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**Research Imperatives for Emerging Economies**

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**Introduction**

The Republic of Ireland has arrived late to the conviction that research plays a critical role in a country's development. Though it enjoyed an economic boom from the mid 1990s to the early 2000s based on winning very high levels of foreign direct investment in a number of sectors targeted by the state such as information technology, pharmaceuticals, medical devices and financial services, only in the late 1990s did the Irish state begin to recognise the importance of investing in research. Its concerted research effort has therefore lasted only a decade but it has already shown some major successes in developing in Ireland significant research capability in fields identified by the state as being strategic for Ireland's long-term development, most notably information technology and biotechnology. Taking account of the brief given to workshop participants, this paper begins by examining the historical context in which this new commitment by the Irish state has emerged. In its second section, it traces the emergence of a culture of research in Ireland and describes its principal institutional features. The third section profiles investment in research in Ireland, the growth in research activity, the fields in which it is taking place, and how Ireland's international position on research league tables has changed. The fourth and final section critically assesses the Irish state's approach towards fostering a research culture, identifying its strengths and weaknesses and the lessons it offers for other late developers.

**Ireland as a late developer**

When the Irish state was established in 1922, it inherited an economy that was predominantly agricultural with around 50 per cent of its exports being live cattle to the British market. Apart from a small food and drinks industry, the country was virtually without industries. Like many Latin American countries at the time, the 1930s saw a determined effort in Ireland to establish industries behind high tariff barriers and with active state involvement, a policy known as import substitution industrialisation. Its neutrality during the Second World War reinforced its economic isolation from its neighbours and the late 1940s and 1950s were marked by a severe balance-of-payments crisis and by a sense of policy drift. Ireland began to liberalise its economy from the early 1960s, signing a free trade agreement with the United Kingdom in 1965 and joining the then European Economic Community in 1973. The state sought actively to attract foreign direct investment, a policy which helped lay the foundations of its modern industrial base. By 1973, foreign firms accounted for almost one-third of all manufacturing employment and by 1983 some 1,000 overseas firms were established in the state. Like other late developers, Ireland suffered greatly as a result of the oil price rises of the 1970s and the high levels of state debt that were built up; this led to a severe and prolonged recession in the early 1980s. A policy of

fiscal austerity introduced by a new government in 1987 helped prepare the economy to benefit from a wave of mostly US investment in the 1990s. Through the proactive efforts of the state agency, the Industrial Development Authority (IDA), many of the major multinational companies in information technology, pharmaceuticals and chemicals were attracted to establish manufacturing plants in Ireland. The state's low tax on company profits compared to most of its neighbours (a 10% rate on manufacturing profits introduced in the 1970s was changed to a 12.5% rate on all trading companies in 2003) was one of the major policy mechanisms to attract FDI. This policy helped lay the foundations for the economic boom of the late 1990s, known as the Celtic Tiger, a success largely driven by foreign firms.

Only in the 1980s did the Irish state begin to devote attention to supporting the development of indigenous firms and, as part of this, turned its attention in the 1990s to developing policy on science and technology. The foundation of the Programme for Research in Third Level Institutions (PRTL) in 1998, of two research councils in 2000 – the Irish Research Council for Science, Engineering and Technology (IRCSET) and the Irish Research Council for the Humanities and Social Sciences (IRCHSS) – and in the same year of Science Foundation Ireland (SFI) as a sub-board of Forfás, the national policy advisory body for enterprise and science, and as a separate statutory entity in 2003 put in place the institutional infrastructure to build internationally recognised research capacity in Ireland. As detailed below, significant public funding is being channeled to research through these bodies. However, it should be noted that Ireland's belated recognition of the importance of research for national development emerged as a result of its economic boom and was not a cause of it. Therefore, as noted by Paus, this is a new strategy for Ireland, to move up the value added chain through significant investment in R&D. And, as she puts it, 'the obstacles to success are formidable' (Paus, 2005: 126).

### **Developing a research culture in Ireland**

Since the late 1990s, a key policy objective of the Irish state is to develop a knowledge economy, creating high quality jobs and moving Ireland up the value-added chain. For example, the 'Strategy for Science, Technology and Innovation 2006-2013' states as an objective that 'Ireland by 2013 will be internationally renowned for the excellence of its research, and will be to the forefront in generating and using new knowledge for economic and social progress, within an innovation driven culture' (quoted in Forfás, 2008a: 4). A study commissioned by the Irish government in 1998 that surveyed leaders in government, academia and industry on the future needs of the Irish economy identified biotechnology and information and communications technology (ICT) as 'the engines of future growth in the global economy' and concluded that 'a world-class research capability in selected niches of these two enabling technologies is an essential foundation for future growth' (see SFI website, [www.sfi.ie](http://www.sfi.ie)). In response, the government created the Technology Foresight Fund with a budget of €46 million and established Science Foundation Ireland to administer it. SFI states on its website that it 'uses an international merit review process to choose far-reaching, high-impact research for support in its target areas and to fund excellent scientists and engineers working on the dynamic intellectual frontiers of biotechnology, information and communications technology and sustainable energy and energy-efficient technologies development'.

While SFI is focused on particular areas of research, the foundation of the Programme for Research in Third Level Institutions (PRTLTI) in 1998 was designed to transform the research landscape in Ireland's third-level sector, primarily its seven universities (all public) but also its network of 13 Institutes of Technology and other third-level institutions such as teacher-training colleges. As stated by the Higher Education Authority (HEA), the unit of the Department of Education and Science that administers Ireland's third-level education, the foundation of PRTLTI 'ushered in a new era for research and innovation and fundamentally altered the research landscape in higher education' (HEA, 2008: v). This it does through its periodic rounds of research funding designed to upgrade the infrastructural and human resource capacity of Irish third-level educational institutions to engage in world-class research. In the decade 1998 to 2008, the Programme has disbursed €65 million to these institutions 'to adopt a strategic approach to research, identifying and building on existing strengths ... and [has] fostered a culture of co-operation and collaboration among researchers within and between institutions' (ibid.: vi). It has helped create nearly 80,000 additional square metres of research space in Ireland, built new research facilities, upgraded libraries and added to their research capacity, and funded in excess of 1,000 researchers and 2,000 postgraduate students. As the HEA states: 'As a result researchers are no longer forced to seek a career path abroad and many talented Irish scholars have returned home and brought with them outstanding researchers' (ibid.: vii). In early 2009, the fifth call for PRTLTI funding was issued with a budget of some €200 million. In addition to the PRTLTI, the two research councils every year fund hundreds of scholarships for PhD students in all the Irish universities and in other third-level institutions. In addition, they fund post-doctoral fellowships, fellowships for senior academics and projects of collaborative research.

The HEA has acknowledged the role of Atlantic Philanthropies as being 'central to effecting a real paradigm shift in Irish research' (HEA, 2008: vi). The role of this private donor is therefore worth examining. Atlantic Philanthropies is a US foundation established by an wealthy Irish American, Chuck Feeney, to make charitable grants. It first established an office in Dublin in 1990 from which it began to invest in higher education projects, quickly becoming the sector's largest private donor and spending €9 million in its first seven years across a wide range of areas including infrastructure, libraries, and access programmes. However, Atlantic recognised the very low level of government investment in research at this time (estimated at about 11% of the EU norm in the early 1990s) and the lack of any commitment by government to address this. It decided therefore to focus its attention on upgrading the research infrastructure in Ireland and to do so in partnership with the Irish government, what they describe as 'a strategy of leveraging substantial government money as part of a programme of funding for both capital and recurrent research costs' (Rhodes and Healy, 2006: 66). Out of this initiative, the PRTLTI programme was founded; of the €605 million given in research funding through the first three rounds of PRTLTI, €178 million of it was a donation from Atlantic. The foundation did not participate in subsequent rounds. Apart from developing a research capacity and culture, Atlantic sought greater collaboration between Irish universities, prioritising the development of different strengths in different institutions, encouraging the emergence of large team-based and inter-institutional research projects, and the establishment of effective management structures and strategic planning units. In assessing the impact of Atlantic's involvement in developing the programme, the chairman and chief executive of Atlantic concluded: 'The PRTLTI

initiative has resulted in a substantial enhancement in the capacity for world class research in Ireland, the enablement of Irish researchers to participate in the international research community as scientific leaders and peers and the considerable strengthening of the “fourth level” in Irish education’ (Rhodes and Healy, 2006: 71).

### **Profiling research in Ireland**

According to Forfás (2008a), Ireland’s overall annual spending on research has increased from €73 million in 1992 to €601.4 million in 2006 (the latest year for which figures are available), measured in current spending terms. From 1998 to 2000 the increase in research funding was 16.6% annually but from 2000 onwards the trend accelerated to an increase of 52.8% between 2002 and 2004 before dropping back to an increase of 22% between 2004 and 2006. Universities dominate the institutions funded, accounting for 94.7% of total spending in 2006. The R&D expenditure of universities has more than trebled since 1998, from €169 million to €68 million. By comparison, the Institutes of Technology received €13.5 million in 1998 which grew to €33.3 million in 2006. The bulk of funding comes from government. For example, in 2006 85% of funds came from government – 44% through institutions such as SFI and the PRTLTI programme and 41.2% through the block grant given by the HEA to fund universities. The breakdown of the total research funding for 2006 by its sources is as follows:

- €66m in direct research funding from government
- €48m in indirect research funding from government
- €8m from EU sources
- €7m from private or individual sources
- €1m from Irish business
- €5m from foreign business
- €5m from other sources

The sources of the direct government funding can be further broken down as follows:

- €107.6m from SFI
- €34.9m from Enterprise Ireland (the state support agency for indigenous industry)
- €29.1m from PRTLTI
- €19.6m from the Health Research Board
- €15.7m from the Irish Research Council for Science, Engineering and Technology (IRCSET)
- €5.7m from the Irish Research Council for the Humanities and Social Sciences (IRCHSS)
- €4.7 from the Department of Education and Science
- €2.6m from Teagasc, the state agricultural research body
- €45.7m from other state sources

The total number of researchers employed in the higher education sector grew from 1,886 or 1.37 per thousand of the labour force in 1992, to 2,425 or 1.5 per thousand in 1998 to 4,689 or 2.2 per thousand in 2006. Identifying fields of activity shows that the great bulk of funding goes to the natural sciences. Expenditure in this field grew from €115.9m in 2002 to €205.5m in 2006, or a 77.3% increase while the number of researchers reached 1,398 by 2006. Research in medical and health sciences grew

from €2m to €18m (820 researchers in 2006) while research in engineering and technology grew from €4m to €15m over the same period (1,108 researchers in 2006). Other fields showed more modest increases with the social sciences growing from €1m to €102m (767 researchers in 2006) and humanities growing from €3m to €43m (483 researchers in 2006). Finally, agricultural science research grew from €7m to €18m (101 researchers in 2006). Overall, 55.1% of funding went on basic research, 36.5% on applied research and 8.4% on experimental research.

More recent figures are available on business spending on R&D in Ireland. According to Forfás, this grew from €900m in 2001 to reach €1.6bn in 2008. Overall, it reports that almost 13,900 people were engaged in these research activities in 2007, of whom 8,300 were researchers. However, this information is given by businesses in answer to a question which asks for the numbers of staff who devoted 'any of their time' to R&D. Altogether 1,211 enterprises were engaged in R&D in 2007, a decline from 1,329 in 2005. Broken down by spending, 419 enterprises spent less than €100,000 a year, a further 399 spent between €100,000 and €500,000 a year, 229 enterprises spent between €500,000 and €2m while 92 enterprises spent between €2m and €5m and only 72 enterprises spent more than €5m (Forfás, 2009). The most recent breakdown provided by Forfás for the ratio of spending by foreign companies compared to that by Irish companies is for 2005. This shows that of the 1,329 enterprises who declared that they funded R&D activities, 390 were Irish companies and 939 were foreign companies. This compared to 284 Irish companies in 1999 and 500 foreign companies, indicating a greater increase among foreign than Irish companies (Forfás, 2008b).

In comparative terms, Ireland's increasing spending on research has resulted in the country moving from 22<sup>nd</sup> place on OECD rankings of higher education research and development (HERD) spending in 2000 to 14<sup>th</sup> place in 2006. Eurostat figures show that Ireland's increasing spending has not resulted in moving up the EU league table of R&D expenditure, measured as a percentage of GDP/GNP. Ireland's spend of 1.43% of its GNI in 1996 increased to a spend of 1.53% in 2006 putting Ireland in 11<sup>th</sup> place among the EU 27. This compares to an average EU spend of 1.84% and is significantly behind the big spenders such as Sweden (3.82%), Finland (3.45%), Austria (2.45%) and Denmark (2.43%), small countries with which Ireland likes to compare itself. Indeed, Ireland found itself in a lower place than Slovenia (1.59%) and the Czech Republic (1.54%).

### **Learning the lessons**

Over the past decade, the Irish state's commitment to research has changed dramatically and an extensive infrastructure of research spending and activity has been put in place. This transformation has been impressive and has begun to position Ireland in international research networks from which it was largely absent in the past. Yet, questions continue to be asked about the contribution this extensive research activity is making to Ireland's longer term development, questions that have become more acute as the country has entered into a sudden and very deep recession over the course of 2008. For example, unemployment increased from 4.9% of the labour force in February 2008 to 10.4% a year later with the expectation that it will further increase dramatically over the course of 2009 and into 2010.

Two principal concerns have been voiced. The first relates to the link between the extensive research effort and industrial innovation. For example, researchers Declan Jordan and Eoin O'Leary have studied the links between university research and its effect on business innovation. Paradoxically, they found that the greater the frequency of direct interaction with academics, the lower the probability of both product and process innovation in these businesses, and they speculate that these findings may reflect differences in work practices and objectives between businesses and academics. They conclude that 'the substantial public investment on research in Irish higher education institutes may have a disappointing, and perhaps even a negative, effect on the innovation performance of Irish business' (Jordan and O'Leary, 2008: 10). This conclusion seems to be supported by research examining Ireland's innovation performance over the period of the Celtic Tiger boom (1991-2005) in which Hewitt-Dundas and Roper find that the proportion of manufacturing plants making product changes increased by only 5 per cent over the period while the proportion of plants undertaking process innovation declined almost 7 per cent. They find that manufacturing innovation 'is driven by a relatively narrow range of external knowledge sources aside from knowledge created within the plant through R&D'. This they put down to the low level of business R&D spending in Ireland and 'the lack of any positive link between the extent of innovation activity and links to public knowledge sources' such as universities. Unsurprisingly, they find that externally owned plants and those with access to group R&D are more likely to be undertaking product innovation (Hewitt-Dundas and Roper, 2008: 59). Furthermore, the annual Innovation Index of the German Institute for Economic Research places Ireland third last on its index of 17 countries, just ahead of Spain and Italy. Ireland scored particularly poorly in education, research and development and networking opportunities, perhaps again drawing attention to the weak links between academic research and industrial innovation (Scally, 2008: 14-15). This is also suggested by the fact that Irish businesses spending on R&D is increasing more slowly than that of foreign companies operating in Ireland (see above) and by Ireland's relatively low ranking on the index of EU patent office applications as reported by Eurostat. While Ireland's rate of applications increased from just over 20 per million inhabitants in 1995 to just over 60 in 2000, it has hovered at that level since while the average EU rate, about double the Irish rate, has continued to increase.

The second major concern relates to the state's seemingly inconsistent policy as it fails to increase funding to run Ireland's universities even as it increases funding for research centres within them. As the heads of two leading universities, John Hegarty of Trinity College Dublin and Hugh Brady of University College Dublin wrote in an opinion column in *The Irish Times* in March 2008: 'On a per student basis, core funding has been reduced by one-third since 1995 in real terms. In addition, the maintenance and upgrading of the physical infrastructure for third-level teaching has virtually ground to a halt through lack of funding'. Rather than closing the gap with universities in other countries (they choose Scotland and Denmark for the purpose of comparison), they state that 'we are allowing it to widen by progressively eroding funding for core teaching. They conclude their article by pointing to the vulnerabilities that result: 'Failure to invest now will place an entire generation of students and the future of this country at a serious disadvantage. To gamble with our future in this way is simply wrong' (Brady and Hegarty, 2008).

The principal lessons of the Irish case for other latercomers to development therefore appear to be twofold. Firstly, Ireland has shown an impressive commitment to increasing funding for research in higher education and developing an extensive infrastructure to support this. This is the positive lesson. The second is more negative, however. This relates to the fragmented nature of policy as it fails to address other dimensions that require equal commitment from policy makers if the extensive investment in research is to pay off in improvements in job opportunities and quality of life for Irish citizens. Foremost among these is policy that would address the link between researchers and business, particularly indigenous business which was for long neglected by Irish policy makers. But policy makers also need to address the growing gap between high levels of research funding and declining core funding in Irish universities. Unfortunately, the failure to develop policy on these issues during the boom makes it less likely now when the Irish state is desperately seeking to cut spending as it adjusts to what many are calling the most severe economic crisis in its history.

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