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Why do growth rates differ? Evidence from cross-country data on private sector production

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The views expressed in this paper are those of the authors and do not necessarily reflect the views of the Bank of Finland.

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Why do growth rates differ? Evidence from cross-country data on private sector production

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Abstract

We estimate a standard production function with a new cross-country data set on business sector production, wages and R&D investment for a selection of 14 OECD countries including the United States. The data sample covers the years 1960–2004. The data suggest that growth differences can largely be explained by capital deepening and an ability to produce new technology in the form of new patents. The importance of patents is magnified by the openness of the economy. We find some evidence of increasing elasticity of substitution over time, all though the results are sensitive to assumptions on the nature of technological progress.

Keywords: growth, R&D, production function, patents

JEL classification numbers: O40, E10, O43

Miksi eri maiden kasvuvauhdit poikkeavat toisistaan? Useita maita käsittävällä tilastoaineistolla saatuja tuloksia yksityisen sektorin tuotannon kasvusta

Suomen Pankin keskustelualoitteita 13/2008

Juha Kilponen – Matti Viren
Rahapolitiikka- ja tutkimusosasto

Tiivistelmä

Tässä tutkimuksessa estimoidaan tuotantofunktio tilastoaineistolla, joka koskee yrityssektorin tuotantoa, palkkoja ja T&K-investointeja. Tilastoaineistossa on mukana 14 OECD-maata mukaan lukien Yhdysvallat. Otosajanjaksona ovat vuodet 1960–2004. Tilastoaineiston perusteella voidaan päätellä, että kasvuerot voidaan pääosin selittää pääoman syvenemisellä ja yritysten kyvyllä tuottaa uutta, patentoitua teknologiaa. Talouden avoimuus korostaa patenttien merkitystä. Jonkin verran näyttöä löytyy substituutiojouston kasvusta otosajanjaksolla, joskin tulokset ovat sensitiivisiä teknologista kehitystä koskevien oletusten suhteen.

Avainsanat: kasvu, T&K, tuotantofunktio, patentit

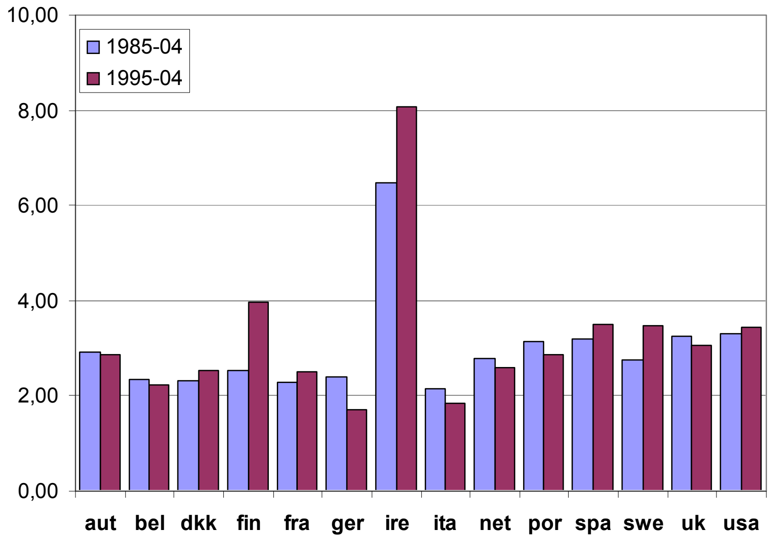
JEL-luokittelu: O40, E10, O43

Contents

1 Introduction

Growth differences across western industrialized countries are widespread and persistent. For instance, recent growth data reveals striking differences in growth performance between a group of large European countries (Germany and Italy) and a group of small countries (Ireland and Nordic countries) and the US during 1995–2004. Germany and Italy clearly lag behind the other countries. While growth rates in Germany and Italy have been roughly 2 per cent during the last 20 years, Ireland and Nordic countries have grown on average clearly much faster (see Figure 1.1). In this paper, we shed some light on the potential reasons for these growth differences by estimating different specifications of production functions with time-series-cross-section methods.

Figure 1.1 **Growth performance in a selection of industrialized economies**



A poor growth performance in many large European countries is often attributed to institutional features. However, the large European economies have already undergone series of structural reforms and the basic institutions that have been found important for growth in Easterly (2001) for example are already in place in all European countries. Institutional differences may thus not be a major cause for such persistently diverse growth performance.

Beside institutions, there are numerous other country-specific factors that may have contributed to these differences, such as size of country, demographics and availability of natural resources. However, these features are beyond the reach of policy. Therefore, it is natural, and in line with the empirical growth literature,[1] to focus on the features that can be influenced by policy.

In what follows, we concentrate on the role of capital deepening, technological change, and possibly time varying elasticity of substitution between capital and labour. A novel feature of our analysis is the data. In contrast to most of the previous empirical work, we use the data for the business sector only. Thus, we abstract from all the complications concerning measurement of government output and government capital stock, as well as the productivity of government production. As pointed by Gollin (2002), these (and other) measurement problems may, especially in the case of developing countries, lead to highly misleading results in terms of income shares and underlying production relationships.

We first illustrate that the growth differences during 1995–2005 reflect not simply different patterns of capital accumulation and employment growth, but also different speed of technological change. We show that roughly half of the differences in growth rates can be attributed to intensity of business sector R&D investment across the countries of our sample. However, once the R&D intensity is complemented with other potential explanatory variables of technological change, such as patents and degree of openness, it turns out that the patents becomes single most important factor explaining technological change. Moreover, we find that the importance of patents is magnified by the openness of the economy. As for the role of elasticity of substitution, our findings are mixed. We find some evidence that the elasticity of substitution has increased over time. However, in the light of the sensitivity of the results to different specifications, we conclude that evidence on the varying elasticity of substitution is not very compelling.

The rest of the paper is organised as follows. First, in sections 2 and 3, we illustrate the the growth rate differences and scrutinize them from point of view of basic factors of input. Then, in section 4, we proceed with estimation by setting up horse races between competing models. The last section provides concluding remarks concerning eventual policy implications.

2 Good and bad growth performers

As pointed out earlier, there are considerable differences in growth rates of industrialized western countries. Figure 1.1 illustrates the case for two sample periods, 1985–2004 and 1995–2004. Since the data are derived from the business sector, changes in public sector output do not directly show up in the figures.

[1] Basic institutions found to be important for growth have been discussed eg in Easterly (2001).

On the basis of Figure 1.1, or other similar figures, one cannot say very much about the underlying reasons for growth differences. But note that the countries that have started from relatively low levels of income seem to be among the best performers. This can be interpreted in terms of technical adaptation: these countries have been able to benefit from general technical knowledge without costly investment in R&D and education. This may also be a reason for convergence of growth rates in the data. Otherwise, our sample of countries is quite homogeneous, and so we are unable to devise a powerful test for the importance of technical adaptation.[2]

In what follows, we therefore focus on other explanations, starting with the role of capital deepening. We perform a simple exercise in which we estimate a Cobb-Douglas production function with constant returns to scale restrictions for all countries, and let the rate of technical change be country-specific. By contrast, factor shares are restricted to be equal across the 14 countries in our sample. Given the estimated parameters of the production function for the period 1960–1994, we use the resulting regression to forecast in-sample GDP using the actual data for capital and labour inputs for the period 1995–2005. This enables us to distinguish between 'bad' and 'good' performers during the ten year period starting from 1995 relative to their historical growth records.

Figure 2.1 displays the actual output values together with the forecast for 1995–2004 from this exercise.[3] We find that the growth differences apparent in Figure 1.1 also show up in the deviations between actual and forecasted values. These deviations reflect different patterns of capital accumulation and employment growth, but they also mirror any other factors not taken into account in the estimation of the basic production function.

Figure 2.2 summarizes the time-series graphs. We can see that again Ireland and Italy represent the polar cases. Finland, Portugal and Sweden (together with Ireland) represent the good performers while the other countries perform more or less poorly. The United States is an interesting exception. Its 'forecast errors' are close to zero, suggesting that 'nothing particular has happened in the US economy' during the last 10 years. Relative to the historical growth record, the US economy has been able to keep up with its growth potential. Alternatively, it is also possible that the conflicting effects have exactly offset out each other.

[2] We estimated a conventional convergence equation in terms of the US (with the data from 13 countries) where the relative output growth was explained by lagged (log) level of relative output (expressed in Euros) and time dummies (fixed time effects). The estimate of the lagged output level was -0.0021, with the t-ratio of 2.24. The result is consistent with the convergence property although the effect is not particularly strong. For a more thorough analysis of convergence, see eg Caselli et al (1996).

[3] As pointed out in the introduction, the data are related to the business sector only, covering the period 1960–2004. The data are annual. The output data have not been available for Greece. Most of the data are from the OECD database (including the STAN database for the R&D expenditures). The data are described in detail in Pyyhtiä (2007).

Figure 2.1 **Actual vs forecasted output**

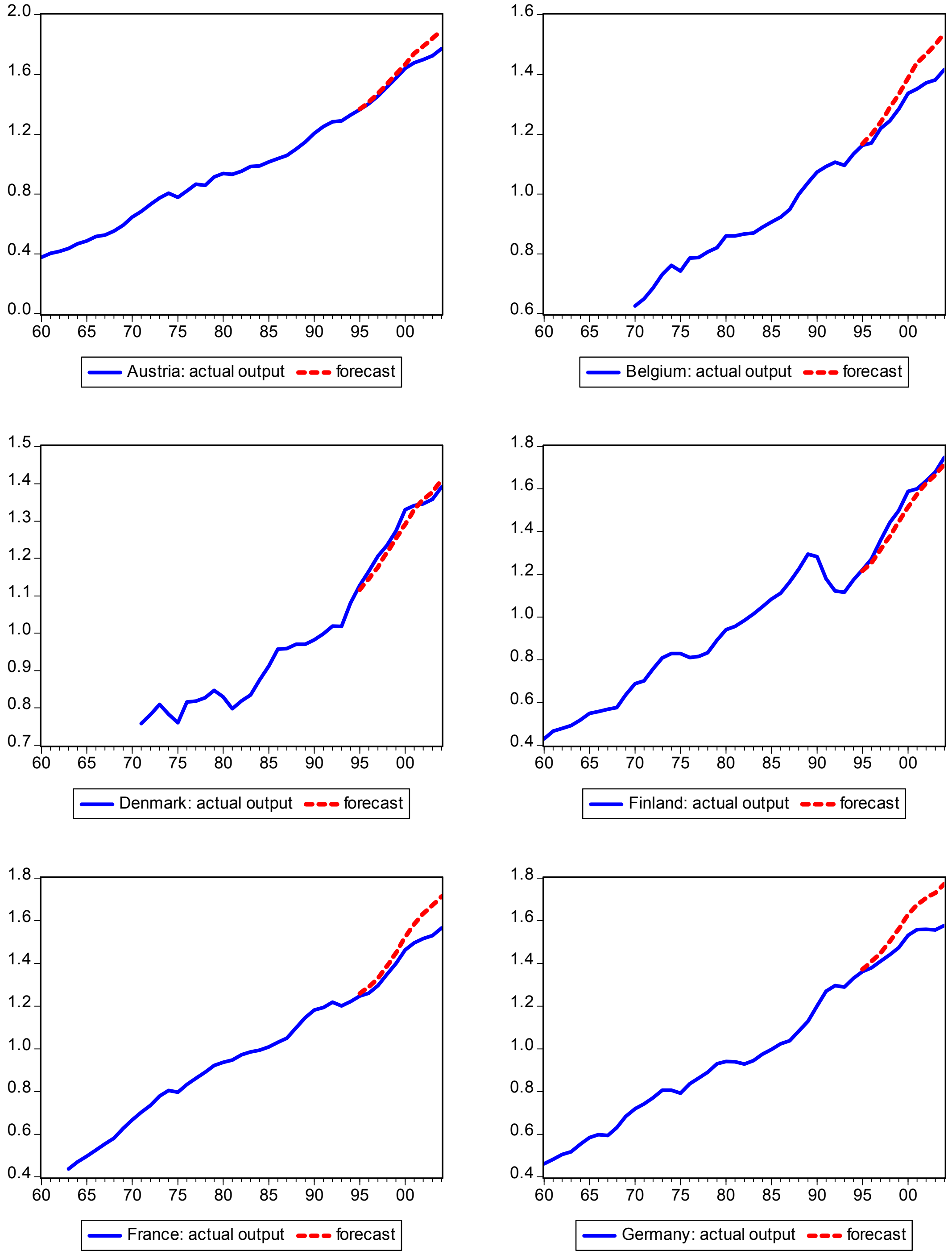


Figure 2.1 continued

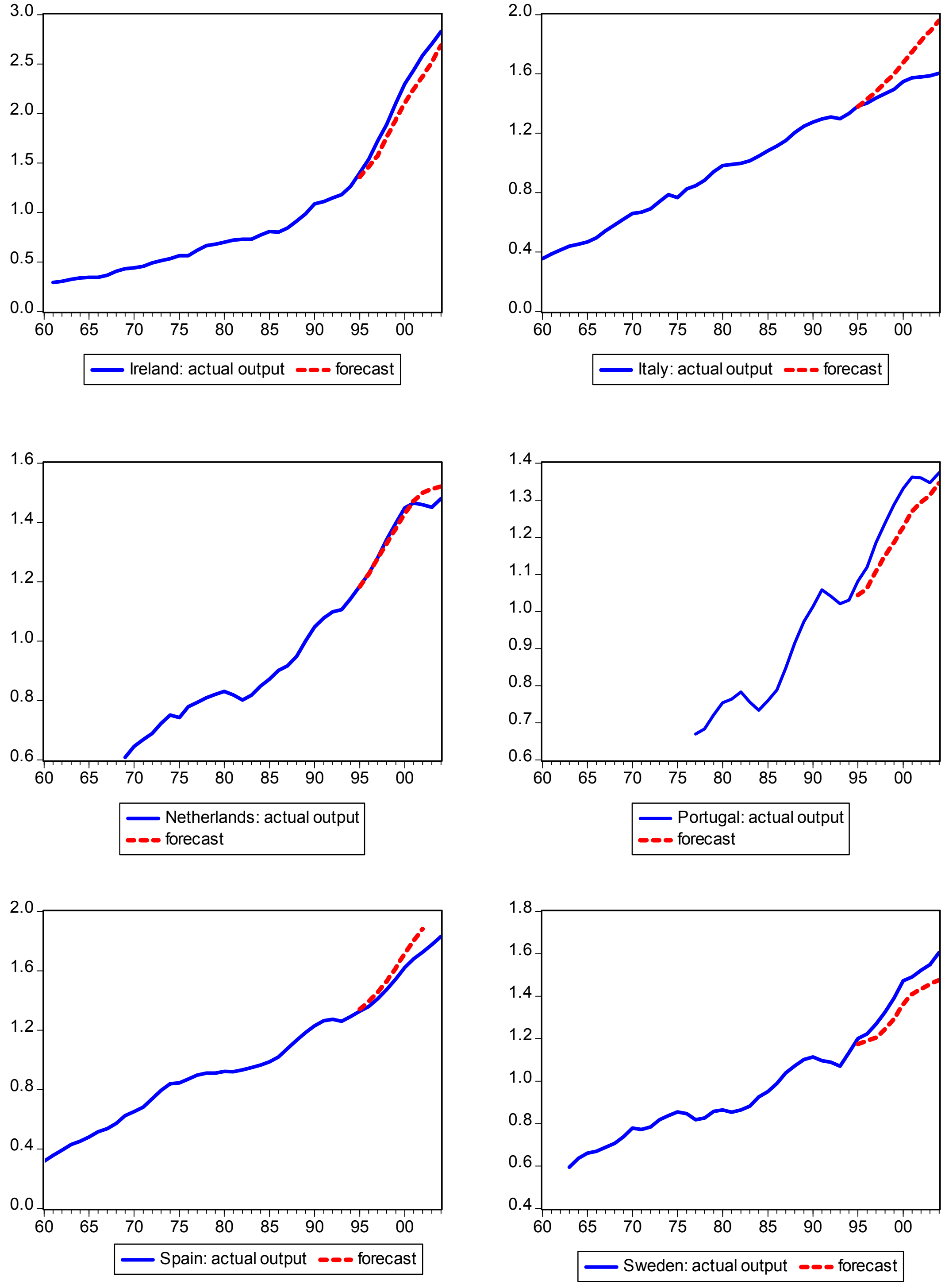


Figure 2.1 continued

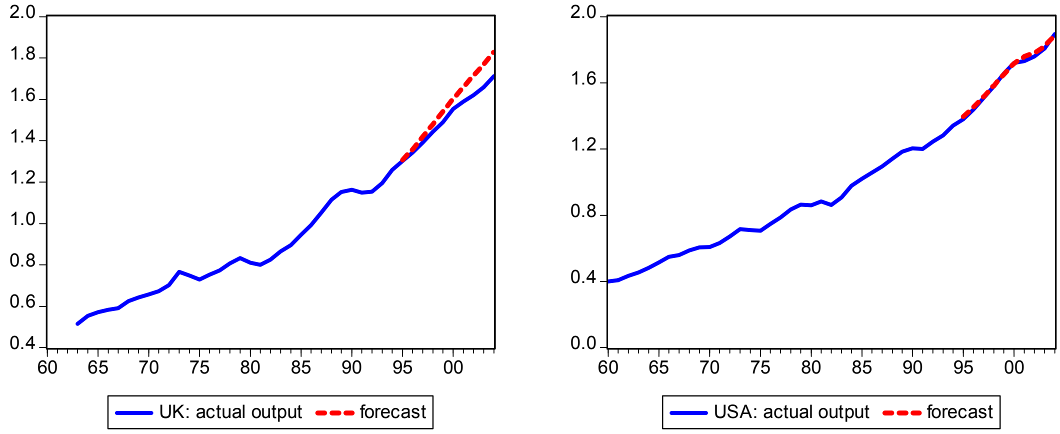
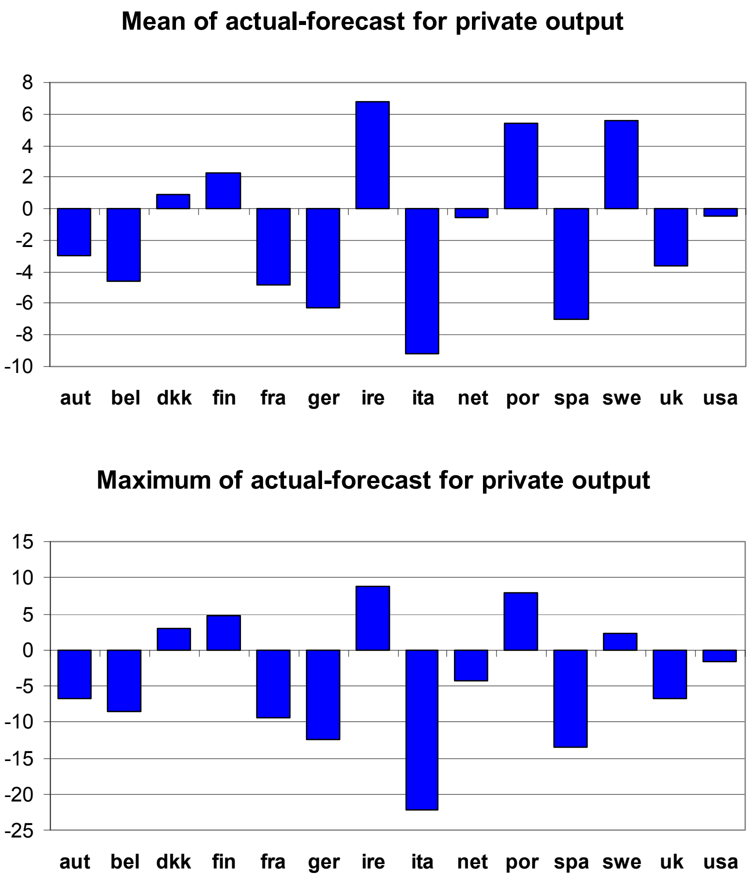


Figure 2.2 **Deviations between actual and forecasted output**



3 Decomposing the growth differences

Given the deviations between actual and forecasted values of GDP, we next discuss possible causes of these deviations. The usual suspect in this context is expenditure on R&D, which proxies the country's resources devoted to technological development. We scale expenditure on R&D (for the total business sector) by GDP, in order to make it comparable across the countries. The data for the variables are derived from the OECD STAN database.[4]

The first exercise which we carry out is the following: We extract the forecast errors from the previous analysis and explain their variation with R&D variables in a panel data set-up. We use least squares estimation with fixed cross-section (country) effects. The residuals are then compared with the original 'forecast errors', shown in Figure 3.1.

Figure 3.1 **Contribution of R&D to forecast errors**

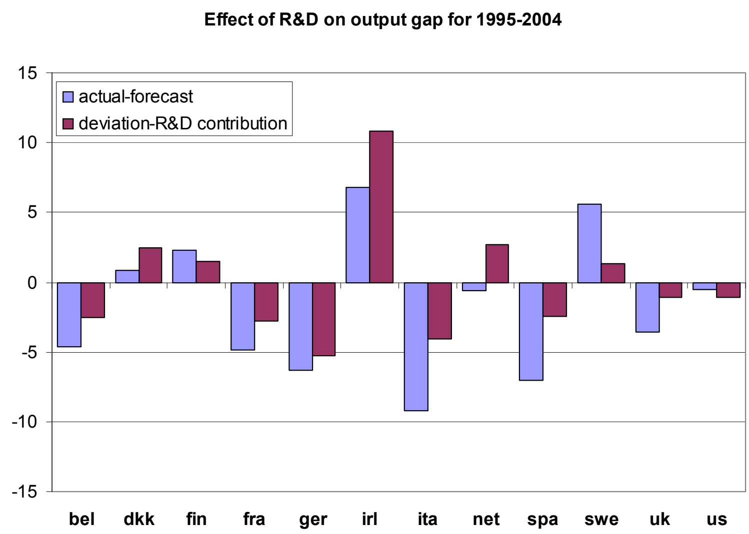


Figure 3.1 suggests that differences in R&D investment intensity across the countries explain roughly one half the deviations ('forecast errors'). In cases like Sweden, almost the whole deviation can be accounted for expenditures on R&D because this expenditure item has been exceptionally *high*. The opposite result is obtained for Ireland, for which the deviation in R&D expenditure is even greater reflecting the fact that Irish R&D expenditures have been exceptionally *low*. But had Ireland invested in R&D in line with other countries, Ireland's (private sector) GDP would have been almost 5 per cent higher. In the case of the US, the

[4] Unfortunately, we havecomparable data on R&D expenditures only for the period 1981–2004 so that we cannot adequately control for R&D for the full sample period. Thus, we can only test the hypothesis that R&D has been particularly important for the last two decades.

deviations remain small but become more negative, reflecting the very high (above sample average) value of the R&D variable.

On the basis of Figure 3.1, we conclude that we have at least tentative evidence suggesting R&D plays a role in separating the good from the bad growth performers relative to their historical records. In order to obtain more definitive results, we turn to econometric analysis.

4 Estimation

4.1 Technical change

We estimate the conventional Cobb-Douglas (C-D) production function with and without the R&D variable.[5] The estimates tabulated in Table 4.1 present both the full sample of 14 countries for the period 1960–2004, and with the R&D variables, a shorter sample (1987–2004) for 12 countries (comparable R&D data are not available for Austria and Portugal). We let the time and cross-section variation total factor productivity be explained by common time trend and possibly by country-specific R&D intensity. The common time trend captures the idea that at least part of the technology is a public good and freely available. It could also capture any other macroeconomic time factors common to all countries of our sample.

The estimated equation reads simply as

$$\log(q_{it}) = a_0 + \alpha\log(l_{it}) + \beta\log(k_{it}) + \tau_t + \psi rd_{it} + \omega ts_{it} + \varphi pat_{it} + u_{it} \qquad (4.1)$$

where i = 1,….14(12) denotes country, t = 1960,…2004 denotes time trend, q is private sector output (value-added), l is employment (number of employees), k is the capital stock, rd_{it} is R&D intensity (business sector R&D expenditure/GDP), ts is a proxy for the openness of the economy (trade share), and finally pat is an indicator for the number of patents (several alternative measures are used). To test the role of the additional variables, we estimate (4.1) by a two-step procedure. First, we estimate the production function. Second, using the estimated parameters we derive the Solow residual and use it as a dependent variable in the regressions where the set of explanatory variables includes t, rd, ts, pat, and the cross-terms of rd, ts and pat. The data for R&D, trade share and patents are displayed in Figures 4.1–4.3.

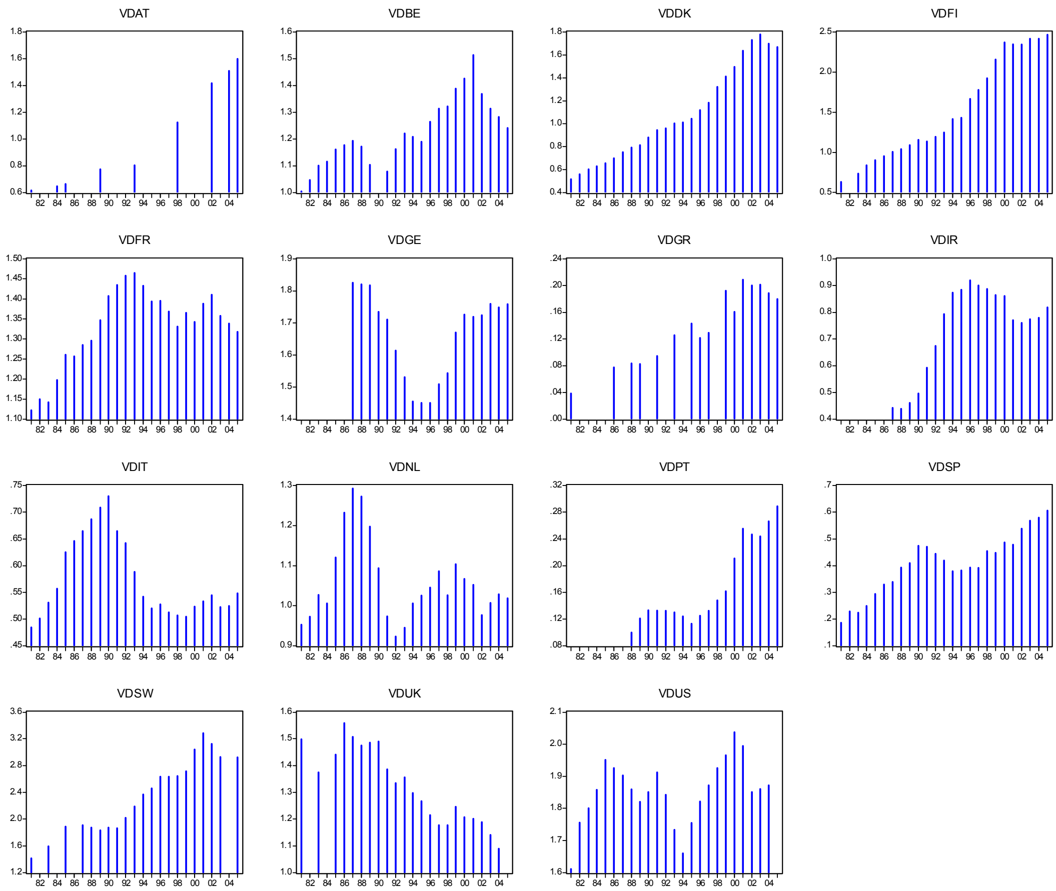
[5] See eg Aghion and Howitt (1998, 2005) and Grossman and Helpman (1991) on the discussion of R&D accumulation, output and productivity.

Table 4.1 **CD estimation results**

Dependent variable	1	2	3	4	5	6	7	8	9
α	.607 (19.25)				.610	.610	.610	.610	.610
1−α		.394 (10.33)	.444 (12.98)	.257 (7.18)					
β	.614 (19.75)				.390	.390	.390	.390	.390
τ	by country			.011 (14.19)	by country	by country	by country	by country	by country
ψ				.104 (12.91)	.019 (4.37)	-.001 (0.22)	.022 (4.06)	.005 (0.51)	.021 (2.36)
ω						.171 (8.99)	.198 (10.97)	.131 (3.17)	.191 (5.06)
φ						.015 (19.57)	.005 (5.78)	.008 (2.92)	.004 (4.35)
rd*ts								-.019 (0.68)	-.001 (0.04)
pat*ts								.018 (2.70)	.009 (2.20)
Estimator	LS,FE	LS,FE	GLS,FE	GLS,FE	SUR,FE	SUR,FE	SUR,FE	SR,FE	SUR,FE
R2	0.990	0.255	0.298	0.976	0.993	0.995	0.994	0.995	0.993
SEE	0.036	0.019	0.019	0.037	0.901	0.947	0.938	0.949	0.942
DW	0.278	1.537	1.547	0.390	1.518	1.542	1.496	1.544	1.474
Dep.var	log(q)	Δlog(q/L)	Δlog(q/L)	Log(q/l)	SR	SR	SR	SR	SR

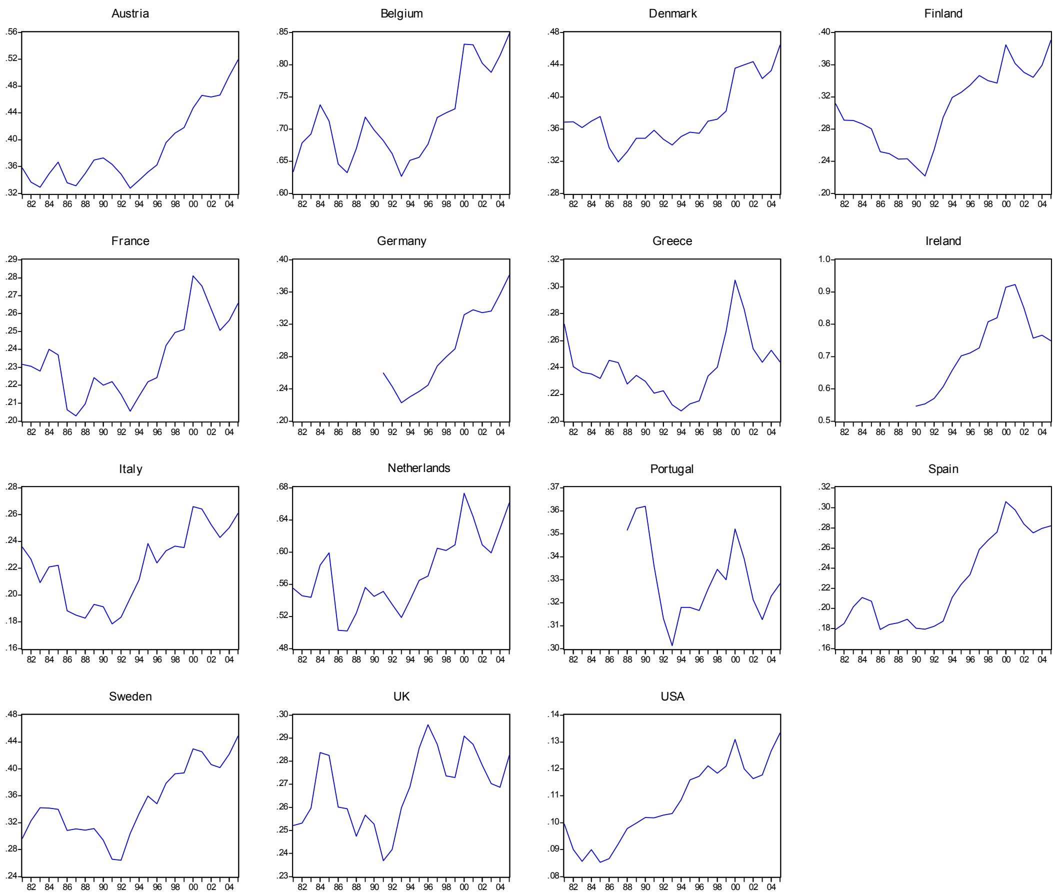
The dependent variables is log(q). τ is the coefficient of time trend, ψ the coefficient of the R&D variable (rd), ω the coefficient of the openness variable (ts), and φ the coefficient of the patent variable (pat). rd*ts and pat*ts represent (the coefficients of) the multiplicative terms of these variables. SR is the Solow residual from equation 2. The number of data points in the level form equation is 548. FE refers to cross-section fixed effects. t-ratios are corrected with the White's procedure. The patent variable is specified so that in equations (6) and (8) it is the number of (triadic) patents relative to total population and in equations (7) and (9) it is the country share of all (triadic patent family) patents.

Figure 4.1 **Data on R&D**



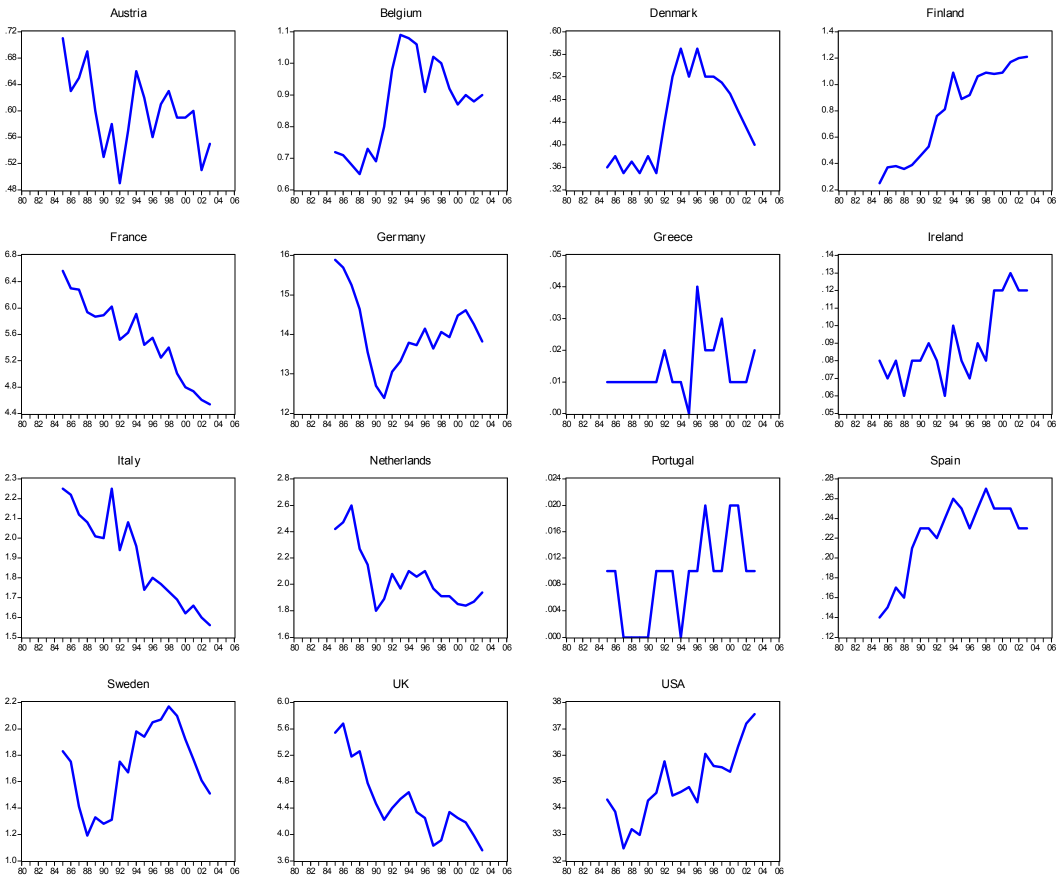
The data represent the percentage share of business sector R&D expenditures of GDP (data source: Eurostat).

Figure 4.2 **Data on openness**



The data represent the share of trade (exports+imports)/2 of GDP (data source: OECD national accounts).

Figure 4.3 **Data on patents**



The data represent country shares of all triadic patents
(data source: OECD Main Science and Technology Indicators 2006-2).

We also estimate the so-called first order conditions in which log(q/l) is regressed against real wage log(w), time trend (t) and possibly the R&D variable (rd), Table 4.2.[6] The benefit of using the latter specification is that we do not need to assume the C-D production structure (in other words, the elasticity of substitution can deviate from unity). This specification takes the form

$$\log(q_{it}/l_{it}) = b_0 + b_1\log(w_{it}) + b_2t + b_3rd_{it} + b_4tt_{it} + b_5pat_{it} + e_{it} \qquad (4.2)$$

The data on average R&D expenditure, productivity and real wages display a fairly strong positive relationship both between the level of R&D and (labour) productivity and (labour) productivity and real wages.

[6] See eg Antras (2004) and Knight et al (1993) on possibilities and problems in testing growth models with panel data.

Table 4.2 **Estimates of first order condition w.r.t. labour input**

Dependent variable	1	2	3	4	5	6	7
low(w)	.503	.863	.473	by year	.429	.510	.493
	(16.26)	(16.01)	(5.09)		(4.47)	(5.25)	(26.09)
T		by year	.012	.005	.011	.010	.011
			(10.27)	(1.09)	(7.65)	(7.07)	(34.92)
rd			.070	.076	.010	.075	.078
			(6.73)	(6.44)	(0.77)	(1.67)	(7.60)
Ts					.351	.581	.568
					(3.61)	(3.54)	(15.54)
Pat					.026	.035	.026
					(4.79)	(1.77)	(6.03)
rd*ts						-.165	-.170
						(1.40)	(6.98)
pat*ts						-.030	-.009
						(0.52)	(0.76)
Estimator	LS, TE&FE	LS,FE	LS,FE	LS,FE	LS,FE	LS,FE	SUR,FE
R2	0.947	0.988	0.927	0.933	0.946	0.947	0.991
SEE	0.059	0.026	0.044	0.044	0.034	0.034	0.033
DW	0.102	0.486	0.145	0.144	0.223	0.238	1.310

The dependent variable is log(q). Number of data points is 453 when the RD variable is not included. When it is included, the number is 276. FE refers to cross-section fixed effects and TE to period fixed effects. t-ratios are corrected using White's procedure. The patent variable (pat) is here specified as number of patents/population.

The estimation results can be summarized as follows. In the case of the C-D production function, the estimates are generally reasonable and in line with the literature, especially when we use the first order log differences and impose constant returns to scale. The typical factor shares roughly represent the values 0.6–0.4 for labour and capital respectively.

When the RD variable is introduced into basic production function estimation (equation 4.1), it is always statistically significant. The coefficient (semi-elasticity) is estimated at roughly 0.1. In other words, if R&D intensity is increased by one percentage point, private sector productivity growth will increase by 0.l per cent. This result is thus in line with the tentative findings of the previous section.

This is not, however, the full story for the RD variable. If we introduce two additional variables (and their cross-terms), trade share (ts) and number of patents (pat) the coefficient of RD decreases considerably. In fact, we cannot reject the hypothesis that the coefficients of the R&D variables are zero. In contrast, the openness and patent variables turn out to be highly significant. This suggests that while R&D investments seem to pay off it is far more important that these investments produce useful innovations, ie patents. Moreover, we find that the importance of patents is magnified by the openness of the economy, since the cross-term between openness and patent variable is positive and significant. (See equation (9) in Table 4.1).

Turning to estimation results from equation (4.2), we conclude that the coefficient of the R&D variable alone is again statistically significantly different from zero. This is true even when the coefficient of the real wage variable is allowed to change over time, ie letting the elasticity of substitution be time variant. Even in this case, the coefficient of the R&D variable has a reasonably large coefficient and a high t-ratio.[7] This finding is not surprising given previous empirical evidence on the role of R&D (cf. eg Jones and Williams, 1997). Again, we find that the openness and patent variables have statistically significant effects, even to the extent that they seem to out-perform the direct R&D effects. In this latter specification, only the cross terms of R&D, patents and openness become insignificant. In fact, signs are even negative.

4.2 Variable elasticity of substitution

Different degrees of substitutability between capital and labour may provide an explanation why some countries have different technical progress than others regardless on how much they actually invest on technological development. As shown by Klump and De La Grandville (2000), when the two countries start from common initial conditions, the country with the higher elasticity of substitution will always reach a higher per capita income.[8,9]

Moreover, the elasticity of substitution does not need necessarily to be equal to constant, as imposed by the estimation of Cobb-Douglas production function in the previous section.[10] Miyagiwa and Papageogiou (2007) show that in a multi-sector economy, the elasticity of substitution does not appear to be constant, but positively related to the capital-output ratio as a market equilibrium condition. Saam (2006), in turn, shows that the elasticity of substitution is positively related the openness of trade. The important thing is – irrespectively of the mechanism

[7] Due to autocorrelation, the t-values obviously do not follow the t-distribution.

[8] Ky-Huyang (1991) find some support for the Klump – De La Grandville hypothesis (2000) using data for South Korea and the US.

[9] Klump and Preissler (2000) discuss a relationship between elasticity of substitution of the economy and the overall flexibility of production and markets, readiness to make structural and institutional changes and so on.Elasticity of substitution between factors of production suggests itself as a reasonably good indicator of overall structural flexibility of the economy.

[10] Willman (2002) points out that after increasing strongly in the 1970s, the share of labour income in GDP in the euro area decreased continuously in the two subsequent decades. This suggests that Cobb-Douglas production function might not be an appropriate choice for production analysis. Furthermore, Duffy and Papageorgiou (2000) report relatively large differences in factor shares across the countries.

behind the change of elasticity of substitution – that the higher elasticity leads to higher output.

In what follows, we next estimate attempt to estimate CES production function and see whether there is some evidence on time varying elasticity of substitution. It turns out that the results are rather sensitive on the assumption on the nature of technical change.

If the rate of technical change is allowed to change over time (Figures 4.4, 4.5) we obtain the result that the elasticity of substitution has been almost constant over time (and declining rather than increasing).

Instead of relying on the first order condition, another common used way of estimating the elasticity of substitution is to rely on a CES production function. Unfortunately, it is almost impossible to compute a nested model, where both the elasticity of substitution and the rate of technical change are allowed to change freely over time. However, we can estimate the usual CES production function but allowe the elasticity of substitution parameter depend linearly on time. In other words, we can write

$$q_{it} = A(\alpha(l_{it}e^{\pi t})^{-\rho} + (1-\alpha)k_{it}^{-\rho})^{-\theta/\rho} \tag{4.3}$$

where $\rho = -\rho_0 - \rho_\Delta t$ and A is a usual shift factor for the production function. Parameter ρ_Δ captures the trend-like behaviour in the elasticity of substitution, α is the 'share parameter' and θ is the scale parameter. The idea that the elasticity of substitution could vary over time is by no means new. It has already been proposed by Revankar (1971). Revankar's VES production function is based on an assumption that the elasticity of substitution depends on the capital-output ratio. The VES specification has been tested in several occasions with somewhat mixed results (see, eg Kragiannis, Palivos and Papgeorgiou, 2004). We did also estimate a VES model from the panel data and found strong evidence against constant elasticity of substitution. It turned out, however, that the relationship between the elasticity of substitution and capital labour ratio (k/l) is not very robust.[11]

Thus, we concentrate here on the estimates of the 'traditional version' of the CES production function. The corresponding results are reported in Table 4.3. The estimated time-varying elasticity of substitution parameter, based on equation (4.3), is presented in Figure 4.6.

[11] During the latter half of the sample, the coefficient of k/l was not significant. When estimating the VES production function we seem, in general, to have problems in identifying the effect of technical change and the effect of changing elasticity of substitution. This is because the capital-output ratios show an upward trend in all countries included in our sample. Consequently, various combinations of the technical change and substitution parameters produce almost identical error variance.

The estimation results are reasonable – particularly when the data are normalized with country-specific sample average values. The only somewhat alarming aspect of the results is that the initial estimate of the elasticity of substitution is very low – of the magnitude of 0.5. Although the estimated elasticity of substitution seems to increase over time it is still lower than one might expect on the basis of previous findings (eg Willman, 2002, Antràs, P, 2004) and what would constitute a reasonable level of substitution. Moreover, the elasticity of substitution parameters are estimated imprecisely, so that the 95% confidence intervals include values which are clearly unrealistic. Given these findings, the evidence on time varying – and especially increasing – elasticity of substitution is not very compelling.[12]

Table 4.3 **CES estimation results**

Parameter	1	2	3	4
A	.739	760	.772	909
	(19.72)	(12.36)	(11.87)	(45.14)
α	.667	.597	-.563	.481
	(4.21)	(2.56)	(2.47)	(12.83)
φ	.0208	.019	.018	-.005
	(21.35)	(10.66)	(5.72)	(3.42)
ρ_0	1.399	1.098	.896	1.648
	(1.12)	(0.85)	(0.66)	(3.71)
ρ_Δ		-.010	-.011	-.037
		(0.37)	(0.40)	(3.00)
Θ			1.014	1.254
			(19.90)	(234.31)
σ	.416	.601	.719	1.027
R2	0.916	0.916	0.917	.996
SEE	0.105	0.106	0.105	0.131

The data is normalized with individual country sample averages in the case of columns (1)–(3) and with panel average values in the case of column (4). The number of data points is 548. σ denotes the (maximum) value of the elasticity of substitution. Numbers inside parentheses are unadjusted t-ratios.

[12] See eg Jones (2003 and 2005) for possible explanations for the poor performance of CES in the cross-country data. Jones's explanation is that the short-run elasticity of substitution might greatly deviate from the long-run (unitary) elasticity.

Figure 4.4 **Time-varying technical change in EU countries**

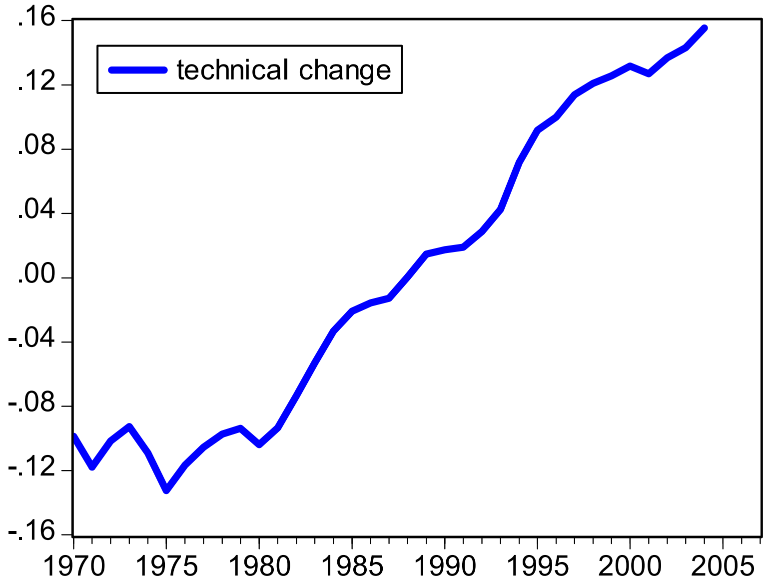


Figure 4.5 **Time-varying technical change and elasticity of substitution**

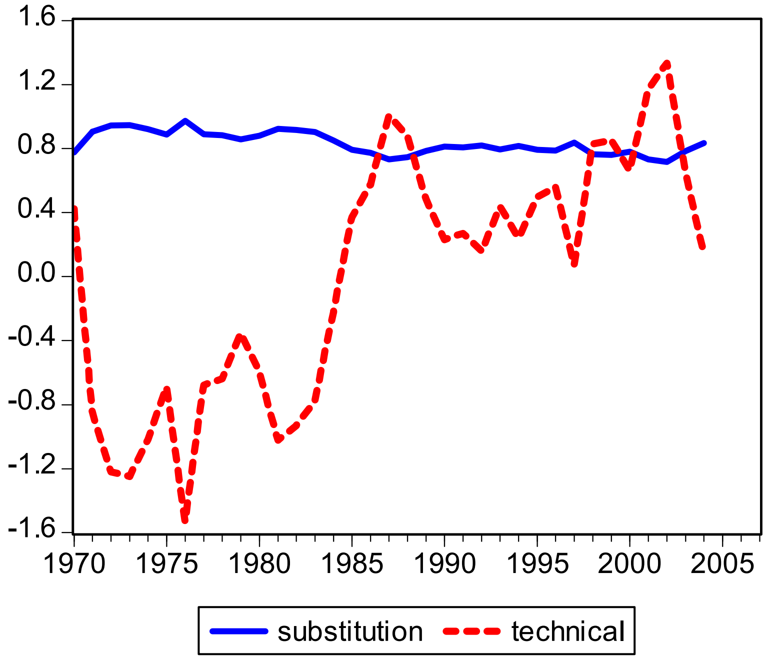
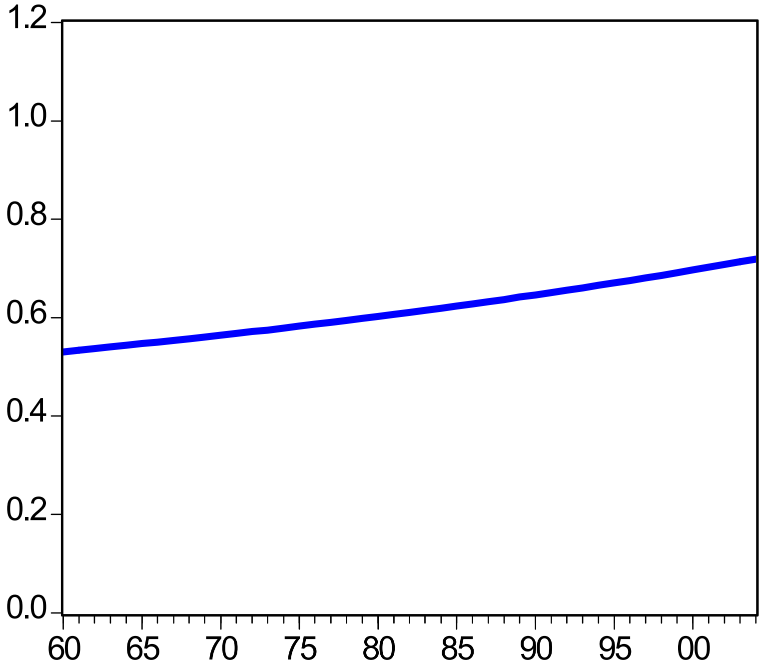
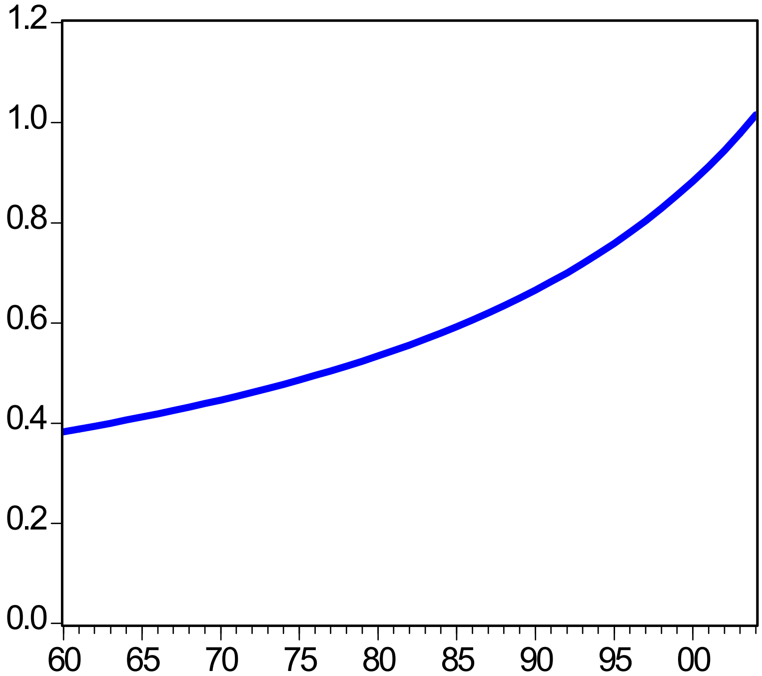


Figure 4.6 **Elasticity of substitution estimates**

Elasticity of substitution: individual country normalization



Elasticity of substitution: panel data average normalization



5 Concluding remarks

The differences in growth performance for the selected OECD countries during the last decade or so are persistent and widespread. A large part of these differences can readily be explained by capital deepening and economic converging. The remaining part, which distinguishes between the good and bad performers, can be explained by evaluating their relative performance in terms of resources devoted to R&D and in fact by capacity to produce new technological innovations in the form of new patents. This view is based on the estimation results of this paper, suggesting that the Solow residual is largely explained by the intensity of R&D investment and beyond that ability to produce useful innovations (here gauged by triadic patents per capita). Furthermore, in an open economy framework, the benefits of R&D and patents seem to be much larger, as suggested by our finding of a positive cross-effect of triadic patents and openness of the economy.

It seems that there are unused opportunities – especially on the European side – for keeping up with the historical growth record, as the US has done, by appropriate structural policies. In particular, the poor growth performers like Germany and Italy seem not to have used the opportunity to speed up technical change by investing in the R&D. Many small countries like the Nordics and Ireland represent the other extreme, having performed better than their historical record would have predicted.

Even though the role of R&D is dominant, we cannot exclude the possibility that structural flexibility has also contributed to changes in productivity. Increased economic flexibility and investment in innovations need not be excluded alternatives for boosting economic growth: they may well be complements. Thus, investment in R&D may benefit from increased flexibility of the whole economy. In fact, the positive role of openness that is found in this study may just reflect this property. In this respect out results are consistent with Saam (2004, 2006) who shows that increased openness and increased elasticity of substitution can affect economic growth in a similar way. Testing for this possible complementarity hypothesis could indeed be challenging task for future research. Increased globalization and development of a single market in Europe would, however, easily motivate the efforts.

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