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The Celtic Tiger In Historical And International Perspective

Nicholas Crafts

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THE CELTIC TIGER IN HISTORICAL AND INTERNATIONAL PERSPECTIVE

NICHOLAS CRAFTS

(University of Warwick)

Abstract

When *Economic Development* was published in 1958, Ireland was a growth failure but thirty years later it became the Celtic Tiger. This paper places this remarkable development in the context of long-run economic growth in Western Europe and establishes the distinctive features of Irish experience and policy. This enables an assessment of the diagnosis and policy proposals that Whitaker provided fifty years ago. The central roles in the Celtic Tiger of foreign direct investment, ICT production, and an elastic labour supply are highlighted while the importance of globalization and the abandonment of misguided autarchic policies is made clear.

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1. Introduction

When *Economic Development* was published in 1958 there was good reason to worry both about Ireland's economic performance and its economic prospects. While most western European countries were enjoying rapid economic growth Ireland was falling well behind the leaders. With an industrial–relations structure based on strong but de-centralized collective bargaining, Ireland was not in a position to follow the corporatist path to rapid catch-up growth based on wage restraint in return for high investment which prevailed in much of Europe. As a small, inefficient, and still quite agricultural economy on the periphery, there were good reasons to fear the consequences of moves to free trade within Europe.

Fast forward to 2007 and Ireland had overtaken all European economies except Luxembourg in terms of real GDP per person and had just emerged from the Celtic Tiger period of economic growth. This phase had seen Ireland take off into a growth trajectory predicated on taking up the opportunities of globalization and the ICT era. Between 1987 and 2007, under the auspices of social partnership, real GDP per person grew at 5.6 per cent per year, comparable with the fast-growth economies of East Asia and far ahead of any other European country.

This paper seeks to place these contrasting experiences firmly in the context of the postwar European experience of economic growth. Obviously, it is important to understand how the tortoise achieved metamorphosis into the hare but it is also instructive explicitly to consider why Ireland under-performed relative to its European peer group during the Golden Age and then out-performed in the late twentieth century. This will allow some reflections on the diagnosis and remedy set out in *Economic Development* informed also by ideas taken from modern growth economics.

2. Irish Growth in the European Golden Age

The years 1950 to 1973 are conventionally known as the Golden Age of European economic growth. It is important to recognize that this was throughout a period of growth failure for Ireland. By 1973 Ireland had sunk to the bottom of the west European league in terms of the level of real GDP per person, below even Greece and Portugal. Table 1, in which the countries are ranked according to the level of real GDP per person in 1950 and which shows a strong inverse correlation between initial income and subsequent growth, gives a sense of the magnitude of the growth shortfall. Comparison with Austria and Italy suggests that growth of real GDP per person at 5 per cent per year rather than 3 per cent per year was par for the course and that the income of level of 1973 might have been at least 50 per cent higher.

A further insight into this disappointing growth performance can be obtained using growth accounting to examine the sources of Irish labour productivity growth, a technique which is particularly useful for benchmarking comparisons across countries. Table 2 reports results from an exercise of this kind carried out by Bosworth and Collins (2003). Compared with other relatively-low income economies of the time, Ireland in the 1960s had a shortfall in each of the sources of labour productivity growth but education does not make much difference. Weaknesses in investment and, especially, total factor productivity (TFP) growth

are highlighted as the key problems.¹ Table 3 reports that Ireland in 1960 had a low level of TFP by European standards. This appears to have been primarily due to inefficiency rather than lack of access to appropriate technology and, moreover, Ireland shows up as inefficient relative to its peer group. Tables 2 and 3 taken together suggest that 1960s Ireland was rather slow to address its efficiency gap.

Modern growth economics based on the key concept of endogenous innovation would predict that inferior TFP performance would be a consequence of incentive structures, perhaps with regard to high direct taxation or inadequate competition, that were less conducive to innovation and cost reduction than elsewhere (Aghion and Howitt, 2006). This suggests that supply-side policies left something to be desired and the most plausible culprit is excessive protectionism given that Ireland was slow to embrace trade liberalization and had effective protection levels that were very high compared with its trading partners until the mid-1960s (Barry, 2008). It is less obvious that Ireland was exposed to unduly high direct taxation given that direct tax revenues were only about 12 per cent of GDP.

The diagnosis that T. K. Whitaker offered in 1958 in *Economic Development* was very much along these lines. He noted that Irish infant industry policies had failed, stressed that lower Irish tariffs would increase efficiency and productivity, and argued for the abolition of controls on foreign ownership of Irish industry. He also prioritized a reduction on income and profits taxes as a key requirement. Whitaker emphasized that productive investment was too low but his analysis was distinctly not based on the 'capital fundamentalism' that was fashionable among economists at the time. Rather, he argued that the dynamic might be found from faster TFP growth which would feedback to investment.² This is a stance of which Aghion and Howitt would approve.

Fully exploiting the potential for catch-up growth also depended on raising investment and the rate of capital deepening. Here, it is important to note an omission in the analysis of *Economic Development* that is highlighted by comparison with high-growth European countries. Eichengreen (2006) argues that, in these economies, state corporatism underwrote a co-operative equilibrium between capital and labour that delivered high investment in return for wage restraint.³ This was clearly not a path followed by Ireland with its tradition of strong but de-centralized collective bargaining (Crouch, 1993).

Whatever the merits of Whitaker's analysis, Ireland's growth performance continued to disappoint throughout the Golden Age. Trade liberalization began, corporate tax reforms were introduced and inward technology transfer was encouraged with the new pro-FDI policy stance consolidated by the establishment of the Industrial Development Agency in 1969. But

¹ An alternative accounting exercise based on a growth-regression technique points even more strongly in this direction, see Crafts and Toniolo (1996) Table 1.14.

² Whitaker did not use this terminology but it is clear that the things that he points to as releasing the dynamic would show up in a larger Solow residual: "A dynamic has to be found and it is not necessarily increased capital investment, though this may be called for to support a higher rate of development once it is set in motion...there are other conditions of economic progress no less important...a raising of the general level of education, health and skill, the loosening of restrictive practices, whether of employers or employees, the practical encouragement of initiative and enterprise, the adoption of improved methods, techniques and principles of organisation and management both in agriculture and industry, and a greater readiness to apply scientific advances" (Ireland, Department of Finance, 1958, p.7).

³ In an Aghion and Howitt-type growth model incentive structures that raise the investment rate also have an indirect positive effect on TFP growth.

growth regressions performed for the Crafts and Toniolo (2008) survey paper suggests that, if anything, Golden-Age Irish under-performance was slightly worse after 1960 than before.

3. The Transition to the Celtic Tiger

Economic Development clearly pointed the way in that it argued that Ireland must seize the opportunities arising from trade liberalization and foreign industrialists coming to Ireland would be a vital source of technology transfer. A recent econometric study concluded that income per person in Ireland in 2000 was 25.9 per cent higher than if economic integration had remained at its 1950s level (Badinger, 2005). Moreover, as everyone recognizes, export-platform foreign direct investment (FDI) was central to transition to fast growth. Ireland became extremely successful in attracting FDI and low corporate taxation was the most important reason for this (Gropp and Kostial, 2000). Beyond this, Ireland developed a sophisticated policy framework to select projects for financial support, and made complementary investments in education and infrastructure (Buckley and Ruane, 2006).

Table 4 reports estimates of the stock of American FDI per person. These show that in 1968, just before the establishment of the Industrial Development Agency, Ireland was on a par with EU countries generally but well below the UK. In 1986, on the eve of the growth take-off, Ireland had almost twice as much US FDI per person as the UK and almost 6 times that in other EU countries. By the end of the Celtic Tiger period, the ratios were 3 times and almost 9 times, respectively.

FDI increasingly clustered in high-tech sectors associated for example with information technology and pharmaceuticals and a quite new revealed comparative emerged based on these foreign-owned industries rather than specialization based on Ireland's strengths in agriculture, food processing etc. which is what *Economic Development* envisaged. This is important because trade liberalization might reasonably have been seen as risky for a small peripheral economy with industry centralizing in the European core and divergence rather than convergence of incomes as can result when economies of scale based on agglomeration dominate location decision at intermediate levels of trade costs (Krugman and Venables, 1990). In the event, tax advantages were enough to outweigh market-access considerations in key sectors with high productivity growth and overcome the dangers of which new economic geography warns (Barry, 1996) and regression analysis suggests that the penalty of distance from the centre for European income levels halved in the second half of the 20th century (Crafts and Toniolo, 2008).

There was, however, more than this to preparing for the Celtic Tiger. The Social Partnership inaugurated in 1987 delivered wage restraint in return for tax cuts and, in some ways reminiscent of the Eichengreen hypothesis, the advent of centralized wage bargaining promoted investment (Baccaro and Simoni, 2007). Ireland's late conversion to a social contract implied the absence of the corporatist legacy of high taxation and strict regulation common elsewhere in 1980's Europe. Enhanced investment in human capital was also apparent – the contribution of human capital deepening to labour productivity growth almost doubled to 0.38 percentage points per year in 1970-1990 (Bosworth and Collins, 2003) – and this was central to a lower equilibrium level of unemployment (Bergin and Kearney, 2004).

In sum, these developments implied that unemployment could fall dramatically from the 1987 rate of 17.5 per cent. Together with the responsiveness of migration flows to faster

growth, these developments ensured that Ireland had an elastic labour supply and paved the way for rapid employment growth during the Celtic Tiger period. This implies that catch-up growth would be much less vulnerable to diminishing returns to capital accumulation than would normally be expected (Barry, 2002). The implication of this analysis is that the labour market matters to the growth process and that malfunctioning of the labour market had been a constraint on Irish growth, something which was not really appreciated when *Economic Development* was written in 1958.

4. The Celtic Tiger from an International Perspective

This idiosyncratic transition path meant that Irish growth during the Celtic Tiger period exhibited a number of special features that made it rather unusual compared with its western European peer group. An implication of this is that comparisons of Irish performance need to be carefully handled. It should also be recognized that while the sui-generis nature of Celtic Tiger growth does reflect the success of the supply-side policies that Ireland implemented it also means that Ireland is not really a role model for others to follow.

It is generally agreed that recent Irish growth is better measured on a GNP- rather than GDP-basis because this leaves out the huge flow of repatriated profits of multinational companies which are inflated by transfer pricing encouraged by the generous corporate tax regime (Cassidy, 2004).⁴ Ireland is a very trade-oriented economy with exports equal to 101 per cent of GNP in 2003 and those exports have been concentrated in products whose prices have been falling. The merchandise terms of external trade fell by about 10 per cent between 1987 and 2003, which means that real national income grew more slowly than real GNP by about 1 per cent per year (Crafts, 2005). This does not detract from the fact that Celtic-Tiger growth was remarkable but it does mean that the usual basis for international comparisons, namely, real GDP per person exaggerates growth Irish real national income per person by about 1.5 percentage points per year.

As was reported in Table 4, Ireland attracted a disproportionate amount of FDI. A very important corollary was that Ireland built up a much bigger ICT-production industry, the sector which experienced phenomenal technological progress and productivity growth at this time. Not surprisingly, TFP growth in this sector dominated in the latter part of the Celtic-Tiger period but it is also the case that TFP growth in the rest of the Irish economy was not particularly impressive, although inefficiency levels did fall quite sharply through the mid-1990s.⁵ On the other hand, employment growth was quite spectacular by European standards averaging 3.2 per cent per year during 1987 to 2003 compared with population growth of 0.7 per cent per year and this was a major reason for rapid per-capita economic growth.

In 1987, Ireland was still at the bottom of the western European income-levels league table. Over the next 16 years, growth of real GNP per person averaged just over 5.5 per cent per year, as Table 5 reports. This growth rate would have been highly respectable during the Golden Age, was easily the highest in Europe in this period, and was more than twice that achieved in the other low-income European economies.

⁴ Accordingly, Tables 5 to 7 use GNP rather than GDP for Ireland.

⁵ The estimates in Jerzmanowski (2007), on a similar basis to those reported above in Table 3, show Irish efficiency at 0.61 in 1985 and 0.76 in 1995.

The sources of this exceptional growth performance and the special features of Irish growth can be quantified using growth accounting. Table 6 shows the standard breakdown for labour productivity growth. Here there are two points to note with regard to comparisons with other European countries. First, while Ireland's labour productivity growth was the highest in Europe in this period, it was not nearly as far ahead of the pack as was real GDP per person. Second, TFP growth was the highest in Europe and accounted for about three-quarters of labour productivity growth whereas the contributions of physical and human capital per worker were below the European median.

Table 7 accounts for the sources of output growth rather than productivity growth. Again, two points of comparison with the European peer group are worth highlighting. First, the exceptional contribution made by employment growth stands out. Only in Spain, where labour market reform also played a significant role, is there a remotely similar contribution from labour inputs. Second, unlike Spain, Ireland succeeded in combining a very strong contribution from employment growth with a high rate of labour productivity growth, based on strong TFP growth. Tables 6 and 7 also allow comparison of the Celtic Tiger with the Asian Tigers. There is a strong similarity in terms of the contribution from labour inputs growth. But, in other respects, the differences are striking. Ireland has much superior TFP growth but has a much weaker contribution from capital inputs growth than the Asian Tigers which have been renowned for their formidable shares of GDP devoted to investment, whereas the Irish investment rate over these years averaged just under 20 per cent of GDP.

Finally, Table 8 quantifies the role of TFP growth in the ICT production sector. It is immediately apparent that Ireland was truly exceptional in this regard.⁶ Even compared with Finland, the ICT production sector was very big in Ireland in this period and it is clear that TFP growth was dominated by ICT production in Ireland to a much greater extent than elsewhere. This has two important implications which are quite unusual, namely, that TFP growth was principally delivered by the technology transfer of multinational companies and that a large part of the benefits of this TFP growth accrued to foreigners as it fed into lower prices for the exports which comprised the vast majority of the sector's sales.

Ireland's growth during the Celtic–Tiger period was exceptional. It was driven by FDI and a very elastic labour supply. This reflected the good policy framework that had been assembled over the previous thirty years and the much greater openness this entailed. However, the implications of openness for growth depend on the specialization that results and the productivity growth potential in the exportables sector. In this Ireland was blessed with good luck in terms of the remarkable technological progress which transpired in ICT production. And other countries may not have the same scope for employment to expand in response to improved supply-side policy. So, while Ireland's growth record has lessons for other countries and students of endogenous–growth economics, there is a strong *sui-generis* flavour about the Celtic Tiger.

5. *Economic Development Revisited*

Economic Development had several important messages which subsequent history has shown to be absolutely right. The basic insight was that if the opportunities of openness were seized

⁶ The estimates in Table 8 are in terms of GDP and are therefore distorted by the transfer–pricing issue discussed earlier. This clearly affects the detail but not the general thrust of the discussion.

independence would be vindicated in economic terms. The central vision was optimistic and rather like that of modern growth economics – establish appropriate incentive structures and faster growth would ensue. The suggestion that the dynamic might come from TFP growth, rather than requiring a massive investment, rate was prescient. And the arguments in favour of low corporate taxation and FDI as a key mode of technology transfer pointed to the path to the Celtic Tiger that Ireland followed.

Clearly, there was much that Whitaker could not foresee in 1958. The transformation of Irish exports, the way in which the potential disadvantages of peripherality were overcome, and the magnitude of the eventual boost to the growth rate must all have been pleasant surprises. Moreover, the analysis in *Economic Development* did not really encompass the social–partnership and labour–supply issues that were central to the rapid employment growth that was eventually such a distinctive feature of the Celtic Tiger.

The Celtic Tiger was, of course, predicated on globalization. It is in this context, rather than the trade–restrictive and capital–immobile mid–20th century that independence could really pay off. In 1958, it must have seemed that independence had done nothing for Irish economic development. Fifty years later, as Whitaker hoped, that view has clearly been refuted. After all, the key policy instrument which underpinned the transition to fast growth, a low corporate tax rate to attract FDI, was an option that would not have been available under British rule.

References

- Aghion, P. and Howitt, P. (2006), "Appropriate Growth Policy: a Unifying Framework", *Journal of the European Economic Association*, 4, 269-314.
- Baccaro, L. and Simoni, M. (2007), "Centralized Wage Bargaining and the 'Celtic Tiger' Phenomenon", *Industrial Relations*, 46, 426-469.
- Badinger, H. (2005), "Growth Effects of Economic Integration: Evidence from the EU Member States", *Review of World Economics*, 141, 50-78.
- Barry, F. (1996), "Peripherality in Economic Geography and Modern Growth Theory: Evidence from Ireland's Adjustment to Free Trade", *The World Economy*, 19, 345-365.
- Barry, F. (2002), "The Celtic Tiger Era: Delayed Convergence or Regional Boom?", *ESRI Quarterly Economic Commentary*, 84-91.
- Barry, F. (2008), "Politics, Institutions and Postwar Economic Growth in Ireland", *CESifo Forum*, 9(1), 23-34.
- Bergin, A. and Kearney, I. (2004), "Human Capital, the Labour Market and Productivity Growth in Ireland", ESRI Working Paper No. 158.
- Bosworth, B. P. and Collins, S. M. (2003), "The Empirics of Growth: an Update", *Brookings Papers on Economic Activity*, 2, 113-206.
- Buckley, P. and Ruane, F. (2006), "Foreign Direct Investment in Ireland: Policy Implications for Emerging Economies", *The World Economy*, 29, 1611-1628
- Cassidy, M. (2004), "Productivity in Ireland: Trends and Issues", *Central Bank of Ireland Quarterly Bulletin*, Spring, 83-105.
- Crafts, N. (2005), "Interpreting Ireland's Economic Growth", background paper for UNIDO, *Industrial Development Report*.
- Crafts, N. and Toniolo, G. (1996), "Postwar Growth: an Overview", in N. Crafts and G. Toniolo (eds.), *Economic Growth in Europe Since 1945*. Cambridge: Cambridge University Press, 1-37
- Crafts, N. and Toniolo, G. (2008), "European Economic Growth, 1950-2005: An Overview", CEPR Discussion Paper No. 6863.
- Crouch, C. (1993), *Industrial Relations and European State Traditions*. Oxford: Clarendon Press.
- Eichengreen, B. (2006), *The European Economy Since 1945*. Princeton: Princeton University Press.
- Groningen Growth and Development Centre (2008), *Total Economy Database*.

Gropp, R. and Kostial, K. (2000), "The Disappearing Tax Base: Is FDI Eroding Corporate Income Taxes", IMF Working Paper No. 00/173.

Ireland, Department of Finance (1958), *Economic Development*. Dublin.

Jerzmanowski, M. (2007), "Total Factor Productivity Differences: Appropriate Technology vs. Efficiency", *European Economic Review*, 51, 2080-2110.

Krugman, P. and Venables, A. J. (1990), "Integration and the Competitiveness of Peripheral Industry", in J. de Macedo and C. Bliss (eds.), *Unity and Diversity Within the European Economy*. Cambridge: Cambridge University Press.

Maddison, A. (2003), *The World Economy: Historical Statistics*. Paris: OECD.

Timmer, M. and van Ark, B. (2005), "Does Information and Communication Technology Drive EU–US Productivity Growth Differentials?", *Oxford Economic Papers*, 57, 693-716.

van Ark, B., Melka, J., Mulder, N., Timmer, M. and Ypma, G. (2003), "ICT Investments and Growth Accounts for the European Union", Goningen Growth and Development Centre Research Memorandum GD–56.

Table 1. Levels and Rate of Growth of Real GDP/Person in Golden Age Europe
(\$1990GK and % per year)

	<i>GDP/Person, 1950</i>	<i>GDP/Person, 1973</i>	<i>Growth Rate 1950-73</i>
Switzerland	9064	18204	3.08
Denmark	6943	13945	3.08
UK	6939	12025	2.42
Sweden	6739	12494	3.06
Netherlands	5971	13081	3.45
Belgium	5462	12170	3.54
Norway	5430	11324	3.24
France	5271	13114	4.04
West Germany	4281	13153	5.02
Finland	4253	11085	4.25
Austria	3706	11235	4.94
Italy	3502	10634	4.95
Ireland	3453	6867	3.03
Spain	2189	7661	5.60
Portugal	2086	7063	5.45
Greece	1915	7655	6.21

Note: levels are measured in constant prices at purchasing power parity in 1990 Geary-Khamis dollars.

Source: Maddison (2003)

Table 2. Contributions to Labour Productivity Growth, 1960-1970 (% per year)

	<i>Capital- Deepening</i>	<i>Human-Capital Deepening</i>	<i>Total Factor Productivity</i>	<i>Labour Productivity</i>
Switzerland	1.40	0.40	1.37	3.17
Denmark	2.15	0.13	1.25	3.53
UK	1.45	0.17	1.24	2.86
Sweden	1.34	0.19	2.40	3.93
Netherlands	1.43	0.74	0.89	3.06
Belgium	1.36	0.42	2.33	4.11
Norway	1.18	0.48	1.80	3.46
France	2.02	0.29	2.62	4.93
West Germany	2.10	0.23	2.03	4.36
Finland	1.66	0.37	2.64	4.67
Austria	2.39	0.18	2.90	5.47
Italy	2.39	0.36	3.50	6.25
Ireland	1.78	0.22	2.21	4.21
Spain	2.45	0.38	3.73	6.56
Portugal	2.05	0.35	3.99	6.39
Greece	3.63	0.26	4.45	8.34

Note: estimates based on the standard neoclassical growth accounting formula with imposed capital share of 0.35 in all cases; capital-deepening reflects the contribution of investment, human-capital deepening denotes the contribution of improved educational attainment of the labour force, and total factor productivity captures the contribution of improvements in efficiency and technology.

Source: database constructed for Bosworth and Collins (2003) kindly provided by the authors.

Table 3. Decomposition of 1960 TFP Level into Efficiency and Technology Components
(USA = 1.00)

	<i>TFP</i>	<i>Efficiency</i>	<i>Technology</i>
Switzerland	1.05	1.00	1.05
Denmark	0.69	0.68	1.01
UK	0.85	0.89	0.95
Sweden	0.73	0.72	1.01
Netherlands	0.77	0.74	1.04
Belgium	0.65	0.64	1.01
Norway	0.54	0.63	0.86
France	0.72	0.71	1.01
Finland	0.62	0.60	1.04
Austria	0.60	0.64	0.94
Italy	0.67	0.71	0.94
Ireland	0.51	0.55	0.93
Spain	0.64	0.74	0.86
Portugal	0.57	0.66	0.87
Greece	0.49	0.57	0.86

Note: TFP = Efficiency*Technology

Source: Jerzmanowski (2007).

Table 4. Inward US FDI Stock/Person (\$)

	<i>Ireland</i>	<i>UK</i>	<i>Rest of EU15</i>
1968	42.9	120.2	39.6
1986	1241.2	628.4	212.6
1995	2212.5	1819.9	601.3
2003	14134.3	4536.8	1616.6

Note: measured at historic cost

Source: US, Bureau of Economic Analysis

Table 5. Levels and Rate of Growth of Real GDP/Person during the Celtic Tiger Period
(\$1990GK and % per year)

	<i>GDP/Person, 1987</i>	<i>GDP/Person, 2003</i>	<i>Growth Rate 1987-2003</i>
Switzerland	19792	22267	0.75
Norway	18164	25871	2.24
Denmark	18023	23080	1.56
Sweden	16949	21462	1.49
France	16553	21417	1.63
Germany	16010	19071	1.27
Netherlands	15639	22237	2.22
Belgium	15541	21206	1.96
UK	15393	21415	2.09
Finland	15382	20849	1.92
Austria	15313	21141	2.04
Italy	14946	19091	1.55
Spain	10520	16169	2.72
Greece	9375	13696	2.40
Portugal	9185	13904	2.63
Ireland	8809	20792	5.53

Notes: Germany is for 1989 to 2003, Ireland is GNP/Person.

Source: GGDC (2008).

Table 6. Contributions to Labour Productivity Growth, 1990-2003 (% per year)

	<i>Capital Deepening</i>	<i>Human-Capital Deepening</i>	<i>Total Factor Productivity</i>	<i>Labour Productivity</i>
Switzerland	0.60	0.08	-0.23	0.45
Norway	0.31	0.21	1.81	2.33
Denmark	0.72	0.19	0.95	1.86
Sweden	0.73	0.44	1.16	2.33
France	0.58	0.27	0.13	0.98
Germany	0.76	0.17	0.60	1.53
Netherlands	0.26	0.28	0.07	0.61
Belgium	0.76	0.25	0.26	1.27
UK	0.91	0.41	0.74	2.06
Finland	0.49	0.31	1.49	2.29
Austria	0.86	0.27	0.37	1.50
Italy	0.60	0.38	0.14	1.12
Spain	0.63	0.37	-0.37	0.63
Greece	0.61	0.35	1.25	2.21
Portugal	1.13	0.47	-0.31	1.29
Ireland	0.49	0.26	2.24	2.99
Singapore	1.76	0.85	0.90	3.51
South Korea	2.40	0.50	0.91	3.81
Taiwan	2.67	0.40	1.69	4.76

Note: Ireland adjusted to GNP basis.

Source: update of database constructed for Bosworth and Collins (2003) kindly provided by authors.

Table 7. Contributions to Real GDP Growth, 1990-2003 (% per year)

	<i>Due to Capital</i>	<i>Due to Labour</i>	<i>Total Factor Productivity</i>	<i>Real GDP Growth</i>
Switzerland	0.75	0.35	-0.23	0.87
Norway	0.62	0.78	1.81	3.21
Denmark	0.78	0.29	0.95	2.02
Sweden	0.57	0.15	1.16	1.88
France	0.84	0.75	0.13	1.72
Germany	0.77	0.18	0.60	1.55
Netherlands	1.19	1.01	0.07	2.27
Belgium	0.96	0.63	0.26	1.85
UK	0.99	0.57	0.74	2.30
Finland	0.33	0.02	1.49	1.84
Austria	1.05	0.63	0.37	2.05
Italy	0.70	0.57	0.14	1.41
Spain	1.33	1.66	-0.37	2.62
Greece	0.79	0.69	1.25	2.73
Portugal	1.45	1.06	-0.31	2.20
Ireland	1.75	2.45	2.24	6.44
Singapore	2.62	2.45	0.90	5.97
South Korea	3.08	1.75	0.91	5.74
Taiwan	3.22	1.43	1.69	6.34

Notes: Ireland adjusted to GNP basis; contribution of human capital included in labour.

Source: update of database constructed for Bosworth and Collins (2003) kindly provided by authors.

Table 8. Decomposition of TFP Growth (% per year)

	<i>Finland</i>	<i>Ireland</i>	<i>EU</i>	<i>USA</i>
<i>1990-1995</i>				
TFP Growth	1.23	2.96	1.12	0.61
From ICT production	0.16	1.17	0.14	0.25
Other	1.07	1.79	0.98	0.36
Memo Item				
ICT Domar Weight	2.61	11.73	1.50	2.63
<i>1995-2001</i>				
TFP Growth	2.67	3.61	0.46	0.80
From ICT Production	0.69	3.62	0.27	0.44
Other	1.98	-0.01	0.19	0.36
Memo Item				
ICT Domar Weight	8.26	22.56	2.07	2.96

Notes: ICT Domar Weight is gross output of ICT/GDP (%); EU excludes Belgium, Greece and Luxembourg in 1990-95 and excludes Luxembourg in 1995-2001

Sources: van Ark et al. (2003) and Timmer and van Ark (2005).