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Cultivating Long-Run Economic Growth in the Republic of Ireland

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ABSTRACT

New ideas and their subsequent diffusion are the ultimate source of long-run quality of life improvements. In many respects the stories of economic growth and human history are the stories of technological change and changing beliefs and ideas. Economic growth comes from the accumulation of labour and capital inputs combined with improvements in the productivity of labour and capital arising from on-going scientific progress and technological change.

Sustainable growth in per capita economic output depends on improving labour productivity. This paper discusses the Irish economy's recent growth performance and considers its medium-and-long-term prospects for growth. A range of policy reforms to increase the economy's long-run potential output are identified. The best way to sustain productivity growth is to increase investment in education and skills, particularly early years learning; to increase investment in the production, diffusion and use of new ideas, and to increase investment in productivity enhancing infrastructure. Human capital is a complement to innovation and technological progress and is therefore fundamental to economic change. A country or region's innovative capacity is a function of education levels; the cost of knowledge; the quality of capital markets and government policies that support R&D. Investment in infrastructure is associated with long-run increases in productive capacity. Where capital markets are not well-functioning there is a strong case for a state investment bank to provide patient long-term finance to support innovative effort and technology diffusion.

The use of tax incentives as a tool of public policy is cautioned against. In general, tax incentives negatively affect growth by distorting allocative efficiency, by creating inefficiencies in production and consumption, and by diverting economic activity toward rent-seeking behaviour. The use of subsidies is also argued against. In general, subsidies for home ownership, business and agriculture are deleterious to long-run growth because they skew economic activity and distort resource allocation. There may be exceptions. For example, subsidies to childcare would increase potential output by incentivising the labour force participation of second earners and lone parents. This in turn would increase the effective size and quality of the available workforce while retaining valuable human capital. Similarly, carefully designed tax incentives for R&D activity can be justified given potential for market failure in the production of knowledge and for productivity gains from knowledge spillovers.

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* This working paper is the first of a series on economic growth. The author gratefully acknowledges helpful feedback from a number of reviewers. The usual disclaimer applies. All correspondence to tom.mcdonnell@nerinstitute.net

Policies for Long-Run Economic Growth in the Republic of Ireland

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1. INTRODUCTION

At the time of writing the Irish economy is recovering from a severe economic crisis. The high annual rates of economic growth seen in 2014 and 2015 are unlikely to be sustained for long. Such high growth rates partially reflect a rebound in domestic demand towards levels more reflective of the domestic economy's productive capacity. This is inherently a short-term effect. Long-run economic growth is the central concern to policymakers as the extent of quality of life improvements in future years depends on the ability of the economy to grow sustainably in the long-run. More precisely, quality of life improvements depend on the ability of the economy to produce and diffuse new innovations and to find ways to use capital and labour more efficiently. There is great uncertainty about future growth rates and heated debate about the type of policies we should pursue. This paper aims to inform that debate and considers a non-exhaustive set of policy reforms designed to collectively increase the Irish economy's long-run productive capacity.

The standard of material wellbeing for most people living in advanced economies today is superior in almost every respect to the living standards of even the wealthiest people just one hundred years ago. A simple consideration of developments in health, nutrition, education, communication, transport and entertainment bears out this claim. The improvements in living standards reflect the growth in real per capita economic output. Economic growth comes from the accumulation of labour and capital inputs combined with improvements in the productivity of labour and capital inputs arising from on-going scientific progress, technological change and innovation, scale economies and efficiency of factor use. According to Paul Romer (1990) 'influencing the cost of finding and using new ideas' is the key to economic growth, while Joel Mokyr (2002) argues that 'in many respects the stories of economic growth and human history are the stories of technological change and changing beliefs and ideas'.

Useful ideas are the key to sustainable economic growth because ideas are non-rivalrous in use. One person's use of a new idea does not prevent others from using that knowledge. Ideas are not depleted by their use. In addition, unlike rivalrous inputs such as workers, materials and buildings, once an idea is produced, for example as a set of instructions, it does not need to be reproduced every time we want to use it. In this way, the non-rivalrous nature of new ideas explains economic growth by giving rise to increasing returns to scale. The more new ideas

spread, or diffuse, the greater the benefits across the economy. The potential for growth in incomes across the economy depends on exploiting the existing stock of ideas and the cost of accessing and using that knowledge.

What does this mean for policy? Per capita economic output is determined by: (A) the proportion of the working-age population as a percentage of the total population, (B) the percentage of the working age population working for pay or profit, (C) the average number of hours worked per person working and, crucially, (D) the average output per unit of hour worked (labour productivity). Policies that increase output are those that either sustainably increase the amount of labour inputs employed or those that increase average labour productivity. An economy can only grow ad infinitum if it is able to keep generating productivity gains year-on-year. However, trend productivity growth has been falling in Ireland, and indeed much of Europe, since the 1990s (OECD, 2015a).

This paper argues that the best way to sustain growth in productivity over the long-term is to invest in education and skills, in productivity enhancing infrastructure, and in the production and diffusion of new ideas manifesting as new technologies and innovations. Insufficient investment in skills, infrastructure and innovation will impede the potential of the economy to grow. It was prior investments in the education and knowledge capacity of the workforce, as well as in infrastructure, that enabled Ireland to come this far out of the recent recession and it is similar investments that will allow the Irish economy to thrive in the future.

A non-exhaustive set of high-level policies to increase the economy's future potential output is described. Examples of such policies include the establishment of a strategic investment bank, increased funding for Research and Development (R&D), increased funding for early years learning and supports to prevent child poverty, and a phasing out of most, though not all, government subsidies and tax breaks. Many of these policies carry upfront fiscal costs. When considered in combination with the fiscal parameters of the Stability and Growth Pact the implication is that the economic case for a fiscal policy based on reducing Ireland's revenue-to-GDP ratio appears very weak. There is little evidence that reducing taxes has much if any effect on long-run growth in advanced economies (LSE Growth Commission, 2013).

Growth in per capita output is not just about labour productivity. Changes in employment and in the total number of hours worked across the economy are important considerations. In this context a number of reforms are proposed to reduce barriers to labour market entry. Examples of such policies include subsidies for childcare infrastructure and the gradual tapering of family supports along with income.

Finally, the desired outcome is not economic growth itself. The goal is sustainable and inclusive improvements in people's quality of life. Sustainable quality of life improvements are incompatible in the long-run with environmental degradation, and, as such, economic policy must always account for environmental costs and benefits. Similarly, inclusive quality of life improvements mean that everyone in society is benefitting from growth. Inclusive growth requires that economic policy should be guided by distributional and poverty impacts.

The paper proceeds as follows. Section 2 briefly describes the underlying causes of long-run economic growth and change. Section 3 examines Irish and international growth performances and the prospects for growth in the Irish economy. Section 4 then considers a set of policy reforms to increase productivity in the Irish economy, while Section 5 outlines an additional set of policy reforms aimed at sustainably increasing the economy's long-run potential output. Section 6 concludes.

2. ECONOMIC GROWTH AND CHANGE

Mainstream economics describes two types of economic growth: extensive growth and intensive growth. Extensive growth is obtained by adding more units of labour or capital, or both, whereas intensive growth is obtained by increasing the average productivity of labour or capital, or both. Diminishing returns to capital and labour make it impossible to sustain economic growth in the absence of productivity improvements. The traditional neoclassical growth models describe how the per capita level of output will be static in the long-run unless the productivity of capital and labour grows over time (Solow, 1956). The implication is that long-run increases in per capita output can only be achieved through intensive productivity based growth.

Growth Accounting

Economic output can be given by the production function:

$$Y = AF(K,L) = AK^{\alpha}L^{1-\alpha}$$

Where Y is output, K (capital) and L (labour) are the factor inputs and A is Total Factor Productivity (TFP) or the Solow residual.

TFP represents the productivity of capital and labour and reflects things like the state of technology and its diffusion, the human capital of the workforce, the strength of economic and

political institutions, the sectoral composition of output, and the efficiency of use of both capital and labour. α and 1-α are the elasticities of output with respect to capital and labour, respectively.

The basic growth accounting formula for labour productivity is given by:

$$\Delta\ln(Y/L) = \alpha\Delta\ln(K/L) + \Delta\ln A$$

Labour productivity growth is decomposed into two parts:

1) The contribution from the percentage rate of growth of the capital stock per unit of labour input (capital deepening), and
2) The contribution from the percentage growth of TFP.

By modifying the production function to explicitly account for the human capital (education and skills) of the labour force we can decompose labour productivity growth into a third part:

3) The contribution from the percentage rate of growth of the quality of the labour force.

Further extensions to the production function can be made to incorporate the contributions to productivity growth from different types of capital (e.g. ICT and non-ICT), from Research and Development inputs (R&D) and, at least conceptually, from changes in the efficiency of factor use.

The United States (US) has been the technological frontier economy since at least the outbreak of the First World War. Per capita growth in the frontier economy is largely determined by the pushing back of the technological frontier and the diffusion and use of new technologies (products and processes) through the economy. Nicholas Crafts and Kevin O'Rourke (2013) describe how investments in human capital (education) and in R&D increased substantially in the US during the 20th century and were much higher in absolute terms than in other countries. The US had the highest average rates of educational attainment for much of the century. Per capita growth in the US averaged a little over 2 per cent per annum between 1913 and 2013.

Total Factor Productivity

Moses Abramovitz (1956) and Robert Solow (1957) used growth accounting methods to separately estimate that 85 to 90 per cent of economic growth in the US economy over the previous century could not be explained by the increases in the capital stock and the labour force over that period. The unexplained residual within their models is now commonly called

Total Factor Productivity (TFP). Much of the residual was assumed to be the result of productivity enhancing technological change. As Paul Krugman (1997) put it, 'Productivity isn't everything, but in the long run it is almost everything.'

Robert Whitt (2009) argues that 'in a globally evolving marketplace, new ideas and technologies are the fodder for economic growth,' and indeed the proximate cause of the large TFP gaps that opened up between countries in the 19th century was due to new industrial technologies being implemented in some countries but not in others (Crafts and O'Rourke, 2013). Yet TFP growth and technological progress are not the same things. Scale economies and improvements in the efficiency of use of capital and labour also contribute to TFP growth. Changes in TFP arise not just from changes in technology but also from changing policies and institutions (Easterly and Levine, 2001). Social norms and institutions are important as enabling or limiting factors in the growth process.

Institutions are the structures, or rules of the game, that humans impose on themselves to order their environment. Such institutional norms condition economic incentives, expectations and behaviour (North, 1990). Examples of institutions include, but are not limited to, the quality of governance, the regulatory system, the education system, the strength and predictability of property rights, the workings of the financial system, the pervasiveness of corruption, the level of political stability, trade policy, fiscal policy including the design of the tax system, the legal system including the existence of patent law and anti-trust legislation, as well as social and cultural norms including generalised levels of trust. Generalised institutions or those of more universal application i.e. more closely resembling a level playing field – are conducive to growth. However, particularised institutions, those whose application varies sharply by group membership, and tilt the playing field in favour of some groups – hinder growth (Ogilvie and Carus, 2014).

Technical change in non-frontier economies is more about the diffusion of advances made elsewhere than it is about the creation of 'new to the world' technologies. Yet, crucially, growth depends not only on the ability to import technologies from leading economies, but also on whether and how those technologies are then actually applied as part of the production process (Abramovitz, 1986). TFP can differ across countries for technology reasons or for efficiency reasons and a workable model of long-run productivity growth must contain at least two driving forces, namely the dynamic processes of technological change and institutional changes.

Productive and allocative efficiencies may be just as, if not more, important than technology differences. A study by Michal Jerzmanowski (2007) estimates 69 per cent of cross country variation in output per worker was attributable to TFP in 1995. However, just 26 per cent of the

variation actually came from technology differences while 43 per cent of variation came from differences in efficiency of use. The remaining 31 per cent of cross-country variation was attributable to differences in factor inputs (capital and labour). Chang-Tai Hsieh and Peter Klenow, (2007) suggest that inefficiency reasons for TFP gaps between countries might relate to institutional structures and resource misallocation. Institutions can be impediments to technological change to the extent that strong vested interest groups are able to prevent or delay change. The institutional structures that impinge on technological change are part of the system of innovation (Edquist, 2005).

Learning and Increasing Returns to Scale

Most modern theories of long-run economic change emphasise the centrality of technological change (McDonnell, 2013). In turn, the cost of knowledge production and diffusion is seen as the main determinant of the rate of technological change. Knowledge is neither freely available nor omnipresent and Nathan Rosenberg (1972) argues that every innovation or incremental advance in the stock of knowledge has its own cost of production. However, knowledge, once obtained, is virtually costless and because knowledge is non-rivalrous in use it is also inexhaustible. Some knowledge is generated without cost as on-the-job improvements (learning by doing) in products, processes or ways of organising production (Arrow, 1962). This learning by doing raises the marginal productivity of labour and capital over time.

The incentive for engaging in knowledge generating activities will increase if the cost of producing or acquiring an innovation falls without a commensurate decline in the benefits of the innovation. The rate of innovation depends not just on the market and market players but also on the institutional constraints. This is because the prevailing set of institutions will influence the costs and benefits of engaging in knowledge production and in other innovative activities.

Kenneth Arrow (1991) points out that, although the cost of acquiring knowledge is independent of the scale on which the knowledge is eventually used, the benefit obtained from the knowledge will very much depend on the scale at which it is eventually used. The inexhaustibility (non-depletion) of knowledge generates increasing returns to scale, which in turn generates productivity improvements. It is these productivity gains that counteract the effect of diminishing marginal returns to capital and labour and allow economies to grow in the long-run. It is for this reason that Romer (1990) argues that the key to influencing economic growth is to first influence the cost of obtaining knowledge and generating and spreading new ideas.

Endogenous Growth Models

The new growth models treat technological change as endogenous (Romer, 1986, 1987, 1990; Lucas, 1988). Their central proposition is that capital accumulation when taken in its broadest sense to include human capital does not exhibit diminishing returns (Mankiw, Romer and Weil, 1992). The growth process is seen as driven by the purposive accumulation of human and physical capital together with the production of new knowledge, often created through R&D activities, and the subsequent diffusion of that knowledge (Snowdon and Vane, 2005).

According to these models the public benefits to R&D activity will exceed the private benefits because knowledge is only partially excludable. Charles Jones and John Williams (1998) find that the social (i.e. economy wide) rate of return to R&D is between two and four times the private rate of return to R&D. The inability of knowledge producers to internalise all of the benefits of investing in R&D reduces their incentive to undertake such activity in the first place. In addition, although knowledge has a once off payment, the size of the payment is of unknown cost beforehand. This makes knowledge production inherently risky and acts as a further disincentive to knowledge production. The implication is that, when left to its own devices, the market will produce less than the socially optimal amount of new knowledge. The resulting market failure is the standard rationale advanced in favour of activist technology policy, whether in the form of R&D subsidies and tax incentives for the private sector or in the form of direct government investments in R&D and human capital.

Evolutionary and Complexity Models of Economic Growth

While the new growth models treat technological change as endogenously induced, the evolutionary models of economic growth argue that economic change occurs as part of a historically grounded path-dependent process (Nelson and Winter, 1982; Mokyr, 1992). These evolutionary, or path dependent, theories of economic change reject the assumption of rationally optimising individuals. In addition, economic systems are considered to be dynamic and permanently out of equilibrium. Individuals and organisations with bounded rationality are seen as learning and searching experimentally in uncertain and permanently changing environments and with uncertain outcomes. New ideas emerge out of something else, and are almost always variants or mutations of ideas that already exist. Innovation is seen as blind, with its success or failure driven by economic processes.

The various complexity models of economic growth conceive the economy as a complex adaptive system characterised by a multiplicity of interactions between economic actors and by a multiplicity of positive and negative feedback loops (Frenken, 2005 and 2006; Arthur, 2009). The economy is seen as characterised by non-linear relationships and by emergent properties. Complexity models of economic growth describe economic change occuring through the exploitation of increasing returns from new and useful innovations. Innovation is treated as an ongoing iterative process characterised by positive feedback loops. Optimal outcomes cannot be guaranteed while new possibilities are continuously emerging as part of a dynamic process within the system.

Such models emphasise the difficulty in picking technological winners. According to these models, instead of picking winners, policymakers should seek to facilitate; nurture and safeguard a diverse, creative, dynamic and genuinely competitive marketplace of ideas with its own internal processes of Darwinian selection. Culture and institutions are seen as important because they influence the spread and adoption of ideas. The prevailing environment, including the prevailing beliefs, types of knowledge flows, sets of incentives, and rules of the game, will determine the long-run rate of production and diffusion of innovation and will therefore determine the long-run rate of economic change.

Neo-Schumpeterian Models of Economic Growth

The neo Schumpeterian models (Grossman and Helpman, 1991; Aghion and Howitt, 1992) retain many elements of the new growth framework yet combines the evolutionary perspective of technological change as a path-dependent process with an understanding of the economy as a complex system. Competition between innovations, rather than competition between firms, is seen as the central force propelling economic growth. According to this framework the transformative processes driving economic change are endogenous to the economic system and a function of knowledge production, innovation and entrepreneurship occurring at the micro level. Innovations will often be combinations of two or more existing ideas and can manifest as new products or services, new processes, new markets, new sources of supply or even new organisations. Philippe Aghion and Peter Howitt (2009) identify two main inputs to innovation:

a) The expenditures made by the public and private sectors to produce innovations, and
b) The publicly available stock of innovations already produced by past innovators.

Neo-Schumpeterian models argue that technological change is induced by the deliberate actions of economic actors responding to economic incentives and that economic growth occurs through the introduction of new and quality-improving innovations to the economy.

The economy enters a new phase of growth when a new and more efficient technology spreads throughout the economy. The new technology renders older products and services obsolete and raises the economy's productive potential. Jobs, businesses, and even industries, which are unable or unwilling to adapt to the new reality will eventually be replaced by those better able to exploit the newer more efficient and useful technology. This process of economic upheaval and change is seen as perpetual. Economic change ebbs and flows along with what Joseph Schumpeter calls the 'creative gales of destruction' (Schumpeter, 1942). Over time the newer innovations are themselves displaced by the next wave of innovations and the productive potential of the economy increases yet again as the economy fluctuates and remakes itself in turmoil. Economic growth is seen as sustainable ad infinitum provided the process of creative and destructive innovation is not impeded and allowed to continue indefinitely.

The neo-Schumpeterian growth models argue that certain transformative technologies generate periods of radical economic change and that these periods of change are punctuated by more extended periods of smoother economic development and incremental change. Timothy Bresnahan and Manuel Trajtenberg (1992) and Elhanan Helpman and Trajtenberg (1998) use the concept of General Purpose Technologies (GPTs) to explain the periodic occurrence of these leaps and bounds of innovation. GPTs are innovations with the ability to easily recombine with other techniques, that are pervasive in the economy, and that have numerous economic applications. The introduction and subsequent development of a GPT opens up a wave of new possibilities for innovation and propels the economy forward. Information technologies have been regularly identified as prototypic GPTs.

Technology Diffusion

No matter how useful a new technology or idea its actual impact will ultimately depend on its diffusion and pervasiveness within the economy. The concept of 'Innovation Systems' was developed in the late 1980s and early 1990s to explain why different economies and societies differ in their rate of innovation and in their rate of diffusion of innovation (Edquist, 2005). The approach emphasises the systemic nature of innovation processes. The level and types of knowledge flows in the economy as well as the nature, density and strength of the relationships

between people and organisations are seen as crucial to innovation. One implication is that the rate of innovation is enhanced by having an open society with multiple transparent flows of knowledge and a robust system of institutional and personal networks.

The historical diffusion of innovations has been heavily influenced by the development of communication and transportation technologies. Improvements in communication technologies increase the connectivity of individuals and organisations and thereby increase the density of the economic system. This facilitates the transmission of useful ideas and the diffusion of innovations. Improvements in communication technologies have transformed the codification, transmission and diffusion of new knowledge and increased the durability of existing knowledge (Mokyr, 1992).

Increasing proximity to other people through urbanisation has also influenced the historical diffusion of innovation. Greater proximity to other people makes you more likely to become aware of other people's ideas and knowledge and thus more likely to subsequently combine those ideas with other ideas as a new innovation. The World Wide Web is relevant to this discussion to the extent that it acts like a virtual city and increases the individual or firm's effective proximity to other people and their ideas. See McDonnell (2013) for a discussion on the factors influencing technology diffusion.

3. GROWTH PERFORMANCES AND PROSPECTS

Per capita output in Europe began to converge on the technology frontier US economy following World War II. According to Crafts (1999) the strong contribution of labour productivity growth to the European Golden Age (circa 1950-1973) was not to any significant extent attributable to domestic R&D, but rather to a combination of technology transfer, scale economies, structural shifts to more productive sectors (e.g. away from agriculture) and improvements in the allocation of capital and labour. Growth also benefited from European integration as it meant a larger effective market size and increased trade flows. Barry Eichengreen (1996) argues that the European model of corporatist domestic institutions resulted in high levels of investment and capital deepening that contributed to high rates of TFP growth.

The EU15 experienced faster growth of real GDP per hour worked between 1973 and 1995 (2.7 per cent) than did the US (1.3 per cent). However, the EU has, since the mid-1990s, underperformed relative to the US (Crafts and O'Rourke, 2013). The EU15's rate of real growth per hour worked has been just 1.2 per cent since 1995, comparing very poorly with the 2.1 per cent growth rate in the US. The process of convergence between the two economies has at best

stalled. ICT has had a large effect on US productivity since the 1970s and in particular since the 1990s. Timmer et al. (2010) find that ICT capital deepening in the US was about twice that of the EU between 1995 and 2005. They argue that Europe's slow growth since the early 1990s is the combined result of a productivity slowdown in traditional manufacturing and other goods production, and a concomitant failure to invest in and reap the benefits from ICT, in particular in market services (Timmer et al. 2010).

Irish Economic Performance

Irish economic performance was relatively poor for most of the 20th century. Per capita growth prior to 1987 was much lower than would have been expected given Ireland's relative poverty at the start of the European Golden Age. A number of reasons for this failure can be identified. Education was under-funded until the 1960s with limited access to secondary education. Capital investment remained below 20 per cent of output until the late 1960s with investment often used for unproductive purposes. In addition, Ireland maintained a highly protectionist policy of self-sufficiency until the late 1950s with Irish firms insulated from international competitive pressures and foreign ownership discouraged. Yet performance was also poor prior to the introduction of protectionism in the 1930s. A notable weakness of the Irish economy prior to protectionism was the failure to develop competitive industries that could export. The problem in the 1950s was not necessarily protectionism per se, it was its misapplication. Arguably much more selective protection of indigenous enterprise would have resulted in more sustainable sub-sectors in the long-run.

Economic performance improved in the 1960s and early 1970s. Educational reforms made secondary schooling universally available. Ireland unilaterally started to cut tariffs in the 1960s and entered the Anglo-Irish free trade area in 1965 and the EEC in 1973. Generous subsidies and tax breaks were used to attract FDI in manufacturing. Such free trade policies turned out to be successful during the 1960s and 1970s, mainly because an important new opportunity was emerging in the world economy with the rise of mobile export-oriented FDI.

Progress stalled in the wake of the 1973 oil crisis and a period of macroeconomic instability and poor economic performance followed. The economy began its turnaround around 1987. Per capita economic growth averaged 5.7 per cent per annum between 1987 and 2000 (Crafts and O'Rourke, 2013). The proximate sources of the growth 'miracle' were rooted in export platform FDI and ICT production, although, as Eoin O'Malley (2004) points out, many indigenous sectors also experienced faster growth in output and exports than their competitors in the EU. The

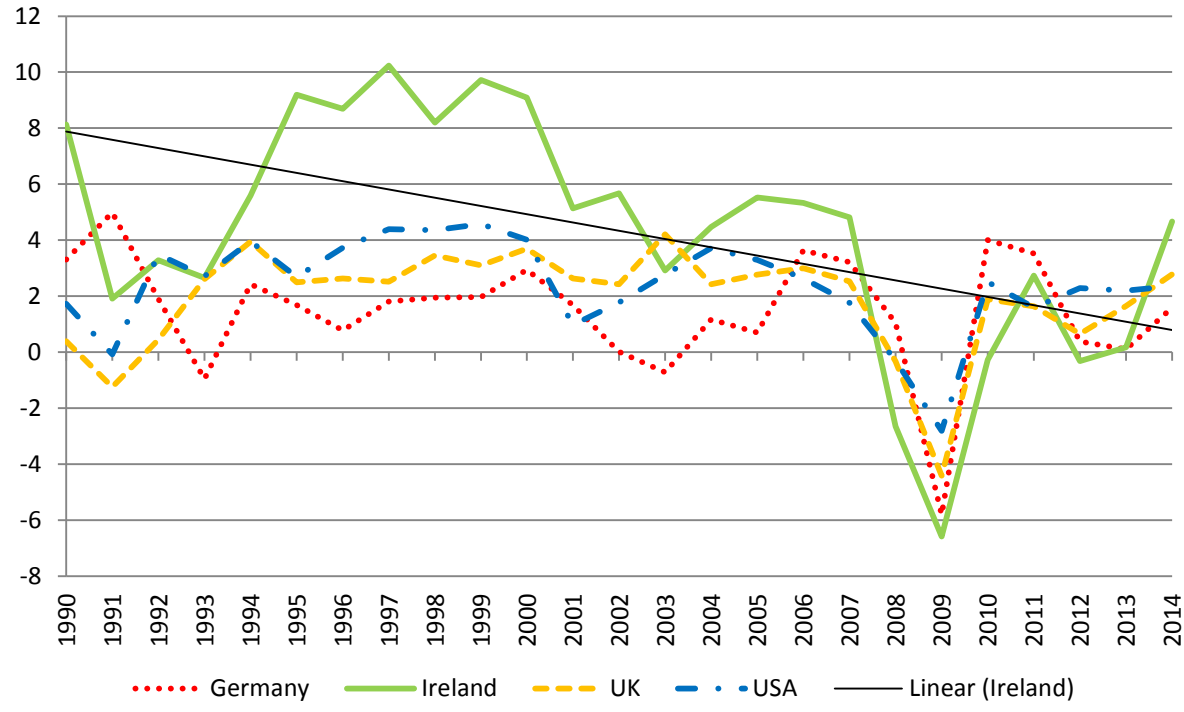
period was characterised by dramatic increases in labour force participation and employment growth, particularly among women, and a reversal of historical migration patterns with immigration outstripping emigration. Employment as a percentage of the population rose from 31 per cent in 1986 to 49 per cent by 2007. Ireland's GNP per head of population increased from 62 per cent of the average EU level in 1986 to 114 per cent by 2007, with most of the gain attributable to the change in employment levels.

David Byrne and Kieran McQuinn (2014) estimate that Irish GNP growth averaged 7.2 per cent between 1987 and 1996 and that TFP accounted for 4.3 percentage points of this growth, well above the TFP growth rate for any other Western European country. While TFP growth was strong, the aggregate figure may be misleading. ICT production by US multinationals accounted for a substantial part of TFP growth during the 1990s and transfer pricing by multinationals makes it difficult to interpret productivity gains in the Irish context. Irish TFP growth fell to 1.1 per cent between 1997 and 2006, although this was still among the highest rates in Europe (Byrne and McQuinn, 2014). The Celtic Tiger era ended around 2001, replaced by a credit fuelled construction and consumption bubble. Byrne and McQuinn attribute the subsequent decline in TFP growth during the bubble period to the increasing share in the economy of the relatively low productivity construction sector. The construction sector came to account for almost 11 per cent of gross value added by 2006 and was well above the EU15 average for over a decade prior to the crash (McDonnell and O'Farrell, 2015). This was unsustainable and the bubble burst in 2008 triggering a banking crisis and severe recession.

The Conference Board's (2015) total economy database shows that real annual GDP growth in Ireland averaged a robust 4.3 per cent over the period 1990-2014 (Table 1) and was 2.7 per cent over the period 2000-2014 (Table 2). Looking at shorter periods than around 25 years is likely to mix up supply-side and demand side-effects. Chart 1 shows the trend for annual per capita GDP growth in Ireland between 1990 and 2014. Labour quantity (employment and hours worked) contributed 0.8 percentage points to annual average growth between 1990 and 2014 while non-ICT capital additions contributed 1.4 percentage points to annual average growth. The Conference Board data shows that Irish over-performance, compared to other advanced economies, was most pronounced for TFP. TFP made a 1.1 percentage point contribution to annual growth in Ireland compared to an average of just 0.2 percentage points for a 25 country group of advanced western economies (Chart 2). This over-performance was strictly a 1990s phenomenon. TFP actually made a negative contribution to GDP growth over the period 2000-2014, partially reflecting changes in the composition of employment towards low productivity sectors. The individual trends for the different factor contributions to growth are shown in the Charts in the Appendix. The trends are all downward.

What catalysed the turnaround in economic performance from 1987 onwards? Ireland certainly had substantial scope for catch-up growth from increased productivity and from getting a much higher proportion of its population into employment. Patrick Honohan and Brendan Walsh (2002) argue that the Celtic Tiger was simply a delayed version of the Western European growth miracle. This may well be true but it doesn't explain why catch-up happened when it did.

Chart 1 Annual Real GDP Growth, %, 1990-2014



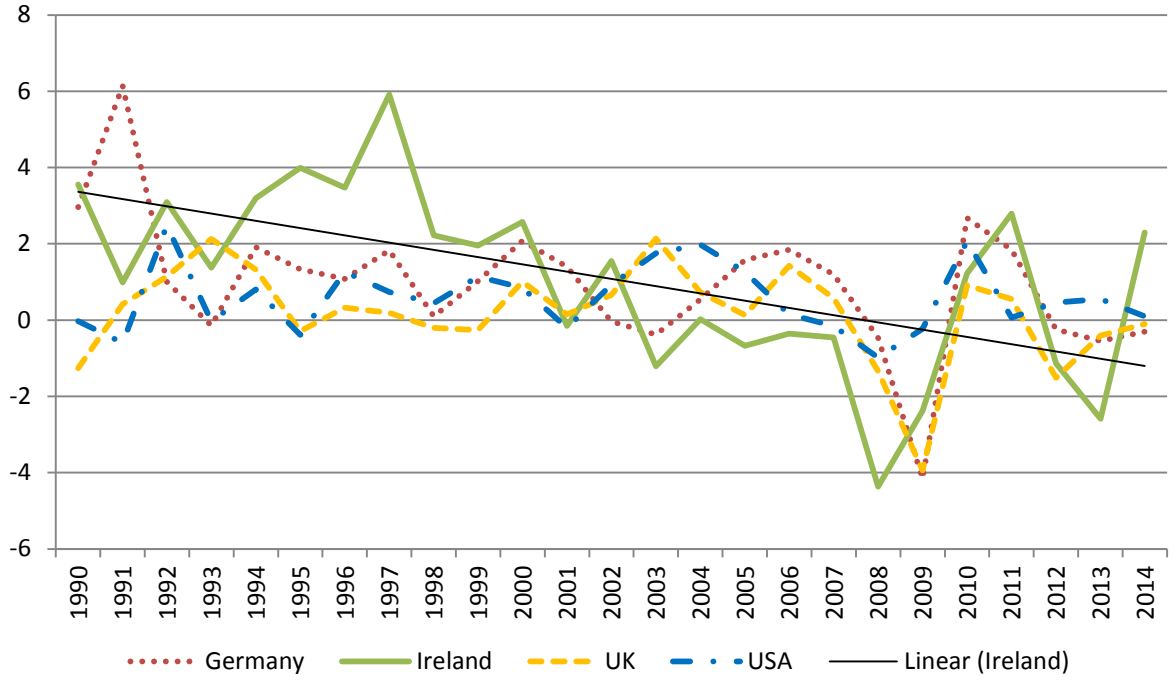
Source: The Conference Board, Total Economy Database (May, 2015)

Table 1 Growth Accounting, GDP Growth and Average Annual Factor Contributions, 1990-2014

	GDP Growth	Labour Quantity	Labour Quality	Capital Services ICT	Capital Services Non-ICT	TFP
Ireland	4.3	0.8	0.3	0.8	1.4	1.1
UK	1.9	0.2	0.4	0.6	0.6	0.2
Germany	1.5	-0.2	0.1	0.4	0.3	1.0
France	1.5	0.1	0.3	0.3	0.7	0.1
Italy	0.7	0.0	0.1	0.2	0.4	-0.1
Spain	2.1	0.7	0.4	0.4	1.2	-0.5
Netherlands	2.0	0.6	0.2	0.4	0.4	0.4
Switzerland	1.6	0.5	0.1	0.6	0.3	0.2
USA	2.4	0.4	0.2	0.6	0.6	0.6
Canada	2.3	0.6	0.3	0.6	0.9	-0.2
Japan	1.1	-0.4	0.2	0.3	0.6	0.3
China	8.6	0.4	0.1	0.9	4.7	2.5
Australia	3.0	0.8	0.2	0.7	1.2	0.0

Source: The Conference Board, Total Economy Database (May, 2015)

Chart 2 Annual Contribution of Total Factor Productivity to GDP Growth, Estimated as Tornqvist Index, 1990-2014



Source: The Conference Board, Total Economy Database (May, 2015)

Table 2 Growth Accounting, GDP Growth and Average Annual Factor Contributions, 2000-2014

	GDP Growth	Labour Quantity	Labour Quality	Capital Services ICT	Capital Services Non-ICT	TFP
Ireland	2.7	0.3	0.3	0.8	1.6	-0.2
UK	1.8	0.5	0.2	0.5	0.6	0.1
Germany	1.2	0.1	0.1	0.4	0.2	0.5
France	1.3	0.1	0.2	0.2	0.7	0.0
Italy	0.2	0.0	0.1	0.2	0.4	-0.5
Spain	1.6	0.4	0.4	0.4	1.1	-0.7
Netherlands	1.2	0.2	0.1	0.3	0.3	0.3
Switzerland	1.9	0.6	0.1	0.5	0.3	0.5
USA	1.9	0.1	0.2	0.5	0.5	0.6
Canada	2.2	0.7	0.2	0.6	0.9	-0.2
Japan	0.8	-0.2	0.2	0.3	0.2	0.4
China	9.9	0.2	0.1	1.0	5.2	3.4
Australia	2.9	0.9	0.2	0.8	1.6	-0.6

Source: The Conference Board, Total Economy Database (May, 2015)

Macroeconomic stability had by and large been achieved by the end of the 1980s. Ireland was also the beneficiary of substantial capital investment in the form of EU Structural funds, effectively a fiscal stimulus that boosted domestic demand and the productive capacity of the economy without a fiscal cost. Currency devaluations in 1987 and 1993 increased the competitiveness of exports while fiscal stimulus in the UK, Ireland's main trading partner, increased demand for imports from Ireland. By the late 1980s Ireland had corporatist labour bargains in place, a highly educated and relatively low paid work force and an aggressively competitive corporate tax regime. As such, and perhaps most importantly of all, Ireland was able to exploit its new found position within the European Single Market in the early 1990s to attract an amount of inward multinational FDI from the booming US economy that was far above the EU15 average. The inward FDI stock per person was over five times the EU15 average by 2000.

Growth Prospects

The key parameters underlying future growth prospects are demographic changes, the participation and employment rates, the investment rate, and changes in total factor productivity. Ireland's growth potential depends on the economy's ability to generate employment and productivity gains year-on-year. Ireland is already a high productivity economy with GDP per worker close to US levels. This suggests the opportunities for catch-up productivity gains may be lower in the future than has prevailed in the past. Karl Whelan (2015) estimates that productivity growth has slowed since the end of the Celtic Tiger (Table 3) with productivity growth averaging just 1.0 per cent from 2004 and 2013. Byrne and McQuinn (2014) attribute the deterioration in productivity growth in recent years to the increasing share in the economy of the relatively low productivity construction sector, although Ireland's catching-up to the technological frontier and the levelling off of the productivity gains from the ICT revolution may also have played a role in this decline.

Table 3 Productivity Growth Trends, Ireland

	1974-1983	1984-1993	1994-2003	2004-2013
Average Annual Productivity Growth	2.5%	2.9%	3.6%	1.0%

Source: Whelan (2015)

The OECD (2013) projects a real GDP growth rate of 3 per cent from 2018 to 2030. This is predicated on employment growth of 1.3 per cent and labour productivity growth of 1.7 per cent. Crafts (2014) argues the projection for employment growth is optimistic as it is based on a

forecast net migration of 30,000 per year. He suggests employment growth of 0.7 per cent may be more realistic. On the other hand, he suggests the OECD projection for productivity growth may be too pessimistic. The OECD's projection for productivity growth is marginally higher for the OECD overall (1.8 per cent) than it is for Ireland. One reason given is that Ireland is considered to have less scope to benefit from 'structural reforms' as it is already considered close to best practice. However, Crafts (2014) suggests the OECD's analysis of Irish productivity makes the mistake of comparing real GDP per person in Ireland with that of the US, instead, he argues, Irish labour productivity and therefore the scope for catch-up is better measured in terms of real GNP per hour worked. This suggests a marginal upward revision to the OECD's productivity growth forecast would be appropriate.

Byrne, Duffy and McQuinn (2015) estimate a set of growth projections for the Irish economy out to 2030. Their projections assume TFP converges to a steady-state of 1.8 per cent by 2020, that the investment rate converges to a steady state of 20.9 per cent of GDP by 2020 and that the unemployment rate converges to a steady state of 7.8 per cent in 2018. Their work illustrates the sensitivity of economic growth projections to migration trends driving population. Different assumptions for migration trends drive substantial differences in growth projections, which, in their case, range from 2.4 per cent GNP growth over 2021-2030 to 3.4 per cent GNP growth over the same period.

Finally, McQuinn and Whelan (2015) project much weaker growth for the Irish economy. Their baseline growth forecast is for 1.2 per cent growth over 2014-2023 and 0.9 per cent growth over 2024-2033. These gloomy forecasts reflect an assumed growth in TFP of just 0.2 per cent per year consistent with their estimates for TFP's contribution to output growth in the Euro area between the years of 2000 and 2013. This assumption for the TFP parameter seems excessively pessimistic. TFP growth was substantially higher in what is now the Euro area in the 1970s, 1980s and 1990s. TFP growth was also higher in the frontier US economy during the 2000s (0.6 per cent). Information Technology has had a large effect on US productivity since the 1970s and in particular since the 1990s. As Timmer et al. (2010) highlight, Europe has scope for catch-up from greater and more efficient use of ICT. Well-constructed economic policy reforms can positively influence future productivity trends.

4. POLICY REFORMS FOR PRODUCTIVITY GROWTH

Sustainable long-run growth in per capita output depends on innovation driving improvements in labour productivity. Investing in education and skills (human capital), equipment and

infrastructure (physical capital), and in the production, diffusion and use of new ideas, is the only way to sustain growth in productivity over the long-term. Insufficient investment in skills, infrastructure and innovation will constrain future economic growth. Underlying all of this is the need for a supportive institutional architecture to incentivise innovation and ensure the efficient use of labour and capital.

Education and Skills

Labour productivity increases along with learning and experience (Arrow, 1962). Human capital represents the knowledge, skills, competences, creativity and other attributes embodied in individuals that are relevant to economic activity (OECD, 1998). We cannot directly measure human capital although skill levels and particularly educational achievement are sometimes used as proxies. Spending on education generates positive externalities for the wider economy to the extent that the education provided represents genuine investment in human capital. Human capital not only enhances labour productivity but is also a necessary input for and complement to innovation and technology adoption (Barro and Sala-i-Martin 2003).

Strong education systems are empirically associated with increases in the long-run rate of per capita economic growth. The OECD contends that half of the growth achieved by OECD countries since World War II has been driven by progress in education. Ireland has a relatively low spend on education compared to peer countries. Despite having a comparatively young population government spending in Ireland on education was just 4.1 per cent of GDP in 2013 compared to 5.0 per cent for the EU and 5.5 per cent for the UK (Eurostat, 2015a).

Skill levels for the population as a whole, as well as for the top of the achievement distribution, have been found to exert positive and independent effects on growth (Hanushek and Wößmann, 2007). Thus, while it is important to have large numbers of scientists and engineers, it is also important to have a well-educated population in aggregate. Population-wide improvements in human capital enable more inclusive growth and less economy-wide inequality. Increasing the skills and learning ability of disadvantaged children provides the largest potential dividend to society, both in terms of economic growth and lower inequality.

Erik Hanushek and Ludger Wößmann (2007) use data from educational achievement tests held between 1964 and 2003 across fifty countries to estimate the impact of educational achievement on economic growth between 1960 and 2000. They find that countries with better

educational achievement scores had higher growth rates and that this effect was robust to the inclusion of a range of control variables. In the long-run, the average annual growth rate for a country was found to increase by 1.2 percentage points for a one standard deviation improvement in measured cognitive skills, based on test scores. Short-run effects are, of course, much more limited and the benefits of improvement in cognitive skills can take years to filter through into higher rates of growth. Ireland performs marginally above average in these tests (OECD, 2014a).

There are serious questions about the quality of schooling in many European countries (Hanushek and Wößmann, 2012). Extra resources, improved buildings, formative assessment and smaller classroom sizes all have positive effects on outcomes. However, the quality of teachers and teaching in schools appears to be the key to better outcomes. Increased teacher autonomy, transparency, accountability, salary levels, as well as life-long learning and training for teachers themselves, all have roles to play in obtaining higher standards. A strong accountability framework centred on quality provides the best hope for improving teaching performance.

Schooling is not the same thing as human capital. The child's home environment determines much of the early development in cognitive and non-cognitive skills. Parental investment of time, along with the fostering of learning attitudes and habits, are important inputs in the development of human capital (OECD, 1998). The early years are the most important for development, and external factors, like poverty, can have extremely damaging and lasting effects on human capital. Family and childcare supports and in-kind public health services are positively associated with long-run growth because these supports decrease the risk of child poverty, and this in turn boosts the formation of human capital (Cournede, Goujard and Pina, 2013).

Children possess powerful learning abilities in their early years. James Heckman (2000) argues that investing in learning in early childhood brings greater returns than at any other stage in life. Early learning makes it easier to go on learning throughout life. In particular, early learning of creativity, scepticism and problem solving leads to better learning of all kinds, and early learning of these abilities may be more cost effective than trying to teach these abilities at university level or beyond. The inference is that additional resources for education should target early years learning. A second conclusion is that extra resources for pre-school education should be concentrated first on disadvantaged families where the risks of falling behind are

likely to be highest. Well-planned education for pre-schoolers also has the potential to help ease the impact of poverty on young lives.

Human capital development is a life-long process. Arrow's (1962; 1991) learning-by-doing models emphasise the importance of life-long on-the-job learning for innovation and economic growth. Training programmes providing market-relevant skills can generate economy-wide employment gains under conditions of skill shortages or mismatches. Well-designed active labour market programmes with market linkages can help lower structural unemployment and boost potential output. However, there is an on-going need to ensure that education and training systems are adapting to the continuously evolving economic environment. There must be a willingness to continuously change the type and scale of training and education places provided and to cease or reduce programmes and schemes that are becoming less relevant in terms of the skills demanded in the labour market.

Innovation Capacity

Innovation and R&D are fundamental determinants of international competitiveness, productivity gains and economic growth. Belitz et al. (2015) find that an increase of one percentage point of R&D spending in the economy leads to a short-term average increase in GDP growth of approximately 0.05 to 0.15 percentage points. Gross domestic expenditure on R&D in Ireland was just 1.6 per cent of GDP in 2012 compared to 2.4 per cent for the OECD (OECD, 2015a) and 2.8 per cent for the US. Combined government and higher education spending on R&D in Ireland was just 0.44 per cent of GDP in 2012 compared to 0.72 per cent for the EU and 0.74 per cent for the US. Business expenditure (1.14 per cent) was close to the EU average (1.28 per cent) but well below the US (1.96 per cent).

New ideas and innovations, and how they are generated and diffused, are different from R&D, and often do not result from R&D. An economy's 'innovative capacity' refers to the ability to generate original ideas and communicate and assimilate existing innovations (Stern, Porter and Furman, 2002). The economy's innovative capacity is itself a function of education and skills levels, the cost of acquiring knowledge, government policies that support R&D, and the quality of capital markets, among other things. Ireland currently ranks 8th in the Global Innovation Index (WIPO, 2015). There is evidence the diffusion of information communication technologies (ICT) has been aided by complementary investments in intangible capital and high-quality human capital, while the availability of finance has implications for a firm's ability to invest in

R&D and new technology. Differences in human capital and educational attainment explain much of the variation in technology adoption rates between firms (Caselli and Coleman, 2001).

Rates of technological change and adoption vary greatly across countries, regions, industries, firms, households and individuals. The concept of 'National Systems of Innovation' (NSI) was developed in the late 1980s and early 1990s to explain why different economies and societies differ in their rates of innovation (see Edquist, 2005). According to David Jacobson (2013) 'the interacting institutions at the heart of a system of innovation include the educational, cultural, social and economic, as well as the policy and political factors that influence how creative, entrepreneurial and change-oriented people are, in the social formation of which the system of innovation is part.'

The NSI approach emphasises the systemic nature of innovation processes. The level and types of knowledge flows in the economy as well as the nature, density and strength of the relationships between people and organisations are seen as crucial to innovation. There is an emphasis on the importance of horizontal linkages allowing new knowledge to diffuse throughout the economy. The implication is that innovation is enhanced by having an open society with multiple transparent flows of knowledge and a robust system of institutional and personal networks with horizontal links between the state, higher level institutes and enterprises. Smaller enterprises would benefit from closer collaboration with higher level institutes with connections to the global technology frontier.

As already discussed the characteristics of knowledge generate productivity gains and increasing returns to scale and scope at the level of the economy. Yet the characteristics of knowledge also make it difficult for knowledge producers to appropriate all of the benefits of knowledge production. The inability of knowledge producers to internalise all of the benefits of R&D investments reduces the incentive to undertake such activity and leads to a socially suboptimal level of knowledge production. In addition, the production of new knowledge is inherently uncertain. There can be no guarantee that useful knowledge will be produced at the rate hoped for by the knowledge producer. This uncertainty of production further diminishes the private incentive to invest in R&D and reduces the overall level of knowledge produced. The result is market failure in the production of knowledge.

One way to encourage innovation, the application of new ideas and risk-taking is to ensure there are sufficient safeguards in place so that the cost of failure is not catastrophic for the individual. For example, a bankruptcy regime that does not overly penalise failure would encourage greater risk-taking and entrepreneurship and would allow entrepreneurs to learn through failure and to apply the lessons learned. Bankruptcy laws and judicial systems that do not

excessively penalise failure also help to prevent resources being trapped in inefficient firms that are just struggling along. Failure need to be recognised as an opportunity to learn and rebound, rather than being seen as the end of the game (OECD, 2015b)

The standard response of most governments to the market failure in the production of knowledge goods has been to incentivise private sector R&D and/or to engage in direct government investment in R&D. Common policies include the awarding of patents as well as the provision of subsidies and tax breaks. The public sector directly invests in R&D through the creation and support of research institutions such as universities, and invests indirectly through expenditure on R&D inputs such as human capital.

Seán Ó Riain (2013) argues that government has played a critical role in the growth of successful innovation economies in countries as different as Finland, the US, Israel and Taiwan, while Mariana Mazzucato (2013a) argues that Germany's successful competitiveness strategy has been driven by its ability to build a strong innovation system, with patient long-term finance (e.g. KfW), strong science-industry links (Fraunhofer institutes) and above average R&D/GDP spending (2.9 per cent in 2012). Ó Riain (2013) notes that, in relative terms, Irish state investments fall well behind the scale of the investments in promising firms made by other countries, including the US. An increasing number of the best technological innovations in the US come from federal labs, federally funded R&D and networks of firms supported through government schemes (Block and Keller, 2009; Mazzucato, 2013b).

The costs of knowledge search and knowledge production are crucial determinants of the volume of innovative activity as the profits from an idea provide much of the incentive to innovate. Falling cost of knowledge acquisition means higher expected returns to innovative effort and therefore a higher volume of innovative effort. The implication is that those technologies, institutions and incentives that reduce the cost of producing, acquiring or using knowledge will increase the rate of technological change and in so doing increase the economy's potential growth rate.

Policymakers can incentivise the production and diffusion of innovations through measures to increase the productivity of R&D and other knowledge production activities. This can be achieved by reducing the cost of innovation inputs or by improving the quality and efficiency of those inputs. One way to increase the productivity of knowledge production is to invest in human capital. This is because human capital is a complement to the production and exploitation of ideas. In particular, there may be an economic case for incentivising (subsidising) take-up of science, technology, engineering and mathematics courses at undergraduate and postgraduate levels to ensure a greater supply of innovating workers. A

second way to increase the productivity of knowledge production is for governments to support and invest in those technologies which themselves reduce the cost of knowledge search and the diffusion of useful ideas.

Vernon Ruttan (2008) makes the point that ICTs have become increasingly pervasive as inputs into the process of technological change. He argues that this is because they greatly increase the productivity of knowledge search and R&D investments, thus encouraging greater private investment in R&D and reducing the degree of market failure in the production of knowledge. This characteristic of ICTs creates a case for public intervention to support the development and diffusion of Internet access technologies such as broadband. It also creates a case for the provision of grants to small and medium enterprises (SMEs) for the adoption of ICTs.

Broadband access is of particular importance to economic growth because it is a General Purpose Technology (Bresnahan and Trajtenberg, 1995) that boosts the productivity of innovation effort across a wide range of economic sectors including, crucially, the R&D sector (McDonnell, 2013). While investment in certain forms of infrastructure, for example roads, may only provide a once-off shift in productivity (a level effect), investment in broadband infrastructure may permanently boost the annual rate of innovation and therefore permanently boost the rate of productivity growth. The flip side is that poor quality broadband infrastructure may contribute to lower rates of growth. Ó Riain (2013) argues that weak state investment in broadband in Ireland has constrained the diffusion of new technology industries capabilities into the broader private sector.

Finally, the patent system's net effect on innovation levels is unclear. There is little empirical evidence to suggest patents increase innovation and productivity (Boldrin and Levine, 2012) and there may be benefits to reforming the patent system. The unique capabilities of a successful firm to achieve repeated product, process and organizational innovation are better protection of their ideas than patents. Appropriate reforms to the patent system would prevent market incumbents from locking-in advantages, excluding new entrants and impeding the process of creative destruction so crucial to long-run growth. In particular, patent protection could be made shorter and weaker in certain industries such as the IT sector. Patents could also be subject to use-it-or-lose-it rules. If the inventor hasn't commercialised the invention after a certain number of years other firms could be allowed to use the invention subject to a modest royalty payment for the duration of the patent.

Productive Infrastructure

Efficient investment in infrastructure is strongly related to long-run increases in the economy's productive capacity. A meta-analysis of 68 studies by Pedro Bom and Jenny Ligthart (2014) concludes that public capital investment has positive long run effects on output while the IMF (2014) argue that increased investment in public infrastructure raises output in the short-term because of demand effects and in the long term as a result of supply effects. The IMF further argue that the net benefits are particularly high during periods of economic slack, where the cost of borrowing is low, and where investment efficiency is high. Investment multipliers also tend to be higher in a liquidity trap environment where central bank interest rates are close to zero. Ireland's cost of borrowing (circa 1 per cent in October 2015) is close to its all-time low while the still-high unemployment rate (9.4 per cent in September 2015) is suggestive of ongoing slack in the economy.

The net benefit to any investment project hinges on the efficiency of the investment process. Public capital investment carries risks. Most obviously there is a danger that unevaluated projects will be given the go-ahead for political and electoral reasons. To safeguard against this all major project proposals should be subjected ex ante to rigorous and independent cost-benefit evaluation, including evaluation of the opportunity costs. There is also a danger that public projects will operate with soft budget constraints and with low levels of efficiency.

Certain types of investment contribute to knowledge based growth and are therefore particularly beneficial in the long-run. Examples include school buildings, broadband infrastructure and research institutions such as universities. However, not all forms of investment are equally productive and market distortions can arise in favour of speculative, wasteful or socially destructive investment. The period leading up to the 2008 crash is an example of this phenomenon, with an overly generous system of tax breaks and cheap credit fuelling a misallocation of capital towards private investment in non-productive assets such as residential and commercial property.

Even so, private investment is fundamental to growth and it is important to create an environment conducive to private investment. This does not imply we should distort the market by incentivising particular types of investment through tax breaks. Instead, the implication is that we should ensure potential investors have adequate access to finance at a reasonable cost and that barriers to investment are low. Access to funding requires well-functioning and competitive capital markets. However, Ireland currently ranks just 61st in the world for financial market development and 117th in the world for ease of access to loans (World Economic Forum, 2015). Where capital markets are not well-functioning there is a strong case for a state investment bank to provide patient long-term finance to support innovative effort and

technology diffusion. While venture capital funding has increased substantially since 2013 such funding remains highly concentrated in the Dublin region. Ireland has historically had low rates of productive investment for a number of reasons and Irish banks have a poor record in providing capital for investment. Capital was systematically misallocated in the 2000s and there is concern that banking organisations may lack the relevant skills and orientation to promote productive investment (Ó Riain, 2013). The establishment of a genuine banking union in the Euro area would be an important policy reform that could increase financial market development and competition in Ireland.

Public spending in Ireland on gross fixed capital formation is close to 2 per cent of GDP in 2015 (European Commission, 2015). This is well below the EU average (2.9 per cent) and almost certainly lower than Ireland's medium-term growth potential. Such a low rate of public investment, if maintained, is likely to produce infrastructure bottlenecks and impede Ireland's growth potential. Ireland's productive infrastructure already lags that of Western Europe in a number of respects. There are infrastructural deficits in transport, renewable energy, schools, wastewater management, and next generation broadband. There are also acute shortages in areas of key need including provision of suitable and affordable accommodation for a rising population. The total fixed capital investment rate as a percentage of GDP is the sixth lowest in the EU (European Commission, 2015).

The OECD (2013) projects Ireland's long-run growth potential at close to 3 per cent. According to Christophe Kamps (2005) the 'optimal' (i.e. growth-maximising) public investment to GDP ratio is 3 per cent for an economy with a trend growth rate of 3 per cent. This suggests a need to increase public investment from its current levels by around €2 billion per annum. Given the recent years of persistent underinvestment and infrastructure deficits this figure should be considered a floor rather than a target. The World Economic Forum (2015) places Ireland just 36th in the world in terms of the overall quality of infrastructure. Inadequate supply of infrastructure is also ranked as the second most problematic factor for doing business after access to financing. In this context a public investment rate of closer to 4 per cent of GDP may be more appropriate in the short and medium term.

The Irish economy could benefit from the creation of a dedicated national development or Strategic Investment Bank (SIB) owned wholly or in part by the Irish Government but independent from government (Duggan, 2013). The government's principal role would be to set high level objectives for the SIB. For example, the SIB could be mandated to focus on projects aimed at enhancing national innovative capacity and projects to boost the quality of physical infrastructure. The SIB model has been shown to work well in Germany and elsewhere (Duggan,

2013). The European Investment Bank (EIB), Germany's KfW, and the UK's Green Investment Bank all provide templates for such a vehicle. The establishment of public investment banks is currently under discussion in a number of countries, for example the US and France. The weakness of Ireland's financial market development adds to the case for establishing an independent SIB or fund. Ireland's cost of borrowing is close to historical lows and an SIB could centralise and leverage financing for investment in infrastructure and innovative capacity. Special purpose vehicles could then be established within the SIB to focus on specialised investment in particular sectors of the economy such as housing or green energy.

Ideally, the SIB would be given the capacity to draw on a group of international and domestic experts to periodically evaluate future infrastructural needs and provide expertise in determining the relative value and costs and benefits of different projects. Crucial for this evaluation would be an understanding of evolving demographic and structural shifts in the economy. Such a body of experts could be required to produce regular reports on infrastructural needs and evaluation methodologies used and should be answerable to the Oireachtas (the Irish legislature).

The Irish government announced the Ireland Strategic Investment Fund (ISIF) in June 2013. The National Treasury Management Agency controls and manages the fund, which was established in December 2014. The ISIF was set up to be a sovereign development fund and the plan is to reorient €6.8 billion of the National Pension Reserve Fund (Ireland's sovereign wealth fund) towards commercial investments in the Irish economy. The ISIF has a dual mandate – investment return and Irish economic impact. This mandate enables it to be deployed as a vehicle for the strategic development of Ireland's productive and innovative capacity. It is intended that fund allocation will be to those sectors with the highest economic impact and the lowest levels of deadweight and displacement. This will include infrastructure that enables competitiveness in areas such as water, energy, transport, broadband, critical real estate for foreign direct investment, R&D and education. As such, the ISIF appears the institution best placed to evolve into a fully formed SIB. Additional resources for the SIB could be obtained from the proceeds of selling off the state's equity stake in Allied Irish Bank (AIB).

Many Irish SMEs still face onerous credit constraints. These constraints restrict their capacity to invest and grow. The Strategic Banking Corporation of Ireland (SBCI), established in 2014 as a lending vehicle for SMEs, could be incorporated within the SIB and expanded to include a network of branches in each major urban area and provincial location to advise and assist SMEs. One of the problems with the SBCI is that its function is merely to provide the funding for banks to lend to SMEs, not to lend to SMEs itself. As such there is a concern that much of the SBCI

funding will simply replace funding that otherwise would have come anyway from the banks themselves and that there won't be an increase in the volume of funding available for investment and innovation. SBCI funding should directly target SMEs and high-potential start-ups looking to borrow for investment purposes, including in R&D and technology adoption. A whole range of financial instruments should be considered including a willingness to take equity stakes in start-ups. It should be possible to draw on, and expand, European Investment Bank funding for SMEs especially in areas of new green technology.

Efficiency of Capital and Labour

As discussed earlier productivity and technological progress are not the same things. Scale economies and improvements in the efficiency of capital and labour use also contribute to productivity growth. Changes in productivity arise not just from changes in technology but from changes in policies and in institutions (Easterly and Levine, 2001). Cross-country differences in productive and allocative efficiencies may be just as, if not more, important for output per worker than technology differences. For example, in a large cross-country study Jerzmanowski (2007) estimates that 43 per cent of cross country variation in output per worker was attributable to differences in efficiency of use. The OECD (2015b) identify the importance of a competitive and open business environment that favours the adoption of superior managerial practices and does not give incentives for maintaining inefficient business structures. In this context they point to the need to remove inheritance tax exemptions for business assets as these may prolong the existence of poorly managed family-owned firms. Policies that reduce barriers to firm entry and exit (e.g. generous bankruptcy laws) can improve productivity performance (OECD, 2015b)

All economic and institutional structures generate inefficiencies to some degree. Lack of competition will lead to allocative and technical inefficiency in the absence of robust regulatory measures. The absence of competition deadens economic performance. If regional or national monopolies are protected by legal or other barriers to competition from better-practice firms they can survive without innovating and often do so (Solow, 2005).

Yet the economic crash makes clear that competition is not sufficient by itself to ensure efficiency (Sweeney, 2013). Establishing appropriate regulatory frameworks, including independence and investigative and enforcement powers for regulators, is necessary to ensure product and service markets operate efficiently. Regulation is particularly important in the case of natural monopolies or where there is a danger of market dominance by firms or other interest groups. Independent regulation of professional bodies (e.g. legal and accounting

services) is necessary to ensure that non-essential barriers to entry are not being set and to ensure that service providers are not colluding to inflate service costs.

Political lobbying and economic rent seeking in the form of requests for subsidies and tax breaks always present a danger to economic development. Subsidies for home ownership, business and agriculture are deleterious to long-run growth because they skew economic activity and distort resource allocation (Ford and Suyker, 1990; OECD, 2004). There are some areas where well-designed subsidies can be appropriate. Good examples include subsidies for R&D and for childcare. Tax breaks change the incentive structure for households and firms, thus influencing their behaviour. The resulting behavioural changes can have positive and negative impacts on both short-run and long-run economic growth. However, in general, tax breaks negatively affect growth by distorting allocative efficiency, by creating inefficiencies in production and consumption, and by diverting economic activity toward rent-seeking behaviour.

Phasing out the system of tax expenditures (simplifying the tax code) and ensuring horizontal equity of tax treatment across all asset classes to the greatest extent possible would boost economic output by improving allocative efficiency within the economy. Phasing out most subsidies for home ownership, business and agriculture would similarly improve allocative efficiency. There may be sound social and cultural reasons for retaining particular subsidies, but the economic case for retention is usually though by no means always weak.

5. ADDITIONAL POLICY REFORMS AND FISCAL CONSIDERATIONS

Table 4 collates an indicative list of high-level policy reforms designed to boost long-run potential output. Increasing potential output is not just about labour productivity. Output also depends on employment levels and on the average number of hours worked in the economy. Data from Eurostat's labour force survey (2015b) shows that Ireland has a low employment rate, for persons of working age, compared to the US, the UK and the Euro area. Just 61.7 per cent of the working age population (aged 15-64) were in employment in Ireland in 2014 compared to 63.9 per cent for the Euro area and 71.9 per cent for the UK. This suggests there is fairly substantial potential to boost output by increasing aggregate labour inputs.

One we can increase employment and the number of hours worked in the economy is by removing barriers to labour market entry. The cost of childcare is one such barrier. Ireland has very high costs of childcare (as per cent of average wage) compared to other OECD countries.

State subsidised childcare would incentivise the labour force participation of second earners and lone parents. This would increase the effective size and quality of the available workforce while retaining human capital within the workforce. Accessible and affordable childcare is particularly important as a tool for enabling labour force participation by lone parents. More generally, labour force participation and employment can be incentivised by gradually tapering down housing and welfare supports along with increases in income, instead of removing these supports completely along with employment. Similarly, policymakers should avoid creating step-effects in the tax and welfare system as these create traps that can distort work patterns.

Labour supply can also be increased by adopting an open-door policy in relation to inward migration and by abandoning policies that prevent migrants from working legally in the economy. Migration tends to boost the working-age population and aggregate output. In addition, migrants arrive with skills and contribute to human capital development in receiving countries (OECD, 2010), while also contributing to knowledge spill-over and technological progress. These benefits would be enhanced by support for English language training for new immigrants. In most countries migrants also contribute more in taxes and social contributions than they receive in benefits (OECD, 2014b). Thus, in addition to the strong human rights arguments for an open-door policy there are also strong economic arguments.

Table 4 Policy Reforms to increase Potential Output – Selected Measures

Area		Measure
Labour quantity	1	Provide substantial state subsidies for childcare
	2	Gradually taper down housing and welfare supports with increases in income instead of making supports conditional on employment status
	3	Eliminate and avoid creating step-effects in the tax and social insurance system
	4	Remove barriers to inward migration and migrants working legally in the economy
Infrastructure	5	Spend more on independently evaluated public infrastructure projects (circa 3% to 4% of GDP)
	6	Establish an infrastructure bank to facilitate the provision of stable, long-term finance for infrastructure and to engage in counter cyclical investment
	7	Establish an expert group to independently evaluate infrastructure needs and co-ordinate evaluation of specific projects
Human capital	8	Increase teacher autonomy and accountability and reduce classroom sizes
	9	Increase education budget for early years learning
	10	Use fiscal policy to reduce economic inequality (income and wealth) and promote social and economic inclusion
	11	Protect childcare, family and housing supports and healthcare services at sufficient levels to avert child poverty
	12	Annually review the efficacy of activation programmes and training schemes and reallocate resources to well-performing programmes and schemes
Innovation	13	Spend significantly more on basic and applied research as % of GDP – many breakthrough innovations had their origins in public research
	14	Incentivise (subsidise) take-up of science, technology, engineering and mathematics courses at undergraduate and postgraduate levels
	15	Reform the patent system to promote innovation and the use of new technologies

	16	Establish a state investment bank to raise affordable funding for innovating enterprises including seed funding for high potential start-ups
	17	Provide grants to SMEs for adoption of new technology
	18	Increase support for horizontal links between the state, higher level institutes and enterprises
	19	Reform bankruptcy law to not overly penalise failure
	20	Address market failures in the provision of high speed broadband access
Efficiencies	21	Gradually phase out the system of tax expenditures (simplify the tax code) and ensure horizontal equity of tax treatment across all asset classes to the greatest extent possible (though see no.26 below)
	22	Gradually phase out *most* subsidies for home ownership, business and agriculture (though see no.1, no.14 and no.17)
	23	Expedite moves towards a genuine banking union to facilitate financial market development and competition
	24	Guarantee independence for all existing regulators including the Central Bank. This includes powers to break-up dominant market operators and enforce macro prudential policies as appropriate
	25	Establish independent regulators with enforcement powers for all professional bodies
	26	Rebalance the tax system with increased taxes on land, property, wealth, inheritances, passive income and gifts

Note: The above list of policy reforms is non-exhaustive. A more exhaustive set of reforms will be outlined in a forthcoming NERI General Research Series.

Of course any additional resources for infrastructure, education, R&D or childcare will have to be funded from somewhere. While in the short-run such policies could be funded through debt financing, in the long-run they must be funded by taxes and charges or by cuts to other areas of public spending. In any event, Ireland will be subject to the preventive arm of the Stability and Growth Pact (SGP) from 2016 onwards meaning Ireland will have to adhere to strict fiscal parameters. The preventive arm of the SGP is assessed under two pillars. These are discussed further in NERI (2015).

The growth rate is not a monotonic function of the tax rate. In general, as Larry Jones and Rodolfo Manuelli argue (2005), there is no growth when taxes are too low (not enough public goods are provided) or too high (the private returns to capital accumulation are too low). William Gale and Andrew Samwick (2014) argue that the net impact on growth of income tax levels is ambiguous theoretically and they point to estimates suggesting the actual effect is small. Even so, the report of the LSE Growth Commission (2013) in the UK points out that: 'there is no reliable evidence that the growth potential of an economy is limited by the size of the government over the wide range we see in OECD countries.' Huge shifts in taxes in the US since 1870 have been accompanied by no observable shift in growth rates. Thomas Hungerford (2012) finds that higher tax rates have not been associated with higher or lower real per capita GDP growth rates to any significant degree in the US. Gale and Samwick do point out, however, that a revenue neutral shift towards base broadening (i.e. eliminating tax expenditures and using the additional resources to reduce headline rates) would be beneficial to economic

growth. Overall the current state of knowledge is that theoretical models have ambiguous implications about the effects of taxes on growth (Jones and Manuelli, 2005).

Economic growth must be inclusive if it is to translate into quality of life improvements for all in society. The IMF (2015a) highlights the link between rising inequality and the fragility of growth. They estimate that lower net inequality (i.e. after taxes and transfers) is robustly correlated with faster and more durable growth. The fund also estimates that redistribution is generally benign in terms of its impact on growth and that the combined direct and indirect effects of redistribution are on average pro-growth. Arguments that redistribution is bad for growth therefore appear to have little if any empirical grounding. On the other hand the OECD finds that there is evidence to suggest that taxes on property, wealth and passive income have minimal negative consequences for economic growth (Johansson et al., 2008) and are highly redistributive. Taxes on land and immovable property appear to be particularly pro-growth. Recent work by the OECD (Cournéde, Goujard and Pina, 2013) has considered the impact of fiscal policy on welfare outcomes (economic growth and equity) and with these objectives in mind constructed a hierarchy of seventeen fiscal consolidation instruments (Table 5). Given Ireland's low revenue/GDP ratio, at least by EU standards, there appears to be scope for eliminating tax expenditures and increasing taxes on wealth (inheritances, gifts, net wealth, property, land) for redistributive purposes as well as for more directly growth enhancing reasons.

Table 5 Balancing Equity and Growth: Hierarchy of Fiscal Instruments

Ranking	Instrument	Ranking	Instrument	Ranking	Instrument
1	Education	6=	Non-environmental consumption taxes	10=	Personal income taxes
2	Childcare/Family	8=	Sale of goods and services	10=	Recurrent taxes on immovable property
3=	Health services (in kind)	8=	Other government consumption	15=	Pensions*
3=	Social Security Contributions	10=	Unemployment benefits	15=	Other property taxes
5	Public capital investment	10=	Environmental taxes	17	Business and other subsidies
6=	Sickness/disability payments	10=	Corporate income taxes		

Source: Cournéde, Goujard and Pina (2013) Reconciling Fiscal Consolidation with Growth and Equity in OECD Journal: Economic Studies – Volume 2013

Notes: Cournéde et al. looked at the welfare outcomes of types of fiscal consolidation and their ordering was from 1 = best consolidation to 17 = worst consolidation. The orderings are reversed here for clarity (see note below).
Hierarchy considers impact of fiscal instruments on growth and equity objectives. Rank 1 represents the fiscal instrument with the *most* beneficial welfare outcome arising from expansion (i.e. from increasing spending or reducing the tax). Rank 17 represents the fiscal instrument with the *least* beneficial welfare outcome arising from expansion (i.e. increasing spending or reducing the tax)
*Ranking for pension refers to a reduction in the retirement age. Increasing the basic pension rate scores better from a welfare perspective mainly because such a measure would be progressive.

The IMF's (2015b) fiscal projections show that, whether measured as a percentage of GDP or as a percentage of GNP, government revenue and government spending on public services will

both be substantially lower in Ireland in 2019 than they were prior to the crisis, and substantially lower than EU averages. In the context of deteriorating age demographics this implies intense pressure on key public services and suggests there is no scope for discretionary budgetary measures to reduce the net tax take. Instead, whatever limited fiscal space there is available should be channelled to the growth enhancing areas outlined earlier as well as to measures to fight poverty and promote social inclusion. Finally, sustainable quality of life improvements are incompatible in the long-run with environmental degradation, and, as such, economic policy must always account for environmental costs and benefits. In this context there may be scope for increasing environmental taxes to generate additional fiscal space.

6. CONCLUSION

Productivity growth is crucial to sustainable quality of life improvements and should be a priority for economic policymakers. The best way to sustain growth in productivity over the long-term is to invest in education and skills, in productivity enhancing infrastructure, and in the production, diffusion and use of new technologies. Careful attention should be paid to the investment/GDP ratio, the fraction of labour allocated to R&D, barriers to technology diffusion, and the fraction of output spent on education, particularly spending on disadvantaged groups and on early years learning. Insufficient investment in skills, infrastructure, applied and basic research and technology diffusion will constrain future economic growth. Underlying all of this is the need for supportive institutions to enable and incentivise innovation and to discourage rent-seeking activities.

A much more activist role for the state in the provision of childcare infrastructure, or at the very least generous subsidies for childcare would be an important reform. Reduced costs for childcare will increase employment rates for second earners and lone parents. The gradual tapering down of housing and welfare supports along with increases in income, instead of removing these supports completely along with employment. If properly designed, this change will remove potential disincentives to work and increase the employment rate.

The establishment of an infrastructure bank; increased funding for basic and applied research; a phasing out of subsidies and tax breaks; increased funding for early years learning and childcare infrastructure, and supports to prevent child poverty have all been identified. Many, though not all, of these reforms carry a substantial fiscal cost and as the Irish Fiscal Advisory Council (2014) point out the current trajectory of fiscal policy in Ireland already implies considerable pressure on government services, public investment and social payments. Indeed budgetary

projections suggest the primary government expenditure share of economic output will, by the end of the decade, be at a very low level by modern historical standards.

There appears to be little evidence that the revenue-to-GDP has much if any effect on long-run growth in advanced economies (LSE Growth Commission, 2013) and in this context, while acknowledging the need for reform of the tax and social contribution system, it is important to re-evaluate plans to cut taxes in future budgets and instead take a more strategic and long-term approach to nurturing growth in the Irish economy. Education, investment and innovation are the keys to unlocking productivity gains and productivity is the key to growth.

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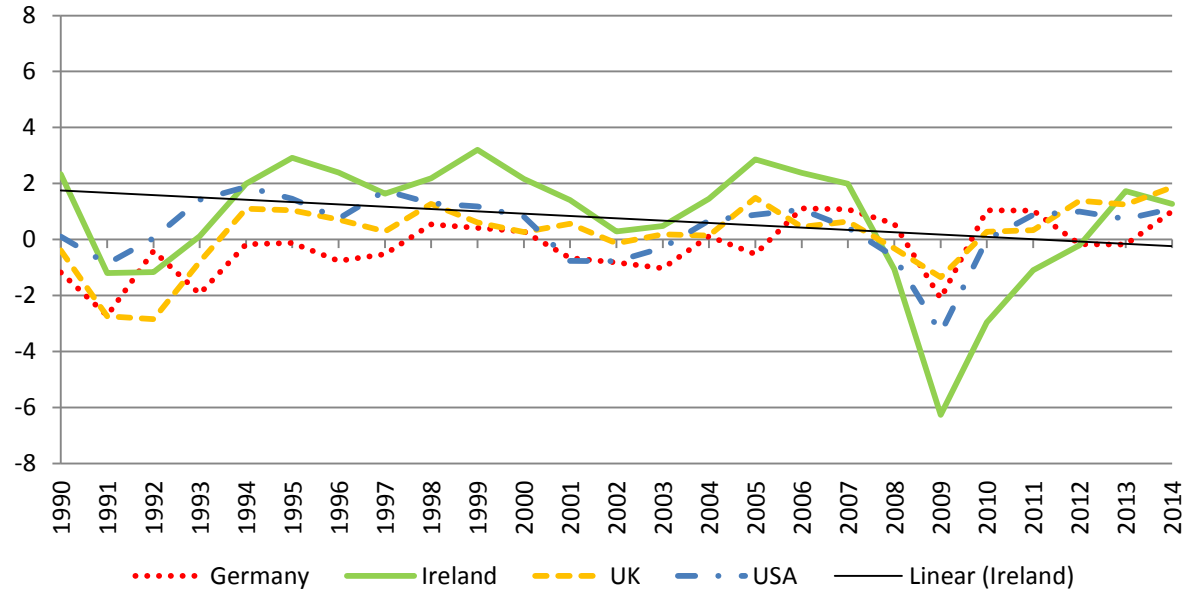
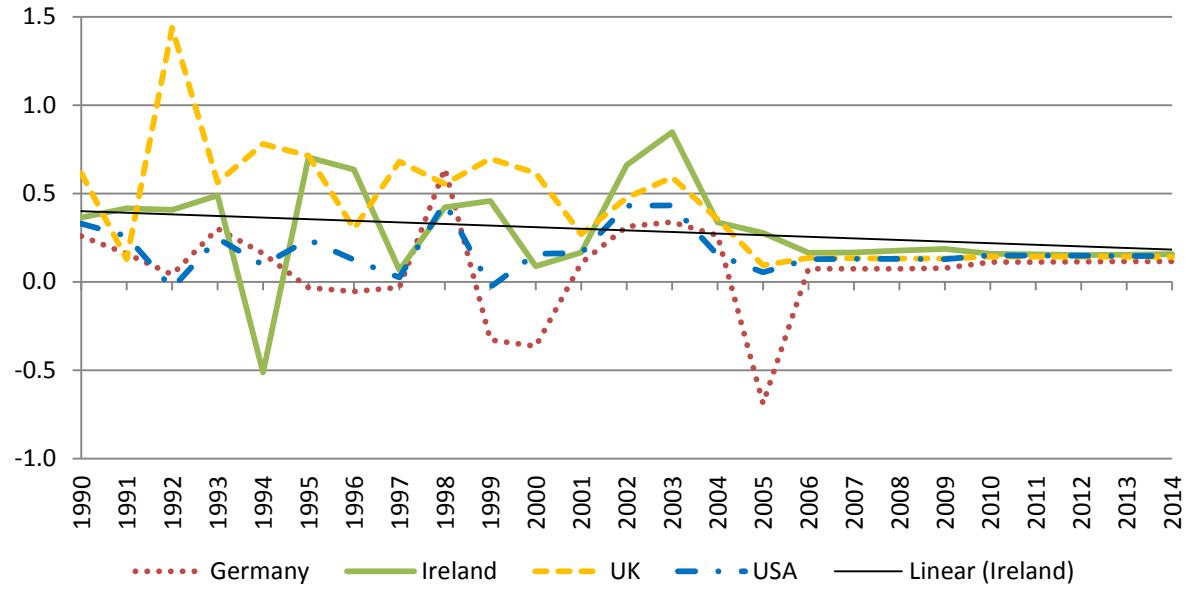
APPENDIX

Chart 3 Annual Contribution of Labour Quantity to GDP Growth, 1990-2014



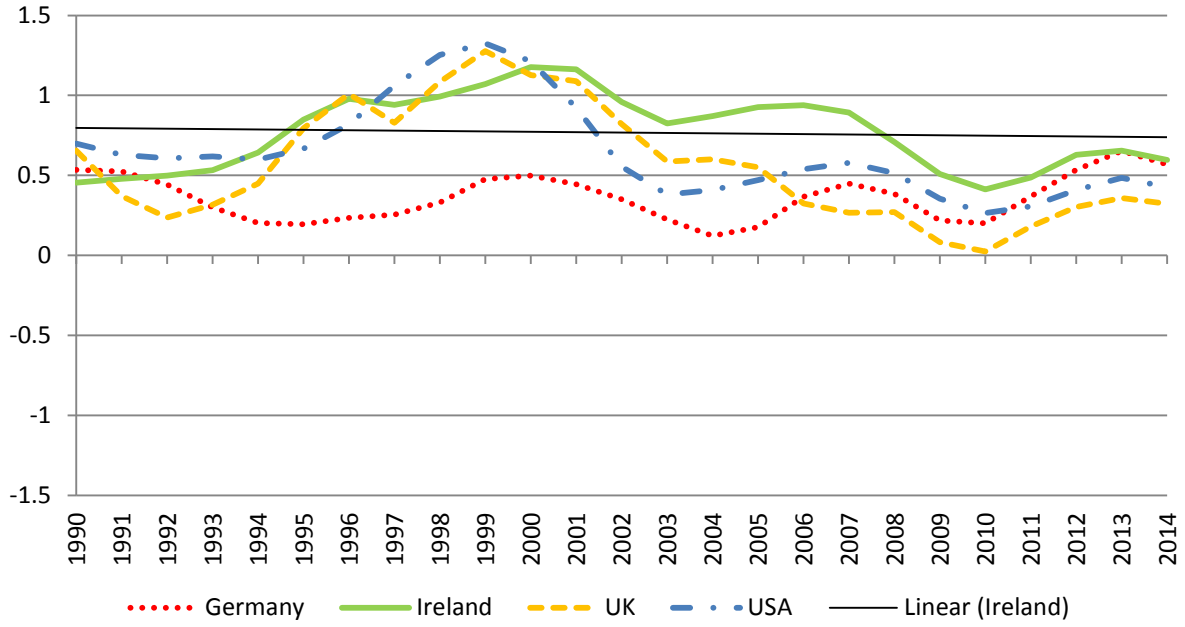
Source: The Conference Board, Total Economy Database (May, 2015)

Chart 4 Annual Contribution of Labour Quality to GDP Growth, 1990-2014



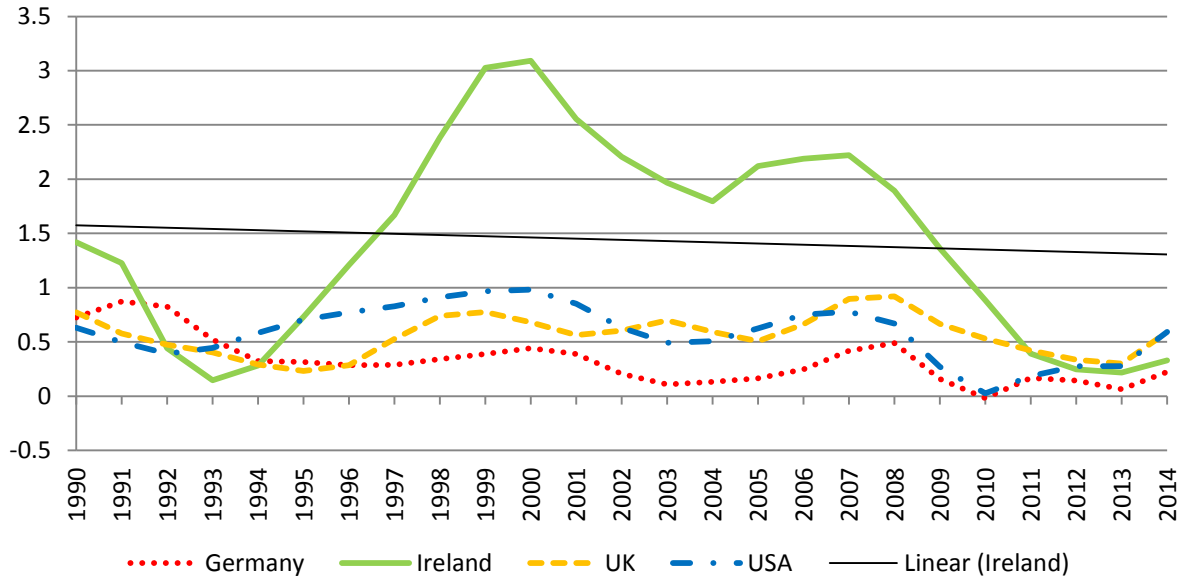
Source: The Conference Board, Total Economy Database (May, 2015)

Chart 5 Annual Contribution of Capital Services provided by ICT Assets to GDP Growth, 1990-2014



Source: The Conference Board, Total Economy Database (May, 2015)

Chart 6 Annual Contribution of Capital Services provided by Non-ICT Assets to GDP Growth, 1990-2014



Source: The Conference Board, Total Economy Database (May, 2015)

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