but the extent and variability of reform across countries). Micro data helps to deal with many aspects of heterogeneity, as well as many, though not all, of the measurement issues. Micro data is certainly needed to capture the complexity of mechanisms for regulating network industries.

The very different experiences of different countries that we document raise the question of whether it is possible to impose a common structure across different countries. Essentially we should ask whether the experience of other EU countries is a suitable counterfactual for estimating the effects of changes in any particular country. An alternative strategy would be to look at firms or industries within a country that were affected by the reforms and compare their performance to those that were not affected, or to pick relevant groups of countries which share similar characteristics to act as controls.

[70] See, inter alia, Hall (1993).

References

Aghion, Bloom, Blundell, Griffith and Howitt (2002) “Competition and Innovation: An inverted U relationship”, *NBER Working Paper 9269*

Aghion, Burgess, Redding and Zilibotti (2003) “The unequal effects of liberalisation: theory and evidence from India” UCL/LSE mimeo

Aghion, Dewatripoint and Rey (1997) “Corporate Governance, Competition Policy and Industrial Policy” *European Economic Review,* 34, 322-329

Aghion and Howitt (1992) “A Model of Growth Through Creative Destruction” *Econometrica*, 60, 323-351

Aghion and Howitt (1998) *Endogenous Growth Theory* MIT Press: Cambridge MA

Antweiler, W. and D. Trefler (2002) “Increasing returns and all that: a view from trade” *American Economic Review* 92:1, 93-119

Barro, R (1998) “Notes on Growth Accounting” *NBER Working Paper 6654*

Basu, Fernald and Shapiro (2001) “Productivity Growth in the 1990s: Technology, Utilization, or Adjustment?” *NBER Working Paper 8359*

Blanchard and Giavazzi (2001) “Macroeconomic effects of regulation and deregulation in goods and labor markets” *NBER Working Paper* 8120

Blundell, Griffith and Van Reenen (1999) “Market Share, Market Value and Innovation in a Panel of British Manufacturing Firms” *Review of Economic Studies*, (1999) 66, 529-554

Boone, J. (2000): "Measuring Product Market Competition", CEPR Working Paper 2636

Bottasso, A. and Sembenelli, A. (1998) “Market power, productivity and the EU single market program: an ex-post assessment on Italian firm level data”, Fondazione Eni Enrico Mattei Nota di Lavoro 17.98

Buigues, P, F. Ilzkovitz and J. F. Lebrun (1991) “The impact of the internal market by industrial sector: the challenge for member states”, *European Economy*, Special Issue

Card and Freeman (2002) “What have two decades of British economic reform delivered?” forthcoming in Blundell, Card and Freeman (eds) *Seeking a Premier League Economy*, Chicago: University of Chicago Press

Dasgupta and Stiglitz (1990) “Industrial Structure and the Nature of Innovative Activity” *The Economic Journal* Vol 90, Issue 358, 266-293

Djankov, La Porta, Lopes de Silanes Shleifer (2000) “The regulation of entry” NBER Working Paper 7892

EC (1996) Commission Communication on the Impact and Effectiveness of the Single Market presented to the Dublin European Council, 13-14 December 1996, http://europa.eu.int/comm./internal_market/en/update/impact/singleen.pdf

EU (2003) "An agenda for a growing Europe: making the EU economic system deliver" Report of an Independent High-Level Study group established on the initiative of the President of the European Commission, July 2003.

Fraser Institute (2002) *Economic Freedom of the World: 2002 Annual Report*,

Gagnepain and Uribe (2003) "Competition and Efficiency in European Aviation" mimeo Universidad Carlos III de Madrid

Geroski, P. (1995) Market Structure, Corporate Performance and Innovative Activity, Oxford: Oxford University Press.

Goldberg, P and Verboven, F. (2001) "Market Integration and convergence of the Law of One Price: Evidence from the European Car Market" *NER Working Paper* 8575

Green, R and J Haskel (2003) "Seeking a Premier League Economy: The Role of Privatisations" *Seeking a Premier League Economy*, R. Blundell, D. Card, R. Freeman (eds), University of Chicago Press: Chicago

Griliches and Mairesse (1995) "Production functions: the search for identification", NBER Paper No. 5067

Griffith, R (2001) "Product market competition, efficiency and agency costs: an empirical analysis", *IFS Working Paper W01/12*.

Griffith, Redding and Van Reenen (2000) "Mapping the Two Faces of R&D: Productivity Growth in a Panel of OECD Manufacturing Industries", *CEPR Discussion Paper 2457*

Griffith, Redding and Van Reenen (2001) "R&D and absorptive capacity: from theory to evidence" *forthcoming in Scandinavian Journal of Economics*

Grossman and Helpman (1991) "Quality Ladders in the Theory of Growth" *Review of Economic Studies* Vol 58, Issue 1, 43-61

Hall R. E. (1988) "The relationship between price and marginal cost in U.S. industry" *Journal of Political Economy*, vol. 96, 921-47.

Hall R. E. (1990) "Invariance properties of Solow's productivity residual" in P. Diamond (ed.), *Growth, Productivity, Unemployment*, MIT Press (Cambridge, US.).

Hall, R and Jones, C (1999) "Why Do Some Countries Produce So Much More Output per Worker than Others?" *Quarterly Journal of Economics*, February 1999, Vol. 114, pp. 83-116 (with Robert E. Hall).

Harrison, A and Revenga, A (1995) "The effects of trade policy reform: what do we really know?" *NBER Working Paper 5225*

Hart, O. (1983) “The market mechanism as an incentive scheme,” *Bell Journal of Economics*, 14 (Autumn 1983), 366-382

Hay, D. and G. Liu (1997) “The efficiency of firms: what difference does competition make?” *Economic Journal*, 597-617

Jagannathan, R. and S. Srinivasan (2000) “Does product market competition reduce agency costs?”, NBER Working Paper No. 7480, January 2000

Jaquemin and Sapir (1991) “Competition and imports in European markets” in Winters, L. and A. Venables (eds.) *European Integration: Trade and Industry*, Cambridge University Press, Cambridge

Jones, C. and J. Williams (1998) “Measuring the Social Return to R&D” *The Quarterly Journal of Economics*, November 1998, 1119-1135

Jones, C “Growth with or without scale effects?” *American Economic Review Papers and Proceedings*, May 1999, Vol. 89, pp. 139-144.

Jones, C “R&D Based Models of Economic Growth” *Journal of Political Economy*, August 1995, Vol. 103, pp. 759-784.

Jones, C “ Time Series Tests of Endogenous Growth Models” *Quarterly Journal of Economics*, May 1995, Vol. 110, pp. 495-525.

Jorgenson, D (1990) “Productivity and Economic Growth” in E Berndt and J Triplett (eds) *Fifty Years of Economic Measurement*, Chicago, IL: University of Chicago Press

Jorgenson, D and Stiroh, K (2000) “US Economic Growth at the Industry Level” *American Economic Review*, 90 (2), 161-167

Klette, T (1999) “Market Power, Scale Economies and Productivity: Estimates from a Panel of Establishment Data” *The Journal of Industrial Economics* December 1999, 451-476

Klette and Griliches (1996) “The Inconsistency of Common Scale Estimators when Output Prices are Unobserved and Endogenous” *Journal of Applied Econometrics* 11, 343-361

Laffont and Tirole (1993) *A Theory of Incentives in Procurement and Regulation*, Cambridge, MA: MIT Press

Levinsohn, J (1993) “Testing the import-as-market-discipline hypothesis” *Journal of International Economics*, 35, 1-22

Levinsohn, J and Petrin, A (1999) “When industries become more productive do firms? Investigating productivity dynamics” *NBER Working Paper* 6893

Martins, J, Scarpetta, S and Pilat, D (1996) “Markup-up ratios in manufacturing industries: estimates for 14 OECD countries”, OECD Working Paper No. 162

Mayes, D. and P. Hart (1994) *The Single Market Programme as a Stimulus to change: comparisons between Britain and Germany*, Cambridge University Press: Cambridge

Megginson and Netter (2001) “From State to Market: A Survey of Empirical Studies on Privatization” *The Journal of Economic Literature*, Vol. 39, No. 2

Melitz (2003) “The impact of trade on intra-industry reallocations and aggregate industry productivity” Harvard mimeo

Nickell, S. (1996) "Competition and Corporate Performance", *Journal of Political Economy*, 104, 724-746.

Nickell, Wadhwani and Wall (1992) “Productivity growth in UK companies, 1975-1986” *European Economic Review* 36, 1055-1091

Nickell, S.J. Wadhwani, Sushil B and Wall, Martin (1992) “Productivity Growth in UK Companies, 1975-1986” *European Economic Review*, 36, 1055-85

Nicoletti and Scarpetta (2003) “Regulation, productivity and growth: OECD evidence” forthcoming in *Economic Policy*

Olley and Pakes (1996) “The dynamics of productivity in the telecommunications equipment industry” *Econometrica*, 64:6, 1263-1297

OECD working papers and data

Pavcnik, N (2002) “Trade liberalization, exit and productivity improvements: evidence from Chilean plants” *Review of Economic Studies*, 69, 245-276

Redding, S and J Proudman (1997) *Openness and Growth*, Bank of England: London

Rodrik (1988) “Imperfect competition, scale economics and trade policy in developing countries” in R Baldwin (ed) *Trade Policy Issues and Empirical Analysis*, Chicago: The University of Chicago Press

Rodrik (1991) “Closing the technology gap: does trade liberalization really help?” in G. Helleiner (ed) *Trade Policy, Industrialization and Development: A Reconsideration* Oxford: Clarendon Press

Roeger, W. (1995) “Can Imperfect Competition Explain the Difference Between Primal and Dual Productivity Measures? Estimates for US Manufacturing” *Journal of Political Economy* 103, 316-330

Romer (1990) “Endogenous Technical Change” *Journal of Political Economy* Vol 98, Issue 5, Part 2: The Problem of Development, S71-S102

Scarpetta, S and Tressel, T (2002) “Productivity and convergence in a panel of OECD industries: do regulations and institutions matter?” *OECD Working Paper No 342*

Schmidt (1997) “Managerial Incentives and Product Market Competition” *Review of Economic Studies* Vol 64, Issue 2, 191-213

Sleuwaegen, L and Yamawaki, H (1988) “The formation of European common market and changes in market structure and performance” *European Economic Review*, 32, 1451-1475

Solow (1957) “Technical Change and the Aggregate Production Function” *Review of Economics and Statistics* 39, 312-320

Appendix A: TFP

We consider a production function of the form[71]

$$Y_{it} = A_{it} F_{it}\left(K_{it}, L_{it}, M_{it}, R_{it}\right) \qquad (1)$$

where *i* indexes countries, t indexes time, Y is output, A is a Hicks-neutral productivity shift parameter (total factor productivity), $F_{it}(.)$ can in principle vary across countries and over time, though in application we will have to restrict it in some dimensions,[72] K is a vector of capital inputs, L is vector of compensated labour inputs, M is a vector of intermediate inputs and R is knowledge inputs.

By total differentiation we obtain

$$\frac{\dot{Y}_{it}}{Y_{it}} = \frac{\partial Y_{it}}{\partial K_{it}}\frac{K_{it}}{Y_{it}}\frac{\dot{K}_{it}}{K_{it}} + \frac{\partial Y_{it}}{\partial L_{it}}\frac{L_{it}}{Y_{it}}\frac{\dot{L}_{it}}{L_{it}} + \frac{\partial Y_{it}}{\partial M_{it}}\frac{M_{it}}{Y_{it}}\frac{\dot{M}_{it}}{M_{it}} + \frac{\partial Y_{it}}{\partial R_{it}}\frac{R_{it}}{Y_{it}}\frac{\dot{R}_{it}}{R_{it}} + \frac{\dot{A}_{it}}{A_{it}} \qquad (2)$$

which says that the growth in output is equal to the growth in inputs weighted by the elasticity of output with respect to each input, denoted $\alpha_{it}^{L} = \frac{\partial Y_{it}}{\partial L_{it}}\frac{L_{it}}{Y_{it}}$ and similar for other inputs, plus the growth in TFP.

The growth accounting literature[73] treats the growth in TFP as exogenous and views it as measuring technological change. In the endogenous growth literature the interpretation of the above equation imply a different interpretation of the growth accounting exercise. The precise

---

[71] See, inter alia, the recent surveys by Hulten (2000), Griliches (1998) and Diewert and Nakumura (2000).

[72] This allows a very general functional form (e.g. it is consistent with a translog production function) and it allows for factor augmenting technical progress as long as is common across all countries.

[73] Solow (1957)

interpretation depends on which variant of the growth model is considered, Barro (1998) provides an excellent and clear exposition of this.

Empirically the main problem we face is that we do not observe these elasticities. There are two basic approaches to dealing with this problem. One is to estimate the production function econometrically. To do this we have to assume a functional form for $F_{it}(.)$ and deal with the problem that inputs and output are determined simultaneously.[74] In the literature this is usually assumed to be Cobb-Douglas.[75] This is a very restrictive functional form and implies constant factor shares.

The alternative approach is to use economic theory to derive further restrictions which may enable us to measure some of the terms in (2) directly. For example, under the assumption that there is perfect competition in factor markets we know that factors are paid their marginal revenue product, and with perfect competition in the product market we know that marginal revenue is equal to price, so that

$$\frac{\partial Y_{it}}{\partial K_{it}} = \frac{p_{it}^K}{p_{it}^Y}, \qquad \frac{\partial Y_{it}}{\partial L_{it}} = \frac{p_{it}^L}{p_{it}^Y}, \qquad \frac{\partial Y_{it}}{\partial M_{it}} = \frac{p_{it}^M}{p_{it}^Y}, \qquad \frac{\partial Y_{it}}{\partial R_{it}} = \frac{p_{it}^R}{p_{it}^Y} \tag{3}$$

where p_{it}^Y is the price of output of the *i*th country at time *t*, and similar for others.

This means that the unobserved elasticities can be measured by the revenue share of each factor

$$\alpha_{it}^K = s_{it}^K = \frac{p_{it}^K K_{it}}{p_{it}^Y Y_{it}}, \qquad \alpha_{it}^L = s_{it}^L = \frac{p_{it}^L L_{it}}{p_{it}^Y Y_{it}}, \qquad \alpha_{it}^M = s_{it}^M = \frac{p_{it}^M M_{it}}{p_{it}^Y Y_{it}}, \qquad \alpha_{it}^R = s_{it}^R = \frac{p_{it}^R R_{it}}{p_{it}^Y Y_{it}}$$

[74] See Griliches and Mairresse (1985) for an excellent explanation of the many problems encountered.

[75] Some papers estimate a translog, see inter alia Nadiri, Bernstein.

which is generally observed (except for capital). Assuming that there are constant returns to scale an expression for the growth rate of output can be obtained using the approximation $\frac{\dot{K}_{it}}{K_{it}} = \ln K_{it} - \ln K_{it-1}$,

$$\Delta y_{it} = \Delta s_{it}^{L} \Delta l_{it} + \Delta s_{it}^{M} \Delta m_{it} + \Delta s_{it}^{R} \Delta r_{it} + \Delta a_{it} \qquad (4)$$

where Δ denotes log difference and lower case variables are logged and scaled by capital, i.e. $\Delta y_{it} = \ln(Y_{it}/K_{it}) - \ln(Y_{it-1}/K_{it-1})$. This is Caves et al (1982) superlative index. It allows us to measure the growth in output as a function of growth in factor shares and factor accumulation, plus the growth in TFP.[76]

This is the basically the approach taken in Nicoletti and Scarpetta (2003) and many other empirical papers. Many papers have discuss the problems with this approach and in particular, the assumption of perfect competition in the product market and constant returns to scale are problematic when it is exactly those effects that we are looking for.

With imperfect competition in the product market, i.e. where price is marked up above marginal cost, then marginal revenue is no longer equal to price but instead can be written

$$MR_{it} = \mu_{it} p_{it}^{Y}$$

where μ_{it} is the ratio of price to marginal cost or the mark-up. This means that

$$\frac{\partial Y_{it}}{\partial K_{it}} = \mu_{it} \frac{p_{it}^{K}}{p_{it}^{Y}}, \qquad \frac{\partial Y_{it}}{\partial L_{it}} = \mu_{it} \frac{p_{it}^{L}}{p_{it}^{Y}} \qquad , \frac{\partial Y_{it}}{\partial M_{it}} = \mu_{it} \frac{p_{it}^{M}}{p_{it}^{Y}} \qquad , \frac{\partial Y_{it}}{\partial R_{it}} = \mu_{it} \frac{p_{it}^{R}}{p_{it}^{Y}} \qquad (5)$$

[76] This index has many nice properties like in multilateral comparisons it is transitive.

In this case the growth in output becomes,[77]

$$\Delta y_{it} = \mu_{it}\left(\Delta s_{it}^{M}\Delta m_{it} + \Delta s_{it}^{L}\Delta l_{it} + \Delta s_{it}^{R}\Delta r_{it}\right) + \Delta a_{it}\,. \qquad (6)$$

Thus in the presence of imperfect competition the Caves et al (1982) index will give biased estimate the true technological growth by $-(\mu_{it}-1)\left(\Delta s_{it}^{L}\Delta l_{it} + \Delta s_{it}^{M}\Delta m_{it} + \Delta s_{it}^{R}\Delta r_{it}\right)$.

[77] See Hall (1988) and Klette (1999).

Appendix B: Data availability

Our main data source for economic performance is the OECD STAN database. Table 24 shows the availability of data on value-added and employment across countries at different levels of aggregation over the period 1985 – 2000.

Table 24: Availability of value-added and employment, 1985-2000

	Total Business Enterprise	Manufacturing, Services	Broad Industry Panel	Manufacturing Industries	Electricity, Gas and Water	Post and Telecoms
Austria	Y	Y	Y	Y	Y	Y
Belgium	Y	Y	Y	Y	Y	Y
Denmark	Y	Y	Y	Y	Y	Y
Finland	Y	Y	Y	Y	Y	Y
France	Y	Y	Y	(91 -)	Y	Y
Germany	(91 -)	(91 -)	(91 -)	(91 -)	(91 -)	(91 -)
Greece	*(95 -)*	*(95 -)*	*(95 -)*	*(95 -)*	*(95 -)*	*(95 -)*
(Ireland)	-	-	-	-	-	-
Italy	Y	Y	Y	Y	Y	Y
Luxembourg	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*
Netherlands	Y	Y	Y	Y	Y	Y
Portugal	Y	Y	Y	Y	Y	(- 95)
Spain	Y	Y	Y	(95 -)	Y	Y
Sweden	Y	Y	(93 -)	(93 -)	Y	(93 -)
UK	Y	Y	Y	Y	Y	Y
USA	Y	Y	Y	Y	Y	Y

Table 25 shows that information on investment, and on other variables constructed using investment such as TFP, is less frequently available. This limits the sample of countries we are able to consider for these variables. In particular, Germany and Greece have shorter time series and Luxembourg and Spain have insufficient investment data.

Table 25: Availability of investment, mark-ups and TFP, 1985-2000

	Total Business Enterprise	Manufacturing, Services	Broad Industry Panel	Manufacturing Industries	Electricity, Gas and Water	Post and Telecoms
Austria	Y	Y	Y	Y	Y	Y
Belgium	Y	Y	Y	Y	Y	Y
Denmark	Y	(93 -)	(93 -)	(93 -)	(93 -)	(93 -)
Finland	Y	Y	Y	Y	Y	Y
France	Y	Y	Y	(92 -)	Y	Y
Germany	(91 -)	(91 -)	(91 -)	(91 -)	(91 -)	(91 -)
Greece	(95 -)	(95 -)	-	(95 -)	(95 -)	-
(Ireland)	-	-	-	-	-	-
Italy	Y	Y	-	Y	Y	-
Luxembourg	-	-	-	-	-	-
Netherlands	Y	Y	Y	Y	Y	Y
Portugal	(88 -)	(95 – 97)	-	(95 – 97)	(95 – 97)	-
Spain	Y	(Y)*	-	(95 -)	(93 -)	-
Sweden	Y	Y	(93 -)	(93 -)	Y	(93 -)
UK	Y	Y	(89 -)	Y	Y	(92 -)
USA	Y	Y	Y	Y	Y	Y

Appendix C: Further econometric results

Eurostat structural indicators

In Table 26 we introduce three Eurostat structural indicators the regression relating the markup to product market reforms for the aggregate economy, manufacturing and business sector services. The Eurostat data is only available over a shorter time period, restricted to 1993-2000, resulting in significantly smaller sample sizes than above. For each sector we first present the results on only the group of indicators used above in order to show the effect of changing the sample, and then introduce the Eurostat indicators. The Eurostat indicators are only available for Austria, Finland and Sweden from 1995 onwards, and so there is no differential variation in the index of the average tariff rate, which is excluded from the regressions as a result. The indicators used above are all coded to be increasing in "economic freedom" as above, while the Eurostat indicators are the original data.

In this smaller sample, the results on the basic specification in columns (1), (3) and (5) are generally less informative than in the full-sample results shown above. For example, the coefficient on "ease of starting a new business" has become insignificant in the aggregate economy and business sector services, and is weakly positive in manufacturing. The coefficients on the CEEP measure of public enterprises and the labour and credit market regulation indices are similar to before.

None of the Eurostat indicators enter significantly in the aggregate economy in column (2). In manufacturing (column 4) the coefficient on "public procurement as a % of GDP" is negative and significant at the 10% level, suggesting that a reduction in public procurement of 1% of GDP is associated on average with a 1 percentage point increase in the mark-up in manufacturing. This could be consistent with the government having a degree of buyer power that enables it to keep prices down. In business sector services (column 6) "state aids as a % of GDP" is negative and significant at the 1% level, and "openly advertised public procurement as a % of total public procurement" is positive and significant at the 10% level. A reduction in state aids of 1% of GDP

is associated with about a 5 percentage point increase in the mark-up in business sector services. Given that the average mark-up in the service sector sample is 0.41 this corresponds to about a 12 % reduction in the mark-up. Few countries experienced reductions in state aids of this magnitude over the sample period, apart from Germany where state aids fell from 2.12% of GDP in 1993 to 0.82% in 2000.

Table 26: Relationship between indicators of product market reform and markup, including Eurostat structural indicators

Dependent variable: markup	(1)	(2)	(3)	(4)	(5)	(6)
Sector:	Aggregate economy		Manufacturing		Services	
Ease of starting a new business	0.007	0.006	0.025 *	0.026 *	0.005	-0.005
	(0.006)	(0.006)	(0.014)	(0.015)	(0.010)	(0.011)
Price controls	0.006	0.006	-0.005	-0.011	0.015	0.017 *
	(0.006)	(0.006)	(0.015)	(0.017)	(0.011)	(0.009)
Average tariff rate	-	-	-	-	-	-
Regulatory trade barriers	-0.003	-0.007	-0.032	-0.061 *	0.022	0.012
	(0.018)	(0.018)	(0.035)	(0.036)	(0.029)	(0.029)
Time with government bureaucracy	0.008	0.008	0.017	0.022	0.039 **	0.027 **
	(0.008)	(0.008)	(0.018)	(0.023)	(0.012)	(0.012)
CEEP measure of public enterprises	0.007 **	0.007 **	0.014 **	0.015 **	0.012 **	0.011 **
	(0.002)	(0.003)	(0.005)	(0.005)	(0.005)	(0.005)
Labour market regulation	-0.037 **	-0.040 **	-0.001	0.002	-0.068 **	-0.055 **
	(0.008)	(0.008)	(0.021)	(0.021)	(0.013)	(0.015)
Credit market regulation	-0.063 **	-0.064 **	0.016	0.045	-0.153 **	-0.134 **
	(0.017)	(0.017)	(0.050)	(0.047)	(0.043)	(0.040)
Output gap	0.003	0.002	0.006	0.007	0.005	0.003
	(0.002)	(0.002)	(0.005)	(0.005)	(0.005)	(0.005)
State aids as a % of GDP		-0.004		0.017		-0.049 **
		(0.006)		(0.026)		(0.017)
Public procurement as a % of GDP		0.001		-0.009 *		-0.001
		(0.002)		(0.005)		(0.003)
Openly advertised public procurement as a % of total public procurement		0.001		0.000		0.004 *
		(0.001)		(0.003)		(0.002)
Observations:	82	82	75	75	71	71
Countries:	12	12	11	11	10	10
Years:	1993-2000	1993-2000	1993-2000	1993-2000	1993-2000	1993-2000

Note: Numbers in () are robust standard errors. All regressions include country and year dummies.
** indicates significance at 10% level,** indicates significance at 5% level*

Robustness in aggregate economy

In this section we present results from regressions of our main macroeconomic outcomes directly on all of our indicators of product market reform for the aggregate economy.[78] These results serve as a test of robustness of our two-stage instrumental variables results presented above. A limitation of this direct approach is that we are not able to capture possible non-linearities at different levels of the mark-up, which are often suggested by theory and are supported by our results.

Results from regressing the product market and other reforms directly on outcomes for the aggregate economy are shown in Table 27. All regressions include country and year dummies as before, as well as a measure of the output gap to control for country-specific cycles. The reform indicators are the same as in column (3) of Table 9, with all indicators coded so that they are increasing in "economic freedom", or equivalently decreasing in the strictness of regulation.

We start with employment in column (1) and investment in column (2) of Table 27. All the significant coefficients have the expected sign and are roughly the expected size according to the logic described above. The index of the average tariff rate has a positive and significant coefficient, as do the indices of labour and credit market regulation, while the index of price controls has a negative and significant coefficient. In earlier sections we found a negative relationship between the mark-up and the levels of employment and gross fixed capital formation. If the results for employment and gross fixed capital formation in this section are consistent with our two-stage results we thus expect the sign of the coefficients on the reform indicators to be the opposite to that found in our first-stage results in earlier sections.

In our two stage results discussed earlier we found that "ease of starting a new business" entered both directly into the employment equation, and indirectly through the markup, and that these

[78] Equivalent results for manufacturing and service sectors are presented in Appendix C

two effects almost exactly cancelled out. In column (1) of Table 27 we see that the coefficient on ease of entry is insignificant, in line with our earlier results. Another example is the coefficient on the average tariff rate. At the aggregate level we found in column (3) of Table 9 that the index of the average tariff rate had a negative and significant coefficient in the first-stage mark-up regression. In other words a higher value of the index (a lower average tariff rate) was associated with a lower mark-up. Combining this with the negative relationship between the mark-up and the level of employment in the second stage we would expect that in a direct regression of the level of employment on our reform indicators the coefficient on the index of the average tariff rate would be positive. In other words a higher value of the index (a lower average tariff rate) should be associated with a higher level of employment. In addition, the coefficient should be of the same order of magnitude as the equivalent coefficient in column (3) of Table 9, given that the estimated coefficient on the mark-up in the second-stage regression in column (4) of Table 10 is about –1.6.

Table 27: Direct regressions, aggregate economy

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependant variable:	ln(empl)	ln(gfcf)	ln(labour prod)	growth in lab prod	ln(TFP)	growth in TFP	ln(R&D)
Ease of starting a new business	-0.004 (0.010)	0.049 ** (0.017)	-0.012 (0.008)	-0.003 (0.003)	-0.020 ** (0.007)	-0.005 (0.003)	-0.184 ** (0.050)
Price controls	-0.021 ** (0.003)	-0.035 ** (0.009)	0.019 ** (0.002)	0.001 (0.001)	0.023 ** (0.003)	0.002 (0.001)	0.134 ** (0.017)
Average tariff rate	0.042 ** (0.020)	0.283 ** (0.054)	0.002 (0.016)	-0.015 (0.009)	-0.030 * (0.017)	-0.030 ** (0..009)	-0.161 (0.119)
Regulatory trade barriers	0.031 ** (0.015)	0.044 (0.042)	-0.054 ** (0.020)	-0.010 (0.006)	-0.021 (0.018)	-0.012 * (0.006)	-0.561 ** (0.073)
Time with government bureaucracy	0.024 ** (0.007)	-0.030 (0.018)	-0.020 ** (0.008)	0.000 (0.003)	-0.031 ** (0.008)	0.003 (0.003)	-0.037 (0.044)
CEEP measure of public enterprises	-0.002 (0.002)	-0.006 (0.004)	0.002 (0.002)	-0.010 (0.071)	0.003 (0.002)	0.000 (0.001)	0.001 (0.010)
Labour market regulation	0.040 ** (0.005)	0.079 ** (0.013)	-0.033 ** (0.004)	-0.001 (0.002)	-0.031 ** (0.003)	-0.004 * (0.002)	-0.030 (0.031)
Credit market regulation	0.017 * (0.009)	0.114 ** (0.027)	-0.003 (0.010)	0.000 (0.004)	-0.031 ** (0.010)	-0.008 ** (0.003)	-0.022 (0.070)
Output gap	0.011 ** (0.001)	0.031 ** (0.003)	-0.001 (0.001)	0.000 (0.001)	0.004 ** (0.001)	0.000 (0.001)	0.008 * (0.004)
Observations:	181	181	181	180	181	178	100
Countries:	12	12	12	12	12	12	8
Years:	1985-2000	1985-2000	1985-2000	1985-2000	1985-2000	1985-2000	1987-2000

Note: Numbers in () are robust standard errors. All regressions include country and year dummies.
** indicates significance at 10% level,** indicates significance at 5% level*

The results for gross fixed capital formation in column (2) are also consistent with our two-stage results. In particular, the coefficient on the index of the average tariff rate is large and significantly positive, as is that on the index of credit market regulation, which might be

expected to be especially relevant to investment behaviour. Thus lower average tariffs and less restrictive credit market regulation are both associated with higher levels of investment.

The significant coefficients for the level and growth rates of labour productivity and TFP in columns (3) – (6) and on R&D in column (7) also go in the expected direction based on our two-stage results. Overall these results support the main findings from our two-stage approach, as do those for the manufacturing and service sectors, which are presented in Appendix C.

Robustness in manufacturing and service sectors

In this section we present results from regressions of our main macroeconomic outcomes on our indicators of product market reform for manufacturing and business sector services.

Table 28: Manufacturing

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependant variable:	ln(empl)	ln(gfcf)	ln(labour prod)	growth in lab prod	ln(TFP)	growth in TFP	ln(R&D)
Ease of starting a new business	-0.007 (0.012)	0.102 ** (0.045)	0.014 (0.011)	-0.002 (0.007)	0.006 (0.013)	-0.008 (0.007)	-0.184 ** (0.052)
Price controls	-0.017 ** (0.005)	-0.045 ** (0.019)	0.039 ** (0.004)	0.008 ** (0.003)	0.023 ** (0.006)	0.011 ** (0.003)	0.141 ** (0.019)
Average tariff rate	-0.012 (0.032)	-0.097 (0.117)	-0.148 ** (0.033)	-0.036 (0.023)	-0.166 ** (0.038)	-0.047 ** (0.021)	-0.406 ** (0.151)
Regulatory trade barriers	-0.007 (0.025)	0.033 (0.101)	-0.134 ** (0.030)	-0.010 (0.017)	-0.120 ** (0.043)	-0.018 (0.016)	-0.620 ** (0.085)
Time with government bureaucracy	-0.011 (0.011)	-0.038 (0.044)	-0.039 ** (0.014)	-0.014 * (0.008)	-0.038 * (0.020)	-0.006 (0.008)	-0.045 (0.043)
CEEP measure of public enterprises	0.009 ** (0.003)	-0.002 (0.009)	0.009 ** (0.003)	0.001 (0.002)	0.012 ** (0.003)	0.002 (0.002)	0.003 (0.011)
Labour market regulation	0.045 ** (0.009)	0.047 (0.034)	-0.015 * (0.008)	0.005 (0.005)	-0.026 ** (0.010)	0.003 (0.005)	-0.062 * (0.032)
Credit market regulation	0.032 ** (0.016)	0.074 (0.061)	-0.072 ** (0.015)	0.006 (0.008)	-0.071 ** (0.020)	-0.003 (0.008)	-0.227 ** (0.093)
Output gap	0.013 ** (0.002)	0.033 ** (0.006)	-0.003 (0.002)	-0.002 (0.002)	0.001 (0.002)	-0.002 (0.002)	0.005 (0.004)
Observations:	159	159	159	158	159	157	93
Countries:	11	11	11	11	11	11	8
Years:	1985-2000	1985-2000	1985-2000	1985-2000	1985-2000	1985-2000	1987-2000

Note: Numbers in () are robust standard errors. All regressions include country and year dummies.
** indicates significance at 10% level,** indicates significance at 5% level*

Table 29: Services

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependant variable:	ln(empl)	ln(gfcf)	ln(labour prod)	growth in lab prod	ln(TFP)	growth in TFP	ln(R&D)
Ease of starting a new business	0.003 (0.012)	0.011 (0.022)	-0.041 ** (0.007)	-0.005 (0.004)	-0.042 ** (0.012)	-0.003 (0.005)	-0.054 (0.089)
Price controls	-0.032 ** (0.005)	-0.009 (0.013)	0.028 ** (0.004)	-0.003 (0.003)	0.016 ** (0.005)	-0.002 (0.003)	0.138 ** (0.047)
Average tariff rate	0.068 * (0.035)	0.615 ** (0.078)	-0.002 (0.022)	-0.002 (0.013)	-0.124 ** (0.031)	-0.032 ** (0.014)	0.902 ** (0.384)
Regulatory trade barriers	0.010 (0.022)	0.212 ** (0.053)	-0.013 (0.020)	-0.013 (0.010)	-0.021 (0.027)	-0.015 (0.011)	-0.574 ** (0.164)
Time with government bureaucracy	0.016 (0.010)	-0.081 ** (0.023)	-0.025 ** (0.007)	-0.001 (0.005)	-0.012 (0.014)	0.001 (0.005)	0.337 ** (0.088)
CEEP measure of public enterprises	-0.002 (0..002)	-0.031 ** (0.006)	-0.007 ** (0.002)	-0.001 (0.001)	-0.004 (0.002)	0.001 (0.001)	0.001 (0.023)
Labour market regulation	0.050 ** (0.007)	0.071 ** (0.017)	-0.048 ** (0.005)	0.003 (0.003)	-0.027 ** (0.006)	-0.002 (0.004)	-0.020 (0.081)
Credit market regulation	0.062 ** (0.016)	0.145 ** (0.038)	-0.015 (0.011)	0.009 (0.006)	-0.045 ** (0.015)	-0.003 (0.006)	0.706 ** (0.220)
Output gap	0.012 ** (0.002)	0.039 ** (0.007)	0.000 (0.001)	-0.001 (0.001)	0.008 ** (0.002)	-0.001 (0.001)	0.021 (0.015)
Observations:	143	143	143	141	143	140	90
Countries:	10	10	10	10	10	10	8
Years:	1985-2000	1985-2000	1985-2000	1985-2000	1985-2000	1985-2000	1987-2000

Note: Numbers in () are robust standard errors. All regressions include country and year dummies.
** indicates significance at 10% level,** indicates significance at 5% level*

Appendix D: Network industries

The network industries are where we have seen some of the most significant changes in ownership and regulation. There is a large and growing literature on the micro econometric analysis of regulated industries as discussed above. This literature emphasizes the fact that the details of the type of competitive and regulatory regime into which an industry is liberalised matters a lot and often in very subtle ways. We are not able to capture most of these subtleties with the data available to us. To investigate these issues properly micro data on both performance and regulations is needed. Here we can only capture the impact of major events such as privatization and liberalisation. We first consider the electricity, gas and water industry and then the telecommunications and post industry. We then go on to consider the aggregate economy and manufacturing and service sectors.

In the network industries it is particularly difficult to measure profit margins, our estimate of the mark-up depends on the assumption that marginal and average costs are approximately equal, which is particularly not true in network industries, which have high fixed costs. In these industries we consider the direct effect of regulatory changes on macroeconomic outcomes.

D.1 Electricity, gas and water

The performance data we have from STAN data is available for the "Electricity, Gas and Water Supply" industries combined (ISIC 40-41). We therefore consider regulation in these three industries together.

D.1.1 Electricity deregulation

In Europe deregulation of the electricity industry started in the UK in 1989. In 1996 the EU adopted a Directive for the Internal Market for Electricity (EU Directive 96/92/EC). The Directive marks the first major legislative step toward the creation of an open and competitive European electricity market. Under this law, all Member States were required to open at least

25.37% of their electricity markets to competition as of February 1999. This represents the overall share of electricity supply used by consumers larger than 40GWh.

In respect to generation, the directive allows individual countries to choose between alternative systems of tendering or licensing for new capacity. Under the tendering system, a Member State issues a tender for new capacity, which enables it to keep overall control of the amount of capacity coming onto the system? Under the licensing system, individual tenders are not issued but generic criteria are set by the member state, for example covering land use, fuel mix and environmental issues.

By February 2000 the market opening requirement had risen to 30%. By February 2003 the Directive requires the majority of industrial and commercial customers to have a choice of supplier creating one single European Energy Market with a combined value of over £50 billion, moving the required level of market opening to 35%. The degree of market opening in 2002 ranged from 30% to 100% and the total market across Europe was estimated to be 80% open.

We have information on the degree of public ownership in the electricity industry from 1986 to 1998 on a scale of one to five, where one corresponds to entirely public, two to mostly public, three to mixed, four to mostly private and five to private. This variable is shown in Figure 29.[79]

[79] Data is currently not available for Austria.

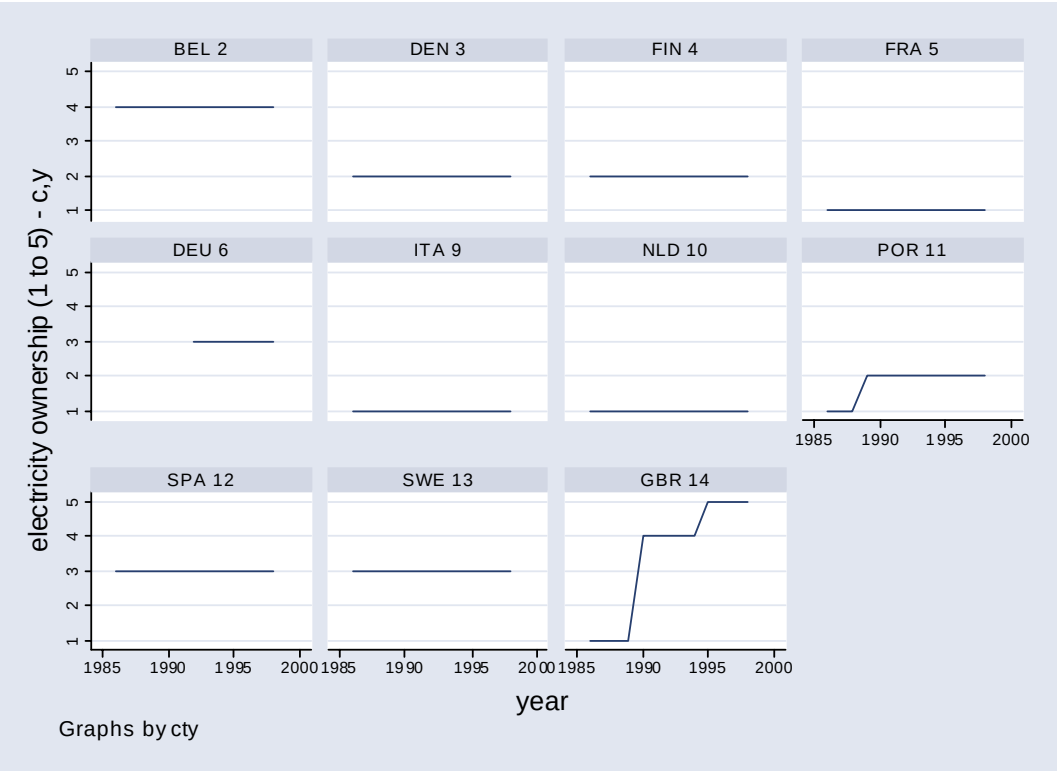


Figure 29: Electricity ownership (1-public, 2-mostly public, 3-mixed, 4-mostly private, 5-private). Source: OECD International Regulation Database.

The UK and Portugal are the only countries where this varies over time. The UK goes from public ownership to private ownership over the period. Portugal switches from public to mostly public. In all other countries the state of ownership remains the same over the period, and thus can not be identified from other country or industry characteristics.

The econometric results for these variables are thus driven entirely by the two changes in ownership in the UK and the single change in Portugal, with performance in other EU countries acting as the counterfactual. That is, the other EU countries represent what we think would have happened in the UK and Portugal if the UK and Portugal had not privatised electricity. There are a number of reasons to believe that the performance of the UK electricity might have differed from other EU countries even if privatisation had not occurred. For example the industry in the UK was perceived to have suffered from long-term under-investment. The history of

privatisation in the UK means that we may not believe these results hold general relevance for other EU countries. That is, we may not believe that if the other countries enacted the same reforms at the UK they would necessarily experience the same changes in performance.

The other product market reform indicators that we use for the electricity industry include an indicator that relates to liberalisation of the industry. This is equal to zero in every year that the country reported that the industry was not liberalised, and one in every year that it reported that the industry was liberalised.[80] Again, since our regressions control for country specific characteristics that are not observed, the effect of liberalisation is only identified off changes over time within countries. Countries that show no time-series variation in a variable act as controls, that is they represent what would have happened if liberalisation had not occurred.

A number of countries liberalised their electricity industries over the 1986-1998 period (Denmark, Finland, Germany, Sweden and the UK), as shown in Figure 30. However, in two of these cases (Denmark and Germany) we only observe one year of data after liberalisation and in Sweden we only observe two years. This means that in practice the identification is coming off a very small number of observations. This is worrying and should lead us to treat any results with caution – their applicability to other circumstances may be limited.

[80] The OECD data for Denmark appeared to conflict with other available information on liberalisation of electricity markets. For this reason we have changed the liberalisation indicator to switch from zero to one in 1998 rather than 1996, which is the year indicated by the OECD. Data for other countries appeared to correspond well with other information sources.

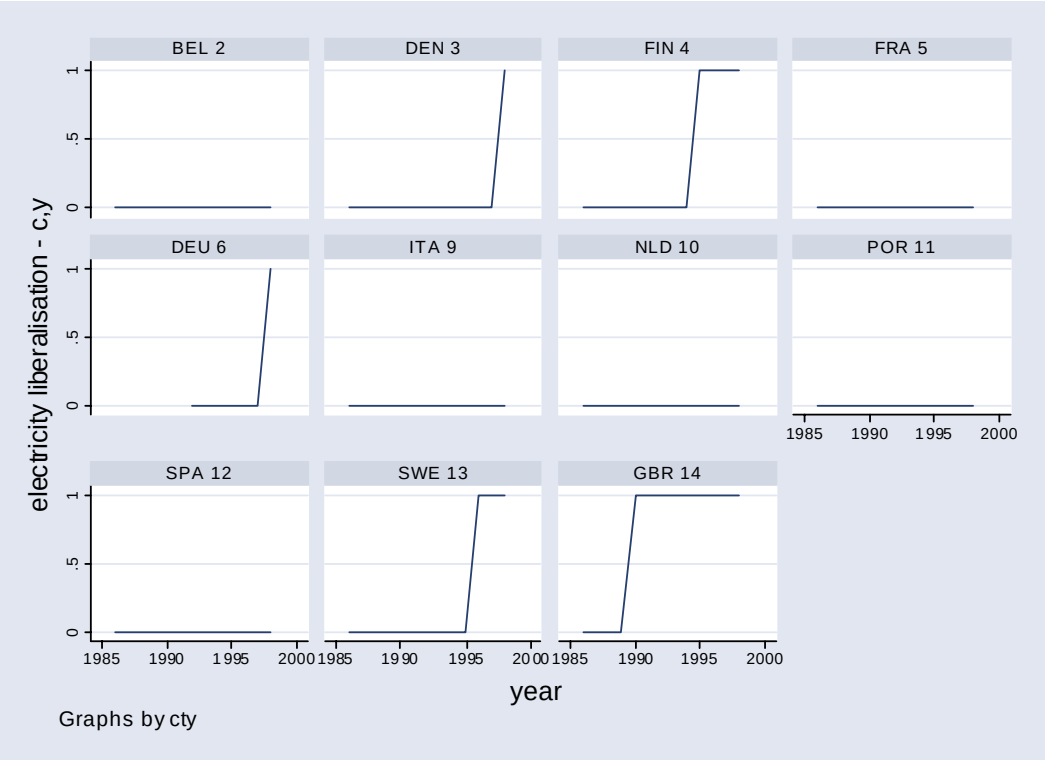


Figure 30: electricity liberalisation. Source: OECD International Regulation Database

We also use an indicator that relates to consumers' choice of suppliers. This is equal to zero in each year that the country reported that there was no choice of suppliers and one if it reported that there was some choice. A number of countries introduced choice of suppliers over the sample period (Finland, Germany, Portugal, Sweden and the UK), as shown in Figure 31. However, we see that many countries introduced this reform at the same time as liberalisation (Finland, Germany, Sweden and the UK) so the impact of these two reforms can not be separately identified from data on these countries. This point is clearer in Figure 32 where the timing of all the electricity reforms is shown together. We can see that in Denmark, Portugal, Spain and the UK all reforms happen at the same time. In Finland, Germany and Sweden there is a one year gap between liberalisation and subsequent reforms.

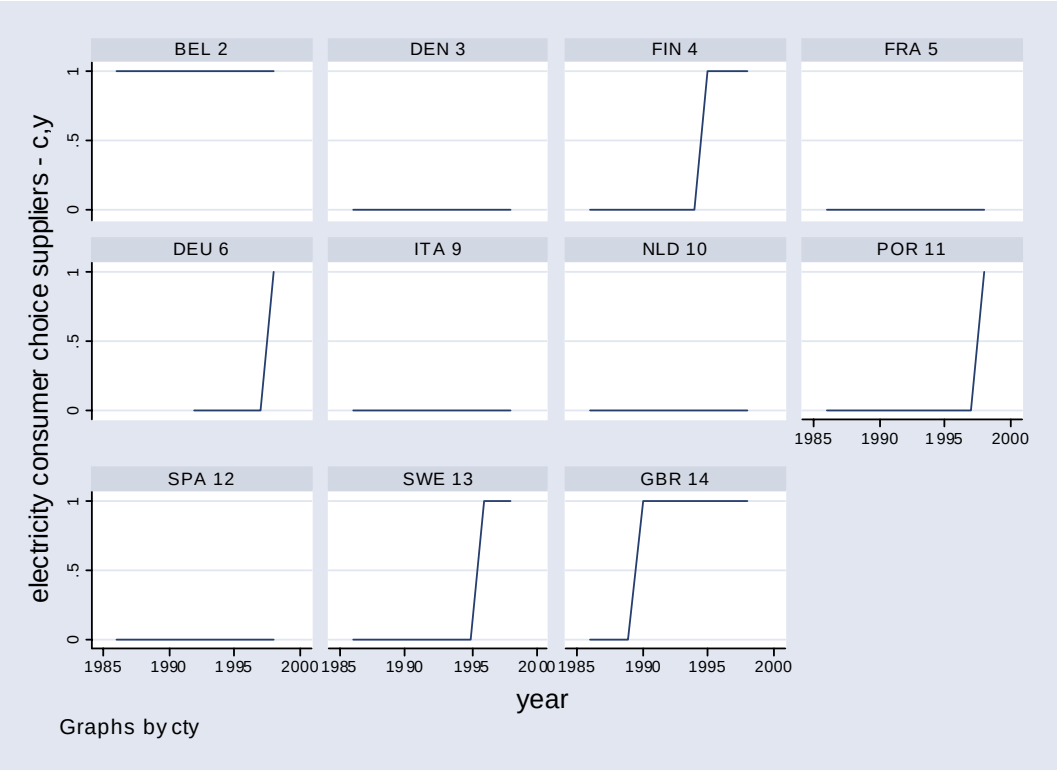


Figure 31: Electricity: Consumer choice of suppliers. Source: OECD International Regulation Database.

Another of the indicators of the nature of reform in electricity relates to the presence of third party access. This is equal to zero in each year that the country reported no third party access, and one in each year that the country reported either negotiated or regulated third party access. Denmark, Finland, Spain, Sweden and the UK introduced third party access during the sample period, as shown in Figure 32.

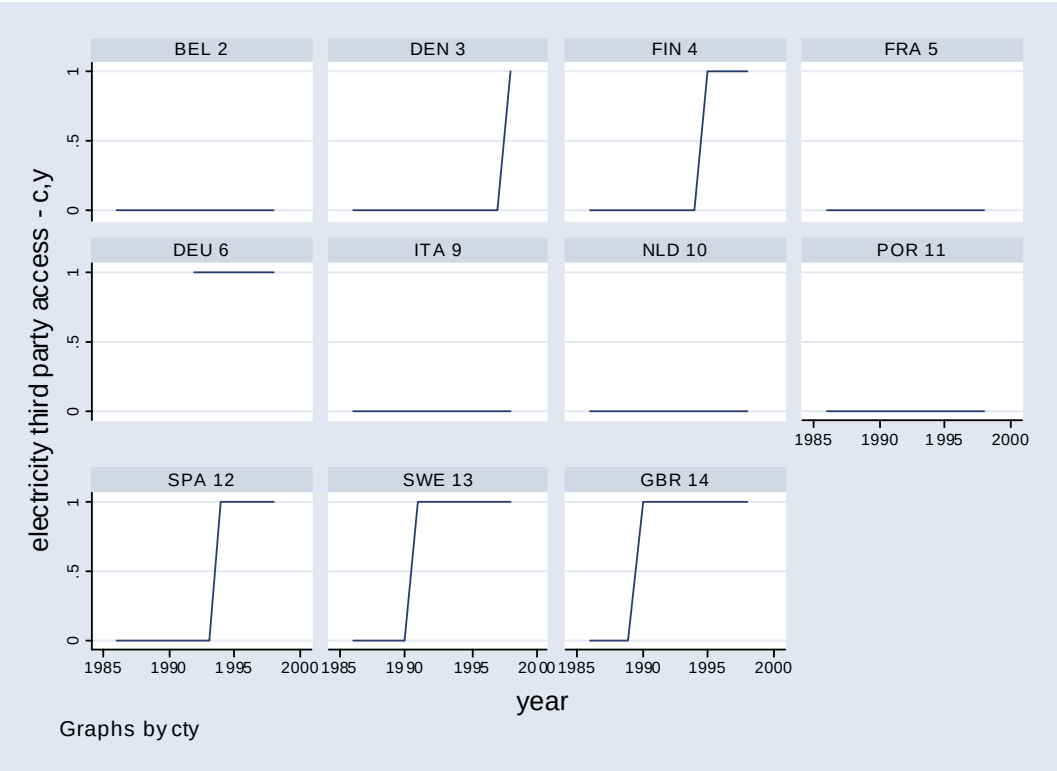


Figure 32: Electricity: third party access. Source: OECD International Regulation Database.

The final indicator that we use relates to the existence of a wholesale pool. This is equal to zero in each year that the country reported that there was not a wholesale pool, and one in each year that the country reported that there was. Finland, Sweden and the UK introduced a wholesale pool during the sample period, as shown in Figure 33. In Finland this took place the year after the other liberalisations, while in Sweden and the UK they happened at the same time.

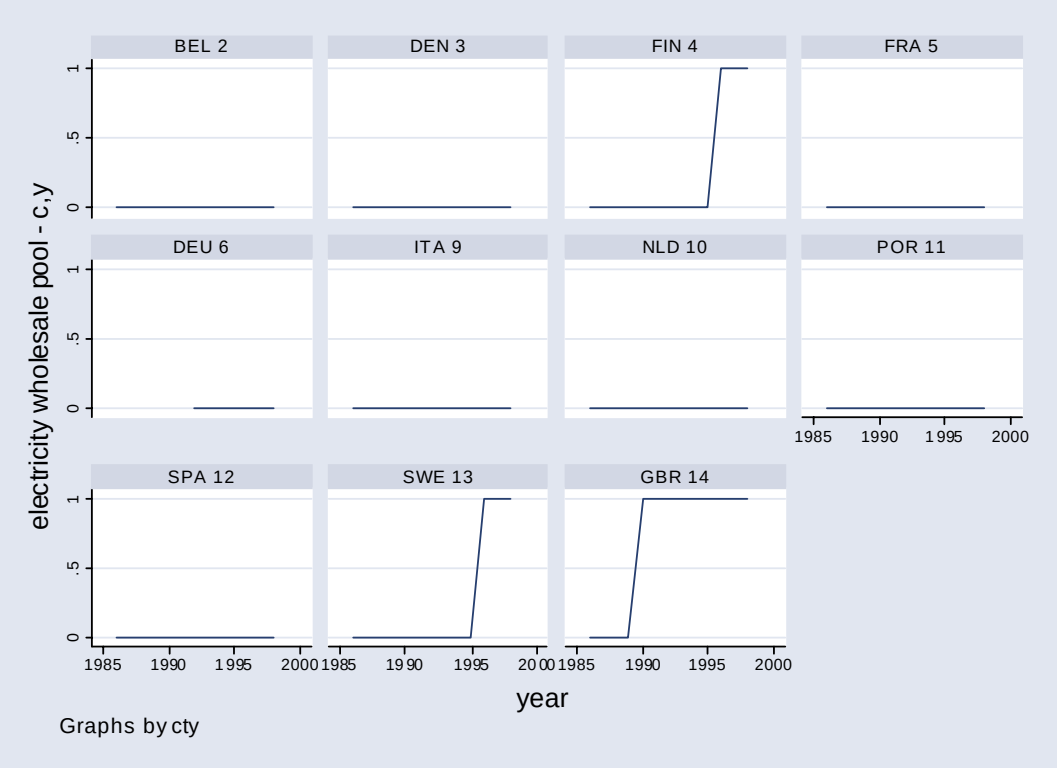


Figure 33: Electricity: wholesale pool. Source: OECD International Regulation Database.

The timing of these reforms was similar in many countries, as shown in Figure 34. While there are sufficient differences for us to identify each of the variables in the regressions below the results are often being identified off single events. Again, this is a concern if we are interested in using these estimates to consider what the impact of similar reforms might be in other countries – it is not clear how general these results are.

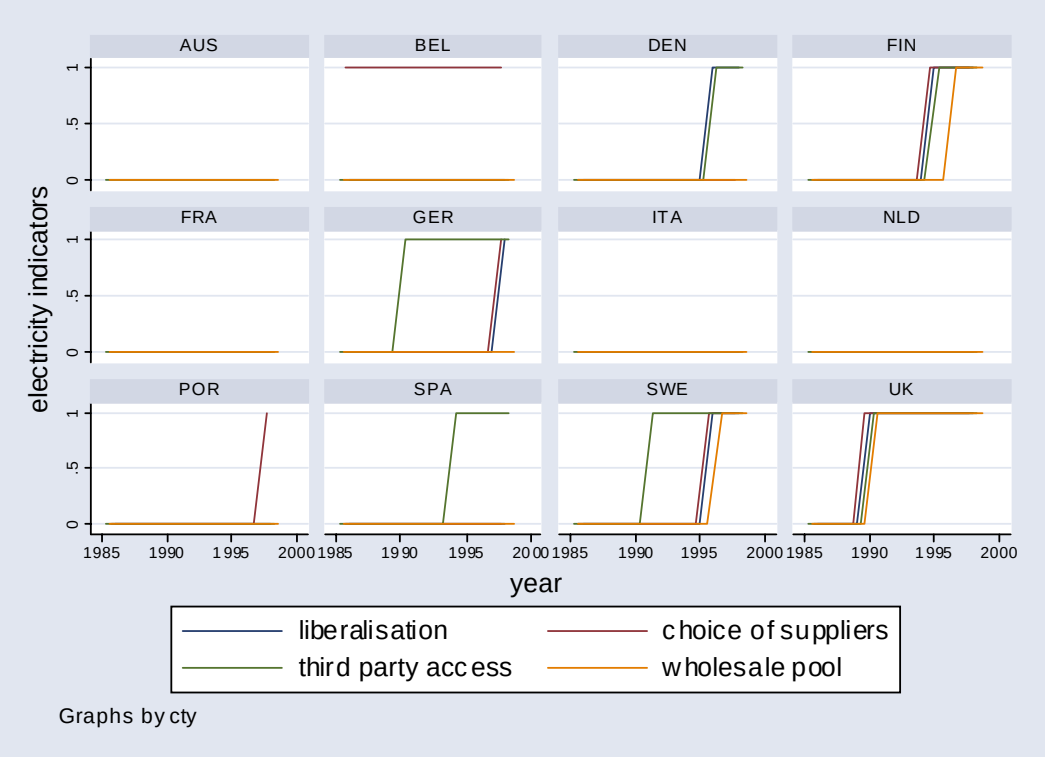


Figure 34: Electricity indicators. Source: OECD International Regulation Database.

D.1.2 Gas

Deregulation of the gas industry in Europe started in 1986 in the UK, when the market was opened for non-domestic customers and British Gas, the largest integrated gas utility company in the world, was privatised. Unlike electricity, liberalisation of the gas sector has progressed slowly in the EU. The EU Gas Directive was issued in 1998.

The gas directive permits member states to choose either regulated third party access to their gas grid, negotiated access or a combination of both. Eight countries chose regulated third party access. The directive also adopted a three-level phased opening of the EU gas market, with an absolute minimum level of opening of 20%, or all customers above a certain size. Compliance varies from country to country. By 2002 the degree of market opening ranged from 20% to 100%.

The US began deregulation of the gas markets in 1978. Over half the states in the US now have residential restructuring programmes. Despite recent gas price increases in the US, the long term trend of prices in the US has been down since 1980. In the UK, the only other country with a comparable history of deregulation of the gas markets, average industrial prices for gas have fallen by 43% in real terms since 1990 and domestic prices by 23%.

Since the changes in the regulation of gas markets have taken place either at the very beginning or after the end of our available sample period, we are not able to identify their effects separately from other unobservable differences across countries. For example, the effects of deregulation in the UK will be picked up by the UK country dummy, along with other constant unobservable characteristics of the UK gas market.

D.1.3 Water

There has been relatively little change in the water industry except in the UK where it was privatized in 1989. The new EU water law encourages the use of economic instruments to achieve environmental objectives.

D.1.4 Impact of reforms on performance in Electricity, Water and Gas

Table 30 presents estimates of the relationship between reforms and the log level of employment in the Electricity, Water and Gas sector, for the 11 EU countries where data is available for the 1986-1998 period. The first column includes the ownership indicators. These have been coded into three variables, all of which are time-varying zero/one dummies. “Ownership: mostly public” is equal to zero in any year when the country reports public ownership (a value of one in the original data), and one if the country reports ownership that is mostly public, mixed, mostly private or private (values two to five). “Ownership: mostly private” and “Ownership: private” are constructed in a similar way. Referring back to Figure 29 above, these three variables are picking up the effects of the three observed changes: Portugal switching from public to mostly public in 1989, the UK switching from public to mostly private in 1989 (captured by the sum of mostly public and mostly private), and the UK switching from mostly private to private in 1995.

The results suggest that all three events were associated with reductions in employment, with the last of the three having the largest effect (this is the marginal effect of a change in the UK from "mostly private" to "private"**)**. The reform in Portugal was associated with a 5.5% reduction in employment, the first UK reform with a reduction of 12.9% and the second UK reform with a reduction of 30%. As emphasised above, the identification of these effects is coming off of single regulatory changes. This means that we should be very careful about using these to infer the likely effects of similar changes in other countries.

Table 30: Electricity, Gas and Water Supply: Employment

Dependent variable: ln (employment)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Ownership: mostly public	-0.055 ** (0.024)						-0.051 ** (0.026)
Ownership: mostly private	-0.074 ** (0.032)						-0.006 (0.047)
Ownership: private	-0.297 ** (0.044)						-0.314 ** (0.048)
Liberalisation		-0.095 ** (0.033)				0.061 (0.045)	0.049 (0.039)
Consumer choice of suppliers			-0.117 ** (0.030)			-0.122 ** (0.043)	-0.123 ** (0.039)
Third party access				-0.059 ** (0.028)		-0.015 (0.024)	-0.015 (0.018)
Wholesale pool					-0.119 ** (0.037)	-0.053 (0.055)	0.016 (0.042)
Observations:	137	137	137	137	137	137	137
Countries:	11	11	11	11	11	11	11
Years:	1986-1998	1986-1998	1986-1998	1986-1998	1986-1998	1986-1998	1986-1998

Note: Numbers in () are robust standard errors. All regressions include country and year dummies.
** indicates significance at 10% level,** indicates significance at 5% level*

In columns (2) to (5) we look separately at the impact of liberalisation, consumer choice of suppliers, third party access and the existence of a wholesale pool. All four enter significantly

and with a negative impact – reforms that open the electricity market up to competition lead to a reduction in employment within the electricity industry.

In column (6) we include all four indicators together. As we saw above, these reforms happened at much the same time, so identifying the impact of each separately is difficult. However, it seems that "Consumer choice of suppliers" dominates as it maintains a significant negative effect once we have conditioned on the other variables. Column (7) brings back the ownership variables. Only the result on "Ownership: mostly private" is significantly changed. Overall, then, the results suggest that the transfer of ownership from public to private, and the introduction of consumer choice of suppliers, are associated with reductions in employment within the electricity industry. The magnitude of these effects is economically significant and in fact quite large (similar to the results found in Alesina at al (2003)). The results in column (7) suggest that moving from public to mostly public ownership (as Portugal did in 1988) was associated with 5.1% reduction in employment, that moving to full private ownership (from mostly private, as the UK did in 1996) was associated with a 31.5% reduction in employment and that the introduction of consumer choice of suppliers was associated on average with a reduction in employment levels of about 12%.

We now consider the effects of regulatory reforms on the level of labour productivity to examine whether reductions in employment have been part of an increase in productive efficiency. Table 31 presents the results for the level of labour productivity, as measured by value added per worker. In column (1) "Ownership: mostly public" has a significant positive effect, as does "Ownership: private". As above these can be interpreted as the effects of specific events in Portugal and the UK respectively. "Consumer choice of suppliers" is the only other variable to have a significant effect, remaining positive in columns (6) and (7) when the other variables are also included. Interestingly, the coefficient on "Consumer choice of suppliers" in columns (6) and (7) is very similar to that in the employment results in Table 30, suggesting that increases in labour productivity were achieved largely through a reduction in the number of employees rather than through an expansion of output. Overall these results accord well with theory: the

movement towards greater competition was associated with an increase in the level of productive efficiency, through labour shedding.

Table 31: Electricity, Gas and Water Supply: level of labour productivity

Dependent variable: ln (value added per worker)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Ownership: mostly public	0.184 **						0.169 **
	(0.041)						(0.041)
Ownership: mostly private	-0.040						-0.08
	(0.051)						(0.085)
Ownership: private	0.309 **						0.311 **
	(0.054)						(0.054)
Liberalisation		0.061				-0.033	-0.011
		(0.045)				(0.040)	(0.031)
Consumer choice of suppliers			0.085 *			0.129 **	0.110 **
			(0.044)			(0.035)	(0.029)
Third party access				0.012		-0.027	-0.027
				(0.034)		(0.033)	(0.025)
Wholesale pool					0.070	-0.001	-0.094
					(0.055)	(0.069)	(0.069)
Observations:	137	137	137	137	137	137	137
Countries:	11	11	11	11	11	11	11
Years:	1986-1998	1986-1998	1986-1998	1986-1998	1986-1998	1986-1998	1986-1998

Note: Numbers in () are robust standard errors. All regressions include country and year dummies.
** indicates significance at 10% level,** indicates significance at 5% level*

Surprisingly, we found no significant results using the *growth* of labour productivity. There are several possible explanations for this. One is that deregulation and the transfer of ownership were associated with one-off changes in the level of productive efficiency, without creating any increase in longer-term dynamic efficiency. Dynamic effects may be particularly important

here.[81] However, our sample period is short and we are probably not able to pick up these latter effects.

Next we consider the relationship between reforms and gross fixed capital formation and the level of TFP. STAN data on gross fixed capital formation in the Electricity, Gas and Water Supply industry (and thus for TFP, which is constructed using an estimated capital stock), has slightly more limited coverage than the output and employment data we have been using so far. In particular it is necessary to drop Portugal from the sample, leaving 110 observations on 10 countries over the 1986-1998 period. This also means that we can not include "Ownership: mostly public" because this was only identified off the one reform in Portugal.

In Table 32 the first column suggests that the shift from public to "mostly private" ownership in the UK was associated with a large (about 30%) increase in the level of gross fixed capital formation. When the other indicators are included on their own in columns (2) to (5) we find no significant results. However, when they are all included in column (6), so that the marginal effect of each conditional on the others can be picked up, all four become significant. Liberalisation and the existence of a wholesale pool appear to have had a positive effect, while consumers' choice of suppliers and third party access appear to have had a negative effect. However, once we also control for ownership changes in the UK in column (7), the result on the existence of a wholesale pool disappears.

These results appear puzzling, but suggest that while liberalisation has been associated with increases in gross fixed capital formation, other pro-competitive changes such as the introduction of consumer choice of suppliers and third party access have been associated with reductions. However, as emphasized above, these are being identified in most cases off of single events and a more thorough investigation would use micro data to look within each country and the impact that these events were having.

---

[81] See, for example, Alesina et al (2003) and Bond and Van Reenen (1999).

Table 32: Electricity, Gas and Water Supply: gross fixed capital formation

Dependent variable: ln (value added per worker)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Ownership: mostly public	-						-
Ownership: mostly private	0.336 ** (0.071)						0.528 ** (0.099)
Ownership: private	-0.092 (0.75)						-0.137 * (0.080)
Liberalisation		0.018 (0.061)				0.378 ** (0.141)	0.386 ** (0.129)
Consumer choice of suppliers			0.003 (0.064)			-0.387 ** (0.106)	-0.419 ** (0.107)
Third party access				-0.084 (0.068)		-0.228 ** (0.105)	-0268 ** (0.099)
Wholesale pool					0.040 (0.071)	0.214 ** (0.090)	0.073 (0.091)
Observations:	110	110	110	110	110	110	110
Countries:	10	10	10	10	10	10	10
Years:	1986-1998	1986-1998	1986-1998	1986-1998	1986-1998	1986-1998	1986-1998

Note: Numbers in () are robust standard errors. All regressions include country and year dummies.
** indicates significance at 10% level,** indicates significance at 5% level*

Table 33 presents the relationship between reforms and the level of TFP. Overall they are very similar to those for the level of labour productivity in Table 31. Column (1) suggests that the shift from mostly private to private ownership in the UK was associated with an increase in the level of TFP.[82] Columns (6) and (7) suggest that the introduction of consumer choice of suppliers has also been associated with a higher level of TFP. As was the case with labour productivity, we did not find any significant results using the *growth* of TFP.

[82] As with gross fixed capital formation, the coefficient on "Ownership: mostly public" cannot be identified because data for Portugal is not available.

Table 33: Electricity, Gas and Water Supply: level of TFP

Dependent variable: ln (value added per worker)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Ownership: mostly public	-						-
Ownership: mostly private	0.000 (0.024)						-0.048 (0.046)
Ownership: private	0.080 ** (0.021)						0.091 ** (0.023)
Liberalisation		0.031 (0.023)				-0.038 (0.042)	-0.033 (0.042)
Consumer choice of suppliers			0.038 (0.024)			0.067 * (0.036)	0..071 * (0.037)
Third party access				0.020 (0.022)		0.002 (0.024)	0.004 (0.024)
Wholesale pool					0.037 (0.027)	0.007 (0.034)	0.009 (0.042)
Observations:	110	110	110	110	110	110	110
Countries:	10	10	10	10	10	10	10
Years:	1986-1998	1986-1998	1986-1998	1986-1998	1986-1998	1986-1998	1986-1998

Note: Numbers in () are robust standard errors. All regressions include country and year dummies.
* indicates significance at 10% level,** indicates significance at 5% level

Finally, we considered the impact that regulatory reforms had on price levels. We have data from Eurostat on electricity prices (in Euros) for industrial and household users over the shorter time period of 1994-2002. The overlap between this data and the OECD data on regulatory changes gives a five year time-period of 1994-1998, with some countries only starting in 1995. The ownership variables do not have sufficient variation over this period to be included. We include these results because of the Commission's specific interest in them, the sample sizes are small.

Tables 34 and 35 show the results of regressing log prices for industrial and household users respectively on the reform indicators, including country and year dummies as before. Third party access has a consistently significant positive effect on prices in both tables, but we should treat

this result with caution since the only observed change in this variable during the short sample period was in Denmark in 1998, at the very end of the period. Once again, this emphasizes the difficulties in interpreting results from small samples where there is only a small amount of differential change across countries.

Table 34: Electricity: prices for industrial users

Dependent variable: ln (prices)	(1)	(2)	(3)	(4)	(5)
Liberalisation	0.069				0.013
	(0.079)				(0.035)
Consumer choice of suppliers		-0.069 *			-0.057
		(0.036)			(0.041)
Third party access			0.177 **		0.152 **
			(0.036)		(0.054)
Wholesale pool				-0.028	-0.025
				(0.050)	(0.051)
Observations:	51	51	51	51	51
Countries:	11	11	11	11	11
Years:	1994-1998	1994-1998	1994-1998	1994-1998	1994-1998

Note: Numbers in () are robust standard errors. All regressions include country and year dummies.
** indicates significance at 10% level,** indicates significance at 5% level*

The only other significant result is in column (2) of Table 34, where consumer choice of suppliers has a negative effect on industrial prices, corresponding to a reduction of about 7%. This is picking up the effect of changes in Germany and Portugal. However, the coefficient becomes insignificant in column (5) once all the other variables are also included. In order to gain a proper understanding of the impact that reforms in this industry has had on prices it would be essential to using more recent and more disaggregated data on electricity prices and on the relevant regulatory reforms.

Table 35: Electricity: prices for household users

Dependent variable: ln (prices)	(1)	(2)	(3)	(4)	(5)
Liberalisation	0.026				-0.015
	(0.039)				(0.013)
Consumer choice of suppliers		-0.022			-0.004
		(0.025)			(0.027)
Third party access			0.074 **		0.088 **
			(0.021)		(0.031)
Wholesale pool				0.028	0.030
				(0.028)	(0.028)
Observations:	50	50	50	50	50
Countries:	11	11	11	11	11
Years:	1994-1998	1994-1998	1994-1998	1994-1998	1994-1998

Note: Numbers in () are robust standard errors. All regressions include country and year dummies.
** indicates significance at 10% level,** indicates significance at 5% level*

D.2 Telecommunications and postal services

We now turn to a consideration of the telecommunications and postal services sectors. Our data for the dependent variables is from the OECD STAN Database for Industrial Analysis and corresponds to the "Post and Telecoms" sector (ISIC 64). Data on regulatory reforms is from the OECD International Regulatory Database which contains time-varying information from 1985 to 1997.

D.2.1 Telecommunications deregulation

Deregulation in the telecommunications industry has a longer history. The first phase of Community policy in this area was initiated in 1984. The most important aspects of this early phase were the development of standards, common research and special development programmes for the least developed regions of the European Union. A second phase of Community policy was initiated in 1987 with the publication of a Green Paper on the development of the common market for telecommunications services and equipment. The

Commission proposed the introduction of more competition in the telecommunications market combined with a higher degree of harmonisation. The Maastricht Treaty and the Treaty on European Union in 1993 extended the legal basis for European integration in the area of telecommunications by means of a Treaty chapter on Trans-European networks.

As of January 1998 telecommunications services were on paper fully liberalized in most EU countries. The Commission presented a draft for a new regulatory framework in July 2000. In 2002, the EU adopted the new regulatory framework for electronic communications. The framework includes five draft Directives and a Regulation that would make up the new regulatory framework for electronic communications infrastructure and associated services. The main trend is towards less detailed ex ante regulation, for operators without market dominance, and more ex post checks. A main reason to propose the framework was to simplify the relevant legislation, bringing the number of Directives from some thirty to just five. The main change in the framework is no longer making a difference between fixed and mobile telephones, but between dominant and non-dominant players.

We have data on liberalisation and privatisation for all countries in our sample, and for three segments of the telecommunications market: basic voice trunk (BVT), referring to domestic long-distance fixed telephony, international long-distance fixed telephony (basic voice international, BVI) and cellular mobile telephony.

To measure the extent of public ownership and privatisation we use data from the OECD International Regulatory Database on the state shareholding in the PTO. Privatisation happened to different degrees across countries and over time. To allow for this, and the possibility that different degrees of privatisation may have differential effects, we use three indicators. The first refers to “partial” privatization and is equal to zero if the state shareholding is 100% and one if the share is less than 100%. The second refers to privatization that enables private “control”, and is equal to one only if the state shareholding is less than 50%. Finally a “full” privatization variable is equal to one only if the state shareholding is zero. Figure 35 shows this data as a step

function, where the three indicators have been added together. It is clear that there is a fair amount of differential variation over time across countries.

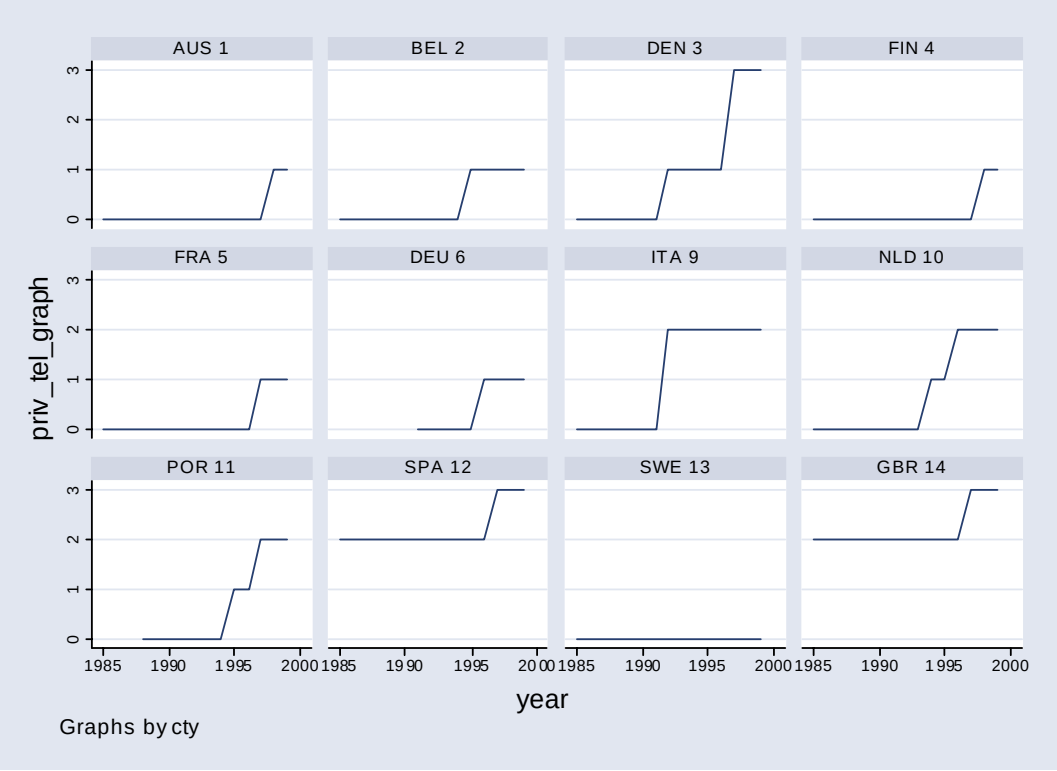


Figure 35: Telecommunications privatisation (0: state share is 100%, 1: state share 50-99%, 2: state share 1-50%, 3: state share is 0). Source: Authors' calculations based on OECD International Regulation Database.

We also have data on the year of liberalization for the three market segments mentioned above. There is little variation between the year of liberalization for the basic voice trunk and basic voice international segments, with only Sweden liberalizing the two in different years. We define a single indicator which is equal to one whenever either segment is liberalized. We treat the liberalization of the mobile segment as a separate variable. These are shown in Figure 36, where we can see that mobile phone liberalization is much more common, happened in different years and happened before basic voice.

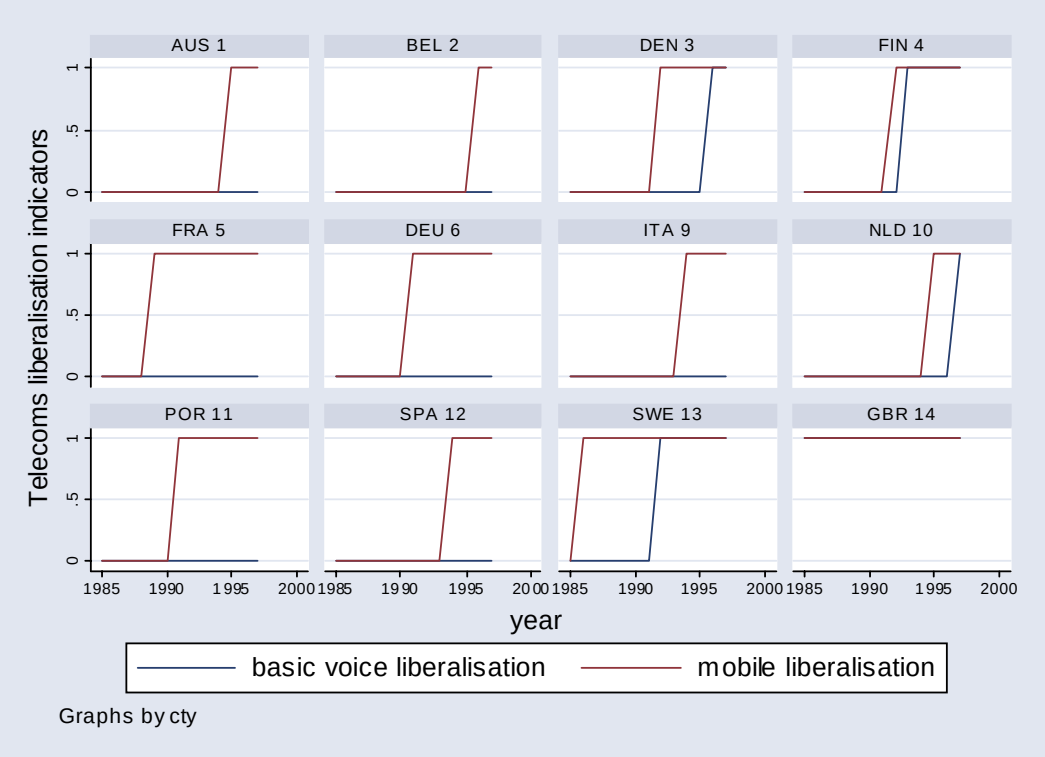


Figure 36: Telecommunications liberalisation indicators.

Source: OECD International Regulation Database.

We also have data on the market share of new entrants in the basic voice and basic voice international segments for the 1984-1998 period. While this data does not represent the exogenous policy environment in the same way as our other data, it does provide some indication of the effectiveness of liberalization in a way that a simple zero/one dummy cannot. Figure 37 shows the liberalisation indicator and the market share of new entrants together.[83] It is clear that market shares begin to rise soon after liberalization, and may provide a better indicator of the extent to which liberalisation has been effective. Again, the market shares of new entrants in the two segments are highly collinear. For this reason we use the market share data for the trunk segment in our econometric analysis, but the results are very similar if we use the international segment, or include both and test for joint significance.

[83] The liberalisation indicator has been rescaled so that it goes to 100 instead of 1 when the industry is liberalised.

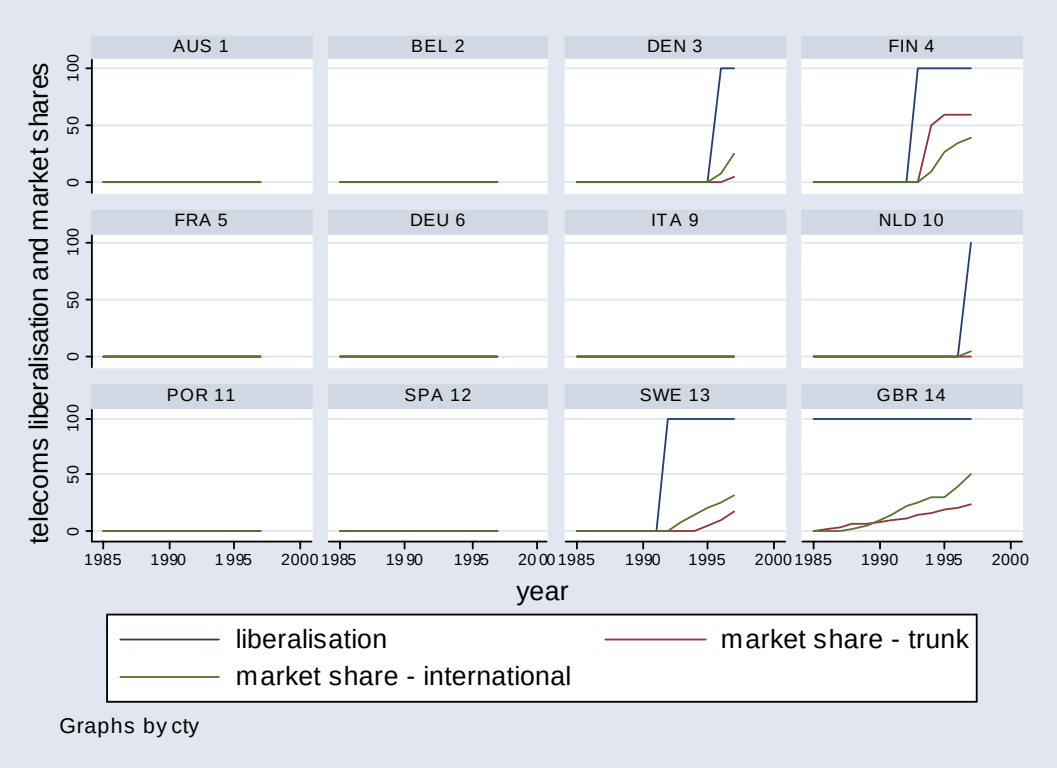


Figure 37: ***Telecommunications liberalisation (basic voice) and market shares of new entrants****.*
Source: OECD International Regulation Database.

D.2.2 Postal services deregulation

The post services are included in the same industry classification as telecommunications. There has been much less deregulation in postal services. The Postal Directive 97/67/EC establishes a clear maximum scope for the reserved area (this is currently 350 grams if less than 5 times 1st class tariff) but *only* to the extent necessary to maintain universal service. There was an obligation on the Member States to implement by February 1999. However, implementation has been uneven across Member States.

In October 2001 15 EU Member States agreed a compromise to lower the reserved area limits and open up more of the postal market to competition by 2006. This will result in between 25% and 40% of the market being open for competition. Cross-Border and direct mail will be completely open for competition from 2003 in most cases. In 2006, the European Commission

will review the impact of gradual liberalization on Universal Service Obligations before any decision on full liberalisation is taken. This could lead to full market opening by 2009.

D.2.3 Impact of reforms on performance in telecommunications and postal services

Table 36 shows the relationship between reforms in telecommunications and employment for 12 countries over the 1985-1997 period. We do not include the "Privatisation: full" dummy because full privatization only ever occurs in 1997 which is the last year in our sample (see Figure 37). There is a significant negative effect of partial privatization on employment (about a 4% reduction) in column (1), but this becomes insignificant in column (2) once we include the indicator for "control" privatization, which is also insignificant. These results suggest that there is a significant reduction in employment when we compare any privatisation at all to no privatisation in column (1), but that we do not detect a significant reduction in employment associated with either the shift from no privatisation to partial privatisation, or from partial privatisation to "control" privatisation in column (2). However, the hypothesis that the sum of the two coefficients in column (2) is equal to zero is rejected at the 5% level, indicating that "control" privatisation is associated with a significantly lower level of employment when compared to no privatisation.[84]

[84] This is not true when we impose a more restrictive functional form, e.g. imposing that the impact of partial is the same as control (which is what we do if we put in a variable that equals 1 for partial and 2 for control), or if we include a single dummy indicating either one.

Table 36: Telecommunications and postal, Employment

Dependent variable: ln (employment)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Privatisation: partial	-0.041 *	-0.036		-0.041			-0.053 *
	(0.021)	(0.024)		(0.026)			(0.027)
Privatisation: control		-0.013		-0.002			-0.013
		(0.027)		(0.029)			(0.028)
Liberalisation (basic voice)			-0.042	-0.047 *		-0.012	0.000
			(0.027)	(0.029)		(0.033)	(0.039)
Liberalisation (mobile)			-0.018	-0.013		-0.024	-0.019
			(0.017)	(0.018)		(0.017)	(0.018)
Market share of new entrants (trunk)					-0.001 **	-0.001 **	-0.002 **
					(0.000)	(0.000)	(0.001)
Test that sum of privatisation coefficients is equal to zero (p-value)		3.99 **		2.49			5.48 **
		(0.048)		(0.117)			(0.021)
Observations:	138	138	138	138	138	138	138
Countries:	12	12	12	12	12	12	12
Years:	1985-1997	1985-1997	1985-1997	1985-1997	1985-1997	1985-1997	1985-1997

Note: Numbers in () are robust standard errors. All regressions include country and year dummies.
** indicates significance at 10% level,** indicates significance at 5% level*

In column (3) we see that the indicators for basic voice and mobile liberalisation on their own are not significant, although they are jointly significant at the 10% level. In column (4) where we include both privatisation and liberalisation indicators we see that basic voice liberalisation becomes negative and significant at the 10% level.[85] In column (5) we include a measure of the market share of new entrants. This is significant and negative – more competition, as captured by the increase in the market share of entrants, is associated with a reduction in employment. This result holds in columns (6) and (7) as we include the other indicators. However, the coefficient on basic voice liberalisation is significantly reduced when the market share variable is included -

[85] The coefficient is not very different from column (3) but has increased sufficiently to change from just not significant to just significant.

compare column (4) to column (7). These results suggest that liberalisation is important, but only to the extent that it actually leads to entry of new competitors. This accords well with theoretical and empirical results in the literature, as discussed earlier. Finally, the coefficient on partial privatisation is once again negative and significant in column (7) where we are controlling for aspects of liberalisation – compare column (7) to column (4).

Table 37 shows the relationship between regulatory reforms and the level of labour productivity in telecommunications and postal services. We see here that both liberalization and entry have a consistently positive impact. In particular, liberalization of the mobile phone sector has led to increases of about 9% on average in the level of labour productivity. None of the other variables is ever significant.

As was the case in the Electricity, Gas and Water Supply results, we found no significant results using the *growth* of labour productivity. As before, this indicates either that the main effects have been one-off changes in productive efficiency, or that our sample period is too short to pick up any impact on dynamic efficiency.

Table 37: Telecoms, level of labour productivity

Dependent variable: ln (value added per worker)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Privatisation: partial	0.003	-0.018		-0.021			-0.003
	(0.038)	(0.047)		(0.050)			(0.051)
Privatisation: control		0.064		0.049			0.067
		(0.052)		(0.055)			(0.057)
Liberalisation (basic voice)			0.033	0.025		-0.029	-0.048
			(0.039)	(0.041)		(0.048)	(0.062)
Liberalisation (mobile)			0.081 **	0.081 **		0.092 **	0.090 **
			(0.033)	(0.033)		(0.033)	(0.033)
Market share of new entrants (trunk)					0.002 **	0.003 **	0.003 **
					(0.001)	(0.001)	(0.001)
Test that sum of privatisation coefficients is equal to zero (p-value)		1.36		0.40			2.03
		(0.245)		(0.528)			(0.158)
Observations:	138	138	138	138	138	138	138
Countries:	12	12	12	12	12	12	12
Years:	1985-1997	1985-1997	1985-1997	1985-1997	1985-1997	1985-1997	1985-1997

Note: Numbers in () are robust standard errors. All regressions include country and year dummies.
** indicates significance at 10% level,** indicates significance at 5% level*

Unfortunately sample sizes are too small to allow us to look at the correlation between regulatory reforms and fixed capital formation, TFP or prices; data on gross fixed capital formation in the Post and Telecommunications sector has poor coverage across countries, and data on prices are only available from Eurostat for the 1997-2002 period, leaving only one year where we have both regulation and price data.