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Convergence among national innovation policy mixes in Europe – an analysis of research and innovation policy measures in the period 2004-2012

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Convergence among national innovation policy mixes in Europe – an analysis of research and innovation policy measures in the period 2004-2012[1]

Abstract

The national innovation policy mix is composed of the set of policy measures that address the innovation policy challenge of a country and aim at affecting its innovation performance into a positive direction. As the academic literature underlines there is no single optimal policy model, but there is a need to understand and respond to the specific characteristics and challenges in each national innovation system. The data series of the Erawatch and INNO Policy TrendChart initiatives of the European Commission dating back to 2000 has provided a unique opportunity to reflect on the evolution of innovation policy measures and policy mixes adopted by the EU countries throughout the past decade. Based on the analysis of these datasets, we identified the composition of the innovation policy mix per country and across countries and changes in the policy mixes over time. The analysis discovered five approaches followed by the EU Member States. We found an unexpected convergence and very slow evolution among the national innovation policy mixes showing that countries with different technological challenges are following similar approaches although their particular profile would require reflecting more differences. Although policy learning might be welcome, too much convergence among innovation policy mixes might undermine the effectiveness of policies.

Content

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[1] The research that form the basis for this paper is based on data collection funded by the EC Funded study 'Learning from Decade of Innovation Policy'

Introduction

This paper reviews the evolution and variety of national innovation policy mixes in the EU (plus Norway and Switzerland) in the period of 2004-2012 using the unique database of research and innovation policy measures gathered through the Erawatch and INNO Policy TrendChart initiatives of the European Commission (referred to as 'TrendChart database' hereafter). The construction of such database offers the opportunity to analyse national innovation policy mix choices in terms of their composition in a set of policy instruments that address the innovation policy challenge of a country and aim at affecting the innovation system into a positive direction. The focus therefore lies in the strands of literature regarding the choice of policy instruments subsequently organised in policy mixes (Borras and Edquist, 2013; Flanagan et al., 2011; Howlett 2004;) not the implementation thereof, or the involvement of actors and institutions or parallel workings framework conditions. Due to the specificities of the TrendChart database our analysis captures research and innovation policy instruments to which a financial flow belongs.

This paper touches to a large extent on the policy mix literature, that has departed from a focus on single instruments and a single optimal policy model, towards the need to understand and address the specific needs and challenges in the innovation system in order to design appropriate instrument mixes (Howlett and Rayner, 2007). In this paper innovation policy-mixes are seen as dependent on differing conditions across countries with different socio-economic political and historical contexts, different actors/institutions engaged and different degrees of policy learning. Nevertheless, due to the coverage of the dataset we take the opportunity to draw first a macroscopic view on the policy mixes designed over a decade of history in innovation policy and reflect upon some of the assumptions we find in the literature. The objective is not however to engage in the theoretical discussion of principles for policy makers to rely on for their design of policy mixes which we believe is best performed in the context of a country or region. We rather take on the challenge to empirically explore if countries at different development levels and maturity of their innovation systems have adopted different innovation policy mixes.

Innovation policy mixes are country specific, however despite the uniqueness and diversity of policy profiles, there are policy mixes that are significantly closer to each other. In the words of Aghion et al. (2013) we address the question whether policy mixes are entirely 'plastic' i.e. unrelated to the nature of technology challenges, which are usually similar for countries that operate close to each other in relation to their technology frontier. It is assumed that the technological position of a country should have some effect on its policy mix. For example, countries that are modest innovators according to a set of innovation indicators defined by the Innovation Union Scoreboard[2], might share more commonalities in terms of policy mixes amongst themselves rather than with countries that are innovation leaders. They are much more focused on imitation and production capabilities when compared with countries that are innovation leaders whose growth is much more dependent on R&D and knowledge generation at world frontier. Equally, policy mixes are reflections of different

[2] http://ec.europa.eu/enterprise/policies/innovation/policy/innovation-scoreboard/index_en.htm

systems of innovation, different political cultures and in the EU27 context, policy mixes reflect very strongly transnational policy learning and a shared common understanding of what is considered to be the 'best practice'. These latter factors may generate policy mixes that are necessarily responses to country specific 'objective' challenges or challenges, which stem from their unique innovation position. In this respect, the analysis is informed by Schumpeterian growth theory[3] (Aghion and Howit, 2009) and systems of innovation literature (Lundvall, 1992).

The article is structured as followed: the first section reviews the literature on the innovation policy mix and innovation system; the second presents the methodological background applied in the identification of policy mix approaches followed by country groups; the third provides the result of the analysis and finally the fourth last section summarises the findings and conclusions.

Literature review

Innovation is a complex, cumulative, interdisciplinary and highly interactive process. It is influenced by a myriad of factors such as innovation culture, social capital, climate for entrepreneurship, education, research or knowledge networks out of which innovation policy can be only one. Lundvall (1992) defines innovation systems as being constituted of a number of elements and by their relationships, where the social interaction between economic actors shapes learning processes and flows of information, which can result in innovations. Learning is thus a key aspect of national innovation systems, which result in accumulation of technological capabilities. This approach stresses the interactive nature of knowledge accumulation through linkages among the actors involved in the innovation process (Lundvall, 1992; Nelson, 1993). Innovation policy can play different functions in innovation systems (Edquist and Johnson, 1997), it can reduce uncertainty by providing information, foster cooperation, or provide incentives for innovation. The key aspects can also be grouped into three intervention areas: support investment in research and innovation; enhance innovation competencies of firms; strengthen linkages within innovation systems (OECD, 2006).

There are several aspects that influence the composition of the mix such as the type of grant schemes, use of indirect measures or demand-side actions, thematic prioritisation, the range and share of funding, the use of mini-mixes or single individual measures and the delivery mechanisms. The mix of innovation policy instruments usually covers a wide range of policy instruments like R&D support, innovation support services provided through innovation centres, business incubators or

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[3] The Schumpeterian growth theory has "operationalised" Schumpeter's notion of creative destruction -the process by which new innovations replace older technologies. This is done not only as in endogenous growth theory where current innovators exert positive knowledge spillovers on subsequent innovators but also where current innovators drive out previous technologies. In this way this theory accounts for facts about the growth process that could not be accounted for by other theories. In particular, Schumpeterian growth theory manages to put industrial organisation into growth, and to link growth with firm dynamics, thereby generating predictions on the dynamic patterns of markets and firms (entry, exit, reallocation) and on how these patterns shape the overall growth process. For accessible account see Philippe Aghion, Ufuk Akcigit and Peter Howitt (2013).

science and technology parks, indirect incentives like R&D tax credits and grants for business innovation support.

A policy instrument can be defined as a public programme, organisation, rule and regulation that can induce a change believed to affecting R&D investments and innovation activities of firms. This usually involves public funding, but for instance regulatory changes or standards can affect research and innovation investments without the intervention of public funds (Cunningham, 2007). A policy instrument is an intervention into a dynamic and ever-changing system of actors, institutions, networks and knowledge in a certain period. The combination of policy instruments together with complementary framework policies (such as fiscal policies, education, regulatory framework etc.) forms the innovation policy mix.

The approach of Arnold and Kuhlmann (2000) rests on the definition of an innovation system as being composed of elements such as demand for innovation, framework conditions (regulatory framework or tax system etc.), industrial system composed of large companies, SMEs and start-ups, education and research system, intermediaries, political system and infrastructure (eg. IPR regime, venture capital, standards). It has to be kept in mind that the system elements can reinforce each other, but can also block and put out each other's directions. The system view also applies that innovation are not so much determined by the simple competition between technologies or solutions but it is the result of a competition between innovation systems or sub-systems (Kemp, 1994; Hekkert et al, 2007).

In the innovation system framework the policy instrument can be captured through four key questions of innovation policy: why to intervene, how, where and when (Malerba, 2009). These questions can guide the selection of policy instruments. Policy instruments will differ country by country, although there are common elements, their implementation can take different forms.

Policy instruments should not be seen as alternatives but as complementary toolboxes (Boekholt et al, 2001). Understanding the linkages between different innovation policy instruments or between related policies (such as environment or education) is important because they can induce both positive synergies or they can hinder each other's effects. The interactive effects of instrument can mean targeting the same actors or targeting different actors involved in the same process. The idea of interactions and trade-offs between policy instruments is fundamental to the policy mix concept. Others for instance Van Nispen and Ringeling (1998) are highly critical of the instrumentalist 'tool' metaphor which dominates seminal reviews such as those of Hood (1983) and Salamon (2002). For them, treating instruments as objects runs the risk of reification (Van Nispen and Ringeling, 1998, p206), categorising instruments into typologies run the risk of privileging formal means over less formal means, and treating instrument selection as an optimisation calculation ignores not just bounded rationality and information asymmetry but also the effects of culture, fashion, habit, interest and politics. Lauscombe & Le Gales (2007, p.3) also criticise the functionalist orientation of much of the literature on policy instruments, arguing that instruments are not neutral devices but rather bear a history, values and are thus social as well as technical (Flanagan et al., 2011).

Innovation policies and the selected policy instruments are supposed to be underpinned by different rationales such as suggested by the neoclassical market failures or of the evolutionary theories.

Metcalfe's market failure approach (1994) emphasised that innovation policies shall react to capacity, network, institutional or framework failures, which could result in an investment level lower than the optimum. The failures as outlined by the evolutionary theory are technological opportunity conditions, learning, the interplay between technology and competences and appropriability.

Policy instruments are widely seen as being substitutable, at least in principle (Landry and Varone, 2005). Public policy is thus a toolbox from which the optimal tools are (or should be) selected. In this view what ends up in the policy mix' is taken for granted whilst the problem of potential policy interaction is simply a matter to factor into tool selection. The only obstacle to adding policy instruments to the mix is cost. The context and implementation of an instrument can be fluid over time as instruments are interpreted and reinterpreted in the light of changing rationales. Implementation is another factor here, and decisions taken during implementation may be critical in determining the impacts of policy action, potentially leading to major variations in the same' instrument across time and space quite independently of differences in strategies, policy rationales or meta-rationales (see e.g. Slembeck, 1997).

Policy instruments are not necessarily stable over time and across space whether in terms of rationales, goals or means. Instruments frequently harden over time into new actors and institutions, which become part of the changed context in which future policy processes (and innovation processes) occur. The emergence of the 'policy mix' concept into common use in the field of innovation policy studies provides us with a window of opportunity to reconsider some basic and often hidden assumptions in order to better deal with a messy and complex, multi-level, multi-actor reality. A number of approaches are taken to policy instruments across the different literatures (principally in law, public administration, policy analysis and economics) which explore them. Linder and Peters (1998) argue that, despite the diversity of perspectives, there is often overlap in terms of assumptions. They argue that most studies focus on the presumed objective merits of individual instruments, attempt to classify instruments according to simple ideas about modality, and tend to overemphasise the economic impacts of instruments at the expense of social and political ones. They also argue that most approaches omit to explore how instruments are actually chosen and given life.

Finding an optimal policy mix is not a one-time exercise but a continuous process that adjusts to the dynamics of innovation systems (OECD, 2010). The design and implementation of innovation policy depends on the extent to which innovation policy instruments are defined, customized and combined into policy mixes that address the 'problems' related to the activities of the system. (Borrás and Edquist, 2013).

Other authors also conclude that there is no ideal policy mix model and criticize that innovation policies were often influenced too much by "best practices". They claim that different types of regions with respect to their preconditions for innovation, networking and innovation barriers need different policies (Tödtling and Trippl, 2005).

A seemingly good policy mix may be de facto appropriate response to country's challenges of yesterday. Often, policy mix is transfer of policy solutions from elsewhere rather than respond on their internal challenges. The design of the innovation policy mix could be improved when based on

policy learning process, which takes into account the environment where it has to operate (Malerba, 2009). Hence any innovation policy should be well aligned to the given circumstances, take into account the size and industrial structure of the country and should be composed of a combination of well-targeted policy instruments if it is to influence it in a positive way. After identifying the needs of the innovation system, the next step is to decide on specific policy instruments that can improve innovation system functioning such as stimulating weak elements or by removing blocking mechanisms (Hekkert et al, 2007).

In this dynamic context it is not straightforward to put in place an effective mix of policies that stimulate learning processes and linkages and that also takes into account possible positive and negative interactions among the selected policy instruments.

When successful they are very much country specific responses to domestic challenges based on policy learning. The literature often points out that different technological and institutional environments may respond in a different way to similar incentives, hence an optimal policy mix in one country might not work at all in another (Callon et al., 1986). For instance in countries still lagging behind in terms of technology development, policy should foster the knowledge absorption and diffusion functions of the innovation system (Kravtsova and Radosevic, 2011) and hence a policy mix which is focused strongly only on knowledge generation may not be appropriate. Also, mature national innovation systems might need specific new focus and the development of internationalisation measures rather than a inward oriented policy mix.

In summary, we should be aware that policy mixes are only the first layer of direct incentives to innovation and R&D: R&D subsidies, tax credits that encourage innovation, etc. A second layer is that of institutions and structural reforms like for example, liberalisation of specific markets, the structure of educational spending, the organisation of financial systems, the governance of firms, etc. These institutional features affect growth indirectly, in particular through their effects on innovation incentives (Aghion and Howit, 2009)[4].

Methodology

The parameters of the cluster analysis were defined by focusing on the composition of the policy mixes. No account has been taken of the level of funding or the technological development of the country, as the analysis is only concerned with the similarities between the mixes of policy measures.

The objective of the cluster analysis is to form homogenous groups of countries in terms of their policy mix focusing on the TrendChart database. To reduce the number of variables (instruments/typologies) we created indexes that measure conceptually similar things. We thus relied on own assessment in defining the indexes instead of a factor analysis given the qualitative nature of the problem and the manageable pool of variables in TrendChart. We did this to fulfil the sample requirements for a cluster analysis. We used a reviewed classification of the TrendChart

4 Aghion Philippe and Peter Howit (2009) The Economics of Growth, The MIT Press, Cam. Ma.

research and innovation policy measures and made a pre-selection of the most relevant instruments for further analysis. [5] We anticipated the following 6 variables: 1) Public R&D including Competitive research and Centres of excellence; 2) Industry-Science Collaboration including Collaborative research, Cluster policies and Competence centres where both industry and academic sector is involved; 3) Knowledge and technology Transfer including Technology transfer and Spin-off measures; 4) Business RDI including direct support to business R&D and business innovation; 5) Tax incentives and 6) Venture capital funds (state-backed). The latter two were incorporated as binomial variables due to the lack of absolute values across years and countries and variables 1-4 were calculated as per cent in total RDI funding.

In assessing the sample size we based ourselves on Formann (1984) who suggests the minimal sample size to include no less than 2k cases (k = number of variables), preferably 5*2k. Under the assumption of 6 instruments we need a minimum of 12 and ideally 60 countries. The TrendChart database covers 61 countries but not all 61 are currently included in our sample. Given our sample of 27 countries we have decided to perform the cluster analysis using the six instruments. Bearing in mind the suboptimal sample size we have tested the robustness of our results by testing with multiple combinations in the number of variables and algorithms.

We performed different clustering methods to test the formation of policy mixes. The k means method was used to find disjoint clusters. In disjoint clusters each object (in our case, country) is placed in one and only one cluster. The most popular method is K-means and the most popular similarity and dissimilarity measure is the euclidean distance. This method tends to find clusters with roughly the same number of observations in each cluster. Wards linkage is used to find hierarchical clusters. In hierarchical clusters one cluster can be entirely contained within another cluster. We tested hierarchical clusters in this study in order to identify how countries fuse forming multi observation clusters. The most popular method is Ward's minimum variance method and the most popular similarity and dissimilarity measure is the squared euclidean distance. This method tends to find clusters with roughly the same number of observations in each cluster. Finally we also test with the average linkage method which we note is somewhat biased toward finding clusters of equal variance.

The group formation we found is the same using either K-means or Wards linkage. This is an indication of stability. When applying conjoint clustering different numbers of clusters were tested and the final number chosen was based on the Pseudo F statistic, graphical illustrations of the

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5 The reason for not including all types of policy instruments in the cluster analysis was that some types were not sufficiently representative. For instance, 'support to R&D and support to innovation skills' falls in some countries under the heading 'university core funding' or under 'education policy.' These are not fully captured through TrendChart data and thus it would be inaccurate to classify countries according to this indicator. The policy instrument 'Innovation support services' was excluded, as the budget of the existing intermediaries appears in some countries under the heading 'Organisations' instead of 'Support Measures' and hence it was not included in the current analysis. Same goes for research infrastructures where the TrendChart database is not representative.

hierarchical application – with the visual help of a dendrogram. Different variable combinations were tested based on own hypotheses of the policy mixes anticipated. Database specific considerations were made in the final selection of the variables included in the cluster analysis. Given the suboptimal sample and the number of variables included in the cluster analysis we relied heavily on the qualitative assessment of the cluster formation.

Country patterns of the innovation policy mix in the period 2003-2012

The cluster analysis enabled the identification of groups of countries that follow similar innovation policy strategies, irrespective of differences in their levels of funding or their positions in terms of innovation capacity. Thus, countries, which may be at very different positions in terms of their innovation performances, may be relatively similar in terms of their policy mixes and vice versa.

Figure 1 and

Figure 2 show the result of the cluster analysis for the periods 2004-2008 and 2009-2013 following a hierarchical cluster application. These so called dendrograms are used to visualise hierarchical clusters. Each country comprises its own unique cluster at the bottom, and is fusing with other countries as the connections in the dendogram show. The countries that fuse at the lowest dissimilarities (y axis) are the least dissimilar or most alike country pairs. This logic follows for the formation of groups of countries. Depending on their similarity-dissimilarity, groups of countries have been identified. The country groups are then summarised in Appendix A.

Figure 1 Policy mix clusters in the 2004-2008 period - hierarchical cluster application dendogram

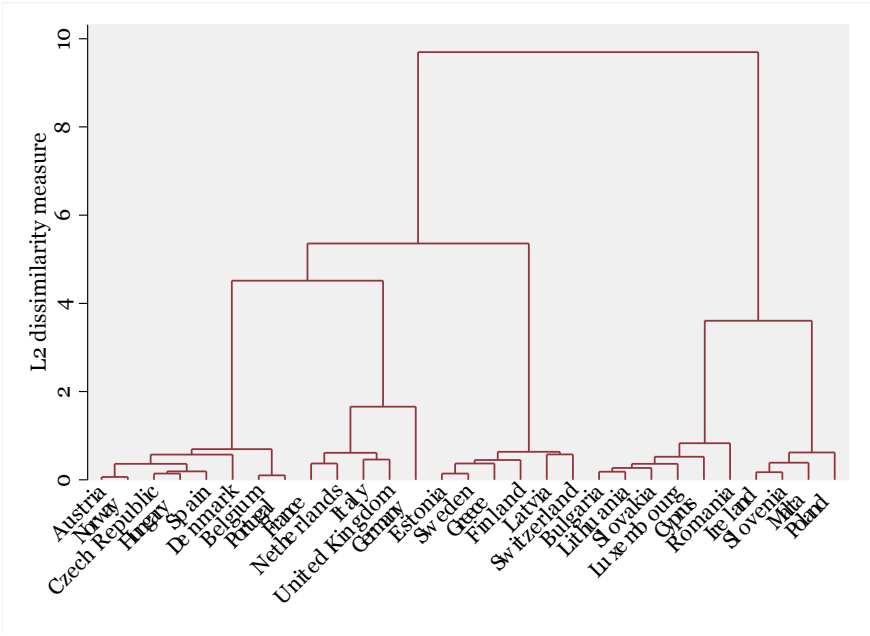
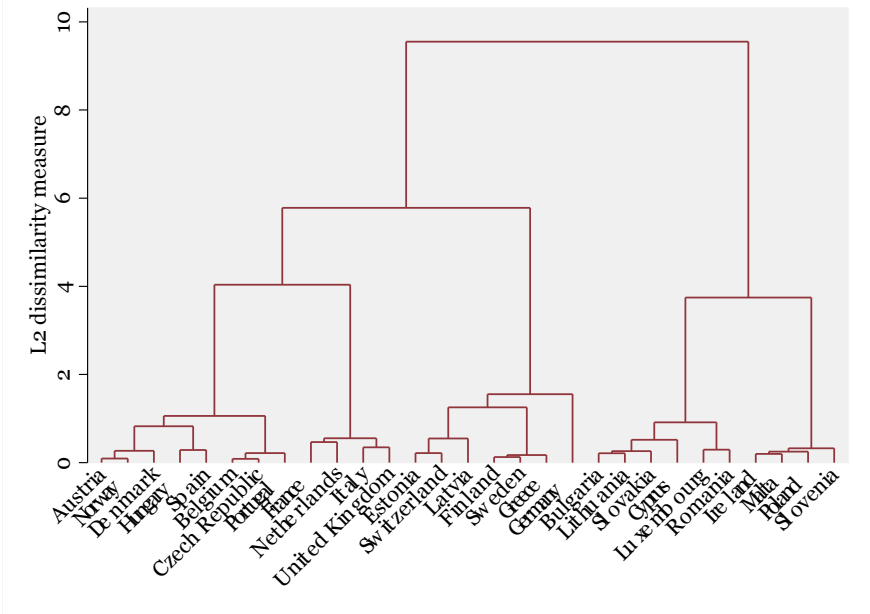


Figure 2 Policy mix clusters in the 2009-2012 period - hierarchical cluster application dendogram



The country patterns point to the relative stability of innovation policy mixes among country groups during the 2004-08 and 2009-12 periods. This was the case despite the fact that there were shifts in terms of countries' funding priorities but these shifts did not alter the key policy mixes and positions of the countries within the groups. In fact, only Germany moved from being a cluster on its own to

join cluster 2. The relative stability of policy mixes is quite a robust feature of the EU27 countries, which suggests that policy mixes are shaped either by durable structural features and/or by equally persistent policy philosophies or policy approaches. The persistence of policy profiles, or specifically of EU policy models, is quite compatible with the persistence of national science and technology specialisations world-wide.

The analysis reveals the importance of some key factors that influence the innovation policy mixes such as the use of the Structural Funds in several countries. This funding source has been decisive in making these innovation policy mixes converge. In addition, the increased policy learning across the EU has led to the introduction into Member States of similar types of 'fashionable' policy instruments such as cluster policies, competence centres or innovation voucher schemes[6]. Also, innovation policy developments have been influenced by international practice and common experience in several countries. Those EU Member States that joined after 2004 followed a common development path with regard to innovation funding and to introducing measures that directly finance innovation activities within businesses. In order to more easily grasp the key features of each group, the table below provides brief summaries and shorthand labels for each group.

Table 1 Similar policy mix groups and innovation performance within the group as measured by the Innovation Union Scoreboard (IUS) 2013

Group	Brief description	IUS 2013 performance groups
Group 1	Structural Funds-driven; Dual orientation on science and business R&D but with stronger focus on science (competitive R&D) orientation	*Innovation followers, Moderate innovators, Modest innovators*
Group 2	Science and collaborative R&D oriented policy	*Innovation leaders, Innovation followers, Moderate innovators, Modest innovators*
Group 3	Orientation towards commercialisation of public R&D coupled with support to framework conditions (fiscal incentives)	*Innovation followers, Moderate innovators*
Group 4	Business R&D and innovation focused policy coupled with support to competitive R&D	*Innovation followers, Moderate innovators*
Group 5	Structural funds driven; Dual orientation on science and business R&D but with stronger focus on business R&D orientation	*Innovation followers, Moderate innovators, Modest innovators*

Notes: The cluster analysis follows the previously outlined logic of capturing policy mix groups across the 27 countries. It has to be noted that even if there are 5 groups identified, it does not mean that the country groups are homogenous. For instance Denmark is further away from the others in group 4 or Latvia in group 2.

6 Even if it should be noted that there has also been diversity in the actual implementation method of these instruments

Groups 1 and 5 are, by and large, dominated by new Member States and their policy mixes are driven by Structural Funds' policies. The policy mix of Group 1, which includes Poland, Slovenia, Ireland and Malta, has been driven mainly by competitive R&D programmes in universities and research organisations and by using indirect measures such as R&D tax incentives. It includes policy measures that support businesses to innovate and to undertake technological upgrading. In Group 5, with the exception of Cyprus and Luxembourg that are specific cases, the countries are modest (Bulgaria and Romania) and moderate innovators (Lithuania and Slovakia) according to the Innovation Union Scoreboard. They are characterised by weak business R&D and it might be expected that the policy mix would target much more business R&D and innovation. Instead, the major focus is on block funding of R&D, which has remained key to research funding, alongside the parallel introduction of innovation support measures such as consultancy services, cluster support or business innovation support. With a dual orientation on science through activities like centres of excellence and on business R&D, Group 1 is more focused on upstream science, while Group 5 concentrates on business or downstream R&D. A dual focus on both science and business R&D is present in Luxembourg within Group 5, which is a case that deserves further scrutiny.

Group 2 countries are very much focused on collaborative R&D, especially on cooperation between R&D in universities and public research organisations with R&D in business. This group shows that a similar policy mix focused on collaborative R&D is present in countries that operate at the technology frontier (Germany, Finland, Sweden and Switzerland), as well as in countries that operate behind the technology frontier (Estonia, Greece, Latvia). In technology leader countries, the focus on collaborative R&D is logical given their ambition to stay ahead by supporting leading edge business and public R&D. In countries behind the technology frontier, which have very weak business R&D, policy aims to enhance R&D through new technology based firms. In the former group the demand side of R&D is quite well-developed, while in the latter group it is one of the biggest constraints and hence policy attempts to generate pockets of demand for R&D through technology based firms that are closely linked to public sector. This leaves open questions about whether this orientation is the most appropriate in the case of the latter group and about whether policy can compensate for the lack in demand for R&D.

Within this policy mix group, Germany, Finland, and Sweden have been increasingly focusing their research and innovation budgets on collaborative R&D programmes and have invested in innovation and technology platforms for academia and industry. Given that their business sectors invest relatively high shares of their revenues in R&D and given their position in relation to technology development, this focus on collaborative R&D appears to be justified. These countries have also dedicated a significant amount of funding to loan-financing and venture capital funds; however they seem to be reluctant to use R&D tax incentives extensively. For instance, the German innovation policy priority has been to support collaboration and cluster policies and it has followed a strategic approach through its thematic R&D programme. On only rare occasions have policy measures funded single R&D projects in enterprises and R&D tax incentives have not been used given the favourable general taxation policy for businesses.

Group 3 contains France, Italy, the Netherlands, and the UK and is relatively homogenous in terms of policy foci on commercialisation and technology transfer and also with regard to the relevance of

indirect policy measures such as tax incentives. In this group, their policies aim to capitalise on investments in public R&D by promoting the commercialisation of the results of public R&D, as well as providing tax incentives for R&D investments. The shift towards commercialisation is quite recent (2009-12) as these countries were previously less oriented towards this area and more oriented towards collaborative R&D activities. This may be a result of the increasing pressures in the post-2008 period to generate visible results in order to justify public investments in R&D. These pressures are particularly apparent in the UK.

Group 4 is strongly focused on support to business R&D and innovation, or in other words, downstream RDI, as well as on competitive R&D. Similarly to Group 2, this policy mix is characteristic of countries which operate closer to the world technology frontier such as Austria, Belgium, Denmark and Norway, as well as of countries that operate further from the technology frontier like the Czech Republic, Hungary, Portugal and Spain. Unlike the new Member States in Group 5, such as Bulgaria, Lithuania, Romania and Slovakia, which are also partly focused on business R&D, this group has significantly higher investments in business R&D and their technological position, such an orientation might be expected.

Conclusions

The analysis of national policy mixes points to a relative stability during the 2004-08 and 2009-12 periods despite that some small shifts occurred in terms of funding priorities. The relative stability of policy mixes is quite a robust feature of the EU27 (plus Norway and Switzerland) countries, which suggests that policy mixes are shaped either by durable structural features and/or by equally persistent policy philosophies or policy approaches.

As the comparison of the results of the cluster analysis and the country ranking on the Innovation Union Scoreboard shows, there is a wide variety of policy mixes and there is no one to one relationship between groups of countries in terms of innovation performance, as depicted by the IUS 2013, and their membership of a specific policy mix profile or group.

From the strictly Schumpeterian growth theory perspective, it would be expected that countries at different innovation levels would have different policy mixes (Aghion and al, 2013).[7] Technology distance from the leading innovator country to the last modest innovator country is given by the IUS ranking of countries. The results show that this strictly Schumpeterian perspective is not supported by the data. This may not be surprising, as it has already been hinted that policy mixes are an outcome of a variety of factors and only one of these is technological distance. Other factors are path dependencies, policy fashions and perceptions of the best practice in innovation policy.

[7] Depending on their distance to the technology frontier

Innovation leaders all follow the 'science-collaboration focused' policy mix, with exception of Denmark that has been included in the group oriented towards business R&D and innovation (group 4) according to the results of the cluster analysis, but its policy mix is also very much focused on supporting linkages in the national innovation system. Innovation followers have selected all policy types and this shows the diversity of the paths that countries have taken in order to move to a position of being an innovation leader. Moderate innovators have also selected all policy types though four countries implement model 4 - a policy mix of 'business R&D and innovation oriented'. Modest innovators apply again a variety of models such as 1 – 'science-competitive R&D focused', 2 – 'science-collaborative R&D focused' and 5 – 'science-business R&D focused'.

Before opting one or another policy instrument, one has to be sure if the specific country challenge and situation was understood. At European level one should be also more cautious popularising new concepts (such as demand-side innovation policies or service innovation) without making understood that innovation policy mix has to be tailor-made and new concepts are not solutions for all.

Appendix A Conjoint Cluster applications (2004-08)

Table A1: Conjoint Cluster applications (2004-08)

Country	Description of group following a qualitative analysis	Main focus based on mean values by instrument by group	Distance between Groups
Group 1: Ireland Malta Poland Slovenia	Focus on competitive R&D programmes with increasing share of business innovation support measures and the use of R&D tax incentives	R&D(0.367075); collaboration(0.035475); transfer(0.065075); business_rdi(0.222275)	furthest from group 2; nearest to group 5;
Germany	Focus on collaborative R&D, support to loan and venture capital funds, no use of R&D tax incentives	R&D(0.0264); collaboration(0.85); transfer(0.0208); business_rdi(0.0287)	furthest from group 1; nearest to group 3;
Group 2: Estonia Finland Greece Latvia Sweden Switzerland	Focus on collaborative R&D, support to loan and venture capital funds, no use of R&D tax incentives	R&D(0.2725); collaboration(0.324917); transfer(0.019417); business_rdi(0.18485)	furthest from group 1; nearest to group 5;
Group 3: France Italy Netherlands United Kingdom	Focus on technology transfer mechanisms, strong support to entrepreneurship, loans and venture capital and extensive use of R&D tax incentives	R&D(0.1883); collaboration(0.25895); transfer(0.05695); business_rdi(0.18095)	furthest from group 1; nearest to group 5;
Group 4: Austria Belgium Czech Republic Denmark Hungary Norway Portugal Spain	Focus on direct business R&D and business innovation, use of R&D tax incentives	R&D(0.23655); collaboration(0.224412); transfer(0.021925); business_rdi(0.274175)	furthest from group 2; nearest to group 4;
Group 5: Bulgaria Cyprus Lithuania Luxembourg Romania Slovakia	Focus on competitive R&D programmes, no use of R&D tax incentives	R&D(0.350817); collaboration(0.059667); transfer(0.03165); business_rdi(0.306317)	furthest from group 4; nearest to group 1;

Table A2: Conjoint Cluster applications (2009-2012)

Country	Description of group following a qualitative analysis	Main driver based on mean values by instrument by group	Distance between Groups
Group 1: Ireland Malta Poland Slovenia	Focus on competitive R&D programmes with increasing share of business innovation support measures and the use of R&D tax incentives	R&D(0.32515); collaboration(0.083725); transfer(0.050275); business rdi(0.194975)	furthest from group 4 nearest to group 3
Group 2: Estonia Finland Germany Greece Latvia Sweden Switzerland	Focus on collaborative R&D, support to loan and venture capital funds, no use of R&D tax incentives	R&D(0.239957); collaboration(0.4385); transfer(0.011314); business_rdi(0.129343)	furthest from group 1 nearest to group 5
Group 3: France Italy Netherlands United Kingdom	Focus on technology transfer mechanisms, strong support to entrepreneurship, loans and venture capital and extensive use of R&D tax incentives	R&D(0.212325); collaboration(0.206575); transfer(0.14135); business_rdi(0.12645)	furthest from group 3 nearest to group 5

Group 4:
Austria
Belgium
Czech Republic
Denmark
Hungary
Norway
Portugal
Spain
	Focus on direct business R&D and business innovation, use of R&D tax incentives	R&D(0.293387);
		collaboration(0.200613);
		transfer(0.018713);
		business_rdi(0.325675)
			furthest from group 3
			nearest to group 1

Group 5:
Bulgaria
Cyprus
Lithuania
Luxembourg
Romania
Slovakia
	Focus on competitive R&D programmes, no use of R&D tax incentives	R&D(0.287667);
		collaboration(0.0882);
		transfer(0.043917);
		business_rdi(0.2786)
			furthest from group 4
			nearest to group 1

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