

Systems failures and innovation policy: do national policies reflect differentiated challenges in the EU27 ?

Observations from a decade of the European TrendChart on Innovation

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1. The systems failure rationale for innovation policy

Over the last 10-15 years, European policy-makers have increasingly begun to use the language of ‘innovation systems’¹ and to refer, at least implicitly, to ‘system failures’ as a rationale for public sector intervention in innovation activities². The shift in thinking recognises that the concept of market failure is not a sufficient explanation of why innovation systems under-perform and why governments should intervene. **Market failure** occurs when market mechanisms are unable to secure long-term investments in innovation due to uncertainty, indivisibility and non-appropriability of innovation process (Arrow 1962). Typically, a market failure manifests itself in an insufficient allocation of funding for risky and innovative investments. In the field of innovation policy, the response to a perceived market failure is generally to provide ‘direct’ funding (grants, etc.) to enterprises in order to lessen the risk of longer-term investments; or providing support for venture capital funds.

Apart from the market perspective, analysis of innovation process has to take into account also key deficiencies of companies and failures in systems (Smith 2000, Arnold 2004). Arnold (2004) differentiates four **systemic failures**:

- **capability failures** - inadequacies in companies’ ability to act in their own best interests, for example through managerial deficits, lack of technological understanding, learning ability or ‘absorptive capacity’;
- **failure in institutions**³ – inadequacies in other relevant NIS actors such as universities, research institutes, patent offices and so on. Rigid disciplinary

¹ The national innovation systems approach stresses that the flows of technology and information among people, enterprises and institutions are key to the innovative process. Innovation and technology development are the result of a complex set of relationships among actors in the system, which includes enterprises, universities and government research institutes. For policy-makers, an understanding of the national innovation system can help identify leverage points for enhancing innovative performance and overall competitiveness (see: <http://www.oecd.org/dataoecd/35/56/2101733.pdf>).

² Smith K. (2000) Innovation as a Systemic Phenomenon: Rethinking the Role of Policy, Enterprise and Innovation Management Studies, volume 1 (1): 73-102
Arnold E. (2004) Evaluating research and innovation policy: a systems world needs systems evaluations, Research Evaluation, volume 13(1): 3-17

³ In the literature on national innovation system, the term institution is taken to mean rules and routines such as the legal system, informal rules and their enforcement characteristics. The approach adopted here is to adopt the more conventional practice of using the term institution as a synonym for organisation.

orientation in universities and consequent inability to adapt to changes in environment is an example of such a failure;

- **network failures** - problems in the interaction among actors in the innovation system such as inadequate amounts and quality of links, ‘transition failures’ and ‘lock-in’ failures (Smith 2000) as well as problems in industry structure such as too intense competition or monopoly;
- **framework failures** – gaps and shortcomings of regulatory frameworks, intellectual property rights, health and safety rules, etc. as well as other background conditions, such as the consumer demand, culture and social values (Smith 2000).

Tsipouri, Reid and Miedzinski (2009) argued that deficiencies in the ‘governance system’ (policy-making, evaluation and learning processes) need to be recognised as a fifth form of system failure, termed ‘**policy failures**’. Hence, the difference in the capacities and effectiveness of governance in a country can be expected to influence positively or negatively innovation system performance.

In the context of system failures, Metcalfe (2004) has argued eloquently that the role of primary role of the state in terms of innovation policy is to facilitate the emergence of well-functioning innovation systems. In a system failure perspective, the public sector role is not to promote ‘individual innovation events’, rather:

“...it is setting the framework conditions in which innovation systems can better self-organize across the range of activities in an economy. Moreover, whereas the market failure approach leads to instruments that allocate resources to firms in the form of R&D grants or tax incentives, the systems failure approach leads to instruments that enhance innovation opportunities and capabilities. Because systems are defined by components interacting within boundaries, it follows that a system failure policy seeks to address missing components, missing connections and misplaced boundaries”.

If it is hypothesised that system failures are a more robust rationale for innovation policy, then there is also need to take into account how the type and degree of development of different national (or regional or sectoral) systems may influence the degree of intensity of the different types of system failures. Since Rostow (1956), it is widely accepted that economies move through ‘stages of development’ and that the factors driving each stage (and hence the public policies brought to bear on the actors in the economy) differ. This approach is applied for instance in the Global Competitiveness Report (2009) based on Porter’s (1990) variant of the stages of growth model in modelling determinants of competitiveness. In the GCR framework countries are categorised into factor-driven economies, efficiency driven economies and innovation-driven economies. At each stage the basic requirements change, with the last depending on business sophistication and innovation.

Similarly, Aghion (2006) has argued that Europe’s lagging performance in growth and productivity is, indeed, partly a reflection of the need to invest more in innovation as the gains from capital accumulation and technological imitation were exhausted in the last quarter of last century. Indeed, he notes that the survival and growth of *all* industries (from textiles to pharmaceuticals) in a high-cost, high productivity economy depends on their ability to innovate. Following this line of reasoning, the Barcelona target (or at least the aim to increase R&D expenditure) is relevant since as EU countries move closer to the world technological frontier, they should invest more in R&D, and within the EU, the most advanced countries should invest proportionally

more as they benefit from a higher productivity of R&D⁴. However, Aghion goes on to argue that Government intervention to support R&D and innovation will be ineffective if the basic micro and macro-economic conditions for innovation-based growth are not in place, namely i) competition and market entry, ii) investment in higher education, iii) reform of credit and labour markets and iv) counter-cyclical fiscal policy⁵. Similarly, Metcalfe (2005) argues that the systems failures approach takes for granted the significance of an economic climate, with low real interest rates and stable macroeconomic and monetary conditions that encourages investment in all forms.

...the primary role of the state is to facilitate the emergence of innovation systems. In so doing it takes responsibility for the ecology of public organizations and institutions that facilitates business experimentation but recognizes that without the necessary interconnections the ecology is not a system. Since competition depends on innovation and innovation depends on the emergence of distributed innovation systems, it is clear that this provides an interesting alternative to the market failure perspective on innovation policy.

It seems fair to deduce as a hypothesis, therefore, that depending on their closeness to the technological frontier, their level of development and the type and extent of failures in their innovation systems, **different EU Member States need to adopt a differentiated “innovation policy mix” in order to boost their innovation performance**. Aghion’s argument about the closeness to the technological frontier implies that *“it is not enough to invest more in R&D here and there to get the economy to grow faster”*. Equally, considering the ‘pillars of competitiveness’ type logic or Aghion’s four ways of fostering innovation-based growth, the emphasis of a ‘broad-based’ innovation policy (the linkages the core instruments of ‘traditional’ innovation policy instruments and those of other policy domains) may need to vary.

As almost all EU27 Member States are already in an ‘innovation-driven’ phase (or in other words close to the technological frontier) there is a need to dig deeper to understand how differences in innovation systems, micro- and macro-economic conditions and the policy mix influence innovation performance. The European Innovation Scoreboard (EIS) provides the most robust and long-standing framework for such a categorisation of European countries. However, the EIS mainly captures the inputs and output to innovation systems and only touches upon the importance of the way in which the ‘components, connections and boundaries’ of NIS act as barriers or drivers to improved innovation performance (and ultimately growth). As Gault and Huttner (2008) have argued

⁴ Indeed the reflection can be extended further by considering the relative R&D productivity and specialisation of a limited number of EU27 regions that dominate in terms of R&D expenditure and outputs. See Peter V and R. Frietsch (2009), Exploring Regional Technology Specialisation: implications for policy. Regional Key Figures of the ERA series. DG Research, European Commission.

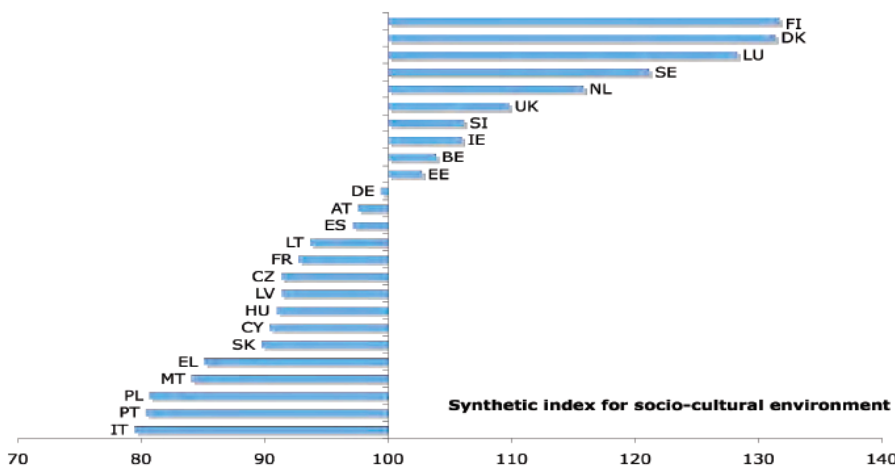
⁵ As Gault and Huttner (2008) argue: *It is difficult for public policy to influence such a complex system. A whole-government approach requires coherent and comprehensive analysis of the system dynamics, and robust statistical measures that describe the actors and processes at work. Without these, policies that make sense on their own may, in combination, produce suboptimal outcomes. Take R&D subsidies. A simple science policy might expect high subsidies to enhance the flow of knowledge. But that benefit might be eroded by relatively high corporate taxes, a fiscal policy necessarily influenced by the subsidies. Pull one thread in the system and distant actors could be affected.*

The dynamic and complex nature of innovation requires a systems approach to analyse both it and the policies that influence it. All the actors – governments, businesses, institutions of education, foreign institutions and more – need to be included in the analysis, as do their activities – R&D, innovation, technology diffusion, commercialization of knowledge. The links between these actors and activities and their outcomes must also be accounted for, including all the feedback and feed-forward loops that engender the messy, nonlinear nature of innovation.

In short, to design better innovation policies, there is a need to develop and monitor a broader set of indicators beyond the quantitative ones traditionally used not only to appraise performance but also as ‘targets’ for Governments to meet (in a somewhat tautological manner, most national governments observe that their national R&D/GDP rates are too low and hence set the objective to boost them, without necessarily undertaking a more extensive reflection on the factors behind this perceived ‘under-investment in R&D’). Hence, designing better innovation policy requires the development of indicators and metrics that improve the ability to understand the performance of institutions and linkages between the actors of innovation systems. As Freeman (2006) argued:

“The huge divergence in growth rates which is so obvious a feature of long-term growth over the past two centuries must be attributed in large measure to the presence or absence of social capability for institutional change, and especially for those types of institutional change which facilitate and stimulate a high rate of technical change. Nowhere has this been more apparent than in Eastern Europe“.

Figure 1: socio-cultural environment and European innovation systems



Source: Bruno et al (2008)

Interpreting one-off ‘social surveys’ such as the InnoBarometer to try and ascertain whether a national innovation system is more or less open to institutional change, technological adoption and organisation innovations is fraught with difficulties.

However, Bruno et al (2008) brought together evidence from a range of surveys and more standard statistical sources to investigate the ‘socio-cultural factors’⁶ influencing innovation in the EU25 (EU27 minus Bulgaria and Romania). The results are summarised in a synthetic indicator in Figure 1 and while the top and bottom performers are not markedly different from the EIS outcomes, some countries do perform considerably worse than their position in more classic scoreboard outcome, notably Germany, France and Italy. Further exploration of the ‘softer’ and systemic factors determining innovation performance would help to inform policy debates on how best to boost innovation performance and create an innovation ‘culture’ or ecosystem.

2. Innovation policy: shifting boundaries ?

Innovation policy is defined as “*a set of policy actions to raise the quantity and efficiency of innovation activities whereby innovation activities refer to the creation, adaptation and adoption of new or improved products, processes or services*” (Cowan & Van de Paal, 2000). In contrast, science (or, as it is commonly termed in the EU, research) policy is concerned with the production of knowledge: it is the art of justifying, managing or prioritising support of scientific research and development (R&D)⁷. To put the distinction in the simplest terms, science policy is concerned with the production of knowledge, while innovation policy aims to improve the overall innovative performance of the economy (Lundvall & Borrás 2005). A ‘grey area’ of over-lapping competence between both policies concerns linkage or bridging policy measures (e.g. competence centres, collaborative technology programmes, technology transfer and commercialisation structures in universities, etc.) and financial support for industrial R&D, both types of instruments seeking to foster the application of knowledge. In addition, it is clear that innovation policy does not intervene in a vacuum and a whole host of other policies (macro-economic, education, etc.) influence innovation performance⁸.

Innovation policy needs to focus on all types of innovation activities and processes in enterprises (at all stages in their development from a business idea to a mature firm seeking to renew its product range, etc.) and not only on R&D or technological innovation⁹. Although private companies are rarely involved in the basic production of knowledge, they do undertake/fund applied or experimental R&D in the course of product or service design.

⁶ Four ‘capitals’ (or dimensions) were used to identify the socio-cultural characteristics of NIS relevant to innovation: cultural capital & consumer behaviour (or demand for innovation); human capital; social capital, and organisational capital & entrepreneurship.

⁷ Research and experimental development (R&D) comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications (OECD Oslo Manual 2005).

⁸ The ‘policy-mix’ study funded by DG Research of the European Commission is a useful source of reference for further insights into the conceptual understanding of the interactions between research and innovation policies, and other sectoral policies. See Nauwelaers C. et al (2009).

⁹ Technological product and process (TPP) innovations comprise implemented technologically new products and processes and significant technological improvements in products and processes. TPP activities are all those scientific, technological, organisational, financial and commercial steps, including investment in new knowledge, which actually, or are intended to, lead to the implementation of technologically new or improved products or processes. (OECD Frascati Manual 2002)

The final beneficiary or target of innovation policy is thus enterprises¹⁰ (including early-stage entrepreneurs seeking to establish an enterprise)¹¹. However, from a systems perspective, innovation policy may choose to achieve its aim by supporting 'indirect beneficiaries', whether these be financial organisations (seed capital funds, etc), innovation and business support services, cluster management partnerships, knowledge transfer structures in universities, public research organisations, etc..

A second intrinsic characteristic of innovation policy, setting it apart from science policy, is that it aims explicitly to support non-technological innovation¹². Indeed, innovation policy focus on what Tidd et al (2005) called the 4Ps: product innovation, process innovation, position innovation, paradigm innovation¹³. Hence, policy measures need to encourage not only formal industrial R&D but also innovative organisational practices, design and creativity and the diffusion and application of ubiquitous technologies (information and communication technologies, biotechnology, nanotechnology)¹⁴.

Moreover, a quite extensive literature on sectoral innovation systems¹⁵ suggests that specific sectors of the economy face different challenges due to different market structures and industrial dynamics, that innovation is driven by different factors (sources of innovation, demand, etc.), that technological regimes (the knowledge and learning environment in which firms operate) and that innovation processes or modes are organised differently, etc.¹⁶. Indeed, the OECD (2005) argues that:

"Innovation processes differ greatly from sector to sector in terms of development, rate of technological change, linkages and access to knowledge, as well as in terms of organisational structures and institutional factors.

¹⁰ Science policy, in contrast, is implemented in three major venues: educational institutions, governments or publicly funded institutes, and not for profit or philanthropic organisations.

¹¹ The word enterprise is used to essentially refer to profit seeking private enterprises, however third-sector, not for profit companies, and increasingly public sector organisations, e.g. health sector, are also seeking to improve their 'innovation performance'. See also the MONIT definition of sectoral innovation or innovation in other policy domains later in this chapter.

¹² Non-technological innovation covers all innovation activities, which are excluded from technological innovation. The major types of non-technological innovation are organisational and managerial innovations: the implementation of advanced management techniques, e.g. TQM, TQS; the introduction of significantly changed organisational structures; and the implementation of new or substantially changed corporate strategic orientations.

¹³ The four types of innovation are defined as follows: product innovation: changes in the things (products/services) which an organisation offers; process innovation: changes in the ways in which they are created and delivered; position innovation: changes in the context in which the products/services are introduced; paradigm innovation: changes in the underlying mental models which frame what an organisation does.

¹⁴ For a review of the 'ubiquitous' impact of ICT on economic activity, see: OECD (2004) The Economic Impact of ICT: measurement, evidence and implications.

¹⁵ Malerba F. (2005) Sectoral Systems: how and why innovation differs across sectors. In Fagerberg J, Mowery D.C. and Nelson R. (Eds.) (2005). The Oxford Handbook of Innovation.

¹⁶ However, the current industrial classification system (the NACE codes) are increasingly inappropriate as a mechanism for describing a set of common business activities even in more 'traditional sectors' (e.g. is a company operating in the field of technical textiles, an apparel company, a fine chemical company, a supplier of industrial materials, a supplier to the automobile industry etc.). Hence, if differences exist in sectoral innovation systems they may be hard to capture due to the multi-sector activities of many innovative firms, notably larger ones. See the body of evidence on sectoral innovation systems developed under the EU funded Sectoral Innovation Watch project (2005-2008): www.europe-innova.org

Some sectors are characterised by rapid change and radical innovations, others by smaller, incremental changes. In high-technology sectors, R&D plays a central role in innovation activities, while other sectors rely to a greater degree on the adoption of knowledge and technology. Differences in innovation activity across sectors (e.g. whether mainly incremental or radical innovations) also place different demands on the organisational structure of firms, and institutional factors such as regulations and intellectual property rights can vary greatly in their role and importance. It is important to take these differences into account when designing policy.

Certainly, the sectoral composition of national economies appears to play a decisive role in terms of the trends and intensity of business investment in R&D (BERD)¹⁷. The role of the structure of the economy (structural effect or ‘between-industry’ effect) appears to be more important as an explanatory factor than sector-specific R&D intensities (intrinsic effect) in explaining differences between the EU27 and US rates of R&D investment (Duchêne 2008). This should give pause for thought to policy makers in EU countries trying to boost national BERD intensity, to be in line with the EU’s “Barcelona target” (3% GERD/GDP ratio, of which two-thirds from BERD) target, with national industrial structures skewed towards medium-to-low technology sectors.

Thirdly, a series of theoretical and empirical approaches have equally placed greater emphasis on the ‘demand side’ of the innovation process, underlining that the sources of inspiration for innovations are as often drawn from consumers, co-developed by users (Von Hippel 1988), influenced by standards-setting processes to target lead markets, boosted by public procurement (Edler 2005, Georghiou 2007). These strands of thinking have rapidly found their way into policy development processes notably through the impulsion given by the Aho report (2006). This report argued that the reason business is failing to invest enough in R&D and innovation in Europe is the lack of an innovation-friendly market in which to launch new products and services. To create such a market they recommended actions on: harmonised regulation; ambitious use of standards; driving demand through public procurement; a competitive intellectual property rights regime; fostering a culture which celebrates innovation.

The argument is hence that it is not enough for policy to focus on attempting to boost knowledge creation and transfer from academic or public sectors to enterprises or correcting the market failures that lead to enterprises under-investing in R&D. In this context, much of the recent literature on innovation policy underlines the need to shift to a horizontal (or cross-cutting) form of policy intervention, the so-called ‘third-generation’ innovation policy¹⁸. Innovation policy, hence, transcends traditional sectoral (or vertical) policies such as science, education and training, environmental, transport, health, etc.

Yet, it should not be forgotten that, however defined, innovation policy in the EU has only a short history: it has developed as a ‘political objective’ since the Green Paper on Innovation (European Commission, 1995) and the re-focusing of traditional ‘industrial

¹⁷ The EU27 industrial structure is relatively more concentrated in medium-high-tech, medium-low-tech and low-tech activities than in the US (more concentrated in high-tech sectors and notably the larger share of both the ICT manufacturing industries and the ‘Aircraft and spacecraft’ industries in the industrial fabric of the US).

¹⁸ The so-called “third generation innovation policy” stresses the need for innovation to become an integrated dimension of other traditional policies. See: Innovation tomorrow: Innovation policy and the regulatory framework: making innovation an integral part of the broader structural agenda; Louis Lengrand & Associés; PREST (University of Manchester) & ANRT; Innovation papers No 28, 2002, European Commission.

policies' towards support for innovation has occurred over the decade in line with changing trends in EU State Aid rules¹⁹. This notably implies that 'horizontal measures' (such as support to innovation and industrial R&D) are to be preferred to selective measures targeted at certain ailing sectors²⁰.

The OECD MONIT study²¹ provided what has remained to date the best exploration of types of innovation policy (see. From one perspective, innovation policy can be considered as an extension of industrial policy (defined as the sum of public measures aimed at the development of industrial structures in a specific sector). 'Traditional' industrial policy is generally viewed as being limited to maintaining a status quo of a given industry sector or trying to help establish (or maintain) national champions with financial incentives. However, a more modern vision of industrial policy developed by Rodrik (2004) argues that instead of viewing industrial policy as an outcome ('picking winners') supported through a range of instruments (subsidies, tax incentives, etc.), it is a process whereby the state and private sectors jointly arrive at a diagnosis about the sources of blockage in new economic activities and propose solutions to them²².

Figure 2: A taxonomy of innovation policy, the MONIT approach

Goals	Sectoral innovation policy	Multi-sectoral innovation policy
Innovation policy, i.e. aimed primarily at innovating industries and economic growth	<i>Innovation policy in a limited sense (basically technology and industrial policies)</i>	<i>Integrated science, technology and innovation (STI) policies</i>
Innovation policy in a wider sense, i.e. aimed at economic growth and quality of life	<i>Innovation policies in other sectoral domains, e.g. in health, in the environment, etc.</i>	<i>Horizontal/comprehensive /integrated or coherent/ systemic innovation policies</i>

Source: OECD (2005)

Third generation innovation policies (the bottom right quadrant of the MONIT taxonomy above) and 'new' industrial policies are clearly part of the same family and indeed this is very much the policy orientation of the European Commission's industrial policy. According to the Commission, "the main role of industrial policy is to provide the right framework conditions for enterprise development and innovation in order to make the EU an attractive place for industrial investment and

¹⁹ The European Council has explicitly invited Member States "to continue working towards a reduction in the general level of state aid, while making allowance for any market failures. This movement must be accompanied by a redeployment of aid in favour of support for certain horizontal objectives such as research and innovation and the optimisation of human capital. The reform of regional aid should also foster a high level of investment and ensure a reduction in disparities in accordance with the Lisbon objectives". European Council Conclusions of November 2004 and March 2005

²⁰ A measure is considered "selective", if the authorities administering the scheme enjoy a degree of discretionary power. The selectivity criterion is also satisfied if the scheme applies to only part of the territory of a Member State (this is the case for all regional and sectoral aid schemes)". Vademecum Community Rules on State Aid, 2007.

²¹ OECD (2005) Governance of Innovation Systems, Vol. 1: Synthesis Report

²² Rodrik D., (2004) "Industrial policy for the twenty-first century," mimeo, John F. Kennedy School of Government, Cambridge, MA: Harvard University. <http://ksghome.harvard.edu/~drodrik/UNIDOSEp.pdf>

job creation"²³. This is very similar in its argumentation to the role of government in supporting innovation systems outlined above.

However, in many countries, innovation policy has only become an operational reality from 2000, or even amongst the NMS with the advent of the first round of Structural Fund support in 2004. Accordingly, discussions on priorities for innovation policy still take place amongst a relatively small community of 'experts' in liaison with a limited, if growing, number of practitioners (regional or national agencies, innovation and technology centre managers, innovation fund managers, cluster managers, etc.). This leads, as will be discussed below, to a disconnection between agenda/objective setting in National Reform Plans or Structural Fund programming documents (often drafted in specialised departments of Ministries of Finance, etc.) and an evidence based priority setting based on a real understanding of the specific bottlenecks in the national (and regional) innovation systems. Indeed, it could be argued that there is a risk of an "unhealthy Europeanisation" of policies taking place, where countries try to adjust policies to an "ideal" set of guidelines rather than develop policies tailored to their specific stage in the development to a knowledge based economy (e.g. technology absorption measures in traditional SMEs versus strengthening global innovation hot spots) and without regard to the existing industrial (including services) structure, existing technological specialisation patterns, foresight on opportunities for carving out future competitive advantage; or trends in human resource for innovation, etc.

Innovation is paradoxically both at the top of the policy agenda (taking a word count in official EU or national development plans for instance); and yet a misunderstood concept in terms of policy design and delivery, squeezed between a powerful 'research lobby' and more classic economic or industrial development policies. The 'place' for a distinct policy intervention called innovation policy in a broader "policy mix" is not always well articulated, objectives are loosely defined, targets imprecisely set, intervention logics weakly articulated, external factors impinging on the success of implementation of measures poorly understood, a limited evaluation culture and even rarer impact analysis.

In innovation policy circles, the concept of a 'third-generation innovation' policy is widely held as being a model to aspire to while in practice many Member States, nationally and/or regionally struggle to implement even 'sector' or technology-specific innovation policy measures. Capturing the systems²⁴ dimension to innovation policy design and implementation is currently beyond the capacity of the vast majority of member states, with for instance action to influence framework conditions (legislation) or correct institutional failures rarely included in a systematic way. Equally, the need to create synergies not only with 'research policy' but also education, transport, environment, energy, etc. policies to adopt a more ambitious agenda for innovation policy where innovation is truly everywhere and in particular where policy seeks to lead to longer-term structural 'system innovation' is not happening (with some exceptions) due to administrative hierarchies and "turf wars".

In this context, the next section of this paper examines the challenges faced in designing innovation policy in a multi-level governance context within a EU composed of diverse economies and innovation systems. It does so by building on the database of policy information accumulated over a ten-year period by the European TrendChart on Innovation initiative (funded by the Directorate-General for Enterprise Policy of

²³ Commission Communication "Implementing the Community Lisbon Programme: A Policy Framework to Strengthen EU Manufacturing - towards a more integrated approach for Industrial Policy" - COM(2005) 474 final of 5.10.2005.

²⁴ The expression National System of Innovation was first used by Chris Freeman in 1987 in his book on technology performance and economic performance in Japan. For a recent review see Edquist Ch. Systems of Innovation, in Fagerberg J, Mowery D.C. and Nelson R. (Eds.) (2005). The Oxford Handbook of Innovation.

the European Commission). The analysis presented here is based largely on the European Innovation Progress Report 2008²⁵ and on an on-going analysis of the TrendChart database enabling a characterisation of national policy mixes through a set of quantitative and qualitative indicators.

3. Does the innovation policy mix tackle system challenges ?

In Tsipouri et al (2009), the concept of system failures was applied as an analytical framework for analysing innovation policy in the EU27 Member States. The analysis was based in a first instance on the policy challenges identified by the 2008 national reports on innovation policy and performance prepared by the network of TrendChart correspondents. Needless to say, the six types of failures do not constitute a strict categorisation and some interpretation is required. Policy challenges as defined by each national report may encompass one or more types of failures. Equally, policy measures addressing specific challenges may address more than one failure. For example, a measure aiming at increasing innovation capacity of companies through technology transfer between companies and research institutes can be classified as addressing both capability and network failures.

Figure 3: Examples of challenges per type of failure in the EU27

	Innovation leaders	Innovation followers	Moderate innovators	Catching up
Market Failures	UK: “Boost relatively weak intensity of innovation activity in Enterprises”	IE: “Increase the level of innovation in the private sector”	CY: “Increase inputs and efficiency of business Innovation”	BG: “Increase R&D expenditure (private and public)”
Capability failures	FI: “Broaden the base of innovative growth-oriented enterprises”	FR: “Increase non-technological innovation (organisational, design) innovation in SMEs”	EE: “Building competences and developing innovation management skills”	PL: "Stimulate and deepen innovation internal capacities of Polish companies"
Institutional failures	DE: “Increasing supply of highly qualified labour”	BE: “Innovation skills mismatch”	IT: Innovation financing	RO: “Improve innovation and business support infrastructure (business incubators, technology transfer offices, S&T Parks, etc.)”

²⁵ See http://www.proinno-europe.eu/admin/uploaded_documents/EIRP2008_Final_merged.pdf

	Innovation leaders	Innovation followers	Moderate innovators	Catching up
Network failures	SE: "Centres of Excellence: creation of globally competitive research and innovation milieux."	LU: "Reinforce synergies, complementarities and collaborations between the public and private RD centres."	CZ: "Cooperation between public R&D and industry"	SK: "Development of knowledge intensive clusters across public knowledge poles"
Framework failures	SE: "Innovative public procurement – Revitalising old models to transform knowledge to commercial value"	FR: "Foster intellectual property use by SMEs"	ES: "Decreasing availability of human capital and skills"	MT: "Sustaining enhanced investments in business R&D and encouraging innovation of SMEs"
Policy failures	FI: "Transformation of firm strategies and new innovation models".	n.a.	EL: "Low effectiveness and limited impact of the innovation measures on economy and employment"	SK: Underdeveloped innovation governance

Source: TrendChart Country Reports 2008, analysis Technopolis Group

Based on the challenges identified in the 2008 EU27 TrendChart country reports, the figure below summarises the relative weighting of innovation policy challenges across the six types of failures. As can be seen from Figure 4, capability failures are the most prevalent type of failures ahead of institutional and market failures. The recognition that capability failures (limited management skills, weak know-how on technological or organisational innovation, etc.) inside companies are a considerable impediment to intensifying innovation is significant.

A general refrain for many years has been to point the finger at 'lack of financing' (captured normally under the market failure or framework failure categories) as a major barrier to more SMEs innovating. The focus of the challenges on capability failures suggests that more attention needs to be given in policy support to alleviating internal factors sapping innovativeness of European enterprises.

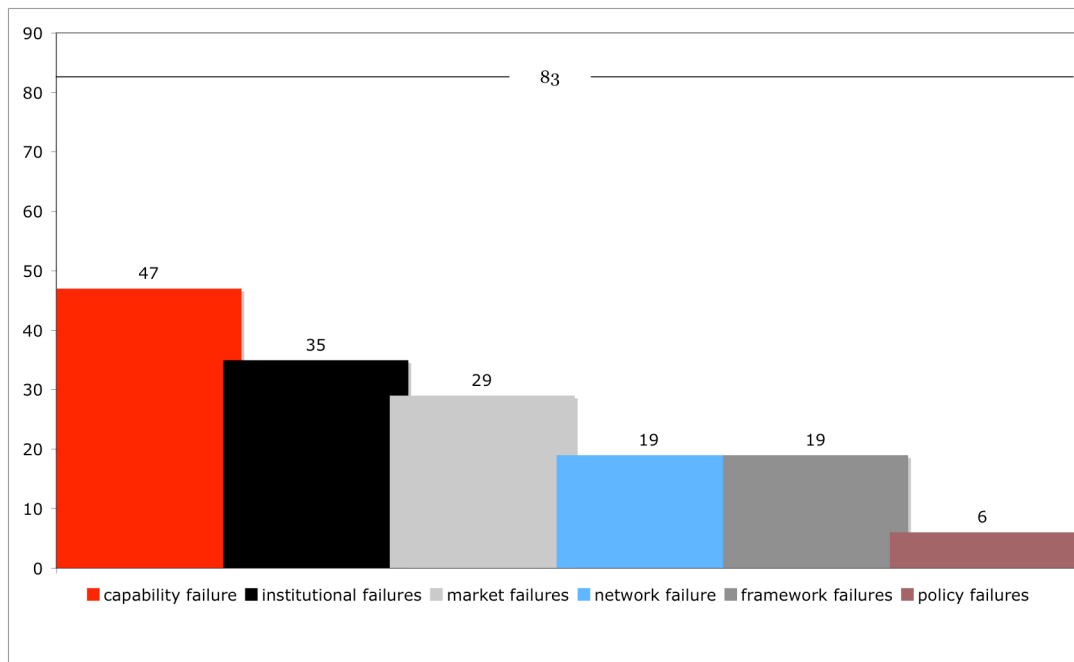
Figure 5 distinguishes the importance of the challenges identified by EIS 2008 country groups. While capability failures are perceived as an important challenge across all four groups, the shortcomings of framework conditions are considered more significant in the innovation leaders and followers.

This could be considered a paradoxical finding but it does not imply per se that framework conditions are weaker in these countries. Rather it is indicative that framework conditions are more often identified as a policy issue, possibly because the basic conditions (internal capabilities of enterprises, innovation infrastructure, access to finance or innovation support services, etc.) are better than in the lagging countries.

Perhaps surprisingly, network failures (industry-science co-operation, clustering, etc.), often highlighted in policy debates as a weakness of many national innovation systems in the EU, have been considered as a key challenge significantly less often than capability, institutional and market failures. Such network challenges were, however, relatively more present in the moderate innovators and the catching-up countries,

suggesting that innovation co-operation and knowledge transfer remain more problematic in these 'less-developed' innovation systems.

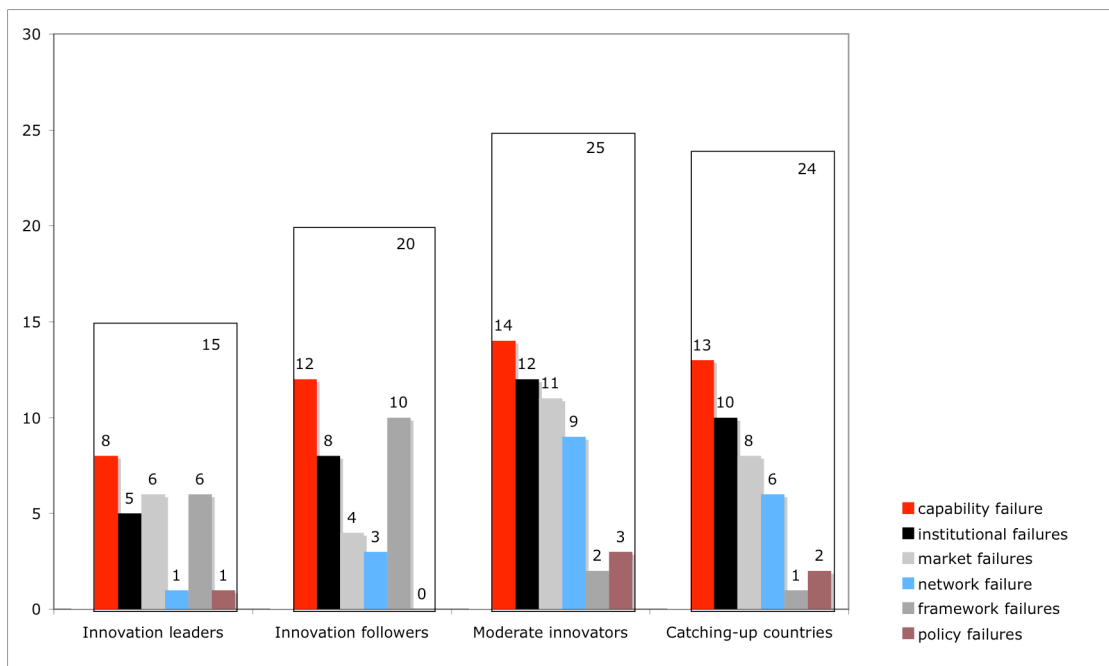
Figure 4: Failures targeted by EU27 innovation policy challenges



Source: TrendChart Country Reports 2008, calculations Technopolis Group

Nb: numbers over the vertical bars indicate the number of challenges addressing a given failure. A challenge can address more than one type of failure. 83 challenges were defined in the 2008 country reports.

Figure 5: Challenges by type of failure and EIS group



Source: TrendChart Country Reports 2008, calculations Technopolis Group

Note: The numbers over the vertical bars refer to the number of challenges addressing a given failure. The numbers in the right upper corner of the black frames are total numbers of challenges in EIS groups. One challenge can address more than one type of failure.

Experts in the “catching-up” countries were particularly concerned about network failures. The Hungarian report points to “Low occurrence of cooperation in innovation activities”; the Bulgarian correspondent called for action "To stimulate partnership and to increase cooperation between science institutions, enterprises and other institutions involved in the innovative process"; the Polish, Romanian, and Slovak reports highlighted the need to improve industry-science co-operation (as did the Czech report from the group of moderate innovators).

The concept of policy failures is less present in the analysis than might be expected, but this is largely due to the procedure for identifying challenges (based primarily on EIS indicators) rather than a sign that all is well in governance. Governance and policy management issues are dealt with in a separate chapter of the TrendChart reports and, indeed, when one delves into the country reports for the CEEC the weakness of governance systems (one element of the social capabilities discussed above) are a source of concern in all the national innovation systems.

4. What type of failures do innovation policy measures target?

According to EIPR 2008 (Tsipouri et al, 2008), the policy priorities²⁶ most often addressed by STI policies in the EU27 Member States during the period 2007-8 was by far ‘support for R&D cooperation including joint research projects run by public-private consortia of business and research’. Nearly one third of all support measures in force targeted R&D cooperation as one of their key priorities. Work in progress to update and deepen the analysis of the policy measure database (to be published in the forthcoming European Innovation Progress Report 2009) tends to confirm the importance of R&D co-operation. The policy priority most often addressed remains “*support for R&D cooperation*” (27% of measures²⁷).

Figure 6: frequency of measures targeting policy priorities in the EU27, 2009



Source: TrendChart-ERAWATCH database; analysis Technopolis Group (N=1094)

²⁶ In the TrendChart, STI policy measures are categorised according to a 3-digit structure and grouped into five main macro categories: governance & horizontal research and innovation policies; research and technologies; human resources (education and skills); promote and sustain the creation and growth of innovative enterprises; markets and innovation culture.

²⁷ Based on an extraction from the database in June 2009.

The next most often addressed priorities include ‘*implementing strategic research policies*’ (16% of support measures), *support to innovative start-ups* (16%), *direct support for business R&D* (15%), *measures targeting excellence and management of research in Universities* (15%) and *in research organisations* (15%).

Financing of innovation is often considered as weakness of national innovation system, however, the numerical importance of measures addressing (Support for risk capital’ was relatively limited (7% of measures). However, the range of measures supporting innovation financing is broader including also horizontal measures in support of financing (6%), fiscal incentives in support of the diffusion of innovation (4%) as well as indirect tax incentives and guarantees (3%).

Surprisingly given the increasing identification in policy documents of human resources for innovation as a bottleneck, the range of measures targeting training and mobility for R&D and innovation seems relatively under-represented in the overall STI policy mix. This is particularly noticeable in terms of the relative importance of measures addressing the skills and availability of innovation staff in enterprises (that is, measures likely to contribute to reducing the gravity of ‘capability failures’): ‘recruitment of skilled personnel in enterprises’ and ‘job training of researchers and other personnel involved in innovation process’ (both 4%). However, compared to 2008, the share of the number of measures addressing more specifically ‘researchers’ has increased: ‘*mobility of researchers*’ (from 6.4% in 2008 up to 9% in 2009); ‘*career development, including long term contracts for university researchers*’ (from 4.8% to 6%); ‘stimulation of PhDs’ (from 6% to 7%). In contrast, there has been a slight decrease in the relative importance of measures aimed at inter-linkages between enterprises: ‘*Cluster framework policies*’ (from 9.4% to 7%), ‘*Support to technology transfer between firms*’ (from 8.2% to 7%), ‘*Support to sectoral innovation in manufacturing*’ (from 9.2% to 8%).

As might be expected, the overall picture changes when the policy mix is analysed at a disaggregated level with a focus on countries with different levels of development. Analysis at the level of EIS country groups reveals some substantial variance in terms of policy priorities addressed by national STI policies.

As Figure 7, highlights, while R&D cooperation is the key policy priority for all EIS groups, the focus on this priority among innovation leaders (40% of all measures) is significantly stronger than in any other group. Similarly, the shares of other priorities related closely to science policy (such as strategic research policies, public research organisations and support to excellence and management of research in Universities) are relatively higher in innovation leaders.

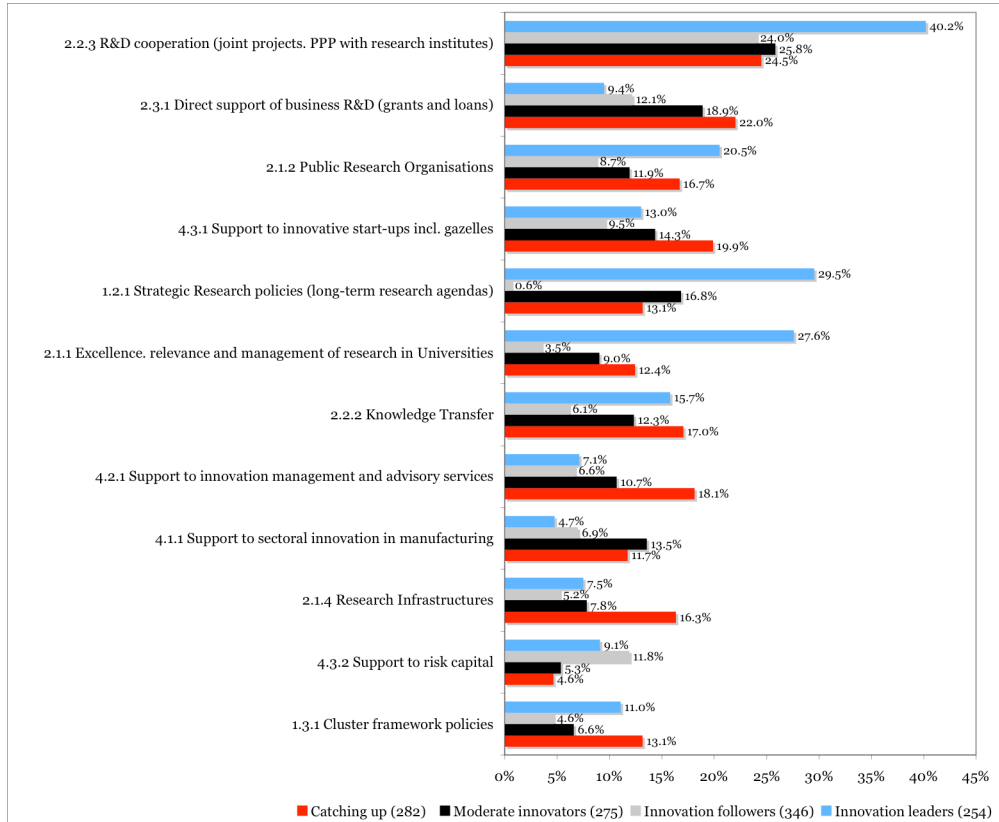
On the other hand, innovation leaders focus much less on providing direct support for business R&D (9%) and support to innovation management services (7%) which are more present in the catching-up countries and moderate innovators (respectively for direct support to R&D 20% and 19% and innovation management 16% and 11%). As expected, given their level of S&T development, catching-up countries give more emphasis to research infrastructures (15% of all measures) than any other group.

Interestingly, both innovation leaders and the catching up group give relatively the same emphasis to measures targeting knowledge transfer (respectively 16% and 17% of their measures) and to the horizontal cluster policies (11% and 13%). Followers and moderate innovators have much lower shares in these categories (apart from 12% share of knowledge transfer measures in moderate innovators).

Innovation followers stand out in their emphasis on the support to risk capital (12%) compared to 9% share of innovation leaders and significantly lower shares in case of moderate innovators and catching countries (about 5% each). Moderate innovators behave similarly to catching up countries with the exception of research infrastructures and cluster framework policies (8% and 7%) where they have less

relevant support measures. On the other hand they place more emphasis on research strategic policies (17% compared to 12% in catching countries).

Figure 7: Key policy priorities in the EIS country groups (2008)



Source: TrendChart-ERAWATCH database; analysis Technopolis Group (N=1157)

Note: Percentages refer to the share of support measures addressing a given policy priority within EIS country group. A single support measure can be assigned up to four policy priorities. The numbers in the legend indicate the total number of measures belonging to the EIS group. The chart includes: (1) 10 policy priorities addressed by the highest number of support measures and (2) 10 priorities with the highest variance between the smallest and biggest share of measures between EIS groups. The most often occurring priorities are the top ten priorities in the exhibit. The priorities with highest variance were (starting with a priority with the highest variance): 1.2.1, 4.2.1, 2.1.4, 2.2.2, 4.3.1, 2.3.1, 2.1.1, 1.3.1, 2.1.2 and 4.3.2.

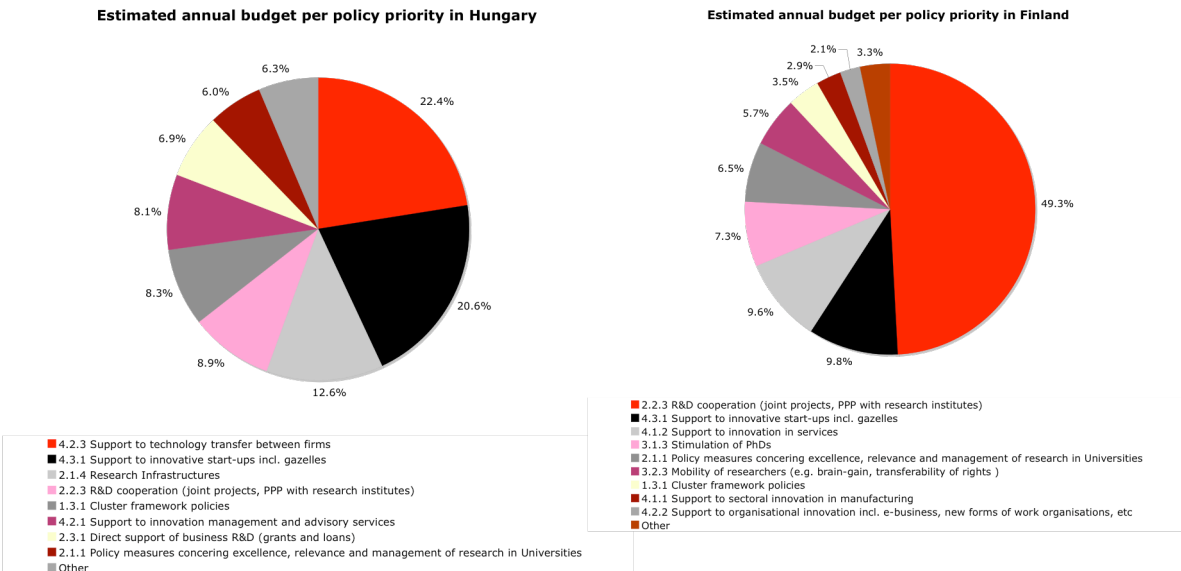
In general, the analysis suggests that innovation leaders concentrate on a smaller number of STI policy priorities than other countries with four key priorities addressed by more than 20% of their measures. Innovation followers have the most diverse policy mix in terms of priorities addressed with just one policy priority above 15% share of all their measures. Moderate innovators and catching up countries seem to have a more horizontal approach with a focus spread more evenly among different priorities.

However, the overall picture would be likely to change if the policy mix was analysed using the budgetary dimension. With a view to the EIPR 2009 (forthcoming January 2010), a detailed analysis of budgetary data for the STI support measures in the TrendChart database is being conducted. This exercise is clearly important since in the context of the 2008 financial crisis, and subsequent pressures on Government budgets, twinned with the on-going commitment of the EU27 to improve their innovation performance, obtaining an estimate of the extent of public funding for innovation and its share between different types of policy measures would enable a more sophisticated analysis of potential impacts of policy on national innovation systems to be developed. Equally, it would enable a refinement of the analysis of the

way in which different countries, at different stages of development or with different intensities of system failures are developing differentiated policy approaches.

At the present time, the data collected on budgetary resources allocated to each measure in the TrendChart database remain difficult to a) collect²⁸ b) aggregate (for a period, between priorities, etc.).

Figure 8: comparison of budget share for STI policy in Hungary and Finland



Source: TrendChart database (data extracted July 2009), calculations Technopolis Group

Figure 8 provides an example of the work in progress by comparing two countries with significantly different levels of innovation performance and innovation systems. Whereas funding for R&D co-operation dominates in Finland (reflecting no doubt the range of collaborative programmes put in place by Tekes), the Hungarian policy mix as defined by budget shares is more varied with a stronger emphasis on technology transfer (logical from the point of view of a country in a catching up phase where internal capabilities of firms need to be boosted) and research infrastructures (again coherent with catching up countries need to put in place the foundations of a more advanced R&D production effort). Finland on the other hand makes a relatively important investment into innovation in services (coherent with the policy emphasis placed on this in Finnish strategies and the growing importance of the service sector in this more advanced economy).

The on-going analysis will aim to build on such budgetary figure to produce a first estimate of the current (2007-13) average annual budgets for STI policies in the EU27 broken down by EIS groupings. ‘Fact-sheets’ per country providing comparative analysis (against EU27 averages) of the data on the beneficiaries (SMEs vs individuals vs research organisations, etc), targeted technology fields, funding sources (Structural

²⁸ As the draft 2009 Finnish TrendChart country report notes “Annual budgets of the policy measures are very difficult to obtain from the agencies and policy makers, and the main innovation policy agencies, such as Tekes, do not differentiate annually the amount of spent money on specific instruments in their annual reviews or other official documents. Only a minority of the Finnish measures reveal the annual budget data, which does not allow us to make comparative analyses. Total budgets of the measures are more readily available but the database consists of on-going measures and fixed-term measures which make the comparison problematic”.

funds, private co-financing, etc.) have been made available to the TrendChart country report authors and it is hoped that such aggregate analysis will be made available in coming years in dynamic form to public users of the TrendChart service.

Of course, not all innovation measures are ‘financial’ in nature (providing funding directly or indirectly to actors in the NIS) and regulatory or legislative interventions could be as important as State aid for R&D projects or tax credits. Again, here the development of a more detailed analysis of the expected outcomes of measures in a national policy mix would enable a ranking of the relative importance of financial versus non-financial measures in targeting and alleviating failures in national innovation systems.

5. Conclusions

The three key messages emerging from the evidence accumulated by the TrendChart project on the policy challenges and responses (policy measures) of the EU27 Member States are as follows:

- Challenges for innovation policy differ across the Member States depending on the level of economic development, performance of their innovation systems and the ‘maturity’ of innovation policies. While challenges addressing ‘capability failures’ are the most dominant for the EU27 as a whole; the Member States in the innovation leaders group give much more emphasis to framework failures. This does not imply that the leaders have weaker frameworks for innovation, but rather a shift to a broader understanding of innovation drivers in their economies.
- Concerning the policy-mix and the extent to which it targets specific market or innovation system failures, the moderate innovators and catching-up countries give much more emphasis to direct support to companies (‘capability failures’), including advisory services and technology diffusion; while the policy-mix in the more advanced countries gives much more emphasis to network failures (possibly reflecting the earlier shift to clusters and joint industry-academia R&D co-operation programmes).
- In terms of the correspondence between challenges and the policy response, it appears that while catching-up countries and moderate innovators recognise that they face significant ‘institutional failures’, the policy response in these countries with respect to this type of challenge remains rather limited. For innovation leaders, there seems to be a discrepancy between the importance given to network failures in the identified challenges and the actual policy response (where it is the most prevalent policy failure).

Further work on analysing innovation policies needs to enrich this analysis by understanding a) the targeting of different instruments of innovation policy on ‘individual agents’ (SMEs, etc.) versus measures aimed at improving wider ‘ecosystems’ b) the relative weight of financial investments made by the public sector in pursuit of different policy priorities and their correspondence with the level of development of different national innovation systems in the EU27; c) the extent to which ‘narrow innovation policy’ is interacting with other policy fields to tackle the social (poverty, ageing, etc.) and ‘grand challenges’ (climate change, energy consumption, resource efficiency, etc.) d) the extent to which non-financial measures are being used to tackle, notably, institutional, framework and governance failures, including in less-advanced innovation systems where such failures are claimed to be more significant barriers to innovation.

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