# Productive Structures and Industrial Policy in the EU

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## [1] Introductory remarks

The issues that have attracted most public attention as the crisis of the euro-zone plays out are the fiscal imbalances and public debt problems of the vulnerable southern member states (Greece, Portugal, Italy, Spain) and the most westerly member (Ireland). However, hidden behind these problems are structural imbalances that have been described as follows:

> "The crisis has laid bare the divergent productive structures in the EU. Regional policies have focused on physical infrastructure and training, but no attention has been given to industrial policy, something which the neo-mercantilist core around Germany has no interest in promoting. EU policies have tended to cement the existing European division of labour, and imposing austerity policies on the peripheral countries will exacerbate this yet further." (*Euromemorandum* 2012: 2)

But has the crisis actually laid bare the divergent 'productive structures' within the EU? Most economic commentary on the divergence in productivity performance has been conducted in terms 'competitiveness', 'labor market flexibility', and government regulation, as if the underlying structure is not the problem, but merely some of its characteristics that could be fairly easily addressed were policy makers willing to address.

The term competitiveness implies that with a change in prices in international markets an economy's enterprises would again become competitive, the trade balance would improve and growth will return. In the case of Greece, this analysis points to the need for breaking with the euro zone and re-acquiring a domestic currency that could be promptly devalued. But this assumes that price competition is the problem. What if the deeper problem is not price but product competitiveness, rooted in limited production capabilities? Unfortunately, devaluation of the currency or lowered prices via fiscal austerity measures will not address this problem.

As one scans the economies of the euro zone, the question that poses itself is the following: Why are there so many globally-competitive, technologically-advanced, mid-sized firms in Germany, Austria, Denmark, Finland, the Netherlands and Sweden and so few in the peripheral economies? Our contention is that companies in these countries benefit from operating within productive structures that facilitate product-led competition and continuous innovation. The absence of the concepts of productive structure and product-led competitiveness from public discourse and academic economic analysis deflects "growth" policy away from its proper focus. It fosters the impression that driving down prices by austerity measures is the only solution to the 'lack of competitiveness' in the destabilized, lagging economies.

Our paper locates the concept of "productive structure" within a political economy perspective in which business organization and industrial policy are explanatory variables rather than outcomes. The concept of productive structure offers an escape from the sterility of existing policy debates. The evidence is abundant

that peripheral economies suffer from a dearth of business enterprises that meet the performance standards required to compete and grow in the Single European Market. The idea of productive structure offers a systemic interpretation of the sources of business enterprise performance and exposes the shallowness of many liberal reform agendas.

Where conventional economic theory presumes price-led competition, industrial policy within Germany and the Scandinavian economies is about product-led competition. This has profound effects for the objectives, implementation and effects of industrial policy. Instead of a conception of industrial policy as merely correcting market failure, it is one of strategic organizer. Its role is precisely to shape productive structure in ways that contribute to business development, industrial innovation, sectoral transitions and socially rational product systems.

In what follows we first develop an economic theory of a productive structure in which industrial policy's role is conceptualized as strategic organizer rather than market optimizer. The perspective is illustrated by outlining the strategic role of industrial policy in Germany. We then turn to industrial policy as conducted by the European Commission and suggest that it diverges sharply from that deployed in the successful social market economies of Europe. European Union regional development policy has failed to address, and in important ways has even deepened, the challenge of lagging productive structures which is illustrated with Ireland. It is shown that income growth can be a misleading measure of industrial policy performance as Ireland and Greece both grew rapidly during the period in which they benefited massively from the inflow of EU structural funds.

The present crisis within the euro zone grew out of and exposed long unaddressed flaws in the productive structure of peripheral member economies. But structural problems can only be ignored for so long. In this the crisis is both a challenge and an opportunity. The old economic growth narrative is passé: neither austerity nor continued deficit spending will recreate the conditions for sustainable prosperity. The opportunity is to formulate industrial and economic policies that address the flaws in the productive structure. Much can be learned from the productive structures of the social market economies in the EU. Unfortunately, these lessons have not to-date informed the EU's regional development policies and programmes. If anything they have served to reinforce the divergence in productive structures between the leading and lagging EU member states.

## [2] Productive Structure: A Conceptual Framework

The high productivity levels of enterprises in the dynamic core of the EU (the core countries) result from 'structured' inter-relationships involving the following four elements.[1]

(1) Entrepreneurial Firms. The entrepreneurial firm or innovative enterprise is the pivotal agency within the productive structure framework. Firms exist because an individual cannot do everything alone and one cannot do everything at once (Penrose 1959; Best 1990). Entrepreneurial firms are companies that are organized to compete on the basis of new products or processes and/or more effective use of new technologies and not primarily on the basis of price. Productivity is a measure of successful innovation in the Schumpeterian sense

[1] For data on productivity see
http://epp.eurostat.ec.europa.eu/portal/page/portal/product_details/dataset?p_product_code=TSDEC310

of improvements in product, process, organization, and technology. Productivity advances are driven by innovative enterprises or entrepreneurial firms but not in isolation.[2]

The superior collective innovation capability of entrepreneurship in the core countries is reflected in patent applications to the European Patent Office. Another indicator is that high level of gross expenditures on research and development (GERD). The latter is a measure of R&D absorptive capacity. High GERDs indicate New Product Development (NPD) and Technology Management (TM) capabilities in the region or nation's business enterprises. Entrepreneurial firms seek to establish a dynamic competitive advantage anchored by a distinctive organizational competence, usually in the form of a production platform ("technology base", in the words of Penrose) that can generate a pipeline of new products. This requires NPD and TM capabilities the development of which presents a challenge well beyond a world class production line. The establishment of replica mass production lines to produce 'mature' commodities that meet world class cost and quality standards has itself become a routine and replicable process. In recent decades branch plants of multinational companies and engineering consultancies in the technologically advanced regions of Europe have diffused world class manufacturing processes to strategically organized, low-cost regions. The productive structure perspective offers conceptual tools to interrogate production in the form of fundamental, engineering-based principles by which regions and nations have historically established competitive advantage and industrial leadership. The result is a set of measures by which performance can be audited for purposes of characterizing global competitiveness. Nevertheless, the idea of productive structure encompasses more than the internal organization of production within firms.

(2) Mode of Competition. The internal organization of the firm is structurally linked to the prevailing mode of competition in the market. To paraphrase a famous philosopher: anarchy in the market begets despotism behind the factory gate.[3] Put differently, intense price competition in the market reinforces models of work organization that divide managers and workers, planning and execution, thinking and doing. These shop floor practices are not consistent with new product development and innovation which depend upon inclusive and flexible models of work organization.

Thus product-led competition creates a different set of pressures on internal organization than price-led competition. Efficient new product development is about the integration of design and manufacturing on the shop floor and entails incessant improvement via experimentation to establish best practice. The introduction of new technologies requires cross-disciplinary teamwork. Companies organized to tap the creative input of a committed workforce are better placed to succeed.

(3) Localized Capability Developmental Infrastructures. Business units do not develop production capabilities in isolation. Successful indigenous global competitors are regionally embedded within a complex of private and public relational networks. Opportunities for networking relations to organize and support new product development and technology management capabilities are stronger in regions with tooling, machine and instrument and equipment making companies. In others, both engineering-oriented consultancies and public

[2] Penrose (1959) investigated the technology base of the individual firm as her case study of Hercules Powder was a government forced spinoff from DuPont Corporation. She did not consider extra-firm but intra-regional knowledge bases that are both leveraged by firms and deepened as entrepreneurial firms develop new technological capabilities in the process of developing new products (Best 2001).

[3] Marx (1867: 243): "If, in a society with capitalist production, anarchy in the social division of labour and despotism in that of the workshop are mutual conditions..."

research institutions provide technical expertise to support product development activities. Financial institutions with locally-calibrated, due-diligence expertise are particularly important to fostering opportunities for long term company development initiatives.

A close examination of NPD and TM capabilities of firms within the advanced productive structures of the EU reveals a range of intermediary agencies that mediate between government funding agencies and organizational capability development activities of firms, particularly small and medium-size enterprises (SMEs). These non-profit, non-governmental agencies have long term developmental orientations or missions and intimate knowledge of firms with whom they engage. For example, in regions with globally successful indigenous technology-driven enterprises, national and regional government agencies fund basic research conducted in research-intensive universities and developmental research conducted in technically focused research institutes in ways that complement applied research conducted in enterprises. In this way, inter-organizational 'chains of innovation' are embedded in triangular relations intersecting the three spheres of government, education, and industry.

(4) Industrial Policy. The fourth element of 'structured' inter-relationships is industrial policy. Attention to linking the inter-related elements of the productive structure distinguishes capability-driven industrial policy from government direct assistance to business. The concept of productive structure points to the dual role of intermediary institutions and infrastructures: they are levers used by entrepreneurial firms and arms-length delivery vehicles for long-term and strategic industrial policy.

Strategic industrial policy designed to foster product-led competition involves subtle shaping of support infrastructures, material and intangible, to advance the product development and technology management capabilities of enterprises as distinct from the two way relation between government and company. The government goal of increased innovation can be pursued by tax incentives. But such programs do not target production capability development. They are likely to have little aggregative impact upon the chain of innovation. This is because the chain of innovation is about the subtle coordination of links cutting across governmental, educational, and industrial spheres. Businesses do not innovate in isolation and winners are impossible to pick.

Strategic industrial policy has a second fundamental role: long term sectoral indicative planning. The government is responsible for collective choice where individual and social rationality diverges. In *The Social Limits to Growth*, Fred Hirsch (1977) brought attention to the 'tyranny of small decisions' which generate a divergence between private and collective rationality. If one person stands on his toes to watch the parade he/she can see it better but once everyone does so the view is not improved and all are less comfortable. In this example individual preferences cannot be achieved by individual actions; instead social action in the form of a collective agreement is the only means of achieving the goal of watching the parade in a comfortable position.

In some cases of large scale consumption interdependence, such as cigarette smoking, government taxes and bans can correct for the 'externalities' of individual choice in the cigarette industry. But other cases are not so easily addressed. Some products, once established, are embedded in a wider 'social infrastructure of consumption' in which the role of the industry in the economy is not tractable to management by taxes, subsidies, and bans. The classic example is the car-based urban transportation industry. Once a highway system, employment and housing patterns, and an energy supply system are integrated and in place, the

transportation industry becomes intractable in three ways. It is intractable to individual choice since the 'market' does not enable individuals to choose between, for example, a Copenhagen bicycle-mass transit system vs. a Dublin car based system. Second, it is intractable to 'market failure' remedies of achieving an optimal transportation system by taxes and subsidies. The structural problem here is that taxes and subsidies only operate to increase or decrease resources for a given product system. Third, once any one system is established it becomes intractable to social choice. It will be locked in place by accompanying infrastructures and vested interests. Choosing amongst product systems like urban transportation necessitates a political means for making social choices. This is a reason why a 'social' market economy can more effectively achieve private preferences under conditions of pervasive consumption interdependence.

A strategic industrial policy is not simply about developing competitive advantage for growth; it is also about characterizing social needs that are consistent with sustainable prosperity. The latter involves creating the administrative capacity to shape sector strategies to account for material and social infrastructures of consumption. Simply investing in infrastructure is not the goal; it is necessary to align infrastructures of production and consumption in ways that foster socially rational long-term growth. As we will argue below, two decades of EU structural fund investments contributed to the growth booms of both Ireland and Greece but also left both countries with a set of intractable sectors which have become barriers to growth. Again in the core area of Germany and the Nordic countries we find intermediary agencies that align production and consumption infrastructures in sectors that otherwise may generate social limits to growth.

**[3] Productive Structures in EU Center: Focus on Germany**

The German, Austrian and Nordic productive structures are highly similar in terms of open-system business models, developmental infrastructures, and 'triangular' industrial policy agencies and instruments. But it is unlike the productive structures by which the United States and Japan established industrial leadership or the yet again different productive structure of China.

In the neoliberal perspective free markets and low taxes are the keys to growth. The theory, however, is not consistent with economic history. Nineteenth century American industrial leadership is not a story of free markets 'creating' an innovative productive structure. It is a story of the building of productive structures and the organizational capabilities that constitute them. Marshall, amongst others, described the first period in US industrial leadership as the American System of Manufactures. Similarly, twentieth century American economic history cannot be told without Chandler's history of the organizational innovations in production and business organization operationalized by the leaders of what became Big Business. Neither of these productive systems spontaneously emerged via the propensity to 'truck, barter, and exchange' or by price-taking firms in the "market".

The rise of the fast growing Asian economies beginning with Japan is also a story of the emergence not of free markets but of productive structures that enabled enterprises to achieve performance standards, sector by sector, that could not be matched by the competition. But the story of the rise of Japan, South Korea, Taiwan and China cannot be explained by organizational innovations in the business model alone, or in terms of 'development states' devising industrial strategies. And this is certainly the case for a narrative to explain the establishment of America's regional innovation systems such as Route 128 and Silicon Valley. These are productive structures constituted by populations of entrepreneurial firms and adaptive clusters. Flexibility

does not stop with new product development and innovation capabilities within enterprises; populations of entrepreneurial firms likely exhibit combinatorial association properties. This refers to the periodic re-combinations of legacy skills, facilities, and capabilities combined with new ones to pursue new market opportunities and take full advantage of technological changes. In some cases such flexibility extends to the growth of new sub-sectors and sectors.

The German and Nordic country productive structures, likewise, have proven highly successful and innovative. German economic policymakers understood the critical relationships between production capabilities, education policy and banking institutions long ago and established industrial leadership with the integration of science and industry in the formative stages of industrialization. It was always a different model of productive structure from that of the United States which, as noted, in the early decades of the twentieth century involved managerial innovations and the establishment of Big Business based on the integration of mass production and mass consumption. The unmatched production power of the American mass production model was not widely appreciated in 1930s Germany. But the postwar German model was not to imitate the productive structure of the United States. Rather, it developed an alternative SME-based business system structurally linked to a 'strategic organizing' industrial policy. Industrial policy was integral but it moved sharply away from the 'direct aid' and prewar corporatist integration regime.

At the center of the German productive structure is the *Mittelstand* business system which is characterized as a large, dynamic population of SMEs. In a study of world leading mid-sized German firms, over 70 per cent are family owned, even though many combine family ownership with professional management and, more striking, the average age of the successful companies was 70 years (Venhor 2010).

Entrepreneurial firms in *Mittelstand* regions can leverage a range of extra-firm resources to facilitate a transition to a focus and network, open-system business model. The diversity of specialist companies is an open-system in which individual company's focus on a core capability and partner for complementary capabilities (Richardson 1972). The entry barriers are reduced as a new entrant can focus on a single, core capability and plug into open-system networks for complementary capabilities. In other words, a small or mid-size firm can pursue a strategy of flexible specialization because of the large number of available partners to jointly coordinate not only production but the development of new products. These are extra-firm, collective organizational capabilities that enhance participant firms' new product and technology management capabilities.

An example is the capital goods infrastructure. Nearly one-third of the German *Mittelstand* companies are in machine equipment and half are in machine equipment, electrical engineering, and industrial products. This capital goods sector performs as a system level resource or infrastructure that can be leveraged by individual firms to develop new products and processes. Inter-firm connections of this type add to the openness of a region's business system; they are a functional equivalent to managerial coordination within multi-divisional enterprises. But most importantly, open-system business models lower the barriers to the transition of mid-sized firms to entrepreneurial firms.

Technology research and human resource agencies constitute a second form of infrastructural or system-level resources that enhance entrepreneurial firms. The *Mittelstand* industrial system contains a dense network of research and skill development institutions closely aligned with sub-regionally distinctive technological capabilities including the Fraunhofer Institutes, the Helmholtz Research Establishments, and the Max Planck

Institutes. Industrial policy rarely involves direct links between government and companies; instead it is largely conducted indirectly to firms through infrastructural agencies. For example, technology policy in the *Mittelstand* regions is not about technology transfer. Rather, it is about coordination of a chain of innovation involving government, industry, and research institutions.

The German government, for example, has invested heavily in R&D for renewable energy technologies via the intermediary of nationally integrated research institutes. The challenge is organize chains of innovation that link basic research, development research and applied research with the NPD and production capabilities of firms. This is a three-way institutional process for which the government has the funding, legitimacy, and capacity to establish the product system goals and manage the multi-institutional cooperation required to coordinate and integrate the inter-organizational activities in the chain of innovation. The basic research is government funded but conducted by independent research labs and universities which, in turn partner with industry to link applied research and NPD into the chain.

For the Nordic regions these triangular inter-relations support and facilitate linked chains of innovation. A measure of the superior innovation performance of regions within the 'social market' economies can be seen in the Eurostat map of patent application data by NUTS 3 regions.[4] Processes of opportunity creation can be found at both ends of the chain of innovation. Mission-driven research is prerogative of government at one end. A population of EFs in form of SMEs at the other end with the capacity to detect opportunities, to develop customers and create a market

Macro-sectoral research on the German economy suggest the secret to Germany's economic success cannot be explained in terms of clusters, localization or agglomeration economies (Alecke et.al. 2006). From the productive structure perspective, what makes these regions innovative is not simply the existence of individual entrepreneurial firms but populations of enterprises which collectively act as an industrial experimental laboratory. The multiplication of new product development experiment across hundreds and even thousands of firms continuously and successively generate new opportunities that can be exploited by industrial policymakers that have sensitive antennae to capture promising developments with infrastructural support in the early stages.

Industrial policy making in the German chain of innovation model is distinguished in a second role of government that is not commonly appreciated. As noted in the introduction, sectors are highly interdependent and have long run consequences for the 'social infrastructure of consumption'. But the form that sectors take and the product systems by which the consumption needs that they serve are also a policy matter. It is often obscured in debates over the optimal size of the public sector. The German model subjects all product systems to an impact analysis in terms of the social infrastructure of consumption and a risk analysis associated with the coordination failure in the form of the 'tyranny of small decisions'. Here we find potentially powerful feedback effects between the productive structure and the standard of living that is not captured in growth statistics.

[4] See Map 4: Patent applications to the EPO, by NUTS 3 regions, 2006 (per million inhabitants) - Source: Eurostat (pat_ep_rtot) "Science and technology at regional level" - Statistics Explained (2012/3/1) <http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Science_and_technology_at_regional_level> Accessed March 12, 2012.

One might ask why and how the Scandinavian countries have the non-congested urban transportation systems; the environmentally-friendly energy and built-environment systems; the inclusive and preventive healthcare systems; and the meritocratic educational systems. The answer is that the government plays an active role in shaping the infrastructures upon which all product systems depend and in conducting impact analyses of product systems to make objective social choices amongst alternatives. Success at this demand side of industrial policy depends upon and is reinforced by success on the supply side of productive structure. The role of detecting and creating opportunities works in both directions: government to companies and companies to government. This is ignored in transaction cost theories of the optimal size of the public sector.

Effectiveness here depends upon taking advantage of and building on a region's legacy of skills, facilities, and capabilities. Government, education, industry each has a requisite ingredient for an 'entrepreneurial' productive system. It is the inter-relationships that give power to the system. Not the firms alone, not brilliant industrial policy, and not leading research intensive universities.

**[4] Structural Funds and EU Industrial Policy**

The EU administers what has been called the world's largest development program (Philip McCann, Special Advisor to Johannes Hahn, Europe 2020 Agenda). The Social Fund was created in 1958 to tackle regional disparities in Europe. It was joined by the European Regional Development Fund in 1975 and eventually the Cohesion Fund: the trio of Funds is commonly known as the Structural Funds (Lords, 2008:6). Boosted by reallocations of funds released by 1990s CAP reforms, Structural Fund expenditures represent about one-third of the Community budget (36% of the EU budget in 2008—0.38% of the EU gross national income, (Lords 2008: 28).

The Structural Funds were designed to support the convergence in income of the lagging Member States and regions with the more prosperous regions in the EU. The Directorate-General for Regional Policy is responsible for design, monitoring, and evaluation of Structural Fund interventions (Bradley and Untiedt, 2012.[5] They are channeled along three lines: physical infrastructure, human capital, and direct assistance to firms to enhance growth and productivity.[6] Since the Lisbon Strategy of 2000 the income convergence objective has been extended to promotion of a knowledge economy and growth in jobs. Two targets were set—increasing the share of public and private investment in R&D to 3% of GDP; and securing an employment rate of 70%, both by 2010.

[5] The DG-Regional Policy runs the Structural Funds programs independently of the DG-Economic and Finance is responsible for wider economic policies, a separation between public investment policy and overall economic policy which as Bradley and Untiedt (2012; Lords 2008) point out is rarely seen at the level of individual member states.

[6] The objects of the three Structural Funds are summarized as follows in a recent House of Lords report (Lords 2008: 13):

• The *European Regional Development Fund* (ERDF) finances direct aid for investment in companies (particularly small and medium-sized enterprises), infrastructure, financial instruments (such as capital risk funds and local development funds) and technical assistance measures. It is allocated on a regional basis.

• The *European Social Fund* (ESF) finances projects in the labour market that improve skills (human capital) and access to employment opportunities and social integration. It is again allocated on a regional basis.

• The *Cohesion Fund* finances developments in transport networks which have been identified as priority projects by the EU; projects related to the environment; and energy and transport projects with clear environmental benefits. It is allocated at the Member State level, with finance from the Fund conditional on compliance with the Stability and Growth Pact requirement of not running an excessive public deficit.

While Structural Funds are designed and commissioned in a form of partnership between national governments in the recipient states and DG-Regional Policy within the EC, they are administered and implemented at the local and regional levels by national administrations. In the language of the Commission: "Cohesion policy has been recognized as a key instrument at the Community level contributing to the implementation of the growth and jobs strategy—not just because it represents one third of the community budget, but also because strategies designed at local and regional levels must also form an integral part of the effort to promote growth and jobs. The role of SMEs (small and medium-sized enterprises), the need to meet local skill demands, the importance of clusters, the need for local innovation centres is such that in many cases strategies also have to be built from below, at the regional and local levels" (COM 2006:281). European Commission, *The Growth and Jobs Strategy and the Reform of European cohesion policy*. Fourth Progress Report on Cohesion, p. 8, cited in Lords 2008: 10)

All seemed well until the crisis in 2007. Ireland and Greece were the biggest success stories with a decade or more of high rates of growth. But the crisis has exposed the lack of competitiveness of indigenous firms and sectors in the peripheral economies. Behind the façade of growth, the large flow of structural funds to the lagging Member States was not accompanied by a convergence in productive structures. What went wrong?

While the policy documents represent a political desire to address regional disparities, they do not outline a development strategy to address the lack of business and organizational capabilities to drive productivity and innovation. The Lisbon Strategy set R&D targets but implementation is not elaborated. By default this falls back on the industrial policy in the Structural Fund programs of direct aid to companies and general investment in human capital and material infrastructure. But this is not how industrial policy is conceptualized or conducted in the successful member states of the EU. As outlined above, in these cases industrial policy is best understood as informed by an analytical economic framework which accounts for productive structure and strategic agency. In the successful, core EU states industrial policy has achieved the strategic and administrative capacity to generate impressive results in advancing R&D levels, innovation, *product* competitiveness, and economic performance. The situation in the less successful, peripheral states is very different, as we show in the next section.

## [5] Productive Structures in the EU Periphery: Focus on Ireland

Ireland and Greece both exhibited very high rates of growth for over a decade preceding the crisis beginning in 2007-08 (see Figure 1). The crisis and resulting austerity programs plunged both into severe recessions. It also exposed the gap if not further divergence in productive structure between the core member states and the peripheral economies of Europe. The peripheral states suffer from the same fundamental challenge: failure to build and grow enough innovative business enterprises to drive productivity advances and create jobs on a regional or national scale.

Indicative data are illustrated in Tables 1-4. [7] Table 1 compares R&D as a percent of GDP of various countries. A similar pattern to that of the patent statistics emerges: Greece at around 0.5 and Spain and Ireland between 1 and 1.2 well below the core economies of the EU at 2.5 and Finland leading at 3.5. Table 2 compares the number of companies by country that are listed in the top 1000 EU companies ranked by R&D investment. Greece, with a population of 11 million, has four while Finland and Denmark, with less than have the population, have 58 and 47 respectively. Ireland has twelve. Finland spends nearly 130 times more on R&D than Greece and nearly 13 times more than Ireland. But as shown in Table 3, roughly 70 per cent of Ireland's R&D is conducted by foreign affiliates of enterprises. Greece, in contrast, enjoys virtually no R&D investment by either domestic or affiliates of foreign enterprises.

Table 4 focuses on the twelve indigenous Irish companies that are amongst the top 1000 R&D performers in Europe, the number of employees they support and the market capitalization. One is a bankrupt bank, one has nine employees; three are food producers. It is quite clear that even Ireland, the "success story" of EU development policy, has not made progress toward the Lisbon Strategy goals of R&D of 3% of GDP or 70% employment. What went wrong? Why does Ireland not have a stronger productive structure generating more entrepreneurial firms? While a full answer is outside the reach of this essay, Irish industrial strategy and played an important role in creating the Celtic Tiger. Given Irish industrial history, it was an impressive achievement.

Ireland's industrial policymakers could not draw upon a legacy of skills and capabilities upon which to build a strategy. The country's lack of an industrial history did not bequeath the country with virtually any world class manufacturing sectors or even individual enterprises.[8] The lack of business enterprises with the capabilities to drive growth was not lost on Irish industrial policy. Established by the Irish Government in the late 1940s, the Inductrial Development Authority (IDA) later in the 1970s became one of the world's leading foreign investment attraction agencies and attracted many of the America's leading electronics and pharmaceutical companies to make Ireland its European base. The strategy was enormously successful and is largely responsible for creating the Celtic Tiger boom years of the 1990s.

The MNCs set up branch plants in Ireland, many of which operated according to world class manufacturing performance. EU Structural Funds were used during the 1990s to improve the state of physical infrastructure and to establish a national tier of Regional Technology Colleges to develop the curriculum and build the staff to educate the students to meet the specific human resource needs of the MNCs to run locally-managed, globally successful branch plants. The IDA was largely responsible for building the inter-organizational links amongst government, education, and industry that were required to attract many world-leading companies to build branch plants and collectively to establish whole sectors in Ireland.

However, the huge success of the FDI-led strategy created new growth challenges. First, FDI did not lead to R&D investment in Ireland. While the affiliate plants did and do operate according to world class production standards in terms of cost, quality, and time, most do not establish New Product Development and Technology Management capabilities in their Irish operations. This is understandable: success at technology management

[7] Eurostat maps illustrating the regional concentration of R&D related data including patent applications and high tech employment, can be found at
http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Science_and_technology_at_regional_level

[8] The only area of the island of Ireland that participated fully in the second industrial revolution of the mid- to late 19th century was in Northern Ireland, which remained part of the United Kingdom when the island was partitioned in 1922 (Bradley and Best, 2012b)

and new product development are tied into extra-firm networks, intangible infrastructures and chains of innovation developed overtime at the company's home base.

Second, success at attracting FDI was not followed by the creation of the emergence and growth of indigenous entrepreneurial firms. Overall national growth remained stubbornly dependent upon FDI. With hindsight, the strategic challenge, that was largely neglected, shifted from one of attracting foreign investment to building an indigenous and integrated productive structure. The response to the challenges facing indigenous enterprise growth led in 1993 to the separation of the IDA into three separate organizations. The IDA would continue to specialize in promoting foreign investment but a new agency, Enterprise Ireland, was established to specialize on assisting domestic industry. Forfás specialized in research and on policy advice.[9]

The IDA continued to do what it did best. As the original waves of computer and pharmceutical firms gradually matured, it attracted a new wave of FDI in international financial services. Concurrently the government established tax incentives to encourage R&D investment by foreign firms, which were extended to indigenous enterprises. And the government created Science Foundation Ireland on the model of the National Science Foundation of the United States to build scientific research capacity in Irish universities.

The question becomes did the new industrial policy measures work in addressing the challenges of limited R&D and scarcity of indigenous, rapidly growing entrepreneurial firms. The aggregative R&D-related data presented above suggests they were not successful in fostering the creation of an indigenous 'knowledge' economy or meeting the R&D and employment growth targets of the EU's Lisbon Strategy. However, the aggregative data could hide real progress in business development not captured by R&D and patent statistics. Unfortunately, official data is either not collected on business organization or not accessible for research purposes for reasons of confidentiality.

To get a deeper understanding of the productive structure in the peripheral region of the counties straddling the border of Ireland and Northern Ireland, an investigative project was conducted in the Irish cross-border region using a research methodology that combined official macro-sector data with FAME, a commercial database of companies, and personal visits to enterprises in the border counties of Ireland and Northern Ireland. Many individual firms were found that are highly successful together with a limited number of entrepreneurial firms (Bradley and Best 2011; 2012a; 2012b). Most of these developed a lone-firm strategy; they were not members of networked groups of firms or adaptable clusters. Nothing is wrong with these companies. In fact, they are quite extraordinary, but the problem is that there are far too few such entrepreneurial firms. The productive structures in which they are embedded do not include "intangible infrastructures" enjoyed by SMEs in the core countries that can be leveraged to develop and grow new products and regions to grow new companies. Consequently, the sectors within which they operate are not integral parts of differentiated clusters with the adaptive capability to develop new products and processes to detect, create and exploit market opportunities and new technologies.

As noted above, the intangible infrastructures have a double role: they are used by firms pursuing product-led strategies and the means of delivering industrial policy measures designed to enhance NPD and TM capabilities of a region or nation's enterprises. Examples of the missing intangible infrastructures are clusters of tooling,

[9] The 1993 reorganization was accompanies by change in name and status from Irish Development Authority to Irish Development Agency (Mac Sharry and White 2000: 223).

instruments, and equipment making companies; science and technology research labs; and business organization development resources. Without a critical mass of companies that pursue product-led strategies it is little wonder that intangible infrastructures common in the core economies are largely non-existent.

It is important to note that infrastructures on their own are not the key to the establishment of a population of entrepreneurial firms. It depends upon the productive structures in which they are embedded. For example, the productive structures can be conceptualized in terms of the 'technology transfer' model and not on the establishment of chains of innovation and alignment of research, product development, and production activities cutting across governmental, research labs, and technology-oriented enterprises.

Comparing the economy of Ireland with the core economies we can distinguish two types of industrial policy. They point to two different development paradigms and consequent business cultures. The intangible infrastructures that structure arms-length relationships between governmental agencies and companies in the core economies are missing in Ireland. The other paradigm is one of direct assistance. It can include government funding of human capital and material infrastructures. But too often industrial policy led by one-to-one relationships between industrial policy agencies and client companies feed into a business culture of state dependency. One can distinguish the two industrial policy approaches in the following way. One leads in the direction of dependency through compensation for perceived threats and weaknesses. It is pushed by state agencies and creates a comfort zone for regional actors. The other seeks to identify existing strengths and opportunities and to shape distinctive regional development strategies that require much greater local inputs and makes greater calls on local imagination and implementation.

The big question is why the gap in productive structures between the EU core and periphery countries has not converged after the creation of a single market combined with over twenty years of well financed EU regional development investments. Ireland is interesting because of the very success of industrial policy in the past. The problem in the periphery is not market failure; it is lack of organizational capabilities. The business enterprises in the periphery lack the capabilities to compete in the single market. Enterprises in the periphery are embedded in productive structures that do not support entrepreneurial firms and do not generate new entrepreneurial firms. The IDA found a successful way to set up plants with world-class manufacturing practices via attracting affiliates of MNCs. The problem came when the challenge shifted to devise the means to establish and diffuse NPD and TM capabilities to the main body of indigenous firms. This demanded a more fully integrated productive structure and associated industrial policy strategy. This is where the Irish strategy was shown to be wanting. Not enough firms develop new products, move into new markets, grow to mid-size, adopt new technologies, or innovate. Lacking the infrastructures to support product-led competition they struggle to survive in a competitive wedge between the technologically innovative European regions on one side and Asian, high volume, low cost producers on the other, both of which productive structures are superior in organizational capability.

### [6] Product Systems and Intractable Sectors

We have addressed industrial policy's role in advancing a region or nation's production and business development capabilities. To this point we have not considered what was being a produced, concern merely

focused on whether it generated growth in isolation. But what is produced is also important particularly when its systemic effects are considered. This is particularly the case for a class of product systems that possess large consumption inter-dependencies. These include energy, transportation, and healthcare. In these industries market coordination suffers from a 'tyranny of small decisions' in which cooperation is necessary to achieve individual self- interest.

In these cases, the socially desired product system is intractable to individuals choosing in the 'market'. In fact a market does not exist to choose between product systems. Either one or another product system is the option; one precludes the other. Will an urban transportation system be car-based or cycle- and mass-transit based; will the energy and electricity transmission system be organized around centralized power stations or distributed power systems; will the healthcare system be single payer or private and insurance-driven. In these cases single product systems, once in place, combine widespread consumption interdependencies, economies of scale and inter-connected infrastructures to dominate the industry. Competition amongst product systems is not credible. One or the other has to be chosen as the two systems cannot fill the same space.

Within the EU we find a systemic difference between the social market economies and the peripheral member states in the choice and design of large scale product systems. The design of product systems in the Nordic countries is not left to the 'market'; a transparent social choice organizing capability is integrated into industrial policy. Urban transportation, building codes, healthcare, and energy systems are all organized to include the 'externalities' of otherwise opaque processes. The social costs of non-transparency can be high.

Transportation is an example. Amsterdam and Copenhagen, in contrast with Dublin, have short times from home to work by organizing mass transportation and bicycle modes of transportation. Once the car based mode of transportation is in place, it affects the cost of living as everyone must buy a car and pay for insurance. And as more move to the car, insurance fees and injury claims mount and the exodus from public transportation drives up its costs per passenger as well. Eventually everyone is worse off as congestion increases the time required for travel. Public pressure will mount for more roads funded by the government as reengineering cities for a combined mass transit and bicycle system would no longer be an option. [10]

For these reasons, industrial policy in the Nordic countries includes indicative planning exercises. In contrast, the Irish growth model during the Celtic Tiger years ignored the idea of socially irrational product systems. When the housing and construction led growth boom stopped and austerity began, the costs of socially irrational product systems have become evident. The construction industry grew rapidly but without any concern for energy efficiency or environmental impact. In fact, studies suggest that there was virtually no innovation in the construction sector. The energy sector grew rapidly but was and remains entirely import dependent. The transportation system was not designed to account for congestion costs of a car-based system. Healthcare provision did not address preventive care or the lack of accessibility and high costs of a private system.

Both the housing and transportation product systems have increased the demand for imported fossil fuels while Ireland's greatest natural resource, wind energy off the west coast remains unexploited. The centralized national grid based on imported fossil fuels would be quickly overwhelmed if off shore wind mills were to be connected to the low capacity transmission lines on the west coast. Once a product system has been

[10] The concept of 'social limits to growth' is eloquently elaborated in Fred Hirsh's book by the same name (Hirsh 1977).

established it creates its own dynamic momentum. The act of building the system involves the creation of market opportunities and the growth of business enterprises to service them. It becomes intractable in a second sense: vested interests make it intractable to industrial policy makers. In the case of Ireland the 'intractable' sectors of transportation, energy, healthcare, and housing were never incorporated into the industrial policy mission.

In each of these industries pervasive consumption interdependencies exist and generate path dependent processes that structurally reinforce the original choice of product system. Over time they create a 'social infrastructure of consumption' that locks them in place. Two decades of infrastructure investments in Ireland contributed to growth both on the demand side and, as noted, as a component in the IDA's inward investment strategy. But the infrastructural performance, according to the Irish Academy of Engineering, is only half that of the Scandinavian countries (2010). EU structural funds that go to regional governments that lack strategic modernization plans risk being wasted on fragmented infrastructure projects, direct aid to companies, and human resource programs that are not joined up by a strategic industrial policy. An unintended consequence is that SFs finance infrastructures that reinforce socially irrational product systems that deepen structural problems.

However, what the core member states policymakers have not done is demand or even push for the institutionalization within the EU of productive structures constituted by the industrial policy paradigm that drives the productive structure divergence. Absent a theoretical analysis of productive structures and the ideological dominance of neo-liberalism, the social market model has not informed EC industrial policy documents. In its wake the 'direct aid' model was applied and industrial policymaking was shunted away from the DG-economic and financial to the DG-regional policy. Here the appeal of decentralization of SFs trumped concerns over the lack of absorptive capacity to meet the challenge of building and rebuilding core economy-like productive structures.

Consequently, in the periphery the three strands of SFs were not aligned to drive investments designed to advance productive structures. Instead, they operated as if in silos. Construction, transportation, energy, healthcare all received SFs but none within a strategic vision in which the sectors of the economy were each scrutinized for consistency for systemic effects. And direct aid fostered the establishment of a client-agency relationship paradigm of industrial policy.

## [7] Conclusion: Government as Strategic Organizer

The problem in the peripheral economies of the EU is the lack of New Product Development and Technology Management capabilities in their business enterprises. Economies in the periphery of Europe lack flexibility but not only or even primarily in labor markets and government regulations. The deeper cause of inflexibility is in the productive structure itself. The way ahead in the EU is for the economic policymaking agencies of the Economic Commission to oversee the development structural change programs in the peripheral regions that have proven successful in the core nations. To do its job government must be a long-term 'strategic organizer' rather than a short-term 'market optimizer'.

This involves developing industrial policies informed by an economic analytical framework that accounts for the inter-relationships of the constituent elements of a region or nation's productive structure. From the organizational capabilities perspective it is the responsibility of government to develop a strategic vision and policies that align the constituent elements of productive structure. Such policies must meet three conditions.

First, industrial policies need to be strategic and built upon an evidence-based, global competitor (SWOT) analysis of the elements of each region or nation's productive structure. For this each region's capabilities, skills, facilities, and infrastructures must be audited, researched, made transparent, and benchmarked with competitor productive structures.

The opportunities for sectoral transitions must be researched within a global strategy framework. Economic development involves sectoral transitions. Figure 2 illustrates the simplified model applied by the Economic Planning Agency of Japan to frame industrial policy as an integral component of economic policymaking. Attention was focused on developing the generic production capabilities needed for business enterprises to achieve international performance standards to compete in increasingly more demanding and complex manufacturing environments.

Evidence-based industrial policy requires company specific databases to search for indicators as expressed in the market of distinctive local technical capabilities and deep craft skills that can be nurtured by targeted infrastructural development. The data can also be interrogated to identify entrepreneurial firms, emerging sectors, cluster dynamics, and sector transitioning processes. Static clusters are relatively easy to identify, the challenge is to characterize innovating firms and adaptable clusters. This administrative capacity is not currently in place in EU economic development agencies. It is part of normal activities in the core countries.

Second, governments in the peripheral economies must design growth plans that address the changes required to transform and align the elements of the nation or region's productive structure including the business system, production capabilities, skill formation institutions, and technical support infrastructures. This includes attention to the chain of innovation as all three spheres must be linked into a triangular system to coordinate basic, developmental, and applied research with the related enterprise processes that support New Product Development. The vision of organizational change must address how companies are governed and the shop floor is organized.

Third, the demand side of the economy must be incorporated into industrial policymaking to account for consumption and sectoral inter-dependencies. It is not enough to grow the easiest sectors which may have very high social costs once consumption and sectoral spillover or inter-dependencies are considered. A snapshot of the Nordic sectoral composition reveals that transportation, energy, and construction sectors have not been treated separately but otherwise hidden costs of consumption and sectoral inter-dependencies have been made transparent.

Industrial policy in the core member states has administrative capacity to account for both production side and consumption side 'infrastructures' and their effects on growth. Moreover, governments have a role in influencing and even creating markets to which companies respond. Governments do this by funding material infrastructures in, for example, highway systems or building mass transit systems or by as buyers of technologically advanced products and services. In these cases the government is creating market opportunities to which companies respond.

Timing is critical. After socially irrational product systems have been 'institutionalized' the consequences cannot be corrected by 'internalizing the market' in the form of taxes and subsides. A carbon tax, for example, that is not accompanied by a restructuring program to transition to alternative product systems in the transportation, energy, and construction sectors does not provide a strategic vision to guide development programs such as the EU Structural Funds. This is the challenge of industrial policy.

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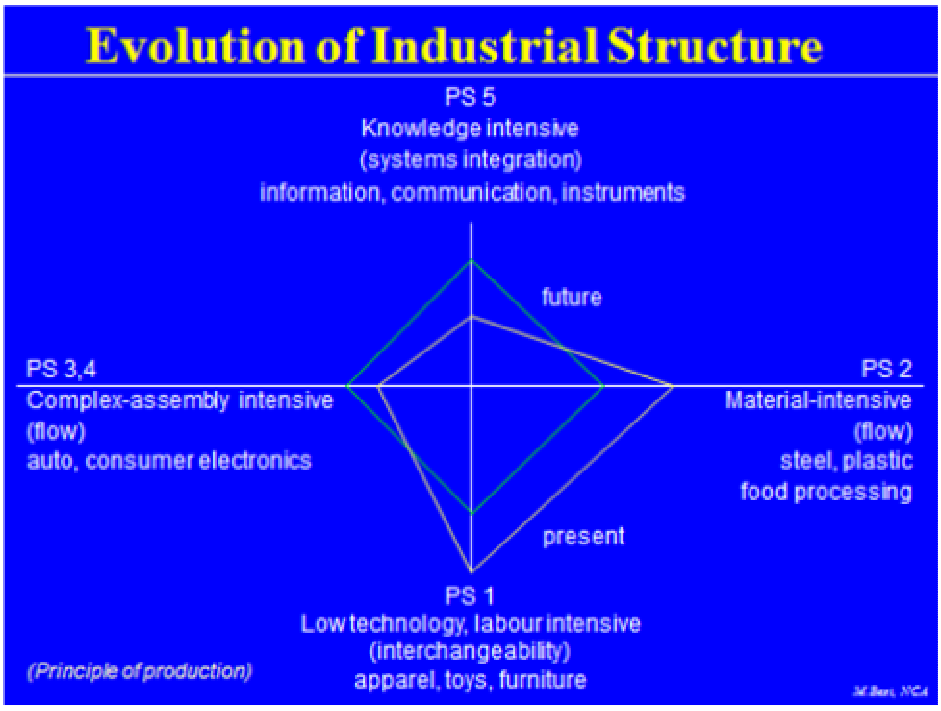
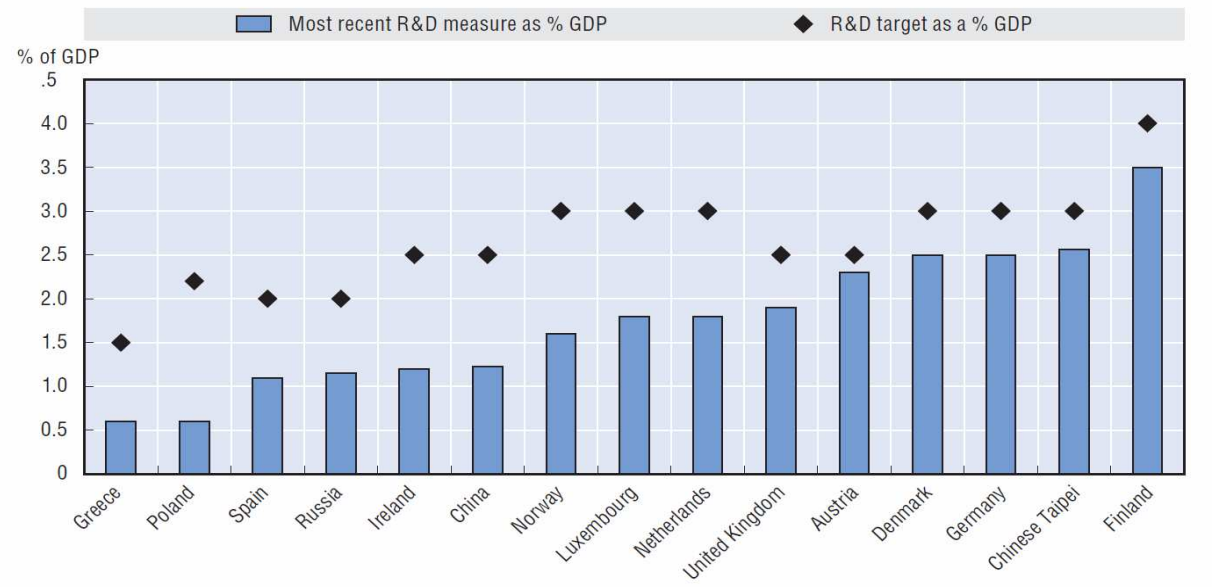
Figure 1: GDP growth rates in Ireland and Greece


Figure 2




Source: Best 2001:57.

Table 1. R&D as % of GDP: Various Countries




*Note:* R&D target dates range between 2005 and 2014.

*Source:* OECD, Country responses to STI policy questionnaire, 2006; Main Science and Technology Indicators database, June 2006.

Table 2: R&D EU Scoreboard Companies and Employment Impact, 2008

| **Table R&D EU Scoreboard Companies and Employment Impact, 2008**** | | | |
|---|---|---|---|
| | Companies | Population million | R&D Investment Emillion | Employees | % of LF* |
| Finland | 58 | 5.3 | 6787 | 534,814 | 25 |
| Sweden | 70 | 9.2 | 6952 | 834,151 | 23 |
| Netherlands | 53 | 16.4 | 9703 | 1,003,566 | 15 |
| Denmark | 47 | 5.5 | 3418 | 310,776 | 14 |
| Belgium | 30 | 10.7 | 2558 | 570,200 | 13 |
| Spain | 21 | 45.3 | 1471 | 485,379 | 2.8 |
| Ireland | 12 | 4.4 | 532 | 60,602 | 3.4 |
| Greece | 4 | 11.2 | 53 | 6,281 | 0.13 |
| Non EU*** | | | | | |
| Switz. | 38 | 7.6 | 17468 | 950,875 | 32 |
| Taiwan | 41 | 23.1 | 5125 | 562,611 | 6.1 |
| * Percentage of labor force derived by assuming labor force equal to 40% of a country's population. | | | | | |
| ** The EU Industrial R&D Investment Scoreboard is a compilation of the top 1000 European headquartered companies by R&D investmen | | | | | |
| *** The EU Industrial R&D Investment Scoreboard has a separate scorecard for the top 1000 non-EU companies. | | | | | |

Table 3.

| | OECD Main Science and Technology Indicators (STI Scoreboard 2009) | | | | | | |
|---|---|---|---|---|---|---|---|
| | R&D expenditure of foreign affiliates as a percentage of R&D expenditures of enterprises | | | | | | |
| | 1986 | 1993 | 1995 | 1997 | 1999 | 2001 | 2003 |
| **Australia** | | | 31.11 | | 41.79 | | |
| **Austria** | | | | | | | |
| **Belgium** | | | | | | | 57.13 |
| **Canada** | | 31.77 | 29.75 | 34.64 | 32.01 | 29.64 | 31.88 |
| **Czech Republic** | | | | 22.09 | 27.40 | 45.26 | 46.63 |
| **Finland** | | | | 13.25 | 14.92 | 14.25 | 13.99 |
| **France** | | | 17.09 | | | 21.54 | 22.58 |
| **Germany** | | 15.87 | 16.06 | 17.17 | 17.84 | 24.77 | 26.74 |
| **Greece** | | 6.51 | 3.75 | 3.61 | 4.52 | | |
| **Hungary** | | | 21.79 | 65.34 | | | 66.50 |
| **Iceland** | | | | | | | |
| **Ireland** | 61.57 | 66.25 | 66.22 | 65.33 | 63.77 | 65.23 | 72.11 |
| **Italy** | | | | | | 32.95 | 26.28 |
| **Japan** | | 0.86 | 1.37 | 1.29 | 3.93 | 3.39 | 4.27 |
| **Netherlands** | | | | 20.57 | 21.52 | 19.62 | 27.13 |
| **Norway** | | | | | | | 25.38 |
| **Poland** | | | | | | 4.56 | 9.31 |
| **Portugal** | | | | | 17.98 | 30.76 | 24.62 |
| **Slovak Republic** | | | 0.83 | | | 18.97 | 22.41 |
| **Spain** | | 39.65 | 26.80 | 35.72 | 32.83 | 30.99 | 26.22 |
| **Sweden** | | 14.72 | 20.71 | 18.65 | 36.38 | 40.65 | 44.70 |
| **Turkey** | | | | 14.84 | 7.29 | | |
| **United Kingdom** | | | 29.16 | 32.80 | 31.16 | 42.81 | 44.55 |
| **United States** | 6.61 | 12.10 | 13.28 | 10.93 | 13.05 | 13.10 | 14.85 |

Table 4: Irish Companies in Top 1000 EU R&D Investment Scorecard

**Table Irish Companies in Top 1000 EU R&D Investment Scorecard**

| No | Company | Rank | ICB Sector NACE Sect | R&D Investment 2008 €m | Employees 2008 # | Market Capitalisation 2008 €m | Change 08/07 % |
|---|---|---|---|---|---|---|---|
| **Ireland** | | | | **531.72** | **60,602** | **10,725** | **-41.0** |
| 1 | Elan | 80 | Pharmaceuticals (4577) | 227.92 | 1,683 | 2,574 | -30.1 |
| 2 | Kerry | 118 | Food producers (357) | 147.46 | 22,312 | 3,184 | -10.6 |
| 3 | Bank of Ireland | 247 | Banks (835) | 56.00 | 15,868 | 2,248 | -66.1 |
| 4 | SkillSoft | 322 | Softw are (9537) | 35.86 | 1,124 | 588 | |
| 5 | Trinity Biotech | 638 | Health care equipment & s | 11.49 | 757 | | |
| 6 | AGI Therapeutics | 640 | Pharmaceuticals (4577) | 11.47 | 9 | 7 | -89.4 |
| 7 | Glanbia | 688 | Food producers (357) | 10.13 | 3,400 | 742 | -46.3 |
| 8 | Norkom | 773 | Softw are (9537) | 7.78 | 304 | 99 | -22.6 |
| 9 | Kingspan | 799 | Construction & materials ( | 7.10 | 6,692 | 958 | -23.6 |
| 10 | Greencore | 823 | Food producers (357) | 6.74 | 8,066 | 282 | -34.7 |
| 11 | Datalex | 903 | Computer services (9533) | 5.40 | 164 | 19 | -33.3 |
| 12 | Trintech | 997 | Softw are (9537) | 4.37 | 223 | 25 | 12.9 |

Source: The 2009 EU Industrial R&D Investment Scorecard, European Commission.