Do we have the right kind of diversity in Innovation Policies among EU Member States?

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Author: Reinhilde Veugelers (KUL)

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Contribution to the Project

The main objective is to provide conclusions and recommendations how innovation policy initiatives can contribute to strengthen Europe's position in a competitive, globalised world, focusing on inclusiveness as central pillar of the strategy.

Abstract

This contribution focuses on the heterogeneity in innovation capacity within Europe across its different Member State. Who are the leading and who are the lagging EU countries? Is there a trend towards convergence over time? And how has the crisis affected this trend of convergence? We then take a look at the research and innovation policies which the EU countries have in place and try to assess whether these policies match with the heterogeneous EU countries' innovation capacity positions. We examine both the budgets allocated by EU Member States to R&I as well as the various kinds of R&I policy programmes being deployed. More particularly, we examine how heterogeneous the deployment of policy instruments is across EU member states and whether this matches with the heterogeneity in innovation capacity development among EU countries. Notwithstanding the large and increasing heterogeneity among EU countries in innovation capacity development, the evidence on innovation policies in EU countries shows a relative homogeneity of policy mixes in different countries. Current innovation policy mixes of instruments do not well reflect the countries' levels of innovation capacity development.

Keywords:

Innovation, Innovation policy, Institutional reforms, Multi-level governance

Jel-Codes:

O31, O38

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Reinhilde Veugelers

1.Introduction

Europe maintains lofty ambitions for building its future socially and environmentally sustainable growth and prosperity through innovation.

Already in its 2002 Lisbon Strategy, the European Union carved its ambition to become the most competitive *knowledge based* economy in the world. An ambitious target of devoting 3% of GDP to R&D by 2010 was set. And in its subsequent EU2020 strategy and Innovation Union Flagship, it set out a roadmap for a sustainable and inclusive growth that needs to be *smart*. The same 3% was again targeted in the EU2020 strategy, having not moved much since 2002, despite the Lisbon Strategy. And in the recent Juncker investment plan, innovation projects are prominently envisioned targets for support to revive Europe's growth.

Despite this policy of attention to innovation-based growth and R&D targeting, Europe's performance on innovation remains weak to date. According to the latest (2015) Innovation Union Scoreboard indicator (IUS), a composite indicator assessing innovation capacity, developed by the European Commission in support of its Innovation Union Strategy, Europe is not doing well. Relative to the US and Korea who are the leading IUS countries (=100), Europe has a score of 81. This leaves Europe still with a substantial lead relative to the emerging markets. But China although with a IUS score still half of the EU, is fast catching up.

Europe's gap relative to the US holds across almost all individual indicators that go into the IUS score for innovation enablers and firms' innovative activities. This is a reflection of the *systemic* nature of Europe's failing innovation capacity. On private R&D expenditures, a crown indicator often used to assess a nation's innovation capacity, the EU gap is substantial: 57% (with US=100). On public R&D expenditures there is no European gap relative to the US. But overall Europe's overall (public and private) R&D-to-GDP-ratio continues to stand at 2%, still far away from the 3% target and significantly lower than the US, Japan, South Korea and Singapore. Furthermore, there are relatively few signs of progress. China is fast catching up on this indicator and already on par with the EU on this indicator.

With lacking results comes fatigue, lack of interests and mounting criticism on policy: not enough public funding dedicated to innovation; lack of governance; no real commitment beyond rhetoric; instruments being used not effectively, missing effective instruments.

Are these criticisms grounded? Should Europe abandon its ambition to become the most innovative region in the world? In this contribution, we focus on a particular characteristic of Europe's innovative capacity, namely the heterogeneity within Europe across the different Member States. We examine in section 3 this heterogeneity in innovation capacity in more detail: who are the leading and who are the lagging EU countries, with respect to which components of innovation capacity? Is there a trend towards convergence over time? And how has the crisis affected this trend of convergence? In section 4 we take a look at the research and innovation policies which EU countries have in place and try to assess whether these policies match with the heterogeneous EU countries' innovation capacity positions. We examine both the budgets allocated by EU Member States to R&I as well as the various R&I policy programmes being deployed. We look at the relative heterogeneity of policy instruments across EU member states and look at whether this matches with the heterogeneity in innovation capacity development. Section 6 examines in more detail for policy programs addressing firms' R&I investments how the heterogeneity in policy deployment of these instruments across EU Member States matches initial strengths or weaknesses of the EU Member States on this dimension. Notwithstanding the large heterogeneity among EU countries in innovation capacity development, the evidence on innovation policies in EU countries shows a relative homogeneity of policy mixes in different countries. Current innovation policy mixes of instruments do not well reflect the countries' level of innovation capacity development. But before we start the analysis, we first, in section 2 look at the insights from the economics literature to help assess the adequacy of innovation policies.

2.What do we know from the economics literature on innovation policies?

2.1.The need for an integrative perspective: innovation capacity

Innovation capacity requires more than the ability to produce new ideas. It also includes the capacity to bring new products and process to market. Using the insights from both macro and micro models, applied economic theorists (e.g., Furman, Porter & Stern 2002) have synthesized what determines an economy's "***innovation capacity***" defined as the ability of a nation to not only produce new ideas, but also to commercialize a flow of innovative technologies over the longer term. From this perspective a range of factors are deemed to be important.

A sufficiently developed 'supply' side of R&D (as reflected in the amount of R&D investment carried out, the number of skilled researchers and S&T infrastructure) is a necessary condition for successful innovation. This is however not sufficient.

Broader framework conditions are important as well, including a sufficient 'demand' for innovation to reward successful innovators. This includes sophisticated lead users willing to pay early on for innovations, effective intellectual property rights (IPR) schemes, a favorable macro-economic environment and effective competition in output markets. With well functioning product markets, firms will have incentives to innovate to improve their competitive position, while new firms, embodying new ideas, can flow into the market. Furthermore, new business opportunities can only be taken advantage of if appropriately educated and skilled workers can be hired under the right conditions. This requires well functioning labour markets providing innovators access to researchers and skilled human capital. Similarly, well functioning risk capital markets assure innovators access to financial capital to finance their risky projects. Especially high-tech start-ups, often an important source of breakthrough innovations, need open product markets with low entry barriers and access to capital, especially early stage financing of high risk ventures.

But perhaps the most critical element in an innovation system is the interconnectedness of its agents. Through networking among firms, financiers, researchers and governments, the supply of new ideas diffuses through the economy. This requires looking at interactions among, or interfaces between, various elements of that innovation system. Of particular importance is the public-private interface, that is, the relationship between elements of the public sector, such as the educational and research system, and the corporate base.

Innovation Capacity: An integrative framework

- Common Innovation Infrastructure: cross-cutting institutions, resources and policies
    - Existing Stock of Technological Know-how
    - Supporting Basic Research and Higher Education
    - Overall Science and Technology Policy
- Technology/Cluster Specific Conditions:
    - Technology specific know-how : specialized R&D personnel
    - Incentives for innovation : lead users, appropriation (IPR) and output market competition: (local) rivalry, openness
    - Presence of related/supporting industries (clusters)
- Quality of Links bt clusters & common factors, incl Industry-Science Relationships
- Supporting framework conditions, including efficient labour & capital markets

Source: On the basis of Furman et al (2002)

In this Innovation Capacity perspective, three types of deficits can arise

(i) deficits in resources and capabilities for innovation
(ii) deficits in incentives for innovation and
(iii) systems failures.

These deficits are likely to be interrelated. When incentives for innovation are deficient, there will be little appetite by actors for investing in capacity building and linking.

Addressing these deficits is the basic rationale for innovation policy interventions.

2.2. Characterizing innovation policies

Innovation policy can affect different functions of activities in innovation systems (a.o. Edquist and Johnson, 1997): it can reduce uncertainty by providing information, offering incentives for innovation or fostering links between the actors. This requires policies that address different innovation system activities and which operate at different levels.

We characterize innovation policies along the objectives and the set of instruments deployed. In line with the OECD (2005) we distinguish

(i) provision of public R&D infrastructure
(ii) support for private R&D and Innovation capacity building in the corporate sector
(iii) strengthening the linkages among the various actors within the innovation system, especially between public R&D and the private sector
(iv) enhancing the framework conditions for innovation; This includes broader policy areas targeting the well functioning of product, labour and financial markets, as well as macro-economic stability and institutional quality.

2.3.Government failures

The empirical evidence supports the sizeable scope for market failures for innovation, see for instance the evidence on technological spillovers, the evidence on social returns well in excess of private returns on R&D investments and the evidence on fragile eco-systems particularly in the early stages of innovations (see Veugelers (2014) a.o. for a review of this evidence).

This however does not yet make the case for public intervention. Also needed is an analysis of potential government failure, ie ineffectiveness of addressing the deficiency, most specifically of raising the private R&D incentives to the socially optimal level. It also requires a comparing of potential benefits of intervention to the opportunity costs, in the form of higher taxes, higher debt and/or less government spending in other areas.

There are several reasons why policy interventions may not be effective. First, public funded R&D may directly substitute for private funding of R&D projects that would have been undertaken anyway in the absence of public support. Second, the extra R&D generated by the public funding may crowd out private R&D indirectly by increasing the demand of R&D inputs, leading to higher costs of research inputs. This crowding out effect will be more significant the more inelastic the supply of research inputs. This holds particularly for labour supply, as the stock of R&D workers is in the short run, more or less given. As the majority of R&D spending is salary payments for R&D workers, this effect may turn out to be major, as argued by Goolsbee (1998). Third, ideally policy triggers research projects with the highest social rates of return. But this assumes that the government is sufficiently informed about these social rates of return, which is notoriously difficult, particularly ex ante. And finally there is the risk of political capture, resulting in the selection of wrong projects.

2.4.Evidence on innovation policies: (when) does it work?

Whether the costs and risk of failure of government intervention eliminate the potential positive effects from government intervention remains an empirical question. What do we know from the evidence and analysis of effectiveness of public intervention?

Most of the evidence comes from micro-level evaluations of specific public R&D programs. Most of these studies have been based on qualitative case studies, interviews and surveys. These studies, at least those that are publicly accessible, are not likely to be representative, suffering from a bias in favour of more successful programs being evaluated and their evaluation outcomes being made public. Furthermore, all of the evaluation studies grapple with the challenge to find a proper counterfactual to compare results with. A proper counterfactual is essential to assess the causal effect of innovation policy interventions. Micro-econometric analysis of R&D policies employs various methodologies to deal with the counterfactual (see Veugelers (2014) for a review). The next section provides a summary of the main insights from this literature.

2.4.1. Econometric analysis of the impact of innovation policies

A growing body of econometric work has been produced, evaluating the effects of R&D subsidies on private R&D spending, correcting for other determining firm, industry and market characteristics affecting private R&D spending. The majority of the empirical literature thus focuses on the issue of whether public R&D spending is "additional" to private R&D spending, or whether it substitutes for and tends to "crowd out" private R&D. Reviewing the macro and industry level literature, Capron and Van Pottelsberghe de la Potterie (1997) conclude that "despite the heterogeneity of the empirical models referred to in the literature, which makes any comparison exercise hazardous, the balance seems to tilt towards the recognition of a complementary effect between the two sources of funds. However, there are some indications that in some industries, or in some countries, government R&D is a substitute for private R&D." In a later survey of this literature, David, Hall & Toole (2000), similarly conclude that "the findings overall are ambivalent", although on average there is more evidence in favour of positive effects. Also Garcia-Quevedo (2004) finds that a little less than one quarter (17 out of 74) of the reviewed studies report substitutability. Substitution is more prevalent among the studies conducted at the firm level, than among those carried out at the industry or country level. This is suggestive of the beneficial effects from positive spillover effects captured in more aggregate industry and country levels of analysis.

David et al (2000) warn that " the existing literature as a whole is subject to the criticism that the nature of the "experiment(s)" that the investigators envisage is not adequately specified. A major issue is the correction for the selection bias: positive effects associated with R&D subsidies are generated from better firms being selected for subsidies, rather than that subsidies cause better performance.

More recent studies have come up with better data and methodologies. The evidence as it stands now (see Veugelers (2014)) suggests that by and large R&D grants and R&D tax credits have scope for positive effects, but only if they are targeted towards firms that are impeded to develop R&D projects where social rates of return are substantially exceeding private rates of return. Interventions that are not targeted enough, like general R&D tax credits, tend to have lower effectiveness. But also for R&D grants or targeted R&D tax credits, the identification and selection of projects of higher social rates of return remains a substantial challenge. Apart from subsidies for basic research efforts and industry science collaboration, it is not obvious that governments are picking the projects with scope for higher social rates of return.

Results from an EU wide approach, using across EU countries a common empirical approach to assess the impact of a commonly used instrument (R&D grants), developed as part of an FP7 funded SIMPATIC project[1], shows a substantial heterogeneity in effectiveness across countries. SIMPATIC uses a novel

[1] For more information see www.simpatic.eu

approach, combining economic theory and advanced econometrics into a structural modelling approach which allows counterfactual policy analysis incorporating the preferences of the firms as well as government agencies to allocate subsidies, thus correcting for the methodological problems characterizing previous studies. SIMPATIC does this on a comparable cross-country basis (currently for 5 countries: Belgium (Flanders), Finland, Germany, the Netherlands and Spain), so that country specific differences in effectiveness of R&D policy can be looked at. The results show that effects found for one particular intervention scheme in one country does not occur when the similar intervention is carried out in another region or country. This heterogeneity is not due to the industry make up (types of sectors and firms), but is reminiscent of other characteristics important for the effectiveness of the schemes, such as the presence of framework conditions and the quality of the implementation of the scheme in the country.

2.4.2. Macro modelling of the impact of innovation policies

The micro-analysis concentrates on the effect of public R&D support on private R&D and innovation. Ultimately this extra R&D and innovation needs to translate into GDP growth and jobs. This requires also taking into account higher order effects, such as impact on demand, wages, interest rates, prices. To capture these higher order effects, we need to resort to macro models. . These macro-models are also able to identify which complementary framework conditions needs to be in place for higher private and social rates of return from innovation and for effectiveness of innovation policy intervention.

Unfortunately, there are few macro-models applied in policy evaluation that have an explicit modelling of the R&D growth process. Early macro models either had no explicit treatment of investment in knowledge capital differently from other capital investments or they treated R&D exogeneously and modelled public R&D policies as TFP shocks (eg Worldscan). These early macro-models lacked details on the process of how R&D and R&D policies impact GDP.

Most current macro models treating R&D use endogenous growth models as pioneered by Romer (1990), and further developed by Jones (1995) and Aghion and Howitt (1998). Looking at macro-models presently in use at the European Commission for quantitative policy analysis, generates a wide interval of predicted long-term effects from public R&D intervention on GDP growth and jobs, depending on how R&D is modelled within these models and calibrated. The modelling ranges from treating either R&D as semi-endogenous (like the DG ECFIN QUESTIII model) or fully endogeneous (like the NEMESIS model). Despite this large interval in predicted effects, a common result from these macro-simulation models is that in order to see the positive effects from public R&D support on GDP growth and jobs, one needs a long enough term horizon before the positive effects fully play out, to generate the extra innovations required to compensate for the short term negative effects associated with reallocations of high-skilled labour from other productive activities and the negative effects from displacing older more labour intensive production processes.

Another result from these macro-simulations is the important heterogeneity across countries in effects from R&D (policies). In Roeger et al (2013) for example, the QUEST III model is used to analyse the effects of various structural reforms in Southern European countries (Italy, Spain, Portugal and Greece). Reforms are modelled as closing the gap of the country with the average of the three best performing countries in the Euro area. The use of R&D tax credits yields positive LR effects on GDP but these effects are only of minor size. The long-run GDP effects are the largest for Greece and Italy, the countries with the lowest current R&D tax-credits, but still are only about 1.4% for Greece and 0.9% for Italy. For Spain it is even lower: 0.1%. In comparison, the structural reforms that yield the most significant results in the long run are education policies decreasing the share of low skilled workers. This gives an increase of 15% in GDP for Italy and Spain. For Greece, the highest economic gains are realised from product market reforms. Such reforms leave significant economic gains in the long-term, 39% of GDP.

The next section will delve deeper in this country heterogeneity: how much differences are there in innovation capacity across EU countries and is there a trend towards convergence in innovation capacity?

3. Country heterogeneity in innovation capacity

3.1. Country differences in innovation capacity characteristics

In the Innovative Capacity perspective, country differences with respect to innovation and growth might reflect not just different endowments in terms of labour, capital and the stock of knowledge, but also the varying degrees of the "knowledge distribution power" or the efficiency of the innovation system.

An important dimension explaining heterogeneity across countries in their innovation capacity relates to differences in levels of initial development and a country's initial position relative to the technology frontier (Aghion & Howitt (1998)).

For countries still at early stages of development, far from the technology frontier, technology contributes to growth through the country's ability to effectively absorb new technologies elsewhere developed (World Bank, 2008; Lall 2002). There are two key ingredients explaining differences across countries in effective technology take-up. The first is *access to (foreign) technology.* This requires openness through trade, foreign direct investment (FDI) and other forms of international cooperation. Second, access to (foreign) knowledge needs to be combined with a sufficiently developed indigenous 'absorptive capacity' (Cohen and Levinthal, 1990) or 'social capability' (Abramovitz, 1986), in order to deliver growth. This *absorptive capacity* depends on many factors, including the extent to which a country has a technologically literate workforce (World Bank, 2008).

For countries at higher levels of development, closer to the technology frontier, *indigenous innovative capacity* comes into play (Hoekman et al, 2005). At this stage, countries require technological know-how, reflected in public and private R&D resources. They also need to be able to incentivise or reward public and private investments (e.g. Furman et al, 2002). Depending on the country's level of development, a set of factors shaping the country's innovative capacity needs to be present. In addition to R&D, technology and ICT infrastructure, these additional factors include access to large markets, (international) openness of markets, competition, access to a highly educated and skilled population (especially tertiary level), well-developed financial markets and well functioning IPR systems. It is important to note that these factors should not be seen in isolation, but as part of a **system of key prerequisites** for innovation-based growth.

3.2.Empirically assessing the (changes in) heterogeneity in innovation capacity among EU countries

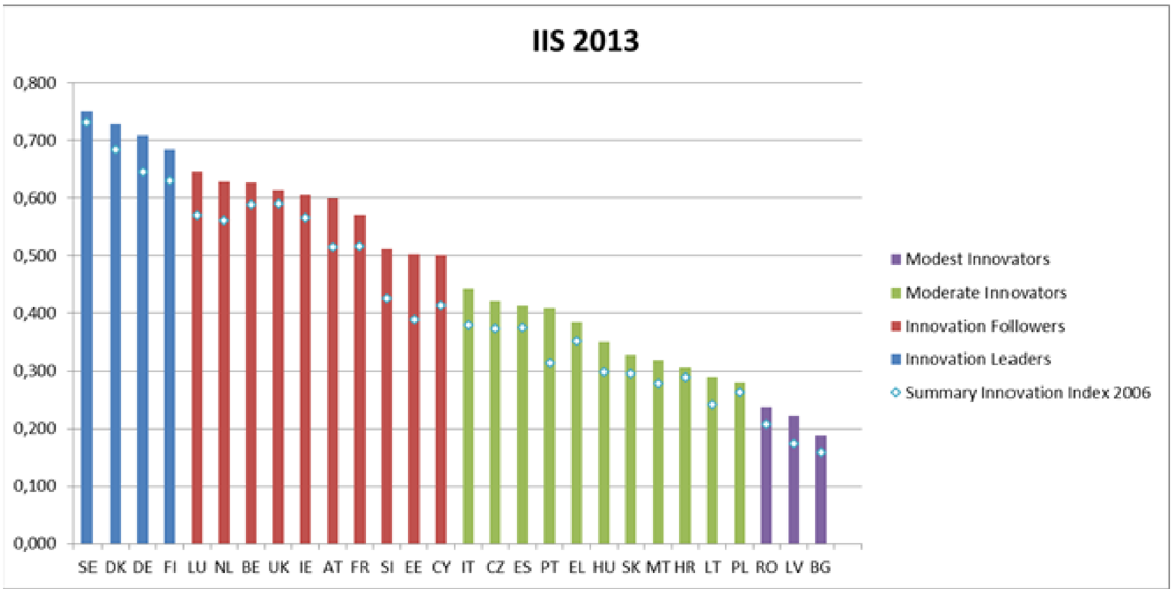
Because of different capacities to put in place a virtuous innovation-growth eco-system, but also because of differences in initial conditions requiring innovation systems to be composed in a different way, we can expect substantial heterogeneity among European countries in innovation capacity. At the same time, we can also expect the process of economic convergence to push convergence in innovative capacity among EU countries.

To measure heterogeneity in innovation capacity, we use the σ-coefficient or the coefficient of variation (√VAR/MEAN). σ-convergence occurs when the dispersion across a group of economies, decreases over time.

To capture the heterogeneity across European countries on the different dimensions of innovation capacity, we revert to the summary assessment of the EC's Innovation Union Scoreboard (IUS). For the comparison across the European countries considered, the IUS uses information from 24 individual indicators to assess 8 dimensions of the Innovation System: Human Resources, Research Systems, Supportive Finance, Firm Investment, Linkages& Entrepreneurship, IPR, Innovative Output, Economic Effects

3.2.1.EU Member States Heterogeneity on Innovation Capacity

Figure 1: Intra-European Heterogeneity on IUS



Source: Innovation Union Scoreboard (IUS) 2014

The best performing (frontier) countries on IUS are (in order): Sweden, Denmark, Finland and Germany. These are the Innovation Leading countries in the EU. Their leadership is very stable, as already in 2006 they had the highest IUS scores. The weakest countries (labelled as Modest Innovators in the IUS) are the 3 transition economies Latvia, Bulgaria and Romania. Also these laggards are persistent, as they were already at the bottom of the rank in 2006.

But the innovation divide in Europe does not follow a simple transition divide. The group of Moderate Innovators also includes some of the older member states, most notably the Southern member states: Greece, Spain, Italy and Portugal. At the same time, some of the transition countries, i.c. Estonia and Slovenia have already made it into the lower-middle group of Innovation Followers, where they sit together with countries like UK, France and the Benelux[2].

Table 1 looks in more detail at the trends in heterogeneity in innovation capacity over time, allowing to assess convergence. It first shows that Europe is slowly progressing on its innovation capacity, as witnessed by its small but steady improvements in the IUS score over time.

Table 1: Trends in the heterogeneity in IUS within Europe

IUS score	2006	2008	2013
Average EU	**0.49**	**0.50**	**0.55**
Coefficient of Variation (CV)	**0.39**	**0.36**	**0.35**
Innovation Leaders (FI, SE, DK, DE)	**0.67**	**0.68**	**0.72**
Innovation Followers (NL, BE, UK, IE, AT, FR, LU, SI, EE, CY): gap with leaders (=100)	76	79	81
Moderate Innovators (IT, CZ, ES, PT, EL, HU, SK, MT, HR, LT, PL): gap with leaders (=100)	47	48	50
Modest Innovators (LV, RO, BU): gap with leaders (=100)	27	31	30
EU-13: gap with leaders (=100)	42	44	46
EU-South (EL,IT, ES, PT, CY, MT): gap with leaders (=100)	52	57	57
High Fiscal Consolidation countries Gap with leaders (=100)	48	50	51

Source: own calculations on the basis of IUS (2014)

Note: High Fiscal Consolidation countries are countries with weak overall budgetary position: program countries, countries with high consolidation pressure (higher spreads relative to German bonds) and/or countries with more consolidation pressure, given their higher deficit and/or debt position): IE, SK, BG, ES, PT, LT, LV, El, IT, HU, CY, CZ, PL

[2] A similar results were also found by Radosevic (2004)). In addition to a high-tech "north" cluster composed of four countries with the highest national innovation capacities in EU (Finland, Sweden, Denmark and UK), he obtained two other clusters comprised of the majority of the catching-up MS as well as some other MS. One cluster is composed of the 3 cohesion states (Spain, Portugal and Greece) and 6 less advanced NMS (Slovakia, Romania, Latvia, Lithuania, Poland and Bulgaria). They are characterized by rather weak national innovation capacities. The 4 more advanced NMS (Czech Republic, Slovenia, Estonia and Hungary) together with 6 old MS (Austria, Belgium, Germany, France, Italy and Ireland) form a kind of a "middle level" group of the EU.

When looking within the EU at its heterogeneity, the coefficient of variation is high, illustrating the high level of heterogeneity on innovation capacity in Europe. Although the dispersion has decreased in the period 2006-2013, reflecting a slow process of σ-convergence, dispersion remains substantial. Furthermore, this slow process of convergence has slowed down since 2008, with the start of the crisis.

This dispersion holds between the Innovation Leaders and the rest, as the average gap scores of the different IUS groups shows. While the Innovation Leaders continue to gradually improve their IUS score, all other group of countries have improved their scoring too and somewhat faster, as the smaller gap scores show, showing a slow process of catching-up. This catching up was most strongest in the pre-crisis period, but has since 2008 lost momentum. The strongest catching up was in the group of Innovation Followers, and also the bottom group of Modest Innovators have been able to use their scope for catching up. It is in the group of Moderate innovators where we find the lowest catching-up.

When we look specifically at the southern European countries, we find that while the EU South countries were making considerable progress in the pre-crisis period, this process of catching up with the leaders has come to a halt since 2008. In contrast, in the EU-13 countries the catching up continued after 2008, albeit at a lower speed than pre-2008.

Most of the EU-13 and the EU-South countries have been in a high fiscal consolidation process since 2008. When we look explicitly at countries in high fiscal consolidation mode, we see first of all that they have a serious gap on innovation capacity with the innovation leading countries in the EU. Next we see that this gap is only very slowly being bridged, with a pace that has slowed down since 2008.

3.2.2. Heterogeneity in the Components of Innovation Capacity

When looking at the 8 dimensions composing the Summary Innovation Index, we see the lowest average score for the EU on Firm Investments: this is Europe's weakest innovation capacity spot. . It is also the dimension where dispersion has increased substantially between 2006 and 2013. Also in linkages the dispersion has increased. In all other dimensions, the dispersion has decreased over time. But despite this decrease, it still remains high for Research Systems as enabler. The lowest dispersion is on Human Resources and Economic Impact.

While the E13 countries have been catching up on most pillars of the IUS, they have fallen further behind on Firm's investments. On Firm's IP they have, despite some catching up, still an important gap with the Innovation Leaders in Europe. The gap with the Innovation Leaders is for the EU-13 countries biggest on Research system and only slowly improving. The gap is smallest on Human Resources and closing faster. This latter trend is important for these countries, as the quality of the workforce is an important part of the absorptive capacity of nations (cf surpa), which is pivotal for most EU-13 in view of their catching up position relative to the frontier countries.

For the EU South, the largest gap with the Innovation Leaders is on Finance as enabler with very little catching up. This may have important implications for their future prospects as these countries are also in high fiscal consolidation mode. And also on Firm's investments they have been losing ground relative to the Innovation Leaders, very much like the EU13.

Table 2: Heterogeneity in Europe in the scoring on the components of IUS

	ENABLERS			FIRM's ACTIVITIES			IMPACT	
	Human Resource	Research System	Finance	Investm	Linkage	IP	Innov	Econ
Average Score 2006	**0.46**	**0.40**	**0.57**	**0.45**	**0.50**	**0.51**	**0.51**	**0.53**
Average Score 2013	**0.58**	**0.53**	**0.56**	**0.42**	**0.55**	**0.56**	**0.55**	**0.60**
CV 2006	**0.32**	**0.64**	**0.49**	**0.35**	**0.46**	**0.65**	**0.51**	**0.36**
CV 2013	**0.24**	**0.58**	**0.43**	**0.43**	**0.49**	**0.51**	**0.48**	**0.31**
EU13-Gap with Leaders-2006	64	26	45	62	40	23	36	52
EU13-Gap with Leaders-2013	76	29	55	49	41	34	37	55
EUSouth-Gap with Leaders-2006	55	47	40	61	48	35	56	69
EUSouth-Gap with Leaders- 2013	59	55	41	50	58	50	59	72
High Fisc-Gap with Leaders 2006	64	41	43	64	45	29	46	58
High Fisc Gap with Leaders 2013	73	44	48	46	46	38	47	66

Source: Own calculations on the basis of IUS (2014)

<u>Note</u>*: 'Human resources'* includes3 indicators and measures the availability of a highskilled and educated workforce. The indicators capture New doctorate graduates, Population aged 30-34 with completed tertiary education and Population aged 20-24 having completed at least upper secondary education.
'*Open, excellent and attractive research systems*' includes 3 indicators and measures the international competitiveness of the science base by focusing on the International scientific co-publications, Most cited publications and Non-EU doctorate students.
'*Finance and support*' includes 2 indicators and measures the availability of finance for innovation projects by venture capital investments and the support of governments for research and innovation activities by R&D expenditures by universities and government research organisations
'*Firm investments*' includes 2 indicators of both R&D and Non-R&D investments that firms make in order to generate innovations. '
Linkages includes 3 indicators measuring innovation capabilities by looking at SMEs that innovate in-house and Collaboration efforts between innovating firms and research collaboration between the Private and public sector. '*Intellectual assets*' captures different forms of Intellectual Property Rights (IPR) generated as a throughput in the innovation process including PCT patent applications, Community trademarks and Community designs.
'*Innovators*' includes 3 indicators measuring the share of firms that have introduced innovations onto the market or within their organisations, covering both technological and non-technological innovations and Employment in fast-growing firms of innovative sectors.
'*Economic effects*' includes 5 indicators and captures the economic success of innovation in Employment in knowledge-intensive activities, the Contribution of medium and high-tech product exports to the trade balance, Exports of knowledge-intensive services, Sales due to innovation activities and License and patent revenues from selling technologies abroad.

In the next sections we zoom in selected individual pivotal indicators of the Innovation Capacity of nations: (i) business investment in R&D; (ii) quality of the science system and (iii) linkages between the public and the private actors.

(i) Business investment in R&D

The business sector is the sector which is responsible for the persistent R&D intensity gap of Europe relative to the US and Asia. It shows a considerable heterogeneity in innovation behaviour within Europe.

Table 3: Business R&D expenditures in Europe

Business R&D as % of GDP	**2006**	**2008**	**2013**
Average EU Score	**0.50**	**0.52**	**0.56**
Coefficient of Variation	**0.30**	**0.31**	**0.31**
EU-13 Gap with Leaders	22	21	30
EU-South; Gap with Leaders	19	21	22
High Fisc; Gap with Leaders	19	19	24

Source: Own calculations on the basis of IUS (2014)

The heterogeneity in Business R&D performance across European countries is substantial, as the coefficient of variation shows. And there is no sign of σ-convergence[3]. The gap which EU-13 and EU-South have with the Innovation leaders is substantial[4]. While the EU-13 have been able to somewhat catch up, this is far less the case in EU South, particularly since 2008.

(ii) Quality of the Science Base

The science base is an important enabler of the innovation capacity of nations. We look at the quality of the national science base, by looking at the share of a country's scientific publications which are among the top 10% highly cited publications in their field. This indicator shows a considerable heterogeneity within Europe, as the high coefficient of variation in Table 4 indicates, even higher than the heterogeneity in Business R&D. The EU-13 countries have a considerable gap with the Innovation Leaders[5] and show no signs of catching up. The gap of the EU South is much smaller and they have been able to catch up. But this catching up process has stopped since 2008.

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[3] Veugelers & Mrak (2009) studied the process of convergence in more detail. They find that the process of convergence in Business R&D (BERD)intensity is slower than the convergence in overall R&D intensity (GERD.

[4] Note that the 4 countries which score highest on the IUS overall, are also the countries with the highest score on this indicator

[5] Note that the 4 countries which score highest on the IUS overall, are also the countries with the highest score on this indicator

Table 4: Quality of the Science Base in Europe

Share Top Cited Publications	**2006**	**2008**	**2013**
Average EU Score	**0.66**	**0.67**	**0.67**
Coefficient of Variation	**0.45**	**0.47**	**0.47**
EU-13 Gap with Leaders	35	35	35
EU-South; Gap with Leaders	69	76	73
High Fisc; Gap with Leaders	51	47	51

Source: Own calculations on the basis of IUS (2014)

(iii) Links between Science and Industry

As indicator to measure the links between science and industry, we look at the co-publications between science and industry of a country (relative to its population size), one of the indicators used in the IUS exercise. Although this is a very imperfect measure of the links between science and industry, capturing only a very specific subset of industry science links, it has the advantage that it can be calculated across countries and time. This indicator shows a considerable heterogeneity within Europe, even higher than the heterogeneity of the two previous dimensions (as the Coefficient of Variation shows). Both the EU-13 and the EU-South countries, have a considerable gap with the innovation leading countries in the EU. Despite some catching up, this gap remains substantial

Table 5: Links between Science and Industry in Europe

Co-publications (rel to pop)	**2006**	**2008**	**2011**
Average EU Score	0.51	0.51	0.55
Coefficient of Variation	0.59	0.58	0.51
EU-13 Gap with Leaders	31	33	39
EU-South; Gap with Leaders	34	34	42
High Fisc; Gap with Leaders	32	33	38

Source: Own calculations on the basis of IUS (2014)

4. Assessing the heterogeneity in Innovation policies in EU countries

A country's optimal innovation policy mix will depend on its level of innovation development and its level of key enablers for innovation based development and will be dynamically evolving along with and driving its growth path. We should therefore expect across EU countries heterogeneity in innovation policies, and within countries changes over time in innovation policies, as EU countries differ in their current position of innovation development and key enablers for innovation based growth. There is no one-size-fits-all optimal innovation policy prescription.

In this section we take a look at the research and innovation policies which EU countries have in place and try to assess whether these policies match with the countries' innovation capacity position.

To empirically assess the (trends in) heterogeneity in innovation policies in the EU, we will look at two important dimension of innovation policy

- how much public funds are spent on research and innovation
- how it is spent, i.e. which instruments are deployed (with which budgets) in the innovation policy mix.

As a source of information for the mix of policy instruments we will use the EU's TrendChart (TC) (http://ec.europa.eu/enterprise/policies/innovation/policy/innovation-scoreboard/index_en.htm.)

The TrendChart database includes programme-based research and innovation instruments but not institutional funding. In other words, this captures active innovation policy but not the regular funding of institutions, which also strongly affect innovation performance.

For this reason, we switch to GBAORD rather than TrendChart for data on public expenditures on R&I and only use the TC database when discussing policy instruments. The disadvantage of the GBAORD data is that it does not include tax incentives and loans. These instruments will only be included in the discussion on policy instruments, based on TrendChart. The TrendChart and GBAORD databases are further clarified in the appendix.

4.1. Public Spending on Innovation in Europe

Table 6 shows the average GBAORD as a % of GDP for the EU countries. It shows first that public spending on R&I is in general very low. When looking at trends over the period 2006-2013, one sees a gradual increase over time. This increase was most pronounced in the pre-2008 period and has slowed down markedly after 2008.

When looking within the EU, one sees again a substantial heterogeneity in public spending, as the coefficient of variation shows. Public spending correlates with IUS performance in general, as the 4 *innovation leading* countries are also the top countries with respect to public spending on R&I. *Innovation leading* countries spend more than *innovation followers*, which in turn spend more than *moderate innovators*. *Modest innovators* spend the least.

When looking at trends over the period 2006 till 2013, one sees very little change overall. While there was catching up by innovation followers, moderate and modest innovators before 2008, this catching up has stopped after 2008 and even turned in reverse, leaving a bigger divide in public spending on innovation in 2013 than in 2006 (see also Veugelers (2014) for more analysis on the increasing innovation divide in Europe). This halted convergence and even divergence holds for the EU-13 but even more so for the South. The trends for High Fiscal Consolidation countries shows a similar pattern of halted convergence and increased divergence with the Innovation Leaders within Europe after 2008.

Within this average trend among High Fiscal Consolidation countries, we see at the same time an increase in heterogeneity within this group of countries after 2008, as the coefficient of variation indicates. Hence, the dispersion in Europe in public R&I spending has increased since the crisis, not only because of an increasing divide between fiscally stronger leaders and fiscally weaker laggards, but also because of a bigger divide among the fiscally weaker laggards. As an example, while Portugal and Spain scored similarly in 2006 (with 0.67% of GDP), Portugal has managed to safeguard its public R&D spending relative to GDP better than Spain, leaving a ratio of 0.93% in 2013 for Portugal versus only 0.54% for Spain in 2013.

Table 6: Trends in the heterogeneity in Public R&I spending within Europe (GBOARD)

GBOARD as % of GDP	**2006**	**2008**	**2013**
Average EU	**0.51**	**0.56**	**0.58**
Coefficient of Variation (CV)	**0.41**	**0.37**	**0.42**
Innovation Leaders (FI, SE, DK, DE)	**0.80**	**0.82**	**0.94**
Innovation Followers (NL, BE, UK, IE, AT, FR, LU, SI, EE, CY): gap with leaders (=100)	68	73	66
Moderate Innovators (IT, CZ, ES, PT, EL, HU, SK, MT, HR, LT, PL): gap with leaders (=100)	54	60	56
Modest Innovators (LV, RO, BU): gap with leaders (=100)	36	39	21
EU-13: gap with leaders (=100)	48	52	48
EU-South (EL,IT, ES, PT, CY, MT): gap with leaders (=100)	56	65	55
High Fiscal Consolidation countries Gap with leaders (=100)	52	59	50
CV within High Fiscal Consolidation	0.37	0.38	0.42
CV within Low Fiscal Consolidation	0.36	0.33	0.35

Source: own calculations on the basis of Eurostat (2014)

4.2. Innovation Policy Instruments used in Europe

As source of information for the mix of policy instruments deployed in EU countries, we use the EU's TrendChart(TC) database.

The TrendChart (TC) database includes programme-based research and innovation instruments but not institutional funding. In other words, this captures active innovation policy but not the regular funding of institutions, which also strongly affect innovation performance. The TrendChart data include tax incentives and loans, not covered in GBAORD. It covers 27 EU countries (Croatia is not included) within the period 1990-2013. For every policy measure, the inventory reports also the allocated budget.

Table 7: Reported instruments in the Trendchart by EU countries

Instrument	Number of countries using the instrument	Average share of reported TC budget allocated to instrument	Instrument	Number of countries using the instrument	Average share of reported TC budget allocated to instrument
Competitive funding of research	25	**18,43%**	**Spin-off support**	13	**0,24%**
Innovation support service	26	**0,13%**	**Mobility schemes**	13	**0,43%**
Direct business innovation support	25	**9,77%**	**Centres of Excellence**	13	**1,35%**
Support to start-ups	24	**2,01%**	**Tax incentive**	12	**8,75%**
Support to human resources for R&D	24	**4,22%**	**Innovation networks and platforms**	12	**1,35%**
Collaborative R&D programme	24	**11,82%**	**Awareness raising**	11	**0,17%**
Direct Business R&D support	22	**9,91%**	**Incubators**	10	**0,70%**
Technology transfer	18	**2,77%**	**IPR measures**	9	**0,30%**
Financial instrument	18	**11,36%**	**Regional programme**	7	**0,71%**
Cluster initiatives	18	**1,04%**	**Science and technology parks**	4	**0,59%**
R&D infrastructure	17	**3,54%**	**Competence centre**	4	**0,41%**
Innovation skills development	16	**4,79%**	**Public procurement**	3	**0,30%**
Innovation vouchers	14	**0,07%**	**E-society**	3	**0,14%**
Support to venture capital	13	**4,55%**	**Public sector innovation**	2	**0,15%**

Source: Calculations on the basis of Trendchart

The most important categories of innovation policy measures implemented over the period (1990-2013) in EU Member States, in terms of number and funding, are the following:

- Funding for specific public research programmes allocated in a competitive manner to universities and public research organisations and referred to as ‘competitive public research’ in contrast to institutional funding of organisations. (AVG = 18.4%; CV=1.01)
- Measures aiming to foster collaboration between public organisations and businesses on RDI programmes, referred to as ‘collaborative RDI programmes’. (AVG=11.8%; CV=1.36)
- Financial instruments (loans) (AVG=11.3%; CV=1.89)
- Direct business innovation support (AVG=9.9%; CV=1.05)
- Direct business R&D support (AVG=9.8%; CV=1.12)
- Tax incentives (AVG=8.1%; CV=1.72)

Together these six instruments account for 70 percent of the reported TrendChart budget outlays. This six-pack of innovation policy instruments take up the bulk of the reported Trendchart budget in all EU countries, irrespective of their innovation performance: 76% for Innovation Leaders, 71% for Innovation Followers, 64% for Moderate Innovators and 70% for Modest Innovators.

There is more heterogeneity across EU countries use when looking at the level of the individual measures within these six instruments. This holds particularly among the set of measures for supporting firms' R&I investments, particularly in the use of **loans** and **tax incentives,** as the coefficient of variation indicates. This heterogeneity holds across all levels of innovation capacity scoring of countries and therefore does not seem to be matching differences in innovation capacity development. With respect to the **tax credit i**nstrument: among the four Innovation Leading countries, Germany, Finland and Sweden do not use this instrument. Only Denmark uses it marginally (with 5% of reported TrendChart budget). It is also not very popular among the moderate and modest Innovators. Only in the group of Innovation Following countries is it more predominant, most notably in **France**, where it consumes more than half of the reported TC budget. In the Netherlands (35%) and the UK (29%) it is also the biggest instrument used (in terms of reported TC budget). **Loans** are not reported as being used in Germany, Finland and only marginally in France, Italy and Belgium. In Denmark it takes up 41% of the reported budget, in Sweden 26%, in the UK 20%. In the mix between grants, tax credits and loans, there is no hard evidence yet from the economics literature which would suggest any a priori preference for one instrument over the other (cf supra). These marked different choices therefore probably reside in other factors besides economic efficiency arguments.

To further analyse the matched heterogeneity in policy instruments being deployed in the EU along differences in innovation capacity development of countries, we group the TC instruments in the following five areas.

SKILLS	**PUBLIC R&D**	**FIRM INV**	**LINKS**	**OTHER**
Support to human resources for R&D Innovation skills development	R&D infrastructure Competitive funding of research (HEI&PRO) Centres of Excellence Public sector innovation	Tax incentive Financial instrument Innovation support service Support to start-ups Innovation networks and platforms Innovation vouchers Direct Business R&D support Direct business innovation support	Incubators Technology transfer Collaborative R&D programme Mobility schemes Science and technology parks Cluster initiatives Spin-off support Competence centre	Awareness raising Support to venture capital E-society IPR measures Public procurement Regional programme

Table 9 details the importance of each of these areas in the total reported TC budgets for the various innovation capacity development groups of EU countries. It shows that most of the reported TC budgets in EU countries goes to support firms' investment in R&I (with various instruments), followed by programs to support public R&D (excl institutional funding) and programs to support linkages within the innovation system. Surprisingly little budgets are reported for programs to support skill formation.

With respect to heterogeneity in reported spending in these areas, the coefficient of variation shows the lowest levels of heterogeneity for programs to support *firms'investments*. There are limited differences in the average reported budget shares for this category of interventions between innovation leaders, followers, moderate and modest innovators.[6] There are also little differences between East and West, North and South Europe and between low and high fiscal consolidation countries. This relative homogeneity in the relative importance of this type of instrument across EU countries is remarkable, especially in view of the high heterogeneity in the relative performance of the EU countries on firms' R&I investments, cf supra.

In the category *Other,* there is also substantial heterogeneity, although it is small residual category in all groups of countries. An outlier country on this dimension is Estonia, one of the (two) EU-13 countries among the Innovation Followers. Estonia reports to spend 44% of its TC budget on support for venture capital, one of the *other* instruments.

Programs supporting *skill formation* also display a high heterogeneity in relative deployment across EU countries, although it remains a minor instrument in most countries irrespective of their IUS score and their geographic location. This is a remarkable result, as one would have expected this area to be most important for catching up countries, as part of their building absorptive capacity. The country with the highest reported budget in this area is Finland, one of the Innovation Leaders. The high heterogeneity in this area does also not only not square with different levels of innovation capacity development, it also does not square with the relative "homogeneity" in the scoring on skills among EU countries (cf supra).

On programs to support *public R&D capacity building*, the results need to be handled with care, as the TC does not include institutional funding for public institutes, only competitive funding programs. Remarkable is the low share of reported TC budget shares in this area by the 4 innovation leaders. Among the non-leading countries, there is less difference in this area.

Where the innovation leading countries stand out most prominently is in their share of reported TC budgets devoted to programs to support *linkages*. Finland reports 51% of its TC budget for collaborative R&D programs. For the EU-13 countries these programs only account for on average 8%. As detailed supra, the EU-13 countries hold a substantial gap with the innovation leading countries on their linking performance. But perhaps their low relative deployment of instruments to support linking can be related to the poor quality of the research system in these countries.

[6] The higher score for Moderate Innovators is due to Greece, which reports in the TC to spend 96% of its budget on Financial Instruments (loans);

Table 8: Heterogeneity in the share of instruments deployed for various innovation policy areas in the EU

	Share of reported TC budget allocated to				
	SKILLS	PUBLIC R&D	FIRM INV	LINKAGE	OTHER
Average EU	**5.5%**	**23.1%**	**47.7%**	**17.7%**	**4.2%**
Average EU weighted	3.9%	14.1%	56.3%	21.4%	4.2%
Coefficient of Variation	**1.09**	**0.85**	**0.45**	**0.96**	**1.82**
Innovation Leaders	6.8%	7.0%	45.1%	37.5%	3.4%
Innovation Followers	6.3%	23.1%	44.8%	16.8%	9.0%
Moderate Innovators	4.6%	23.3%	57.0%	11.6%	1.0%
Modest Innovators	6.1%	23.5%	47.4%	17.6%	5.9%
EU-13	5.3%	29.0%	47.2%	8.0%	10.4%
EU-South	4.5%	22.0%	51.4%	21.0%	1.2%
High Fisc Cons	5.8%	19.6%	54.6%	14.7%	5.2%

Note: weights are the country's reported TC budget

Source: Calculations on the basis of Trendchart

Overall the analysis shows that the mix of instruments for innovation policy deployed by EU Member States is a rather standard set of instruments, with most countries deploying a similar mix of bread and butter policy instruments, relatively irrespective of their innovation capacity development.

5. Inspiration for innovation policy instruments : EU versus national

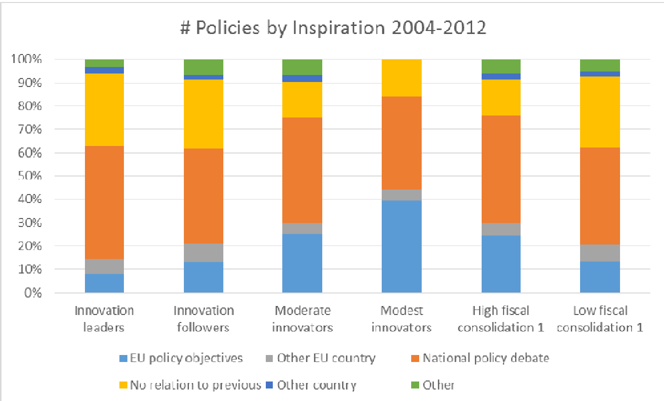
The Trendchart database includes also information on the source of inspiration for the various policy instruments deployed in the EU member states. Beyond "national policy debates" there is also the category of "EU policy objectives" which allows to examine the impact of European integration on member states innovation policies, which is at the core of the European Research Area (ERA) project. Another pathway of ERA is the mutual learning among EU countries.

These EU policy objectives and mutual learning can be important vehicles for establishing a relative homogeneity in innovation policy deployment within the EU.

Overall the majority of instruments remains "inspired" by national policy debates: 46% of instruments and 51% of the reported budget. The EU level influences either through "EU objectives" or learning from "other EU countries" accounts for 17% resp 6% of number of instruments, which is sizeable, but not overwhelming. Nevertheless these EU inspired instruments take up only 12%, resp 3.5% of the total reported budgets. There is also very little change over time, with the impact of ERA on number of instruments even slightly decreasing over time, although the budget associated with them slightly increasing. Overall, the “national policy debates” remain the most important inspiration for EU countries on average.

The importance of the EU level differs however substantially depending on the EU country’s innovation performance. While for Innovation Leaders, like Germany, the EU level is of minor importance (both through “EU objectives” as through the learning from other EU countries), this is not the case for the moderate and modest innovators. For these countries, the EU level is a major source of inspiration, both through EU objectives and mutual learning. ERA therefore seems a potent instrument for catching up and convergence on innovation policies in the EU for lagging countries, with however the potential danger that these countries will be ‘’importing’ average EU innovation policy objectives and instruments which may not be sufficiently adapted to their specific catching-up status (see also Veugelers & Schweiger (2015)).

Figure 3: European Inspiration for Innovation Policies in Member States



Source: Calculations based on Trendchart

6. Matching innovation policy deployment and innovation capacity development: the case of programs supporting firms’ investments

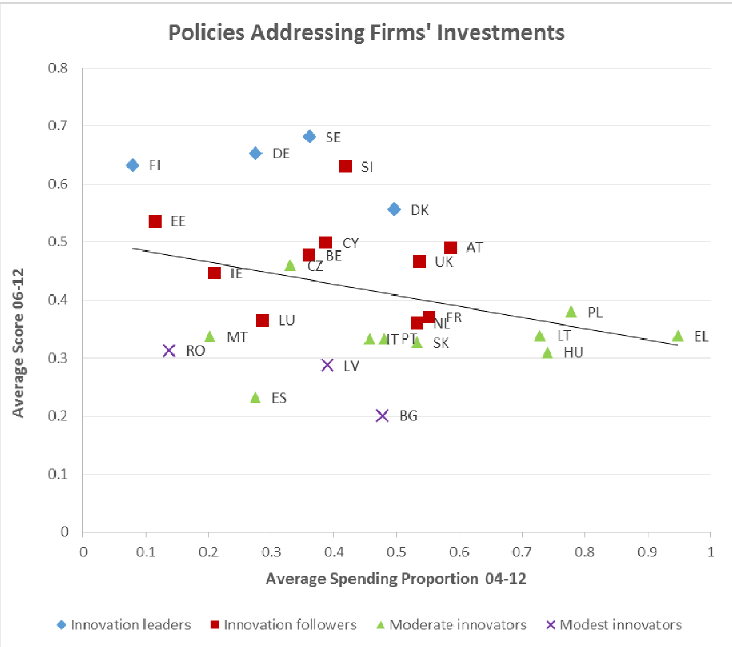
A final piece of analysis in this contribution matches the mix of policy instruments deployed by EU member states to their innovation performance. More specifically, we want to further investigate whether countries are deploying their innovation policy instruments and budget in areas where they have strong innovation performance, or rather introduce measures to address areas of weak innovation performance. It is important to stress that the analysis cannot establish any causal relationship between (changes in) policy mix and the (changes in) innovative performance, it can merely suggest correlations.

For this exercise, we try to map the area of policy instruments as closely as possible to the targeted area of innovative performance. We can do this mapping most adequately for the IUS component of firms’ investments in R&I. This is the area where most of the reported TC budget is concentrated on for most EU countries. It is also the area where Europe on average scores relatively weak compared to global competitors as the US and needs to catch up as a group. Within the EU, it is the area where there is a high and persistent heterogeneity, particularly a considerable gap between leading and lagging countries. It is also the area where despite this heterogeneity in performance, there is a remarkable relative "homogeneity" in innovation policy deployment (cf supra).

Innovation Policy Instruments to address firms' RDI investments (Trendchart)	**Performance on firms' R&D and Innovation Investments (IIS score)**
Tax Incentives Direct Business R&D support Direct Business Innovation support Financial Instruments (loans) Innovation support services (intermediaries) Innovation vouchers	R&D investments of the business sector Innovation investments of the business sector

Note: Also public procurement and incubators are included, as they are mainly targeted at the business sector. As these are only of marginal importance in the reported TC budgets, the analysis does not change when excluding these instruments. Support for start-ups is not included, as this addresses a specific type of firms (new firms) which are not represented in the firms' innovation performance data, which only represents firms with a minimum critical scale (typically 5 employees).

Figure 4: Firms' Investments in R&I: Matching Scoring and Spending

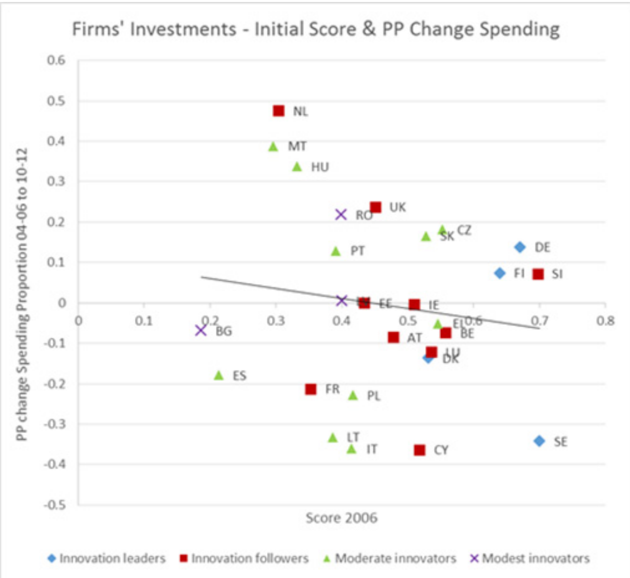


Source: Calculations on the basis of Trendchart and Innovation Union Scoreboard 2014 Database.

We examine first whether countries that score well on firms' investments in R&I are also spending a large share of their public R&I budget on supporting firms' investment in R&I overall. Figure 4 shows no clear correlation between the two. The *innovation leading countries* are the best scoring EU countries on firm's investment in R&I (together with Slovenia). The instruments for supporting firms' investment take up a relatively small part of their total reported TC budget compared to other countries. The countries that have more of their innovation policy budget concentrated on stimulating firms' investment in R&I (PL, LT, EL, HU) are scoring relatively low on firms' R&I investments. This is suggestive of the deployment of this group of instruments to address country weaknesses. But this evidence is only very weak. Overall, there is no clear pattern to discern.

We examine this association further in Figure 5. Figure 5 maps the 2006 score of the countries on firms' R&I investments onto a change in the consequent period in spending on instruments to support firms' R&I investment . It allows us to see whether changes in innovation policy measures (as measured by allocating larger parts of the reported budgets) address initial weak points in the innovation performance of the country or rather support strongholds.

Figure 6: Firms' Investments in R&I: Matching Scoring and Changes in Spending



Overall, Figure 5 shows a weak, rather negative correlation, suggesting weakly that countries with low scores on firms' R&I tend to increase their spending on instruments to support firms' R&I investment. A prime example of this is the Netherlands. On the other hand, Sweden, one of the best performing EU countries on this dimension, decreased the importance attached to instruments supporting firms' R&I investment. Germany, also among the better performing EU countries on this dimension, in contrast to Sweden continued to increase the importance attached to instruments supporting firms' R&I investment, albeit modestly. The same holds for Finland.

Overall the figures illustrate that the relationship between innovation policy deployment and performance is a complex one, which needs careful assessment and a good understanding of country heterogeneity.

7. Concluding remarks

The challenges that innovation policy in Europe need to address are huge. Europe continues to display a innovation capacity gap with other major countries and regions in the world, with a very slow speed of catching up. Furthermore, there is substantial heterogeneity in innovation capacity among EU Member States. The divide between the Innovation Leaders in the North on the one end and the Innovation Laggards from the South and the East on the other end proves to be very difficult to address. Since 2008, the process of convergence which was already very slow, has come to a halt if not moved in reverse gear, a trend which is in view of the weak fiscal consolidation position of many of the innovation lagging countries likely to persist if not even further aggravate in the near future.

In view of the scope of the problem, tackling the deficient EU innovative capacity requires a longer-term, broad, systemic policy framework. No single action will deliver innovation based higher growth. Rather, a series of interconnected initiatives and structural changes are needed. Going beyond stimulating the research inputs from the public and the private sector, it is important that other structural reforms are part of the policy agenda as well, affecting the demand for innovation and the incentives to link. Workable innovation policy mixes cannot compensate for weaknesses in the overall framework conditions.

A policy strategy for innovation capacity catching up requires a systemic, long-term consistent, dynamic policy mix that takes into account the countries' initial strength and weaknesses and supports the potential of the country for innovation based development by providing the framework conditions, promoting the access to (foreign) technologies, supporting the building of absorptive as well as creative and by supporting the linking among innovation agents. This requires a high level of development of the quality of the institutions involved in the design and implementation of the innovation policy.

Notwithstanding the large heterogeneity among EU countries in innovation capacity development, the evidence on innovation policies in EU countries shows a relative homogeneity of policy mixes in different countries. Overall the mix of instruments for innovation policy deployed by EU Member States is a rather standard set of instruments, with most countries deploying a similar mix of bread and butter policy instruments, relatively irrespective of their innovation capacity development. The majority of EU country policy mixes need a careful review to assess their adequacy in addressing country-specific innovation challenges. There is only very weak evidence to suggest its addressing countries'weaknesses. As an example, more emphasis in innovation policy on supporting the absorption and adaption of existing frontier technologies by industry would make more sense for the EU countries in catching-up mode. Particularly for countries in less advanced innovation development phases, more attention to stimulating the quality of human capital formation and supporting firms' incentives to adopt new technologies would be more effective rather than supporting creative capacity building to improve the country's innovation potential.

The evidence suggests that policy mixes are an outcome of a variety of factors and only one of these is a country's innovation capacity development. Other factors include policy fashions and perceptions of one-size fits all best practices in innovation policy. There may loom a danger for ERA. Exercises like the National Reform Programs, the European Semester, the Smart Specialization programs may drive EU-countries innovation policy rhetoric too much towards a same fashion (see also Todling & Trippl (2005) for similar observations)

Innovation Policy in the countries of the EU with lower innovation capacity cannot be pursued as imitating a "common practice". The EU2020 strategy and the ERA should not be thought of as a harmonization process: innovative and productive structures' differ across countries and regions. A decentralized policy approach implies more possibilities of adaptation to local specific needs. Nevertheless, coordination among the various policy levels is important. European level policies and national policies as well as regional policies should form a coherent mix, in which all policies focus on those capabilities, market and systemic failures best solved at each level. The idea is to facilitate co-optition and to boost diffusion of policy know-how.

Policies need to be supported by analysis, monitoring and evaluation practices, which then feed back into the policy process. In the set of indicators currently being collected and monitored to evaluate progress, the area of indicators that is least represented relates to the diffusion and linking capacity. Especially the lack of Industry Science Link Indicators is disturbing since this is one of the particular deficiencies of the EU innovative capacity. This is due to a lack of systematic data on this. More could be done here. Furthermore, since the systemic approach often operates at the specific technology/sectoral/regional level, this implies that indicators should be traced at technology/sectoral/regional level.

To conclude, the way forward for improving innovation policy in Europe is in better analysis/diagnosis to guide policy design ex ante, more experimentation with new (combinations of) instruments and better evaluation ex post, killing experiments if unsuccessful. Although these policy suggestions seem to represent only incremental innovations to the current policy framework, they are nevertheless not easy to implement, requiring innovations in organisational design of the policy process and bolder, but better supported, policy makers.

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Appendix: TRENDCHART and GBAORD database

The Erawatch/TrendChart inventory reports policy measures that have been launched at the national level across 27 EU Member States plus Norway and Switzerland, covering the period 1990-2013. For every policy measure, the inventory reports a starting and ending date, typology, and the allocated budget.

The Trendchart database includes programme-based research and innovation, but not institutional funding; it captures active innovation policy but not the regular funding of institutions, which can be found in indicators such as GBAORD (Government budget appropriations or outlays for research and development).

In particular, support measures included in the EW/TC are defined as measures that mobilise resources (financial, human or organizational) through publicly (co-)financed research and innovation programmes or initiatives; and/or fund the generation or diffusion of information and knowledge (studies, road mapping, technology diffusion activities, advisory services, public-private partnerships etc.) in support of research and innovation activities; and/or promote an institutional process (legal acts or regulatory rules) designed to explicitly influence the undertaking of research and innovation by organizations. In addition, a policy measure is normally implemented on an on-going (multi-annual) basis, rather than being a single project or one-off event.

GBAORD, which covers all appropriations (government spending) given to R&D in central (or federal) government budgets, is the statistic most comparable to TrendChart. Both measures are based on reports by R&D funders, include payment to performers beyond the national territory, and exclude payments from local (and sometimes provincial) governments; while the GBAORD covers only R&D financed by governments, TrendChart also includes co-financing schemes.

There are nevertheless notable differences between the two measures: TrendChart incorporates both R&D and more broadly defined innovation programmes, and hence has a wider coverage of funds allocated to innovation-oriented activities; it does not include regular yearly funding, complex national operation programmes or policy governance, nor institutional funding for universities or other public research institutions. Financing through Structural Funds is included in TrendChart and excluded from GBAORD (explaining the large TrendChart figures compared to GBAORD of Structural Funds dependent countries); loans, among other forms of funding, are included in TrendChart and do not appear in GBAORD.

The main reasons explaining the differences between GBAORD and TrendChart are thus:

- Financing through structural funds is included in TrendChart. In GBAORD pre-financing of projects financed by EU structural funds is excluded.
- Institutional funding to universities and research organisations is not covered in TrendChart's support measures database. In GBAORD however the latter is included.
- Loans among other forms of funding are included in TrendChart, while this is not the case in GBAORD.

Project Information

Welfare, Wealth and Work for Europe

A European research consortium is working on the analytical foundations for a socio-ecological transition

Abstract

Europe needs change. The financial crisis has exposed long-neglected deficiencies in the present growth path, most visibly in the areas of unemployment and public debt. At the same time, Europe has to cope with new challenges, ranging from globalisation and demographic shifts to new technologies and ecological challenges. Under the title of Welfare, Wealth and Work for Europe – WWWforEurope – a European research consortium is laying the analytical foundation for a new development strategy that will enable a socio-ecological transition to high levels of employment, social inclusion, gender equity and environmental sustainability. The four-year research project within the 7th Framework Programme funded by the European Commission was launched in April 2012. The consortium brings together researchers from 34 scientific institutions in 12 European countries and is coordinated by the Austrian Institute of Economic Research (WIFO). The project coordinator is Karl Aiginger, director of WIFO.

For details on WWWforEurope see: www.foreurope.eu

Contact for information

Kristin Smeral

WWWforEurope – Project Management Office

WIFO – Austrian Institute of Economic Research

Arsenal, Objekt 20

1030 Vienna

wwwforeurope-office@wifo.ac.at

T: +43 1 7982601 332

Domenico Rossetti di Valdalbero

DG Research and Innovation

European Commission

Domenico.Rossetti-di-Valdalbero@ec.europa.eu

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Partners

Austrian Institute of Economic Research	WIFO	Austria
Budapest Institute	Budapest Institute	Hungary
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