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Economic Growth and Productivity

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I. Introduction

Let me start by thanking you for inviting me to address such a distinguished audience. On what is definitely a burning issue here in the UK. A country that has implemented far-reaching reforms over the last decades and would like the expected pay-off, in terms of productivity, to finally materialise.

By contrast, reforms have visibly paid off in boosting labour utilisation. And indeed labour deepening has been the main driving factor behind the impressive catch-up in UK GDP per capita during the past two decades.

However, I will barely touch on this latter issue today. Instead, I will focus on the determinants of productivity. And here I am confronted with one major and one lesser challenge. The major one lies with the UK productivity paradox. Why on earth isn't UK productivity catching-up faster, given economic theory, good UK policies and comparatively low productivity levels to start with? (**Figure 1**)

To be frank, on this basis alone, I would have shied away from this Inaugural Address. But fortunately, Nick Stern eased my pain with a gentler assignment: economic growth and productivity OECD wide.

I will proceed in two steps:

- First build on our research to discuss what we at the OECD think we have learned about the policy drivers of productivity growth. This is sort of the easy part.
- Second discuss whether there is a UK productivity puzzle, and if so what its causes might be. This is the daunting part.

II. Understanding the policy drivers of productivity

Before taking you through the wealth of empirical expertise accumulated by the OECD over the past few years, let me tell you where we stand in terms of theoretical framework when it comes to thinking about growth.

Our perspective is one of conditional convergence, where policies and institutions are very important growth and productivity drivers. Growth is certainly endogenous, human capital and ideas matter but agents operate in a constant-returns-to-scale world. Discrete policy changes can generate large level shifts in economic activity but no permanent change in trend growth.

In a sense we are applying a precautionary principle. We want policy makers to know they are influencing long-term economic performance. But we do not want to instil complacency and mislead macroeconomic and fiscal policy makers into believing that growth can bail them out.

In certain areas, such as the impact of R&D spending, our empirical results could be construed as being compatible with increasing returns. But we refrain from making this risky bet. In any case, and from a practical perspective, very good policies can boost growth for a substantial number of years even in a conditional convergence framework.

II.1 The role of structural factors

We think we have learned a good deal about policy channels through the various empirical analyses we have carried out in recent years. One of these lessons is that so-called framework conditions matter. This is true of structural factors. For example, OECD research finds that low and stable inflation, developed financial markets, a low tax burden and a low share of distortionary taxes increase the steady-state level of GDP per capita through three channels (**Figure 2**):[1]

- First, an investment channel. Indeed, several of the macro variables I have just listed enter significantly the investment regressions we estimated within the context of the OECD *Growth Study* a few years ago.

- Second, a R&D channel. OECD research finds that the size and quality of financial markets and the user cost of R&D capital –which combines interest rates and taxes– are significant determinants of R&D spending. This is an important channel because growth regressions point to large effects of business R&D spending on productivity.

- Third, and finally, economy-wide factors affect GDP through an efficiency channel. That is, even after controlling for physical and R&D capital, several additional macro variables –such as the tax burden, the share of distortionary taxes, the volatility of inflation or the size of financial markets– remain highly significant in panel data growth regressions.

Short-term macroeconomic developments may also have persistent effects on growth. This idea has been suggested in a recent paper by Aghion, Barro and Marinescu.[2] After controlling for the usual determinants of growth, they found a significant positive impact for counter-cyclical fiscal policies. Furthermore, this impact is greater the less developed financial markets are.

One interpretation[3] is that counter-cyclical fiscal policy can help reduce macroeconomic volatility and its potentially negative impact on innovation. Volatility matters because innovation is a process that requires continuous efforts and where the cost of interrupting research may be very large.

As a result, macroeconomic volatility reduces the propensity of firms to innovate. This is especially the case when credit constraints on innovative firms are tight, for instance in bad times when firms can not easily borrow to keep financing their R&D investments.

In this respect, there is a striking difference between, on the one hand, the euro area and, on the other hand, Nordic and English-speaking countries, including the UK. Discretionary fiscal policy has been counter-cyclical in Nordic and

English-speaking countries over the past two decades, as one would expect. But it has been disappointingly pro-cyclical on average in euro area countries (**Figure 3**).

II.2 Public infrastructure

I referred to the detrimental effects of government size and distortionary taxes on productivity growth. Maybe I should have mentioned *en passant* that this is not inconsistent with the traditional view that infrastructure investment is good for growth. OECD empirical research suggests that controlling for the level and structure of taxes, public investment has a significant impact on activity. Here I am referring again to our panel data growth regressions.[4]

II.3 Product market regulation and labour market institutions

Another key framework condition is the degree of competition in product markets. Visible progress has been made in reducing barriers to competition in most areas of regulation, but there remain significant differences in product market regulation across OECD countries (**Figure 4**).

According to our so-called PMR indicators, the UK has the most liberal regime across the OECD. English-speaking countries in general, as well as a number of small European countries –in particular Nordic ones– also have fairly competitive product markets. By contrast, there remains much room for progress in large euro area countries, not least in services sectors.

Product market competition is expected to stimulate productivity through a variety of channels. It should first increase static efficiency, through both a better allocation of resources and greater efforts on the part of managers to reduce so-called "X-inefficiency" at the firm level. More competition should also yield dynamic efficiency gains, *via* greater dissemination of best practice and maybe sharper incentives to innovate at the technological frontier.

Unsurprisingly, OECD empirical work suggests indeed that strict product market regulation has detrimental effects. Concretely, we have two main pieces of evidence, one about productivity growth and the other about innovation. First, there is evidence that product market regulation undermines productivity growth at the industry-level. It appears, in addition, that product market regulation is bad for innovation.

Regarding evidence at the industry level, OECD panel data estimates show that regulatory barriers slow the catch-up process towards the productivity frontier.[5] Interestingly, the detrimental effect of product market regulation on the speed of catch-up appears to be greater in those industries that are heavy users of ICT.

This may actually help explain an apparent paradox. Namely that despite cross-country convergence in product market regulation, productivity trends have diverged in recent years. If indeed lightly regulated countries incorporate best production techniques more quickly than others, then productivity may diverge in times of rapid technological change.

In other words, the opportunity cost of regulatory barriers may have increased with the emergence of such a pervasive technology as ICT. This view receives additional support at the aggregate level, where there seems to be a negative cross-country correlation between product market regulation and the change in average MFP growth between the 1980s and the 1990s (**Figure 5**). This is bad news for Europe, and, in particular, for large euro area countries.

The analytical link between deregulated markets and productivity catch-up is fairly intuitive. What is less settled in theory is what happens at the technological frontier with open product markets. Do they boost innovation and technology or not?

Here, neo-Schumpeterian growth theories point to two opposite effects of competition on firms' incentives to innovate:[6]

- On the one hand, an "appropriability" effect, by which stronger product market competition reduces productivity growth by reducing the post-innovation rents that reward a successful inventor.

- And, on the other hand, a counteracting "escape competition" effect, by which stronger product market competition increases incentives for firms to innovate in order to outpace competition.

Now looking at the evidence on the determinants of innovation, we found negative effects of product market regulation on business R&D intensity and subsequent patenting.[7] This in turn hints at negative effects on productivity *via* the innovation channel.

Taking a step back, I am not sure that the debate around the optimal degree of market openness is well framed. From the outset, the notion that some impediments to product market competition may help reward successful inventors looks sub-optimal. Product market regulation is actually poorly designed to reward innovators, because it does not only provide *ex-post* but also *ex-ante* rents.

Strict protection of intellectual property rights is arguably a better instrument, as it targets only post-innovation rents. In practice, it seems that countries typically jointly optimise the use of these two instruments. Those that have liberal product market regulation also have strict protection of intellectual property rights (**Figure 6**).

This combination of strong intellectual property rights and liberal product market regulation is visible in top innovative countries such as the US or the Nordics. It is therefore no surprise that our empirical research on innovation also finds support for this choice of policy instruments.

We obtain strong positive effects of intellectual property rights on patenting, while light product market regulation is found to increase R&D spending. Note that the UK has also opted for a combination of relatively high levels of protection of intellectual property rights and strong product market competition. But let me come back to this later.

There remains a major open question, however, regarding the optimal degree of protection of intellectual property rights. Up to now, the trend towards greater protection seems by and large to have been beneficial.

However, the degree of protection now reached in some OECD countries such as the US looks very high. So high in fact that strengthening it further could be counterproductive, reducing the benefits of enhanced product market competition. Indeed evidence suggests that it could lead to more patenting, but with little if any boost to R&D expenditure, possibly implying that patents may be used as entry barriers.

II.4 Labour market regulation

Labour market regulation matters too for innovation and productivity. And, in particular, the stringency of employment protection legislation (EPL). This is perhaps a more complex issue than meets the eye (**Figure 7**).

On the one hand, EPL raises the cost of adjusting the workforce. This may discourage major innovations, that typically require work-place reorganisation and substantial changes in the composition of the workforce. Also, EPL increases workers' bargaining power, with the risk of weakening innovation rents.

On the other hand, strict EPL increases job tenure. Firms can then gain from training their workers. All the more so if wage bargaining is highly coordinated across firms.

Highly coordinated wage bargaining tends to compress the wage distribution. It also creates tacit codes that limit poaching from other employers, making it less risky for firms to train workers.

To put it in a nutshell and from a theoretical perspective, we can expect strict EPL to weaken the emergence and adoption of major innovations, but to facilitate incremental innovations that require specialist knowledge and occupation-specific experience.

So what do we find in practice? Using micro data from the European Innovation Survey, we find that product innovation is negatively related to the stringency of EPL.[8] Using cross-country time-series data, we find no effect of EPL on R&D spending but a clear negative impact on patenting.[9]

This result is interesting because patenting provides an indication of the "quality" of research. In this regard, major technological innovations are precisely those that are worth patenting.

Finally, using sectoral data, we find that strict EPL reduces R&D spending in high-tech, low-concentration sectors such as software. By contrast, strict EPL, when combined with highly coordinated wage bargaining, appears to stimulate R&D spending in industries with strong but incremental innovation, such as aircrafts.[10]

Overall, these findings are therefore consistent with the view that strict EPL primarily discourages major technological innovations. At times when general purpose technologies such as ICT emerge, this is likely to be detrimental to overall productivity performance.

This may contribute to explaining why the English-speaking countries and – to a lesser extent– the Nordic countries have so far reaped greater benefits from ICT than most continental European countries, where employment protection legislation is stricter (**Figure 8**).

II.5 Human capital

Let me close this discussion of framework conditions with a few words on human capital. Despite strong theoretical underpinnings, the effects of human capital accumulation on growth have often been hard to identify in practice.[11] But using proper data and more recent econometric techniques, the *OECD Growth Study* brought to light large and significant effects.

A one-year increase in the average number of years of education, across the working-age population, appears to raise GDP per capita by 4 to 7 percentage points in the long run. Such estimates may even point to sizeable externalities from investment in human capital.

Now do these high social returns imply that public spending on education should be raised further in most OECD countries? Not necessarily, at least regarding higher education. Private returns to tertiary education are already very high in most OECD countries, much higher in general than real interest rates.

For example, a 2002 OECD study found private rates of return to tertiary education ranging from about 6-7% in Japan and Sweden to 15-16% in the UK and the US. The average return across 10 OECD countries exceeded 11%.[12]

These high returns reflect not only sizeable wage premia but also heavy public support by governments. Therefore private incentives are already there.

Rather, we advocate a shift towards more private funding of tertiary education in those countries where overall spending is currently low.

More private funding would improve quality –and equity– without significantly hampering private incentives. The low spenders I am referring to include the UK and most other EU countries, with the exception of a few Nordics. From this perspective, the introduction of a graduate contribution scheme in the UK is certainly welcome.

II.6 Specific policies

Human resources for science and technology and public spending on R&D

Tertiary education policies affect the availability of human resources for science and technology. Skilled researchers play a dual role in the innovation process, helping in the emergence of new inventions as well as maximising the benefits that can be obtained from existing knowledge.

OECD research on innovation indeed suggests that large numbers of available scientists and engineers help raise the national capacity to absorb foreign knowledge. More specifically, our research finds that the stock of foreign R&D has positive spillovers on domestic R&D, all the more so as the share of scientists in employment is high.[13]

Such estimates may to some extent suffer from endogeneity problems. But they are further supported by micro evidence obtained from the European Innovation Survey.[14] It shows that the proportion of firms which are successful innovators is negatively correlated across countries and sectors with the proportion of firms who report a lack of qualified personnel.

Against this backdrop, measures to raise the availability of human resources for science and technology could be effective in stimulating innovation. The same holds for expanding activities in public research organisations. Higher public R&D is found to boost innovation *via* two channels. A direct channel, as reflected in higher patenting. And an indirect channel, through spillover effects on business sector R&D.

Still, governments should be careful in raising expenditures. We estimate that the supply of skilled researchers is fairly inelastic in the short run. As a result, large increases in public spending would essentially push up wages without having much of an impact on innovation. The bottom line is that any efforts to increase public spending on R&D and the supply of human resources for science and technology need to be spread out in time.

Other science policies

Other science policies can affect innovation. I am thinking in particular about fiscal incentives for R&D. All OECD countries provide such fiscal incentives, either through direct government funding of private R&D or through tax incentives (**Figure 9**).

Both instruments have pros and cons. In a nutshell, direct funding allows better targeting. It is also more effective to support young firms with little taxable income and tight credit constraints. But tax incentives leave allocation decisions to the market and they are less prone to capture. However, tax incentives increase the possibility that research efforts will be duplicated unnecessarily.

OECD research finds that tax relief is usually more effective than direct funding in boosting R&D spending and patenting. Direct subsidies appear to have small positive effects only when profits are low. In such situations, the availability of funding from the government might indeed help alleviate credit constraints.

So empirical analysis provides some support for the use of fiscal incentives to stimulate innovation. It also tends to support a change in the mix of public funding for private R&D, with reduced use of grants and a more extensive use of tax incentives. This is actually what most OECD countries have done in recent years. Partly as a result of the reduction in direct funding of defence-related research.

Before I close this discussion of science policies, I should mention one caveat. I have implicitly assumed that any increase in R&D spending is good for innovation, productivity and growth. Based on this partial equilibrium analysis, any public intervention that stimulates R&D spending would seem to be commendable. This is to some extent supported by the high social returns found in growth regressions.

Still, it is fair to say that externalities are very difficult to quantify in practice. And unlike good framework policies, science policies induce deadweight losses. At some point, these deadweight losses could well more than offset positive externalities.

This question needs to be borne in mind when making practical policy recommendations. For instance, it is unclear whether public subsidies to R&D should be raised further in the US, where they are already quite high.

III. Is there a UK productivity puzzle and what do we know about it?

So far I have tried to draw policy lessons from applied research on the determinants of productivity growth. Let me now turn to the second and most challenging part of my intervention. That is, use this knowledge to discuss the UK's recent productivity growth performance.

As underscored upfront, UK labour productivity *levels* look rather low relative to the best performing economies (**Figure 1**). This should imply higher productivity *growth* in the UK, at least if one believes in some version of economic convergence. And this is indeed what is happening. Since the early 1990s, average labour productivity growth has been higher in the UK than in the US and the EU (**Figure 10**).

Likewise, multi-factor productivity growth has also been somewhat higher in the UK than elsewhere (**Figure 11**).[15] Seen from this perspective, there does not seem to be any UK "productivity puzzle".

But the recent UK productivity performance may still be seen as rather disappointing from at least two perspectives:

- First, productivity growth has not picked up over the past two decades (**Figures 10 and 11**). By contrast, a number of OECD countries have experienced a significant productivity acceleration in the second half of the 1990s. These include not only the US but also Australia, Canada, Finland or Ireland.

- Second, assuming recent productivity growth rates were maintained, the UK would be catching up rather slowly to the higher productivity levels found in the US and the most productive EU economies. Given the wide range of structural reforms undertaken over the past two decades, most of us would certainly have bet on a more rapid catch-up.

Indeed, many of the key framework conditions are definitely in place. Monetary policy has achieved low and stable inflation, owing to credible inflation targeting and the independence of the Bank of England. Public finances are in a sounder position than in other large EU countries and the US, although the fiscal position has deteriorated in recent years.

Also, fiscal policy has been clearly counter-cyclical, thereby contributing to dampen economic fluctuations. Partly as a result of sound monetary and to a lesser extent fiscal policies, macroeconomic volatility has been reduced dramatically. Over the past decade, the standard deviation of OECD output gap estimates has been lower in the UK than in any other OECD country, while it was quite high previously (**Figure 12**).

Likewise, the UK has the most liberal regulation of product markets across the OECD area. It combines this with strong protection of intellectual property rights, which in theory should be the best possible combination for innovation. Furthermore, it also has fairly unrestrictive employment protection legislation. This should facilitate major innovations and speed up the adoption of new technologies.

The UK also has first-class financial markets, although these may remain too fragmented when it comes to specialised areas such as venture capital. Finally, it is a very open economy. In particular, it has the least stringent restrictions to inward FDI across the OECD (**Figure 13**) and it tops the OECD's worldwide list of FDI recipients.

So what may account for the somewhat disappointing productivity performance of the past decade? At least four hypotheses can put forward:

- First, an explanation emphasising the existence of lags
- Second, an ICT-based story
- Third, measurement issues
- And fourth, an innovation problem

Let me discuss these four hypotheses in turn.

The existence of lags

First, the existence of lags. It may well take more time than we usually think for structural reforms to pay off. For instance, the US may have reaped only in the second half of the 1990s the benefits of the reforms undertaken in the early 1980s. I do not have much to offer on this story.

But let me just point to one puzzle, which makes me somewhat sceptical: if anything, most of the key reforms –in particular in product markets– have been undertaken earlier in the UK than in Australia, Canada, Finland or Ireland. Yet, unlike the UK, this group of countries has experienced significant productivity acceleration in the second half of the 1990s.

ICT stories

This brings me to the second possible explanation, the ICT story. One common feature of most countries I have just mentioned is that **they are ICT producers**. Just like the US, but unlike the UK.

It is by now well-known that multifactor productivity growth within the ICT sector itself contributed to a large extent to the productivity pick-up of the second half of the 1990s. Not only in the US[16] but also in others like Finland for instance, with the "Nokia" effect. So there is some truth to that story.

However, it suffers from two important limitations. First, it does not explain why the UK is not an ICT producer in the first place, despite its outstanding framework conditions. Second, recent research by Dale Jorgenson and his co-authors shows that ICT production does not account for the second productivity surge that took place in the US following the turn of the century.[17]

While ICT production played a big part in the first productivity surge of the mid-1990s, the most recent one is mainly explained by an acceleration of multifactor productivity in ICT-using sectors.

It is of course too early to tell whether this second productivity surge will be long-lasting. It could reflect the delayed impact of ICT via learning-by-doing effects, or the role of ICT as a general purpose technology.

If it is not an ICT-producing story, could it then be an **ICT-using explanation**? At first glance, this would seem hard to believe. The UK has been heavily investing in ICT throughout the 1990s, not much less than the US actually (**Figure 14**). So *a priori* any spillovers from ICT that have materialised in the US could also be visible in the UK.

However, we know by now that a sizeable portion of the US productivity surge stems from multifactor productivity acceleration in the wholesale and retail sectors. Using industry-level data, Bosworth and Triplett show that retail and wholesale explain more than two-thirds of the MFP growth acceleration of the second half of the 1990s.[18] By comparison, productivity growth in retail has been twice as small in the UK as in the US over the past few years, despite similar ICT take-up.

To be sure, there is arguably more space in the US than there is in the UK for Wall-Mart operations. Still, there is also a presumption that **strict zoning laws** are impairing the good functioning of the UK retail sector. Tight zoning laws may be restricting the ability of retail outlets to enter markets and operate on an efficient scale.

Another explanation for the disappointing productivity performance in ICT-using sectors has been put forward by two economists at the Bank of England.[19] Their basic premise is that ICT investment needs to be accompanied by **organisational change**. This in turn requires investment in human capital in the form of retraining.

Insofar as such **complementary investments are not captured** in the national accounts, conventionally *measured* multifactor productivity growth typically slows down in the short run. Therefore, periods of heavy investment in ICT should be associated with a MFP slowdown.

This story seems consistent with the UK experience of the second half of the 1990s. However, it is not consistent with the US experience, where heavy investment in ICT in the late 1990s was actually associated with a productivity acceleration and was even followed by another productivity spurt in the early 2000s (**Figures 11 and 14**).

So if the US is an appropriate benchmark, productivity growth should have by now started to edge up in the UK. The fact that it did not therefore weakens the argument. Hence, I am more convinced by the sectoral story which emphasises insufficient productivity growth in wholesale and retail trade.

Measurement issues

The discussion of unmeasured investments in human capital brings me to the third possible explanation for UK productivity growth performance, which has to do with measurement. We are all aware of the sizeable confidence intervals that surround any output and productivity growth estimates.

Let me just mention a few specific **issues** that hint at some possible **under-estimation** of recent UK productivity growth:

- It is striking that the UK is one of the few OECD countries where **net national income (NNI)** has been growing significantly faster than GDP over the past decade **(Figure 15)**. The average gap between annual NNI and GDP growth rates exceeded 3 tenths of a percentage point over the period 1994-2003.

This mainly reflects not only an increase in net investment income but also a favourable terms-of-trade effect. And in turn, the favourable terms-of-trade effect is to some extent the beneficial counterpart to not being an ICT producer and being specialised in services instead.

- Another issue relates to **productivity measurement of government non-market activity**. Many OECD countries still use the convention of government output being equal to inputs. A few have started to incorporate direct measures, with the UK being an international leader in this area.

Such methodological efforts are most commendable, but as it turns out they have had an unfortunate characteristic: they have resulted in ***negative*** **public service productivity growth**. To be sure, improved measures of outputs and inputs are gradually being introduced as a result of the Atkinson Report.

But so far, even on the improved metrics, public service productivity is still declining. This to some extent reflects a "real" phenomenon, namely that the rapid increase in public sector resources in recent years had a less than proportional impact on outcomes, at least up to now.

Still, it remains true that aggregate labour productivity growth would be one or two tenths of a percentage point higher if public sector output were measured by reference to inputs, as is still the case in most OECD countries.

- **Banking and finance** is another sector where output is **hard to measure**. Quality improvements are difficult to capture, and as a result productivity growth is typically under-estimated. This is clearly an important issue, as shown by the recent upward revision of value added growth in banking and insurance. The revision was in fact so large that it had noticeable effects on measured GDP growth in National Accounts over the period 2003-2005.[20]

More broadly, it may **not** be **a coincidence** that the productivity growth differential between the US and the UK is mainly in **large hard-to-measure sectors**, such as finance, retail and wholesale trade.

The problems I have just mentioned fall readily into the category of measurement issues. But I would also like to emphasise another, *quasi* measurement issue. A consistent pattern across the OECD is that high productivity levels are typically associated with low labour utilisation, and vice versa.

As **Figure 16** shows, there is a negative cross-country correlation between the overall employment rate and GDP per hour worked. What seems to be happening is that low-employment rate countries exclude low-skilled, low-productivity workers from the labour market. This results in a "spurious" boost to average productivity.[21] Conversely, "structural" productivity levels may be under-estimated in high-employment countries such as the UK.

What seems true in level terms is probably also true in growth terms. Insofar as changes in the quality of labour input are not fully accounted for, **labour**

deepening achieved by reincorporating low-skilled workers into the labour force should **reduce *measured* productivity** growth.

This is particularly relevant for the UK because of the large increase in labour utilisation achieved since the first half of the 1990s. It may be no coincidence that New Zealand has also experienced a combination of deep structural reforms, significant labour deepening and somewhat disappointing productivity performance over the same period.

An innovation problem?

Let me now turn to the fourth possible explanation for UK productivity growth performance, which is an innovation story. This is a complex issue, over which there are differing views even among the OECD Economics Department staff. In particular, while our cross-country analysis points to an innovation problem, our country experts are much less convinced. So I will try to bring arguments from both groups into the debate.

By most standards, UK innovation performance looks rather poor (**Figure 17**).[22] Focusing in particular on innovation output measures, the intensity of patenting is strikingly low. The UK ranks 12th out of 20 in terms of triadic patents, *i.e.* those patents of universal coverage which are the most costly to get but also the most rewarding.

This is below the US, Japan and Scandinavian countries, but also below France and Germany. In a similar vein, the most recent Community Innovation Survey puts the share of innovative firms in the UK at a low 20%. This is again lower than in France and Germany, not to mention Scandinavian countries. And the UK had the lowest proportion of "true" product innovators of any of the 16 countries surveyed.

However, these figures may to some extent understate actual innovation performance in the UK. The UK has a low share of firms applying for a patent, but it has the highest proportion of firms using *some* form of protection across the EU.[23] A large number of firms use other forms of protection than patents, including trademarks, copyrights or secrecy.

This is consistent with the UK being mainly a services economy, for which patents may be less relevant for protecting innovations. For example, creative industries such as fashion, leisure software, movies, books and music are flourishing in the UK. This might be labelled the "Harry Potter" effect. But while commercial exploitation of new ideas is an integral part of such creative activities, it is typically not reflected in conventional measures of innovation.

More broadly, the UK innovation picture is partly distorted by industry-mix effects. The UK is heavily represented in services, where as noted earlier *measured* innovation is low. Also, when compared with other European countries such as Germany, aggregate R&D intensity in manufacturing is lower in the UK largely because industry composition is skewed towards industries where R&D intensity is lower.

This would still be worrying if it reflected UK specialisation in low-technology manufactures, but this is actually not the case. The UK has a sizeable share of high-tech manufacturing, not far below that of leading OECD countries. It is poorly represented mainly in medium-high-technology manufactures such as motor vehicles, where R&D spending happens to be pretty high.

But one may wonder whether the UK would really gain in being specialised in such industries, some of which are facing severe overcapacity problems.

Still, these caveats are not the whole story. Industry-mix effects do not contribute at all to the innovation gap with the US. And even within the services sector, innovation performance is significantly better in the US.

It thus seems overall that the UK innovation performance remains somewhat disappointing. Especially if one considers that overall framework conditions, which are most crucial for innovation, are actually very supportive in the UK.

According to our empirical analysis of R&D determinants, the problem, if any, would lie in science policies. While framework conditions are among the most supportive across the OECD, science policies appear to drag down R&D intensity with respect to the OECD average (**Figure 18**).

As we have seen earlier (**Figure 9**), fiscal incentives to private R&D are average, with nonetheless high tax incentives. Also, tax incentives have been introduced only recently –in 2000. So it might take time for them to pay off.

But the biggest drag on innovation is found to be the insufficient capacity to absorb foreign knowledge. This is captured in our empirical work on R&D determinants by the positive interaction between the stock of foreign R&D and the proportion of researchers in employment. The proportion of researchers in employment is indeed much lower in the UK than in the US, Japan, Finland or Sweden. The UK benefits from strong FDI but its impact on local R&D could be blunted by lack of scientists.

However, it is far from obvious to control for endogeneity in such estimates. In theory, the low availability of trained researchers could reflect a lack of job opportunities in R&D activities and greater opportunities elsewhere, not least in finance. And in practice, the UK ranks pretty well in international comparison as regards the number of graduates in science, engineering and technology.

This suggests that the *potential* supply of researchers significantly outstrips the *actual* number of researchers (**Figure 19**). Many science graduates are simply more attracted by the big bonuses they can get in the City. And by the way, les nôtres aussi. Whether this is bad for growth and incomes is thus far from obvious, even in a long-term perspective.

Nevertheless, it is also a fact that employers regularly report shortages in R&D and engineering jobs. Larger numbers of graduates in science and engineering would thus improve the ability of the UK to both foster and adopt innovations. The incoming increases in tuition fees may help in this respect. They should lead to an improvement in both the quality and the attractiveness of post-compulsory education in general, and scientific courses in particular.

But making and adopting innovation requires broader human resources. Not only in terms of researchers, but also in terms of a skilled workforce capable of implementing the needed organisational changes.

In this respect, perhaps the major weakness in the UK is the very high share of the workforce having little or no formal qualifications beyond compulsory schooling: 30% of the 25-34 year-olds are low-skilled, a considerably larger share than in most other OECD countries (**Figure 20**).

And many adults lack the most basic literacy skills. There is therefore a clear need to expand education and training at the intermediate level. In this regard, it may take some time before the ongoing efforts to improve education pay off.

On this note, let me open the floor to questions and comments.

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[1] See OECD (2004), *The Sources of Economic Growth in OECD Countries*; Jaumotte F. and N. Pain (2005a), "From Ideas to Development: The Determinants of R&D and Patenting", *OECD Economics Department Working Paper* No.457.
[2] Aghion P., R. Barro and I. Marinescu (2005), "Productivity Growth and Counter-Cyclical Budgetary Policy", *mimeo,* Harvard.
[3] See Aghion P., A. Angeletos, A. Banerjee and K. Manova (2005), "Volatility and Growth: Credit Constraints and Productivity-Enhancing Investment", *mimeo,* Harvard-MIT.
[4] See OECD (2004), *op.cit*.
[5] See Conway P., D. De Rosa, G. Nicoletti and F. Steiner (2006), "Regulation, Competition and Productivity Convergence", *OECD Economics Department Working Paper,* forthcoming.
[6] See for instance Aghion P. and P. Howitt (2005), "Appropriate Growth Policy: A Unifying Framework", Joseph Schumpeter Lecture, 20th Annual Congress of the European Economic Association, Amsterdam. These two offsetting effects could also result in an inverted U-relationship between competition and innovation. See Aghion P., N. Bloom, R. Blundell, R. Griffith and P. Howitt (2005), "Competition and Innovation: an Inverted U-Relationship", *Quarterly Journal of Economics,* May.
[7] See Jaumotte and Pain (2005a), *op.cit*; Jaumotte F. and N. Pain (2005b), "Innovation in the Business Sector", *OECD Economics Department Working Paper* No.459.
[8] See Jaumotte F. and N. Pain (2005c), "From Innovation Development to Implementation: Evidence from the Community Innovation Survey", *OECD Economics Department Working Paper* No.458.
[9] See Jaumotte and Pain (2005a), *op.cit*.
[10] See Bassanini A. and E. Ernst (2002), "Labour Market Institutions, Product Market Regulation and Innovation: Cross-Country Evidence", *OECD Economics Department Working Paper* No.316.
[11] See for instance Barro R. and X. Sala-I-Martin (1995), *Economic Growth,* McGraw-Hill, New York.
[12] See Blondal S., S. Field, and N. Girouard (2002), "Investment in Human Capital through Post-Compulsory Education and Training: Selected Efficiency and Equity Aspects", *OECD Economics Department Working Paper* No.333. These figures are currently being updated by the OECD Economics Department using the methodology developed in De la Fuente and Jimeno, who also conclude that there are high returns to post-compulsory schooling across the EU, with the highest rate of return (13%) in the UK. See De la Fuente A. and J-F. Jimeno (2005), "The Private and Fiscal Returns to Schooling and the Effect of Public Policies on Private Incentives to Invest in Education: A General Framework and Some Results for the EU", *CESifo Working Paper* No.1392.
[13] See Jaumotte and Pain (2005a), *op.cit*.
[14] See Jaumotte and Pain (2005c), *op.cit*.
[15] This holds provided similar methodologies are used across OECD countries to compute deflators for computer hardware, software and telecommunications.

[16] See Oliner S. and D. Sichel (2000), "The Resurgence of Growth in the Late 1990s: Is Information Technology the Story?", *Journal of Economic Perspectives*, Vol. 14, Fall.

[17] See Jorgenson D., M. Ho and K. Stiroh (2006), "The Sources of the Second Surge of U.S. Productivity and Implications for the Future", paper presented at a joint Banque de France - Bank of Canada Workshop on *"Perspectives on potential output and productivity growth",* Enghien-les-Bains, April 24 and 25.

[18] Bosworth B and J. Triplett (2003), "Services Productivity in the United States: Griliches' Service Volume Revisited", paper for the CRIW conference in memory of Zvi Griliches, September 19-20.

[19] See in particular Oulton N. and S. Srinivasan (2005), "Productivity Growth in UK Industries, 1970-2000: Structural Change and the Role of ICT", *Bank of England Working Paper* No.259.

[20] Concretely, annual GDP growth was revised up by between 0.1 and 0.2 percentage point a year over the period 2003-2005, mainly as the result of improved methods for measuring the output of insurance and banking.

[21] For an attempt at quantifying this "spurious" effect, see Bourlès R. and G. Cette (2005), "Une comparaison des niveaux de productivité structurels des grands pays industrialisés", *OECD Economic Studies*, No.41.

[22] For a thorough discussion of the UK's innovation performance, see OECD (2005), *OECD Economic Surveys: United Kingdom*.

[23] See Jaumotte and Pain (2005b), *op.cit.*

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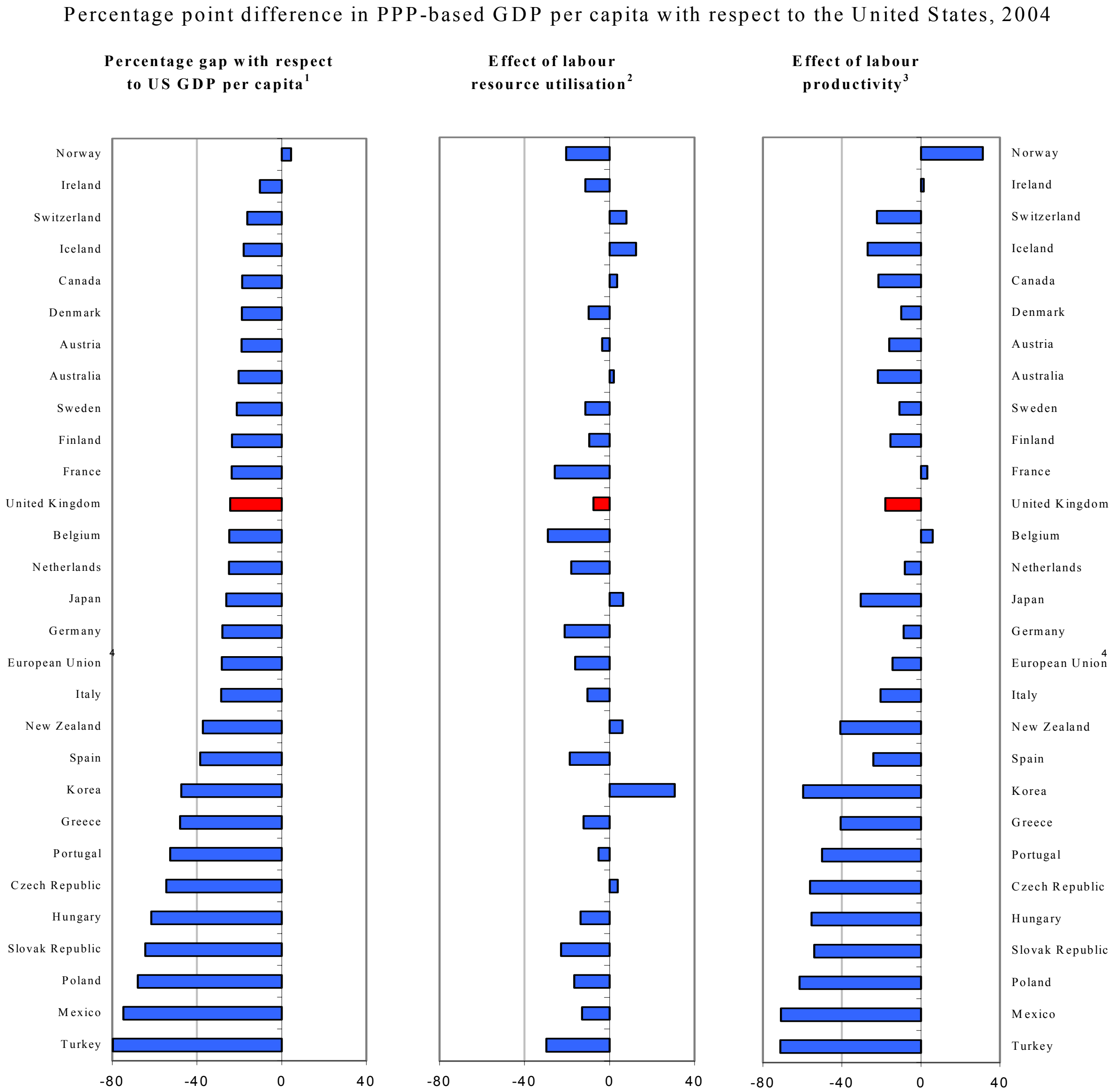
Economic Growth and Productivity

Jean-Philippe Cotis
OECD Chief Economist

OECD

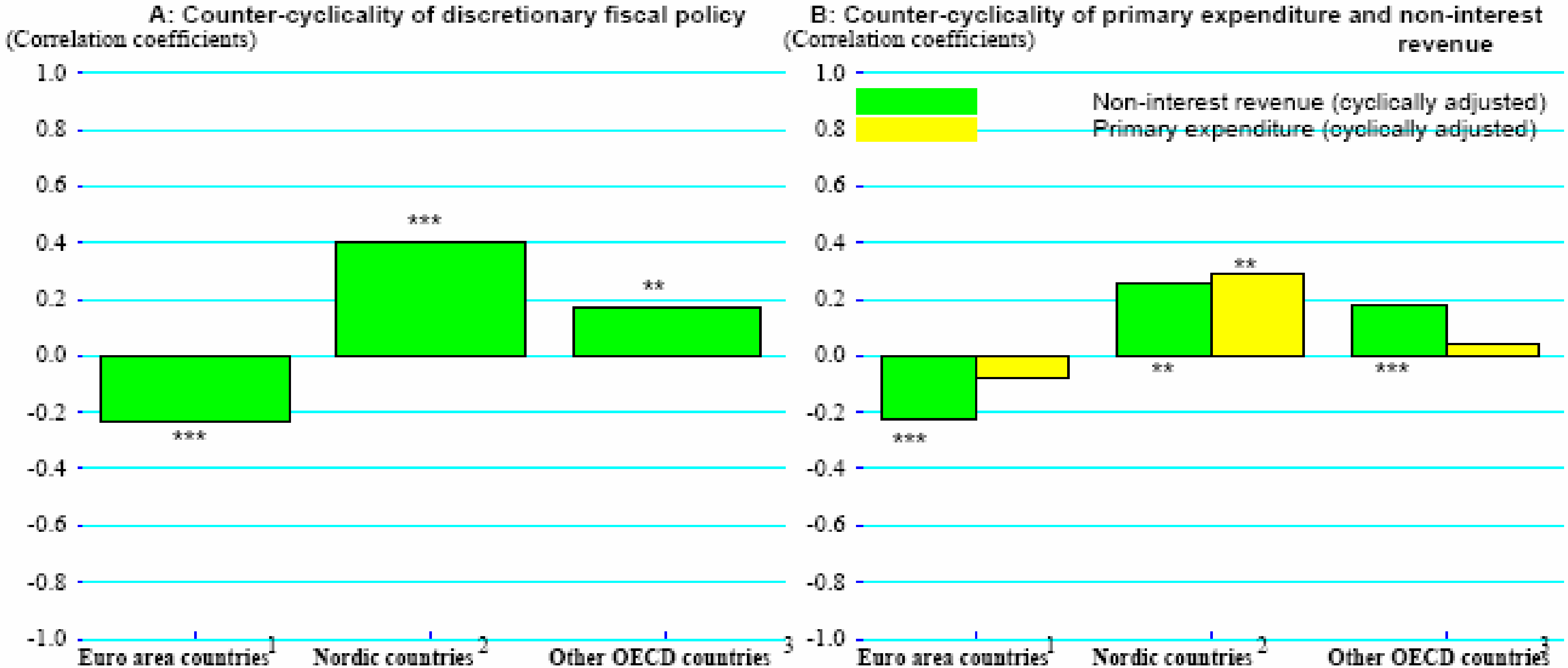
What's been driving the gap in per capita incomes?



1. Based on year 2000 purchasing power parities (PPPs).
2. Labour resource utilisation is measured as total number of hours worked divided by population.
3. Labour productivity is measured as GDP per hour worked.
4. Excluding Luxembourg,
Source: OECD, *National Accounts*, 2005; OECD, *Economic Outlook*, No. 78; and *OECD, Employment Outlook*, 2005.

OECD

Pro-cyclicality of discretionary fiscal policy does not help in the euro area



Note: Panel A : Contemporaneous correlation between changes in the cyclically adjusted primary balance and the output gap over the period 1981-2005 (1991-2005 for Germany).

Panel B: For each variable, the cyclical behavour is indicated by the contemporaneous correlation with the output gap over the period 1981-2005 (1991-2005 for Germany). The sign of the correlation for primary expenditure has been inverted so that a positive correlation always indicates counter-cyclicality.

1. Current Euro area members with the exception of Finland.
2. Denmark, Finland, Norway and Sweden.
3. United States, Japan, United Kingdom, Canada, Australia, Korea, New Zealand and Switzerland.

*=indicates significance at the 10% level, **=indicates significance at the 5% level, *** = indicates significance at the 1% level.

Source : OECD.

The role of structural factors

- Low/stable inflation, developed financial markets, low tax burden and low share of distortionary taxes increase the steady-state level of GDP per capita through:

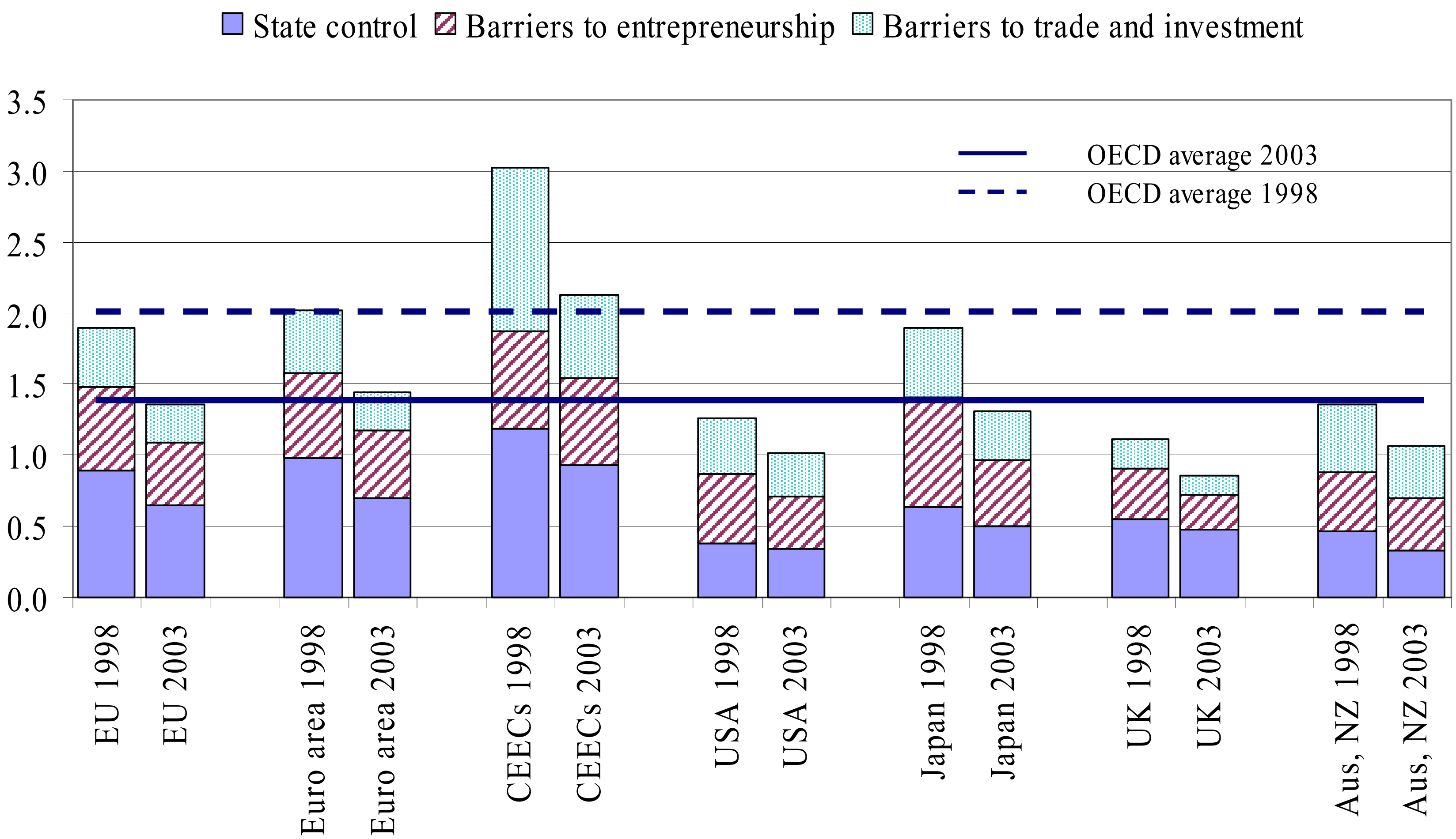
  - an investment channel

  - a R&D channel

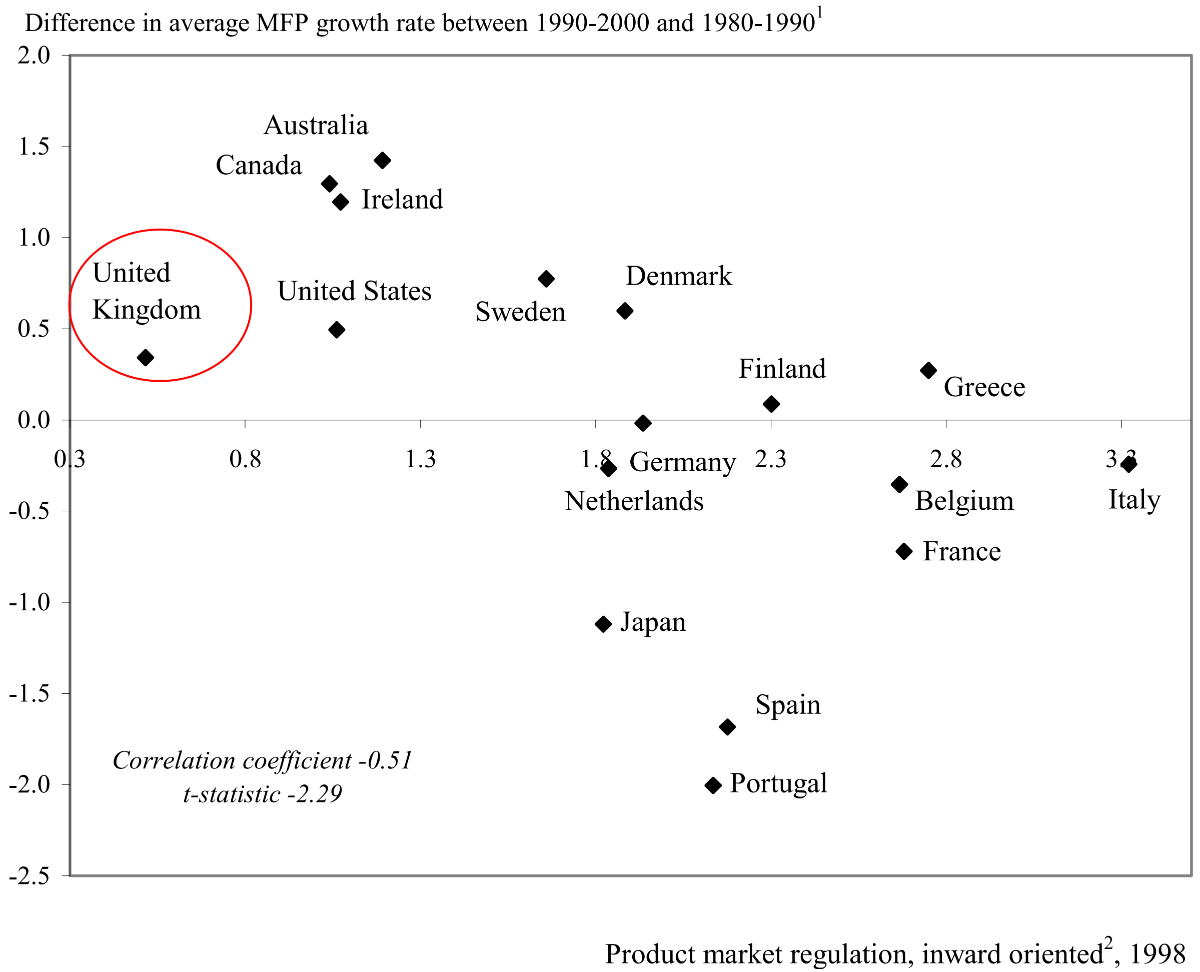
  - an efficiency channel

- Macroeconomic stability also helps, and counter-cyclical fiscal policies can play a role in this respect

Product market regulation is converging towards a more liberal stance but cross-country differences remain



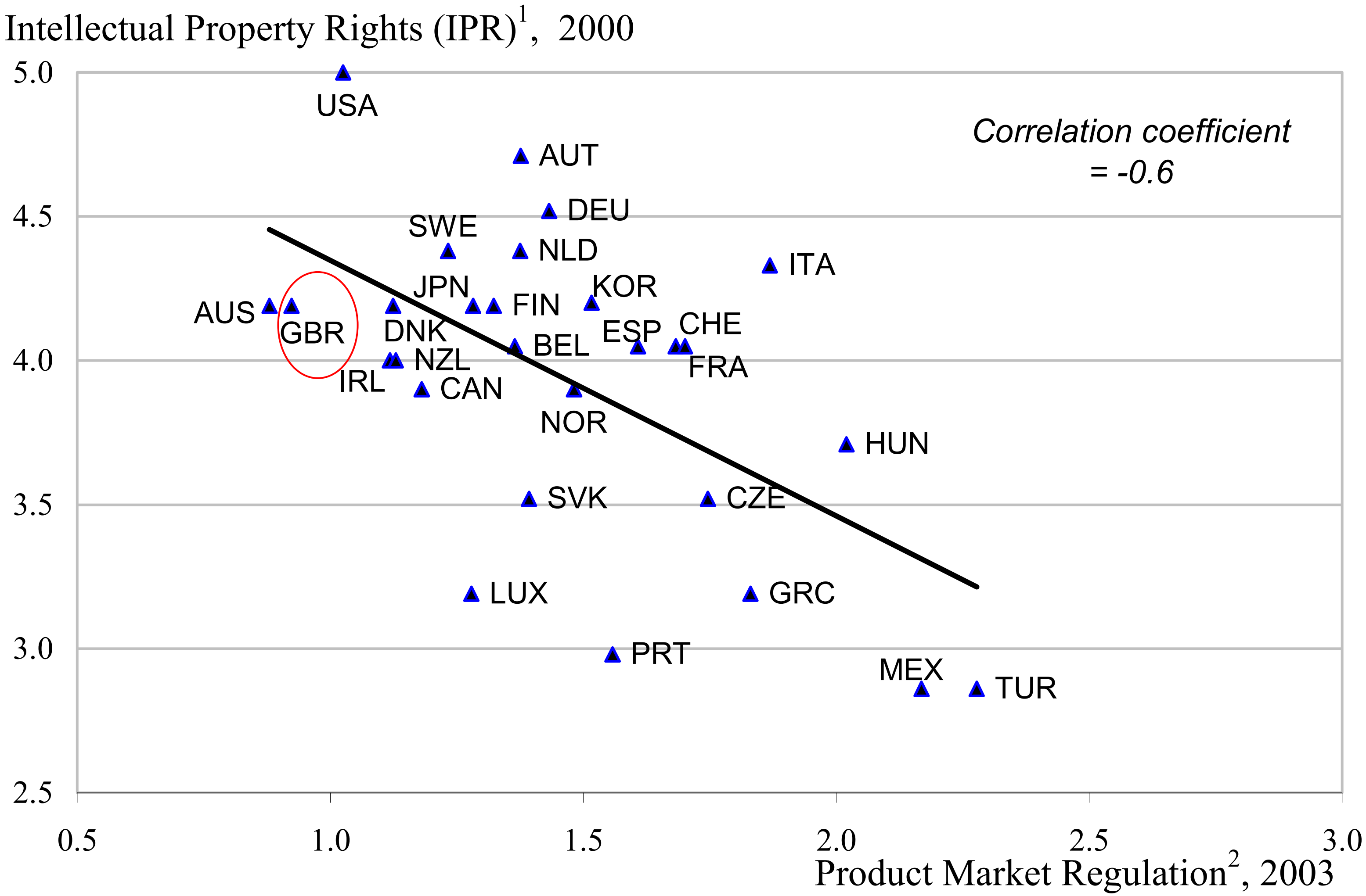
Cross-country differences in product market regulation may have contributed to divergent productivity trends



1. Adjusted for hours worked.
2. Indicator of economy-wide regulation excluding barriers to international trade and investment. The indicator ranges from 0 to 6, from least to most restrictive. See Nicoletti et al. (1999).

Source : OECD Productivity Database.

Competition-friendly regulations tend to go hand in hand with intellectual property rights protection



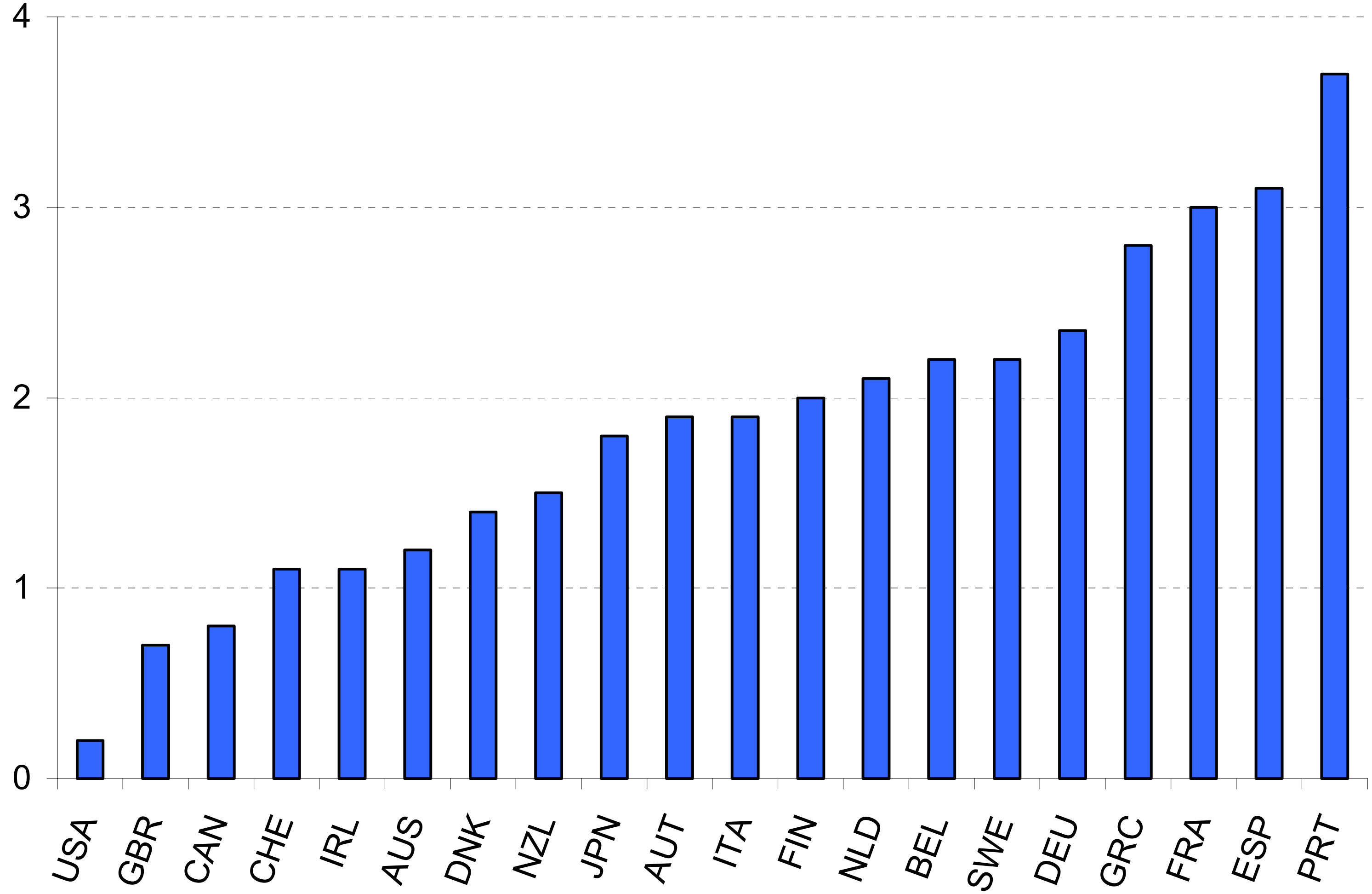
1. Index scale of 0-5 from least to most restrictive.
2. Index scale of 0-6 from least to most restrictive.
Source: Park and Wagh, 2002 and OECD, *Economic Policy Reform, Going for Growth* , 2005.

Labour market regulation also matters for innovation and productivity

- EPL raises the cost of adjusting the workforce
- It may discourage major innovations but facilitate incremental ones, especially where there is coordinated wage bargaining
- In practice EPL tends to weaken product innovation and patenting
- EPL reduces R&D in high tech, low concentration sectors (software) and stimulates it where innovation is also strong but incremental (aircrafts)

English-speaking and Nordic countries have less stringent employment protection legislation than most continental European countries

Stringency of employment protection legislation[1] in selected OECD countries, 2003

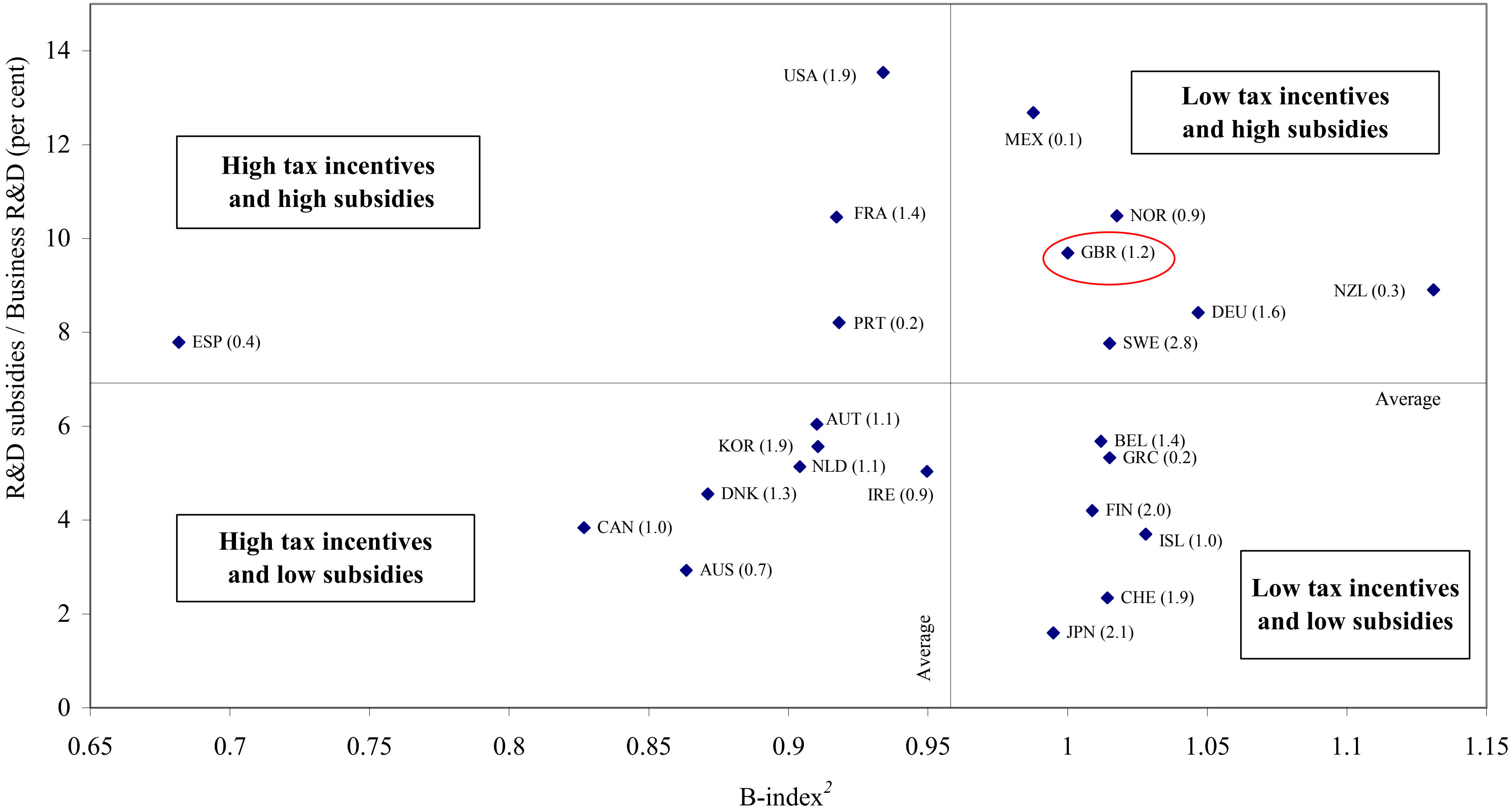


1. Index scale of 0-6 from least to most restrictive. *Source:* OECD Employment Outlook, 2004.

OECD countries provide fiscal incentives to private R&D through both direct funding and tax incentives

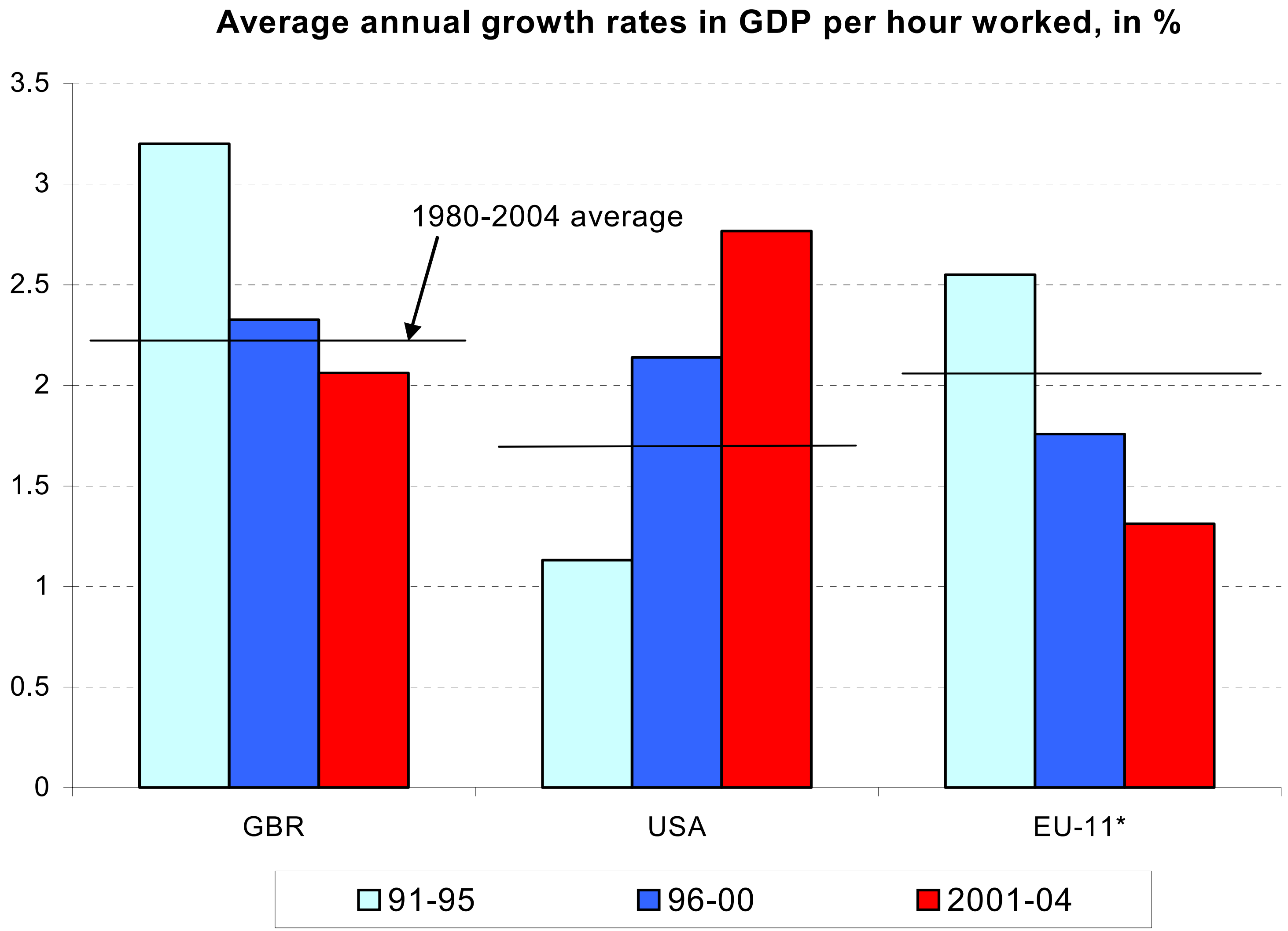
Tax and subsidisation policies

Average per annum, 1996-2000



1) The numbers in parentheses are the average business R&D intensities in 1996-2000.
2) The B-index is defined as one minus the rate of tax subsidy for R&D.
Source: OECD Main Science and Technology Indicators database for data on R&D subsidies; OECD, STI/EAS Division for data on the B-index.

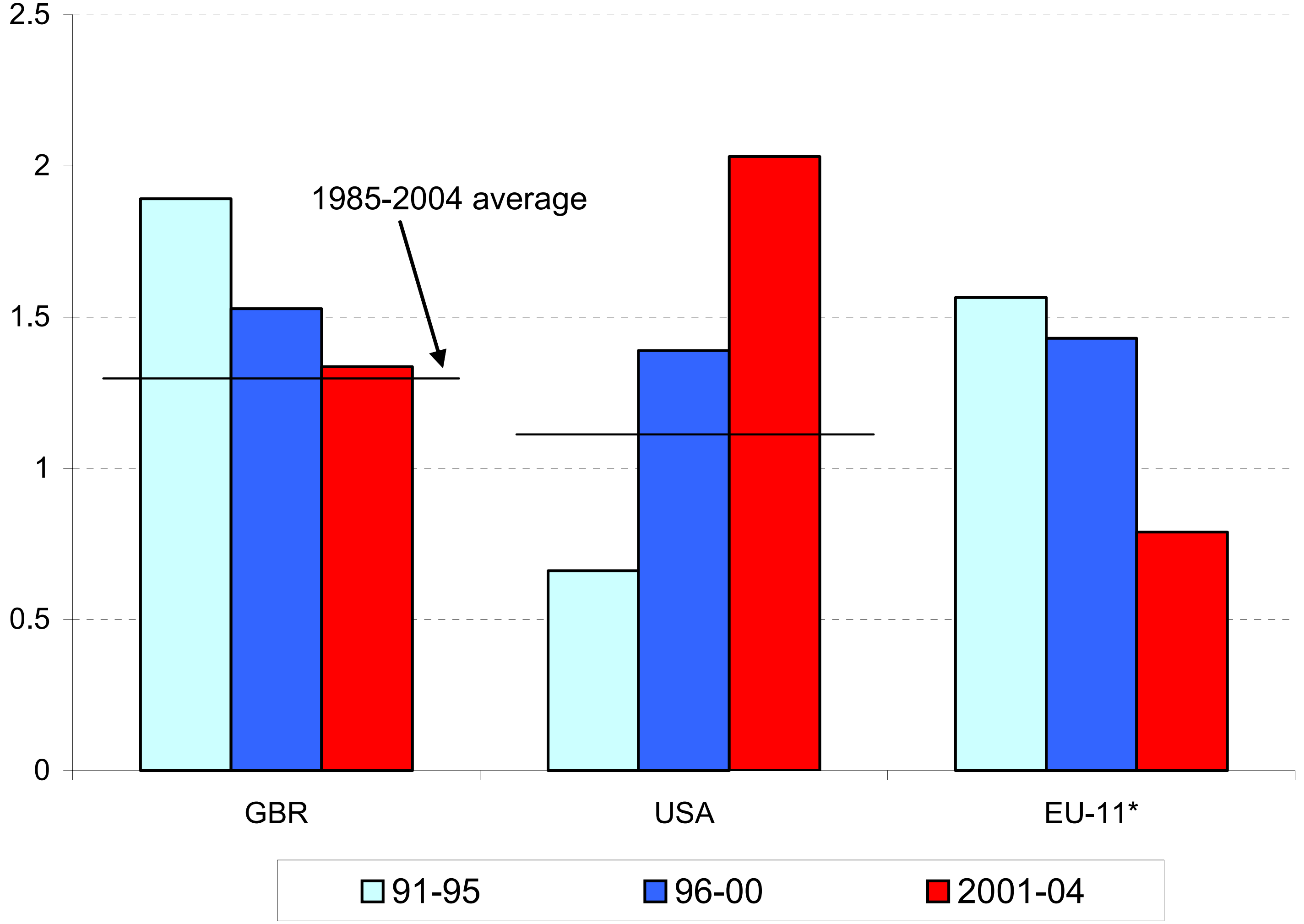
Labour productivity growth has not picked up in the UK…



*: EU-15 excluding AUT, GRC, LUX and PRT.
Source: OECD productivity database.

…and multifactor productivity growth has not increased either

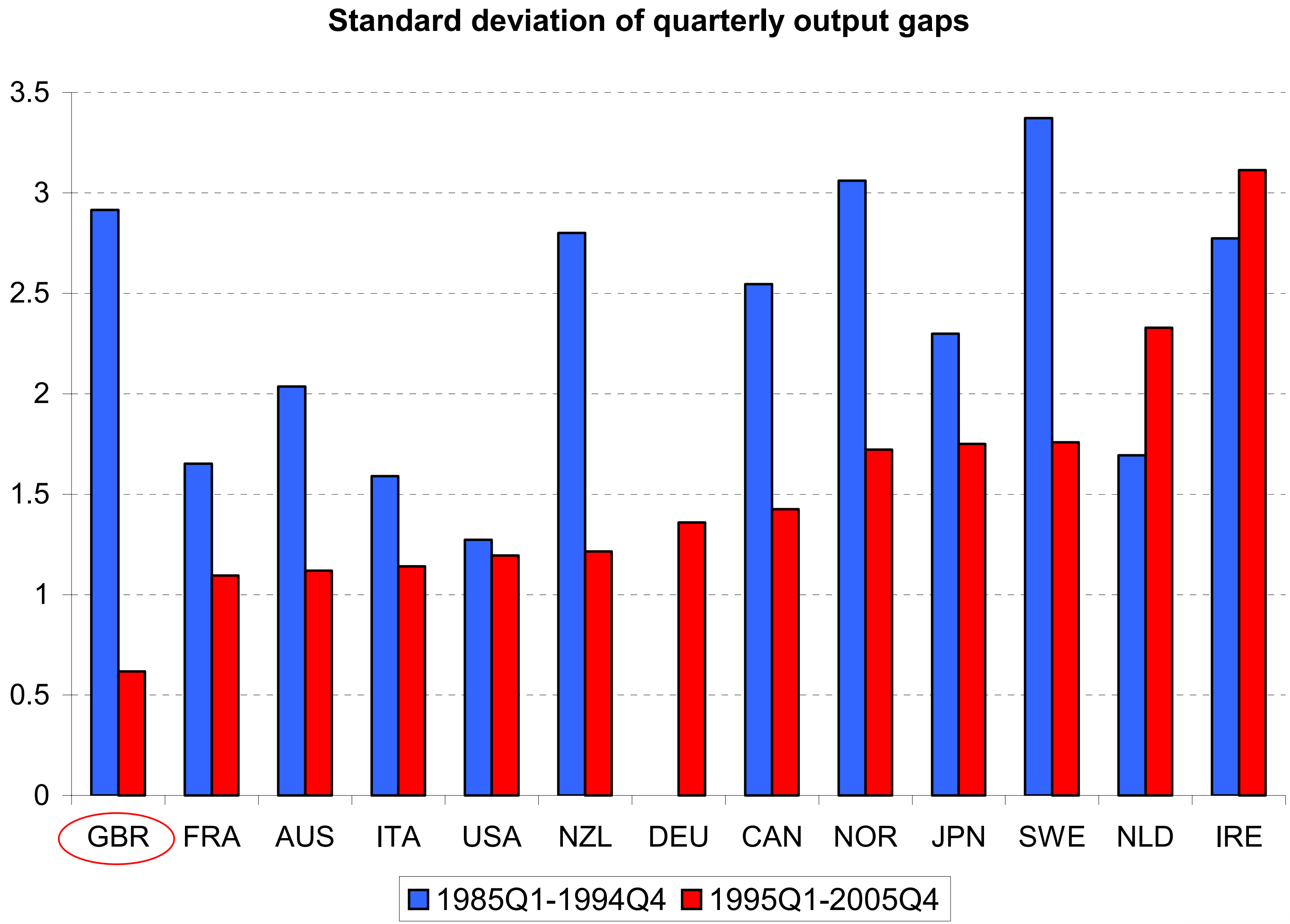
Average annual growth rates in multifactor productivity, in %



*: EU-15 excluding AUT, GRC, LUX and PRT. 2000-03 instead of 2000-04 except for DEU, NLD, ESP and UK.

Source: OECD productivity database, University of Groningen.

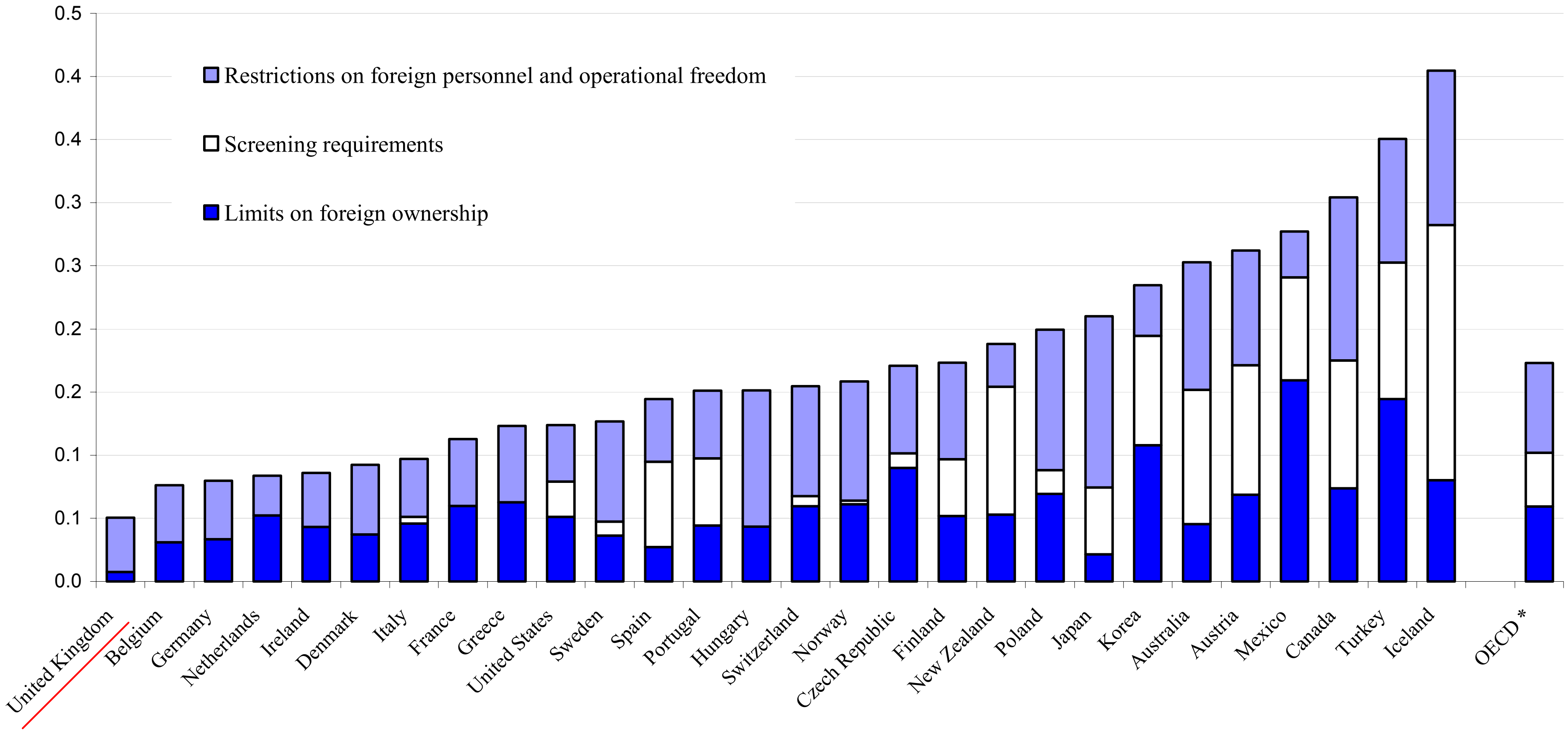
Output volatility has been lower in the UK than in any other OECD country over the past decade



Source: OECD Economic Outlook 78.

The UK has the least stringent restrictions to inward FDI across the OECD

OECD indicators of FDI restrictions, 2001 [1]

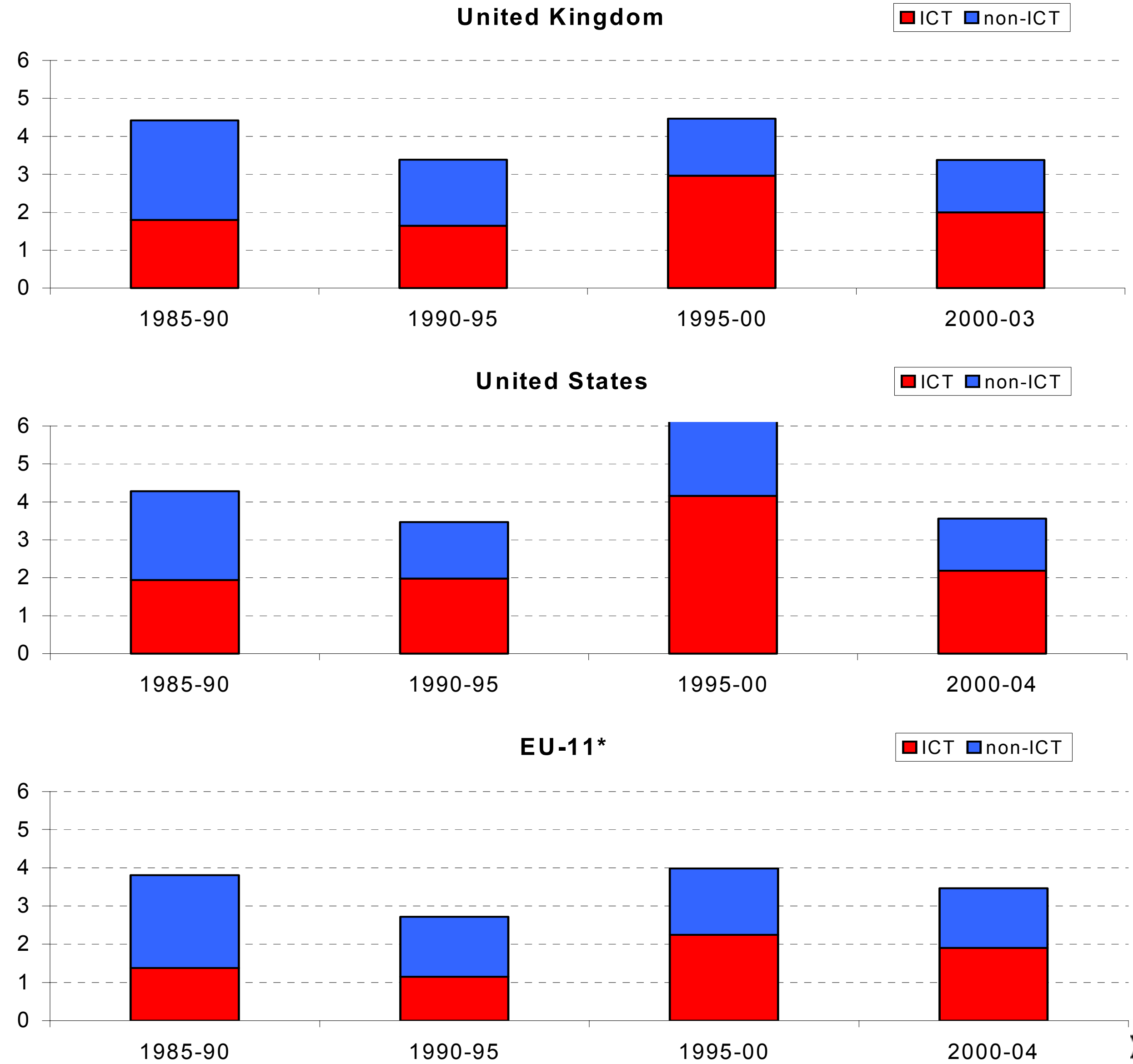


1. The indicators range from 0 (least restrictive) to 6 (most restrictive).
   * Simple average

Source : OECD, Golub (2003).

The UK has been investing heavily in ICT

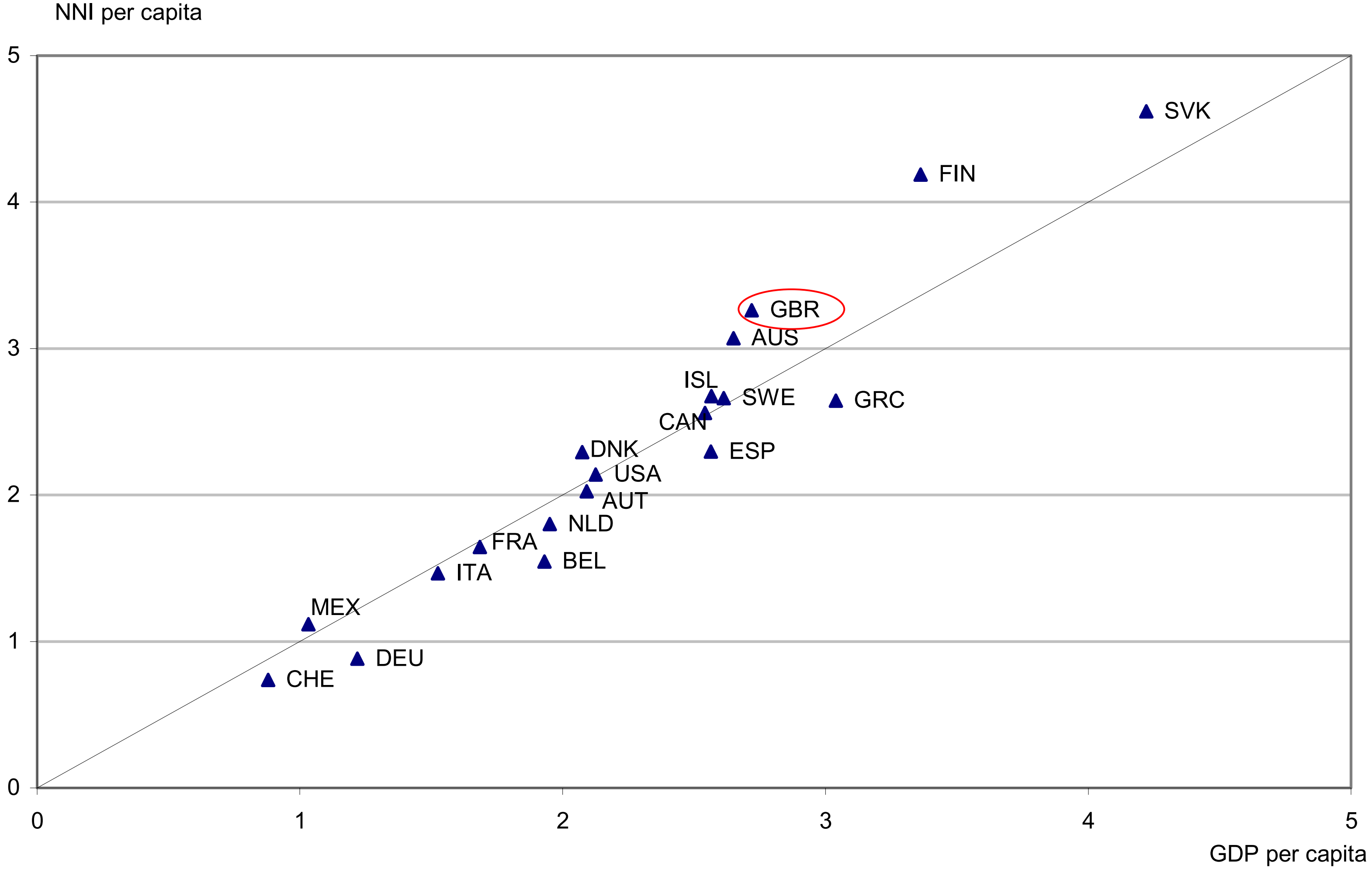
Decomposition of average annual growth in the volume of capital services, in %



*: EU-15 excluding AUT, GRC, LUX and PRT. 2000-03 instead of 2000-04 except for DEU, NLD, ESP and UK.
Source: OECD productivity database, University of Groningen.

NNI has been growing significantly faster than GDP in the UK over the past decade

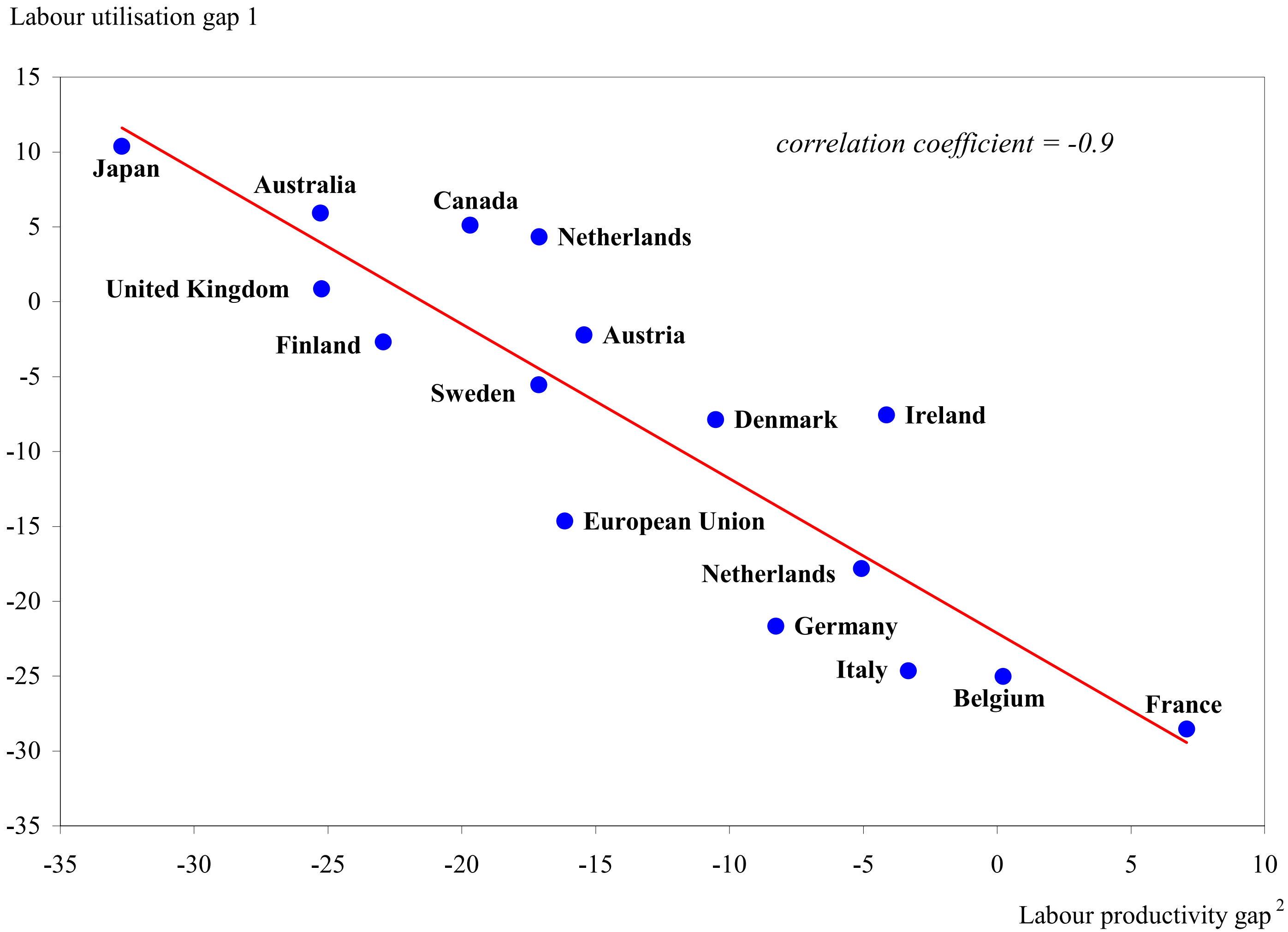
Annual average per cent growth rate between 1994 and 2003



Source: OECD, *National Accounts of OECD Countries,* 2005.

High labour utilisation seems to go hand in hand with low productivity

Percentage gap with respect to the United States level, 2002, 2000 PPP



1. Labour resource utilisation is measured as total number of hours worked divided by population.
2. Labour productivity is measured as GDP per hour worked.
Source: OECD.

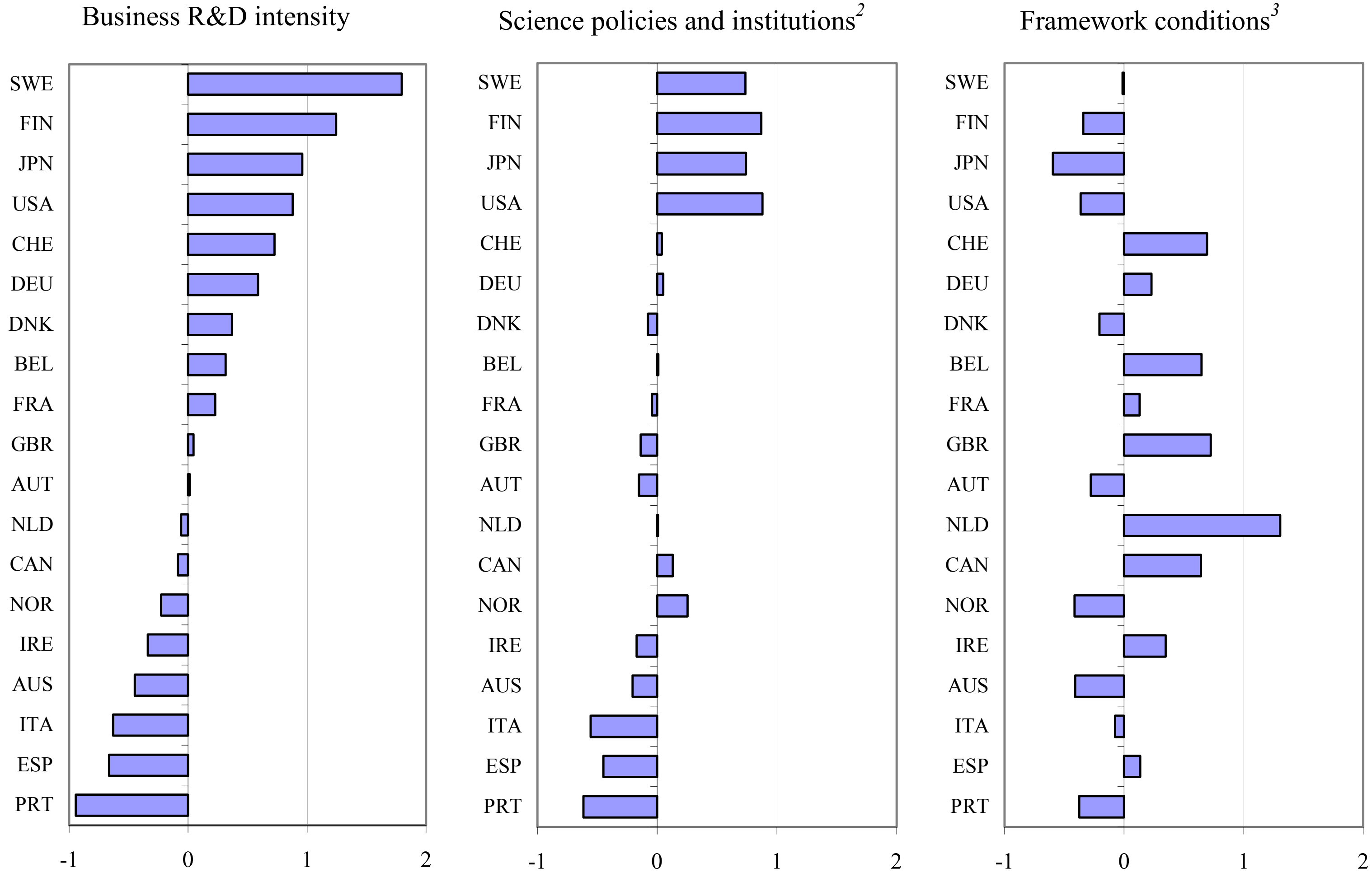
UK innovation performance looks rather poor by most standards

	Total R&D intensity	Business R&D intensity	Non-business R&D intensity	Scientists share[2]	R&D employees share[2]	Triadic patents (1999)	Average indicator[3]
Sweden	1	1	3	3	*2*	2	2.0
Finland	2	2	2	5	*1*	4	3.7
Japan	3	3	4	2	*6*	3	2.7
Iceland	4	6	1	4	*5*	13	7.0
United States	5	4	11	1		6	4.0
Switzerland	6	5	13	7	*3*	1	4.7
Germany	7	7	9	8	*8*	5	6.7
Denmark	8	8	10	12	*4*	8	9.3
France	9	10	6	13	*9*	10	10.7
Belgium	10	9	17	9	*7*	9	9.3
Austria	11	11	12	10	*10*	11	10.7
Canada	12	14	7	14	*14*	15	13.7
Netherlands	13	13	8	16	*12*	7	12.0
United Kingdom	***14***	***12***	***14***	***15***	***15***	***12***	***13.7***
Norway	15	15	15	6	*11*	14	11.7
Australia	16	17	5	17	*16*	16	16.3
Ireland	17	16	20	11	*13*	17	15.0
Italy	18	18	18	18	*17*	18	18.0
Spain	19	19	19	19	*18*	19	19.0
Portugal	20	20	16	20	*19*	20	20.0
Correlation with Total R&D intensity	1	0.99	0.73	0.85	0.94	0.87	0.97

Source: OECD Main Science and Technology Indicators database, R&D database and Patent database.

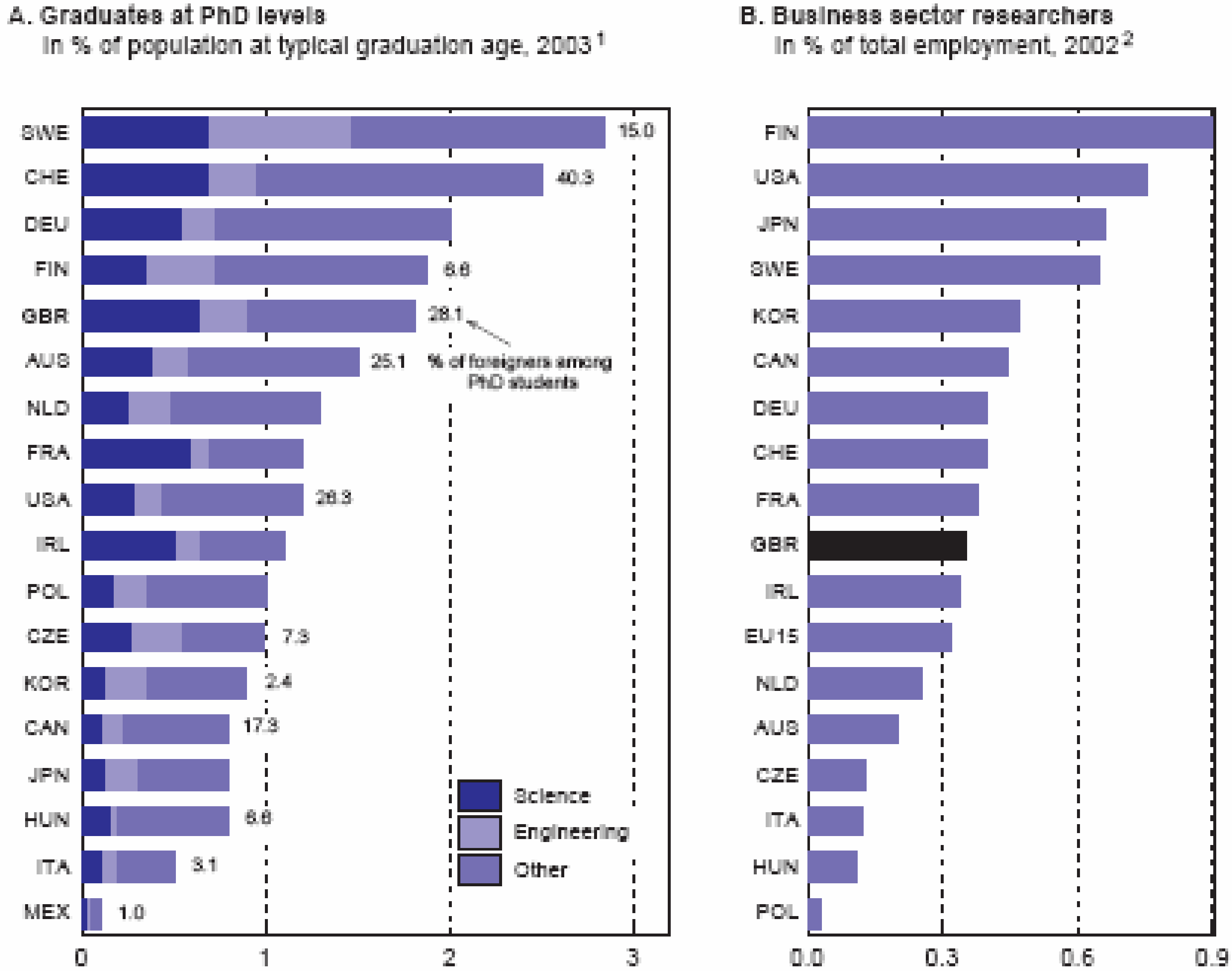
Contribution of science policies and framework conditions to cross-country differences in business R&D intensity, 2000

Measured in percentage point deviation of R&D intensity relative to average OECD R&D intensity[1]



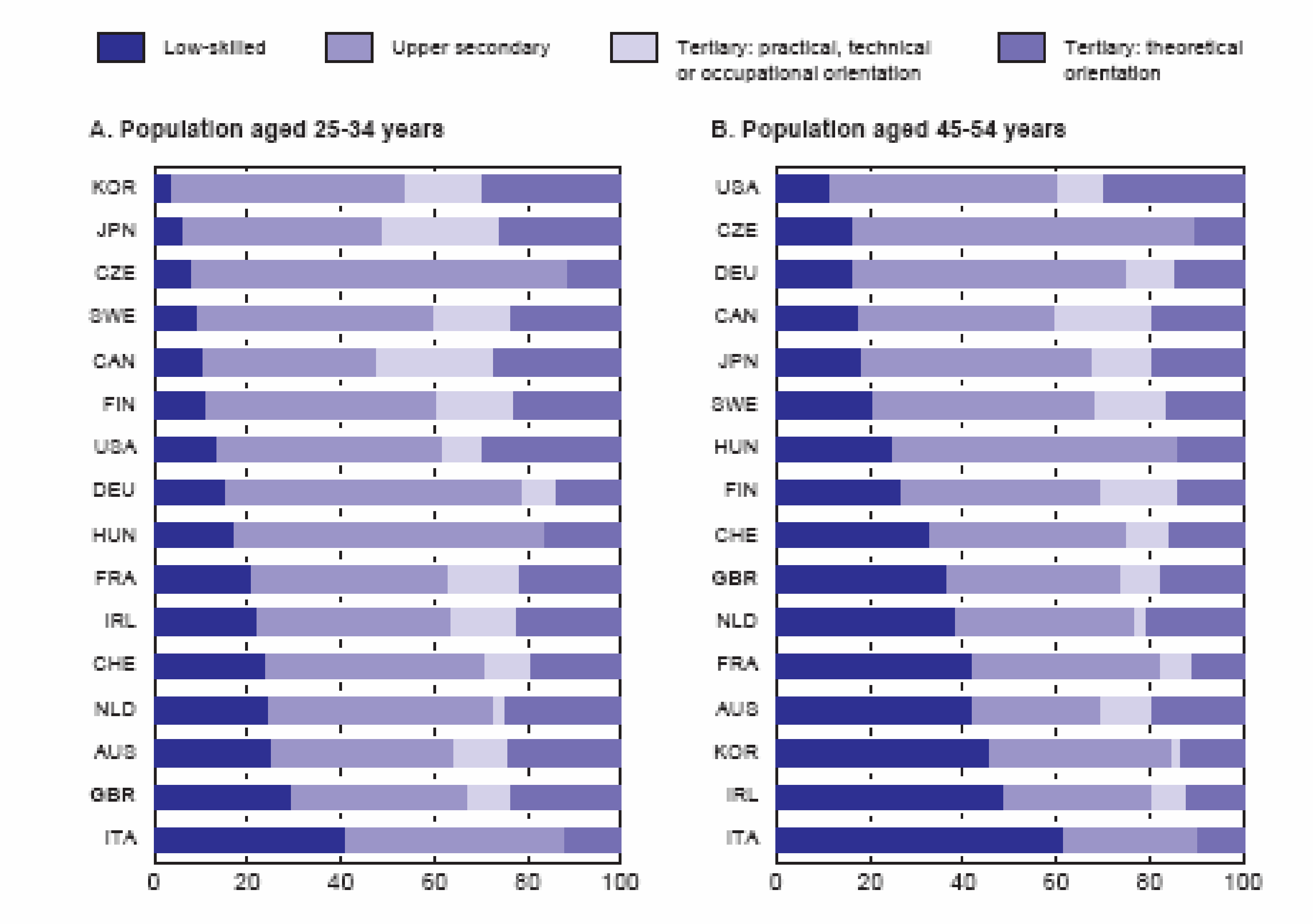
1) Contributions calculated based on the long-run parameters from the equation reported in Jaumotte and Pain (2005a), Table A3-2, column 3.
2) Science policies include R&D tax incentives, subsidies for private R&D, business funding of non-business R&D, non-business R&D intensity, intellectual property rights, the share of scientists in total dependent employment and absorptive capacity.
3) Framework conditions include financial factors, real interest rates, real exchange rates, foreign exposure (foreign R&D stock and openness), import penetration, and product market regulation.
Source: OECD estimates as reported in Jaumotte and Pain (2005a).

The UK ranks high in terms of PhD graduates but significantly lower in terms of actual business sector researchers



Source: OECD Economic Surveys, United Kingdom, 2005

The UK has a considerably larger share of low-skilled workers than most other OECD countries



Source: OECD Economic Surveys, United Kingdom, 2005