Report on the 2012 ERAC Mutual Learning Seminar on Research and Innovation Policies

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Introduction

The Commission presented the 2012 Annual Growth Survey on 23 November 2011. During the current period of fiscal consolidation, it called on Member States to give priority to growth-friendly expenditure in areas such as education, research and innovation. At the same time, it emphasised the need for other growth-enhancing policy measures that combine short-term macroeconomic fixes with longer-term structural policies designed to catalyse the EU's economic growth.

In this context, the aim of the 2012 ERAC Mutual Learning Seminar was to stimulate discussion amongst Member States about the ways in which research and innovation policies could contribute to the enhancement of economic growth and competitiveness.

The need for a strong focus on research and innovation was emphasised in the opening address by Máire Geoghegan-Quinn, the European Commissioner for Research, Innovation and Science. She noted that fiscal discipline is necessary but isn't enough to solve Europe's problems. It must be complemented by action for growth.

In particular, she stressed the need for action along the three potential growth paths presented and discussed during the 2012 Mutual Learning Seminar – paths that demand policies aimed at:

- Improving the efficient functioning and operation of the science base;
- Promoting business investment in research and innovation via the coordinated use of supply and demand instruments;
- Removing bottlenecks to the growth of innovative enterprises.

After the opening address by the Commissioner, these growth paths were discussed by Member State representatives in three separate sessions, with a strong focus on obstacles to growth and the policies needed at national and EU level to overcome them.[1] Background papers[2] were prepared by independent experts for each session and commented upon by Discussion Panels composed of Member State representatives and other independent experts. A broader discussion between all participants was then moderated by the authors of the background papers.[3]

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[1] The Agenda for the meeting, which includes the names and affiliations of all speakers, is attached as Appendix 1. The speech of the Commissioner can be found in Appendix 2.

[2] The three background papers are attached as Appendix 3:

Guy, K., "Improving the Performance of the Science Base in Europe and the Role of the ERA"

Tsipouri, L., "Combining Supply- and Demand-side Measures to Stimulate Business Investments in New Technologies and Innovative Products"

Autio, E., "Removing Bottlenecks to the Growth of Innovative Firms"

[3] Due to illness, the discussion in Session 1 was led by another member of the Discussion Panel.

This report provides an overview of the discussion in the 2012 Mutual Learning Seminar, divided into three sections covering each of the topics covered in the seminar. The hope expressed by the Commissioner in her opening address was that the discussion and report would serve as an important input to the ERAC opinion on the Annual Growth Survey and prove useful when Member States update their National Reform Programmes in line with Europe 2020 objectives during the course of 2012.

Session 1

Improving the Performance of the Science Base in Europe and the Role of the ERA

Ken Guy[4]

Introduction

Most public expenditure on research and innovation is directed towards the science base, i.e. towards higher education institutions (HEIs) and other public sector research organisations (PROs) such as government labs and academies of science. It is important, therefore, that the science base performs efficiently and delivers value for money via the transformation of financial and human resource inputs into desirable outputs. This calls not only for improvements in the performance of the research community, but also in the way in which research funding bodies administer the allocation of funds nationally and internationally via cross-border mechanisms.

Policies that improve the performance of the science base are those that both maximise inputs and improve the efficiency of the transformation process. Moreover, given the need for the science base to link effectively with other sub-systems of national and international innovation systems in order to improve overall system performance, policies facilitating such linkages are also needed.

The background paper for Session 1 (see Appendix 3: Guy) discussed the policy steps needed to improve the performance of the science base under five main headings and made the following points:

Ensuring inputs

In a period of scarce resources and great competition for public funds from other quarters, a priority for all Member States is to strengthen the arguments for a continued focus on support for the science base and communicate these effectively to Finance Ministries. Efforts to maintain or even increase financial inputs will also be necessary in order to maximise the perceived impact of efficiency improvements, and improvements will be needed in the supply, quality and mobility of adequately qualified scientific and technological personnel.

Funding mechanisms

There is increasing evidence of the need to rationalise research funding structures via a greater emphasis on simplification and cross-border funding. A greater emphasis needs to be placed on simpler, trust-based systems that acknowledge the inherent riskiness of research, and there is scope for simplified EU procedures to provide a template for national bodies. Common procedures would also facilitate the increased rationalisation of funding structures in the EU via an increased emphasis on cross-border funding mechanisms.

[4] Based on notes of the discussion taken by Patrick Brenier and Johan Stierna.

Structural reform

There is also emerging evidence of a need to reassess existing modernisation strategies for the higher education institution (HEI) and public research organisation (PRO) sectors and to accelerate the rate of progress. Modernisation and reform of both sectors, especially in terms of improving research conditions and facilities and promoting the formation of critical masses of research excellence, has been highly variable across the EU and much still remains to be done. Access to advanced research infrastructures is also needed in many scientific areas in order to catalyse knowledge generation and facilitate the networking of researchers. Major steps have been taken along this path in Europe, but maintaining momentum in a period of fiscal restraint will be difficult and renewed efforts will be needed to safeguard commitments and find new funding mechanisms.

Improving outputs

Compared to the US, the EU public research sector underperforms in both the quantity of scientific publications per researcher and the quality of output,[5] suggesting that public sector research performance in the EU needs to improve in both quantitative and qualitative terms. One way of doing this is to stimulate the proportion of funding available to researchers and research institutions via competitive research funding structures that emphasise excellence as a key selection criterion. The balance between funds available on competitive and non-competitive bases varies significantly from one country to another, but there is little doubt that a greater emphasis on competitive research funding is required in most settings. Another way of improving research performance would be to place a greater emphasis on allocation systems that relate research funding levels to the performance levels of research institutions and the success of their valorisation activities.

Facilitating linkages

Improvements in the performance of the science base will not in themselves be enough to improve the overall efficiency and performance of national and EU innovation systems. For this to occur, improved linkage, transfer and valorisation structures and processes are needed. One way of increasing the potential contribution of research to the overall performance of innovation systems and to the socio-economic systems within which they operate is to place a greater emphasis on research perceived to be of relevance to societal goals. Another is to involve science base actors in the development of innovation hotspots, clusters and regional growth poles via the development of smart specialisation strategies, i.e. strategies that lead to clusters differentiated along thematic or sectoral lines that are distributed across multiple regions in such a way that most regions have distinctive but complementary competence profiles. The existence of a truly cross-border research market within the EU facilitated by improved IPR regimes, codes of practice for research institutions and universities, and innovation-friendly standards, regulations and procurement

[5] European Commission (2011), Innovation Union Competitiveness Report. http://ec.europa.eu/research/innovation-union/index_en.cfm?section=competitiveness-report&year=2011

practices would also improve links between the science base and the realisation of innovative potential.

Report on the Discussion

The presentations made by Member State representatives, the commentaries delivered by the other independent experts on the Panel and the ensuing discussion amongst all participants ranged across most of the topics covered in the background paper, lending support to the notion that policy initiatives along multiple fronts are needed if the performance of the science base is to be improved.

Not surprisingly, there was little support for the generic use of specific policy mixes, but a general acceptance that appropriate policy mixes are context-specific. There was acknowledgement, however, that many of the obstacles confronting efforts to improve the performance of the science base are prevalent across the whole of the EU and affect many policy strands. In particular, conservative attitudes towards change affect modernisation agendas in the HEI and PRO sectors, while the lack of an entrepreneurial culture and pervasive risk averseness affect the efficient valorisation of science base activities.

Support for the evidence-based belief that research and innovation can underpin growth – exemplified by the performance of Germany since 2005 – was also widespread, as was the need for serious investment in research given the weaker performance of the EU research base vis-à-vis the US and recognition that the current debt crisis in Europe masks an even more serious growth crisis. Critically, the discussion also focused on the catalytic role that the 'Entrepreneurial State' has to play in fostering innovation-led growth.

Key Issues

Although the discussion covered a broad terrain, some issues received more attention than others. These are detailed below:

Focus

Partially driven by the current climate of austerity, but underpinned also by natural limits to the resources available to individual nations and an intervention logic that refrains from spreading these too thinly, many Member States now accept the need to focus and prioritise.

This can take many forms. In Germany, recent efforts to strengthen the science base have involved building on strengths via a focus on initiatives that reward and encourage excellence rather than overt attempts to remedy deficiencies, while in the Netherlands and Finland research and innovation policies have focused on a limited number of strategic areas that correspond to existing scientific and business strengths and new opportunities, particularly those relevant to major societal challenges. Smart specialisation is another manifestation of the same phenomenon.

The acts of focusing and prioritising are not new, but whereas in the past focusing often involved the use of single, blunt instruments (e.g. increased research budgets distributed via conventional allocation mechanisms) to tackle complex problems such as weak research performance, the tendency nowadays

is for more sophisticated packages of instruments, often involving measures on the supply- and demand-side, to be deployed.

Excellence

There was general support for the idea that a greater proportion of research funding should be allocated via competitive mechanisms. Moreover, a focus on excellence as the sole or predominant criterion for the award of competitive research funding is becoming increasingly noticeable across the EU, with many associated benefits. In Germany, for example, research competitions with a focus on excellence have mobilised the science sector; helped establish new networks and businesses; encouraged interdisciplinarity; and increased the internationalisation of German science and raised its profile. By helping to counter distorting political influences, the use of the excellence principle in the selection of cluster development initiatives has also facilitated the development of real smart specialisation strategies.

There are limits, however, to the extent to which considerations of excellence should dictate policy responses. A number of discussants pointed out that a strong focus on excellence almost inevitably leads to concentration of funding in a few 'hot spots', and while this can be beneficial in terms of the establishment of critical masses, it can also lead to wide disparities between winners and losers at institutional and regional levels. R&D measures of this type are not a substitute for structural regional policy and need to be embedded within smart specialisation strategies and complemented by other mechanisms. Similarly, at an institutional level, there is an argument for maintaining some research capability in institutions outside the 'first circle' in order to continue to attract students into research careers.

Two broader issues were also raised. In the first instance, if research and innovation are to be brought to bear on the resolution of major societal challenges, excellence criteria will increasingly need to be complemented (but not replaced) by relevance criteria. Secondly, focusing on excellence is a manifestation of policies that build on strengths, whereas in most innovation systems the weakest links play a significant part in the determination of overall system performance. This again suggests the need for complementary measures rather than a sole focus on excellence-based competitions.

People

The need to invest in people and encourage their interaction was emphasised at numerous points throughout the whole discussion. As one participant noted, "everything starts with clever people". Within educational systems, efforts are needed not only to make science and engineering options more attractive to students, but also to encourage interdisciplinarity, to orient scientists and researchers to the task of meeting societal challenges, and to nurture a culture of entrepreneurship via the inculcation of appropriate skill sets and attitudes. Steps also need to be taken to lower levels of risk-averseness in existing public and private sectors in order to accommodate new generations of risk-oriented scientists, engineers and entrepreneurs.

The importance of mobility and 'brain circulation' was also stressed as a means of facilitating knowledge flows and enhancing overall knowledge capacity. This includes the mobility of researchers not only across borders, but also between the public and private sectors. Similarly, there is a continuing need for measures aimed at stimulating and improving interactions between individual researchers in HEIs and PROs and those in industry (e.g. via collaborative R&D programmes), and between research institutions and other innovation actors (e.g. via cluster initiatives).

Openness

The issue of 'openness' raised its head on a number of occasions, not least in connection with the issue of people and the mobility of researchers. But two aspects of openness stimulated particularly interesting debates.

The first concerns the cross-border funding of research within the EU. There was extremely strong support in some quarters for an open approach. For very small Member States with low research intensity, access to wider knowledge pools is a necessity and the use of common pots (real or virtual) is welcomed. It was also pointed out that the benefits for larger, highly research-intensive Member States are also appreciable, since the proportion of research carried out in individual Member States is only a small proportion of the EU total, and a much smaller proportion of the world total. Sweden, for example, conducts only about 1% of the world's research even though it is one of the most research-intensive countries in the world.

But there was also acknowledgement of resistance in some political (and administrative) circles to the concept of shared funding and truly common pots, justified in some instances by an absence of reciprocity and few mechanisms to enforce it. In terms of lowering resistance, more progress is needed in the development of legislative and regulatory frameworks capable of facilitating cross-border funding.

The second aspect concerns international cooperation more broadly and the funding of researchers outside the EU. Some noted that political resistance here was much higher, and the argument was made that the benefits associated with funding researchers in non-EU countries are much less than those accruing to the EU when researchers relocate and perform the research in the EU itself. Other participants disagreed, however, on the grounds that EU-based researchers reaped the benefits of collaborating with non-EU researchers irrespective of the location of the latter. There is thus ample scope for further research to establish the true short- and long-term benefits or otherwise of international collaboration that involves cross-border flows of funds.

Main Lessons

The most important lessons to emerge from the discussion can be summarised as follows:

- Governments have an important role to play in fostering research and innovation led growth;
- Actions are needed on many policy fronts if widespread obstacles are to be overcome and the performance of the science base improved;

- This will involve efforts to ensure adequate inputs to the science base; to rationalise funding mechanisms and public sector research structures; to improve research outputs; and to link the science base with other elements of national and EU innovation systems;
- Even if adequate measures are put in place to improve the performance of the science base, research budgets need to be maintained or increased if desirable growth levels are to be attained;
- Focused policy packages are needed to avoid spreading resources too thinly, to tackle major societal challenges, and to ensure that the science base is adequately linked to other innovation system elements;
- Strong emphases on competition, excellence, building on strengths and cluster development have much to recommend them, especially in conjunction with complementary measures that attempt to rectify weaknesses in innovation systems and ensure their smooth running;
- In terms of the development of the ERA, greater efforts are needed to develop legislative and regulatory frameworks capable of facilitating cross-border funding;
- Effective human resource development and circulation strategies are critical to the success of any attempts to improve the performance of the science base in the EU.

Session 2

Combining supply- and demand-side measures to stimulate business investments in new technologies and innovative products

Lena Tsipouri

Introduction

Public support mechanisms for private innovation activities can be divided into:

- Instruments that provide additional inputs for private innovation processes, thus supporting the supply side via the public provision of resources. These can take a direct form (e.g. research and innovation grants, subsidised loans) or an indirect form (e.g. tax incentives, access to publicly funded scientific knowledge);
- Instruments that influence the creation of public markets (e.g. public procurement) or stimulate private markets (e.g. subsidies for users to increase the demand for innovative products). All these improve business expectations and hence create incentives that trigger innovation outputs.

Supply-side measures have dominated the scene for most of the past thirty years, but a resurgent interest in demand-side policies has been evident since the late 1990s, with an emphasis on public procurement for innovation and the use of product market regulation and standards instruments. A more extensive discussion of supply and demand measures can be found in an appendix to this report (Appendix 3: Tsipouri).

As demand-side policies are crucial to the attainment of the 3% target and the stimulation of European competitiveness, a better balance between supply- and demand-side measures is needed. Supply measures alone cannot generate the necessary inputs and associated impacts, especially in a period of austerity. Public-private partnerships can be used to generate new private investments, with the public sector playing a leverage role and contributing not only to the 3% target but, more importantly, to the attainment of the target for the ratio of public (one third) and private (two thirds) contributions to the total. In addition, the creation of larger markets at a European level is expected to mobilise foreign direct investment both within and from outside the EU (provided that the markets develop in sufficiently attractive ways).

Supply-and demand-side mechanisms can take the form of single interventions (typically involving the creation of platforms and lead markets, where supply- and demand-side elements are closely integrated to achieve first mover advantages), or looser but still synergistic combinations of independent instruments within the context of balanced policy mixes tailored to the specificities of national contexts and business cultures.

Report on the Discussion

The discussion covered a range of topics, especially the treatment of risk in the design and implementation of demand-side policies; the relevance of priority setting; and the role of indicators and evaluation tools and techniques. Evidence presented indicated that the demand-side interventions mostly used by Member States are the public procurement of innovation and awareness raising, whereas regulation and tax incentives are less frequently used. SBIR schemes have been adopted as demand-side measures in the UK and the Netherlands, and some variations in other Member States were discussed as well. The UK is a particularly interesting case as the first pilot SBIR scheme failed, but it has since been adapted and now appears to be functioning effectively. Innovation contracts, technology platforms and lead user initiatives are different ways of trying to raise awareness and provide the intelligence needed for successful demand-side policies. Their degree of effectiveness varies, however.

Innovation Leaders (in the terminology of the Innovation Union Scoreboard) are increasingly evolving policies that take users and their needs into account. Vinnova in Sweden places special emphasis on the public procurement of innovation, which historically played a part in the success of both ABB and Ericsson. For this reason, in addition to supporting conventional procurement practices, a new 2.4 million € programme was launched in 2012 to support the creation and development of new procurement processes and competences and the sharing of experiences. Ultimately, the aim is to stimulate the demand for innovative solutions and products and creation of new public and private lead markets. Sustainable cities are also an area where demand-side initiatives can play a significant role.

Similarly, Finland has designed an action plan for demand- and user-driven innovation that involves around fifty measures. Some of these are at a pilot stage but others are more well-developed. The plan was formulated after extensive and intensive consultations with both public and private stakeholders and its implementation has been undertaken jointly. The lessons learned from the implementation of the plan to date are twofold:

- Structural and systemic changes are needed if implementation is to be successful;
- Coordination between actors whose familiarity with innovation and innovation policies varies considerably can present a major challenge.

One of the hopes at the outset of the seminar was that the discussions within it would focus on the barriers to effective policy implementation and the shape and nature of future policies at national and EU levels. During this particular session, much of the discussion focused on *national policy priorities* and the perception that demand-side policies seem best linked to societal needs and targets, where raising the bar can often lead to innovation. It was suggested that, for the public procurement of innovation to succeed, it is important to send clear signals via roadmaps and to establish stable expectations. Overall governance and the organisation of procurement were also addressed, especially in terms of the need to raise capabilities in the public sector and the potential need to create or empower specialised agencies and intermediaries to overcome hurdles.

The discussion on *barriers* was brief as there was wide agreement on those covered in more detail in the background paper. They were reformulated in part as follows:

- Price and the short-term satisfaction of immediate needs rather than innovation and longer-term considerations dominate in the minds of public procurers;
- Indirect effects are hardly ever taken into consideration;
- At the level of overall policy making, there is a lack of interaction between relevant ministries and agencies and little articulation of innovation need;
- There is little early communication of future needs;
- Capabilities are limited and risk is high, which discourages innovation-oriented interventions.

There was also some discussion of *EU and cross border policy priorities*. This focused primarily on the need for networking; the desirability of cross-border coordination between the public procurement offices of countries within specific regions (e.g. within the Nordic region);the need to combine niche markets in order to establish critical mass; the potential role of EU institutions and use of their budgets; and the use of EU resources to fund studies, training and the dissemination of material on good and bad practices.

Key Issues

Some issues received more attention than others. These are covered below:

The risk element

High risk is a major problem for the introduction of demand-side policies. While there is increasing support for innovation-friendly procurement in many political circles and the debate concerning benefits is intensifying, effective implementation is very limited. Risk averseness seems to be the most significant barrier, both in terms of technological risk and the risk of policy failure. There are ways, however, to mitigate risk – especially through intelligence gathering, stakeholder interaction and experimentation with alternative technologies.

The success of US demand-side policies can be attributed to the care devoted to the process of risk management, with DARPA's procedures an example of good practice. In Europe one of the problems may be that there are no departmental budgets as large in order to achieve de-risking through large numbers.

The role of prioritisation

A pre-condition for successful demand policies is the explicit adoption of priorities, not solely for demand-side policies alone but for combinations of supply- and demand-side policies aimed at improving overall innovation system performance. The Netherlands is an example of a country that has recently focused its innovation policies on nine 'Top Sectors', where innovation is seen as the key not only to the solution of major societal problems but also as a source of economic growth via the development of new technologies and the creation of new markets for innovative goods and services. Innovative public procurement involving the signing of innovation contracts is a critical component of the proposed policy mixes, with 2.5% of all procurement set as a quantitative target

for innovation-related procurement, and demand-side measures are linked with human resource measures on the supply-side. The UK has similarly focused on five sectors in the past, and many more countries are adopting prioritisation in the context of their National Reform Programmes (NRPs) and promoting smart specialisation at a regional level.

Although priority setting is increasingly a prerequisite for the launch of balanced supply and demand policies, there are two downsides that policy makers should take into consideration when framing priorities:

- On the one hand, there is the risk of selecting the wrong priorities, a government failure with dire consequences for both demand- and supply-side policies. Market changes and the emergence of new areas requiring support in the medium term are difficult to take into account during priority setting exercises, but the identification of new, key enabling technologies is even harder to accomplish. A degree of flexibility concerning long-term priorities is thus called for;
- The second caveat is more closely related to the demand-side and particularly to the public procurement of innovation: if policymakers embrace new technologies too early, this may lead to lock-ins or to the acquisition of inappropriate and/or premature technologies. Procurement practice thus calls for the excellence not only in technological fields but also in the ability to gather relevant intelligence.

Using indicators, evaluation techniques and quantitative targets

The collection of data on indicators and evidence concerning policy performance and user needs is an increasingly important element in policy formulation and the justification of future policies. A large survey of companies in the UK, for example, has provided evidence that many firms consider public procurement relevant to their innovation activities and to export success via the creation of lead markets.

Indicators can be used to set *ex ante* targets or exploited in the *ex post* evaluation of demand-side policies. An example of an *ex ante* target is the Dutch ambition to make 2.5% of all government purchases via the use of innovation-oriented public procurement practices, e.g. via mechanisms similar to the US Small Business Innovation Research (SBIR) scheme.

Although hard econometric indicators are needed to justify interventions, the evaluation of demand-side measures is difficult to organise because the results are long-term and often indirect. Overall value for money and the precise impact on company profitability and spillovers is difficult to determine, and the systemic nature of demand-side policies cannot be captured via econometric approaches. From this it follows that attention should be redirected from final outcomes to measures of trajectories – examining, for example, the type of behavioural changes that are triggered.

Main Lessons

The most important points and lessons to emerge from the discussion can be summarised as follows:

- Demand-side policies are increasingly discussed in the Member States but their implementation lags behind political commitment;
- The most frequently encountered schemes involve the public procurement of innovation, awareness raising schemes and technology platforms. The areas in which they are applied mainly relate to energy, the environment and ICT;
- The expectation is that more demand-side measures will be designed and implemented in the near future;
- For these to be successful, Member States need to develop a greater understanding of demand conditions, since they vary greatly across countries and regions;
- They also need to experiment with, adapt and apply tools that have been developed and tested elsewhere, e.g. in SBIR schemes, Lead Market Initiatives, Innovation Alliances and, if they prove successful, Innovation Partnerships;
- Given that experience with demand-side policies is limited, there are also lessons to be learned from failures in this area. Governments should therefore be encouraged not only to share examples of success but also those of failure;
- Pooling resources at EU and regional (multi-country) levels can establish critical masses and markets and make demand-led innovation more effective;
- The Commission can lead the way via support for initiatives such as the Lead Market Initiative and JTIs; via exemplary use of its own procurement budget; via the identification and reporting of good and bad practices; and via support for studies and training.

Session 3

Removing Bottlenecks to the Growth of Innovative Firms

Erkko Autio

Introduction

The background paper written for this session (see Appendix 3: Autio) made a number of observations. First, it is possible to distil 'stylised facts' regarding the role of innovative growth firms and their contribution to economic development, especially in terms of their contribution to job creation. These include the following:

- Innovative growth firms contribute disproportionately to job creation;
- Innovative growth firms can be found in any sector – it appears that the predominant form of innovation driving growth is Business Model Innovation (BMI) and not technological innovation as such;
- The innovative growth phenomenon is not confined to new, small, or technology-intensive firms alone: indeed, some studies have found that the average age of 'high-impact' firms is nearly 25 years;[6]
- Innovative growth firms may have a particularly important role to play in helping to end economic recessions.

Innovative growth firms thus constitute a very important target for policy action, particularly at times of economic downturn such as the current one. In particular, EU member countries experiencing severe economic distress are well advised to consider how to best harness the potential of this category of firms.

Second, the background paper observed that while supply-side policies and support mechanisms are relatively well known, much less is known about demand-side policies and support mechanisms. The paper presented a simple matrix that could be used to assess the comprehensiveness (and complementarity) of both supply- and demand-side policies to encourage innovative firm growth.

Third, the paper observed that, although the growth of firms (especially of innovative and entrepreneurial firms) has been extensively studied empirically, there is no widely accepted theory of innovative firm growth.[7] This is a deplorable gap, since such a theory is necessary to identify causal drivers of growth as well as to articulate their operations. The discussion paper thus drew on some 20 years of empirical research on firm growth to distil six generic drivers of firm growth: motivation, ability, legitimacy, market demand, resource access, and appropriability. The paper then proposed that supply- and demand-side policies aimed at encouraging growth should be based on these drivers.

[6] The findings of this particular study (cited in the background discussion paper) should be read with some caution as the findings were derived from Dunn & Bradstreet data and the study may therefore have under-sampled younger and smaller firms.

[7] Penrose's (1959) 'Theory of the Growth of the Firm' focused on larger conglomerates.

Fourth, focusing on supply-side support mechanisms targeted at facilitating the growth of innovative firms, the paper summarised good practices that should be of some help when planning new ones.

The paper concluded by presenting the concept of National Systems of Entrepreneurship (NSEs) and proposed an approach to the identification of bottlenecks in NSEs that could be useful when designing policy measures designed to improve the performance of NSEs.

Report on the Discussion

The discussion during Session 3 centred upon a number of themes. First, observations were made concerning the share of innovative growth firms in the total firm population. The proportion of innovative growth firms varies across countries. In some countries, there is plenty of self-employment activity, but only relatively few firms innovate. Yet, because of the size of the firm population, even these countries sometimes exhibit relatively high absolute levels of innovative growth activity. This raises the question of why the balance between self-employment and innovative growth firm activity varies across countries.

Institutional framework conditions are likely to play a role here, raising the question of which institutional conditions are decisive in regulating the innovativeness and growth-orientation of the general firm population. Although the discussion did not go into detail, it is likely that a low proportion of innovative activity (relative to the innovative activity of the overall firm population) is caused by a combination of barriers to growth (e.g. structural barriers to entry for innovative firms, insufficient incentives to innovate, and insufficient incentives to grow firms. A growth-oriented policy framework, therefore, should address barriers as well as incentives when considering firm-level innovation and firm-level growth.

Finland was cited as an example of a country where the policy framework strongly encourages firm growth. Support for fast-growth firms is currently a central priority of Tekes, the Finnish National Technology Agency. The SME sector share of Tekes support has grown rapidly in recent years, with this support concentrated more explicitly and exclusively on high-growth firms.

The Young Innovative Company (YIC) programme (www.tekes.fi/niy) exclusively targets high-growth innovative firms. It exemplifies many of the good practice principles outlined in the background paper for this session and has an enviable record of success:

- YIC companies have been growing 2.5 times as fast as the non-YIC customers of Tekes;
- There is evidence that this growth effect is robust and primarily due to self-selection effects;
- There are indications that the support funds invested will produce a significant positive return.

Another successful Finnish example that follows the same good practice principles is the Vigo Accelerator programme (www.vigo.fi).This entails

accelerators both investing and participating in the management of growth companies.

Overall, the discussion suggested that the high-growth firm support environment in Finland is quite well developed and holds lessons for other countries. On the basis of the YIC experience in particular, Tekes plans to extend its focus beyond young firms, as it has observed that an exclusive focus on young firms neglects older firms (e.g. family businesses) that exhibit strong growth potential.

The next important focus in the Finnish high-growth firm support system will be the development of support for National Ecosystems of Entrepreneurship. In its strategic planning, Tekes is moving beyond individual support initiatives towards a system that covers the entire life cycle of innovative firm growth.

During the discussion, it was emphasised that innovative growth firms constitute a distinct target group for growth-oriented policy frameworks. A combination of a general innovation policy framework and a specific high-growth policy framework is needed. In addition to encouraging innovation, policy frameworks also need to pay specific attention to firm-level growth. Firm-level policies need to draw on, and be embedded in wider innovation policies.

It was suggested that the needs of innovative high-growth firms are distinctively different from those of other firms:

- They require more finance because of the need for up-front investment in inherently uncertain innovative activities;
- They need IP protection in order to appropriate the returns generated by their innovations;
- They need appropriate competition policies for the creation of markets for new innovations;
- They need innovative public procurement schemes to mitigate the uncertainty inherent in innovative activity;
- They need well functioning regulations and standard-creation mechanisms to facilitate new market creation.

Although innovative growth firms have distinctive needs, supporting them via traditional mechanisms is problematic because of the difficulty of recognising high-potential firms *ex ante*. Policies to support high-growth innovative firms should also recognise that rapid growth is a temporary condition – it tends to come in bursts.

The discussion in the session also reinforced an observation made in the background discussion paper, namely that, to date, there have been few or no causal theories to explain innovative firm growth. The list of growth drivers presented in the background discussion paper is thus a welcome contribution to the high-growth policy debate.

When designing a growth-facilitating policy framework, the importance of creating a growth-enabling environment should not be underestimated. This means that policies should focus on removing barriers as well as facilitating and encouraging firm-level growth drivers. There is a need to complement supply-

side policies and support measures with demand-side policies and the removal of regulatory and other barriers that artificially hamper growth.

The discussion also supported the observation that, viewed at a country level, entrepreneurship is a *systemic* phenomenon. There is a need, therefore, for analytical models that convey an idea of system dynamics as well as describing individual constituent parts, and that go beyond description and facilitate policy prescription.

Concerning growth-facilitating policies, the importance of early-stage venture capital was emphasised. However, it was also cautioned that this element is often misunderstood by policy-makers:

- For very good economic reasons, it is very difficult, if not virtually impossible, for private-sector players to maintain a viable early-stage equity funding sector;
- Public-sector participation is therefore important, though many mistakes have been made in this area and it is very important to learn from previous failures. Even when implemented correctly, public-sector participation is rarely profitable, even if evidence suggests that the wider net benefit is positive;
- It is possible to evaluate the economic impact of public-sector venture capital initiatives, but most evaluations are made too soon – only 2-3 years after initiatives end.

Finally, the introductory discussion identified two specific areas that appear to merit closer attention:

- Corporate venturing initiatives deserve renewed attention. Even though there have been mixed experiences in the past, the trend towards 'open innovation' means that this area offers good potential for initiating high-growth innovative firms;
- Lack of managerial experience may be a more pressing bottleneck than lack of funding and greater attention should be paid to mentoring initiatives.

Key Issues

Three major topics dominated the overall discussion:

- The characteristics of innovative growth firms;
- Demand-side policies;
- Supply-side policies.

Characteristics of Innovative Growth Firms

It was noted that innovative growth firms are not necessarily young and small and that they do not necessarily operate in high-technology sectors. This should be taken into account when designing policy frameworks that support innovative firm growth. Specifically:

- Policy-makers should pay particular attention to corporate spin-offs and independent subsidiaries, as these are often able to grow robustly;

- Large firms can often contribute significantly to productivity growth, which implies that facilitating productivity-enhancing innovation (such as business model innovation) in the large firm sector is important;
- Sectors exhibiting strong productivity growth in the US include the wholesale, retail, financial services and real estate sectors. This serves as a reminder that a high-growth policy framework should not focus exclusively on high-technology sectors such as ICT and biotechnology, but also, include services and low- and medium-technology sectors;
- Drawing on the above, therefore, the concept of 'innovation' should be understood in a broad sense – i.e. not only covering technological innovation, but also covering Business Model Innovation (BMI), as BMI is often key to unleashing rapid growth potential in firms.

In summary, policy frameworks facilitating innovative growth firms should have a broad focus covering:

- Old firms in addition to young ones;
- Large firms in addition to small ones;
- Corporate units and subsidiaries in addition to independent ventures;
- Service and low- and medium-technology sectors in addition to high-technology sectors;
- Business Model Innovation in addition to technology-based innovation.

Demand-Side Policies

The discussion confirmed that, in general, demand-side policies supporting innovative growth firms are much less developed than supply-side policies. This is a problem, because many analyses (e.g. those of GEM and GEDI) show low growth motivations to be an important bottleneck in many member countries. Firm growth rarely, if ever, happens without strong growth motivation. Therefore, in order to enhance the effectiveness of supply-side policies and support measures, it is important to complement these with effective demand-side policies.

What, then, are effective demand-side policies to foster the growth of innovative firms? The first important ingredient identified in the discussion was the removal of unnecessary barriers to rapid organisational growth. Such barriers can be created, for example, by regulatory compliance requirements that increase in a non-linear fashion as a function of a firm's size. Other barriers can be created by the uneven fiscal treatment of firms of different sizes. Restrictive regulations governing market entry, especially for new firms, constitute another important institutional barrier – which might help explain why some Member States have high rates of self-employment activity but only low rates of growth-oriented entrepreneurial activity. Finally, unnecessarily burdensome exit regulations might inhibit the entry of innovative growth firms, as growth is often risky, and high exit costs will increase the option value of postponing growth attempts.

One interesting observation concerned the role of SME interest groups in maintaining and reinforcing many barriers to growth. Such groups often favour policies tailored to *small* but not *rapidly growing* firms. If too much attention is

given to these groups, governments could unwittingly reinforce some barriers to growth, e.g. regulatory barriers to entry.

Finally, one important barrier to growth is, quite simply, lack of demand. It was noted that, according to recent surveys in the UK, growth-oriented innovative firms considered weak demand to be more of an obstacle to growth than lack of financial resources.

This observation sparked a lively discussion on the role that the public sector could play as a lead user to innovative growth firms, thereby operating as a source of demand, especially during times of economic recession. It was concluded that, although governments have a potentially important role to play in this regard, care should be taken to avoid mistakes. It was emphasised that an effective procurement policy involves:

- Acting as a lead user of innovative – and thus often high-risk – products (the Innovative Procurement Programme of Tekes was mentioned as an example of good practice);
- Complementary measures to facilitate market creation – again for innovative products and new markets (the SBIR and DARPA programmes of the US were mentioned as examples);
- Government participation in risk sharing;
- Learning from best practices elsewhere – but also from failures.

The discussion on demand-side policies concluded with a wide-ranging debate on fiscal incentives to promote rapid growth. Fiscal incentives could be designed, for example, to facilitate capital accumulation in growing firms, thereby strengthening the capacity of innovative firms to finance their growth. There could also could be fiscal incentives to invest in R&D, or fiscal incentives favouring retained earnings if these are reinvested in company growth. Experience in the Netherlands suggests that fiscal incentives are more effective than tax subsidies, but evidence elsewhere is mixed. Such incentives should thus be implemented with caution, with adequate systems in place to monitor and evaluate effectiveness.

Supply-Side Policies

Supply-side policies and support measures were extensively covered in the background paper and the discussion on this topic was thus briefer than that on demand-side policies. The main point of interest concerned the role of government in facilitating and supporting early-stage venture capital, as discussed earlier. Another interesting policy idea concerned fiscal incentives to permit the carry-over of interest on venture capital funds to facilitate the formation of venture capital industries. Incentives to encourage innovative firms to grant non-exclusive licenses was also mentioned as a potential mechanism to facilitate the access of innovative growth firms to new technologies.

Main Lessons

Drawing on the background document and the presentations and discussions during the Mutual Learning Seminar, the following overarching lessons

concerning support for innovative, high growth firms are likely to be of interest to the member governments of ERAC:

- *A systemic* approach is needed when designing growth-facilitating policy frameworks. An explicit focus on National Systems of Entrepreneurship, for example, calls for policies to be orchestrated across a wide range of policy departments (e.g. education, science, labour etc.);
- Innovation needs to be defined in a broad sense. In addition to technological innovation, innovative growth policies also need to cover service innovation, particularly Business Model Innovation;
- Governments should remember that innovative growth firms include all kinds of firms – including young and old; small and large; independents and subsidiaries; and low-, medium- and high-technology companies – and policy frameworks should encompass all of these;
- Comprehensive and complementary sets of both supply-side and demand-side policies are needed when developing growth-oriented policy frameworks. When implementing such frameworks, it is important to pay attention to the removal of unnecessary barriers to growth;
- 'Motivation', 'Ability', 'Legitimacy', 'Market Access', 'Resource Access' and 'Appropriability' were identified in the background paper as key drivers of high-growth. Growth-oriented policies and support measures should be designed to heighten motivation, reward ability, enhance market access etc.;
- It is important to identify gaps in policy frameworks by mapping policies and support measures against firm-level growth drivers;
- Indicators capable of highlighting the strengths and weaknesses of National Systems of Entrepreneurship are complementary to existing indicators of the performance of National Systems of Innovation.

Appendix 1: Agenda

EUROPEAN COMMISSION
DIRECTORATE GENERAL FOR RESEARCH AND INNOVATION

Directorate C - Research and Innovation

2012 ERAC mutual learning seminar on research and innovation policies

Time: **24 January 2012, 9:00-17:00**

Place: **European Commission, Berlaymont building, Walter Hallstein room**
Brussels, rue de la Loi 200

The Commission presented the 2012 Annual Growth Survey[i] on 23 November 2011. It calls on Member States to give priority to growth-friendly expenditure (such as education, research and innovation) when carrying out fiscal consolidation. At the same time it puts emphasis on other growth-enhancing policy measures, which requires combining short-term macro-economic fixes with longer-term structural policies for spurring EU's economic growth.

In this context, the aim of the 2012 ERAC mutual learning seminar is to stimulate discussion amongst Member States about the ways in which research and innovation policies can contribute to the enhancement of economic growth and competitiveness. Three growth paths based on research and innovation will be presented and discussed during the day. The outcome is expected to guide national policy makers when adapting their reform agendas in line with Europe 2020 objectives.

Opening session

8:30-09:00 *Registration & coffee*

09:00-09:10 Welcome and introduction

- **Clara de la Torre**, Director, Research and Innovation, DG Research and Innovation, European Commission

09:10-09:30 Opening address: ***Putting research and innovation policy at the heart of Europe's future growth***

- **Máire Geoghegan-Quinn**, European Commissioner for Research, Innovation and Science

Session I

Improving the Performance of the Science Base in Europe and the Role of the ERA

- *What are the main factors limiting the performance of the science base in national and EU settings?*
- *What policies should be implemented at a national level to improve performance?*
- *What policies should be implemented at a cross-border/EU level?*

09:30-09:40 Presentation by the moderator of Session I

- **Ken Guy**, Wise Guys Ltd. (Replaced by **John Smith**)

09:40-10:15 Discussion panel

- **Krysztof Gulda**, Director at the Ministry of Science and Higher Education of Poland
- **Andrea Ruyter-Petznek**, Federal Ministry of Education and Research of Germany
- **John Smith**, Deputy Secretary General of the European University Association
- **Mariana Mazzucato**, Professor of Economics and RM Phillips Chair in Science and Technology Policy, University of Sussex, SPRU

10:15-11:00 General discussion

11:00 -11:30 *Coffee break*

Session II

Combining supply- and demand-side measures to stimulate business investments in new technologies and innovative products

- *What are the main factors limiting the application of combined supply and demand policies to stimulate business investment in new technologies and innovative products?*
- *What policies should be combined and implemented at a national level to stimulate investment?*
- *What policies should be implemented at a cross-border/EU level?*

11:30-11:40 Presentation by the moderator of Session II

- **Lena Tsipouri**, Professor at the University of Athens

11:40-12:15 Discussion panel

- **Arie van der Zwan**, Ministry of Economic Affairs, Agriculture and Innovation of the Netherlands
- **Johan Stålhammar**, Ministry of Enterprise, Innovation and Industry of Sweden
- **Jakob Edler**, Professor of Innovation Studies, Manchester Business School
- **Alan Hughes**, Professor of Enterprise Studies at the University of Cambridge and Director of the Centre for Business Research

12:15-13:00 General discussion

13:00-14:30 Lunch buffet

Session III

Removing bottlenecks to the growth of innovative firms

- *What are the main factors limiting the growth of innovative enterprises?*
- *What policies should be implemented at a national level to stimulate their growth?*
- *What policies should be implemented at a cross-border/EU level?*

14:30-14:40 Presentation by the moderator of Session III

- **Erkko Autio**, Professor, Imperial College London Business School

14:40-15:15 Discussion panel

- **Antonello Lapalorcia**, Director, Ministry for Economic Development of Italy

- **Risto Setälä**, Director - Growth Companies, Finnish Funding Agency for Technology and Innovation (Tekes)
- **Reinhilde Veugelers**, Professor at Katholieke Univeriteit Leuven, Bruegel
- **Gordon Murray**, Professor of Management (Entrepreneurship), University of Exeter Business School

15:15 -16:00 General discussion

16:00 -16:15 Coffee break

Concluding session

16:15-16:45 Main messages to emerge from the discussions - Summary by the moderators

16:45-17:00 Conclusions

- **Pierre Vigier**, Head of Unit, Economic analysis and indicators, Directorate Research and Innovation, DG Research and Innovation, European Commission

Background material distributed prior to seminar:

- *Improving the Performance of the Science Base in Europe and the Role of the ERA*, by Ken Guy
- *Combining supply- and demand-side measures to stimulate business investments in new technologies and innovative products*, by Lena Tsipouri
- *Removing Bottlenecks of Growth for Innovative Firms*, by Erkko Autio

Appendix 2: The Commissioner Geoghegan-Quinn's Opening Address

ERAC mutual learning seminar on Research and Innovation Policies

24 January 2012 (Walter Hallstein Room, Berlaymont)

"Putting research and innovation policy at the heart of Europe's future growth"

Ladies and gentlemen, dear colleagues,

A year ago almost to the day, I had the pleasure to close the first ERAC mutual learning seminar organised under the new Europe 2020 strategy.

At that time, the focus was on fiscal consolidation, albeit "smart consolidation", protecting, where possible, investment in research and innovation, and other growth-enhancing areas.

Today, public finances are still a major focus. But there's a change of emphasis. People recognise that, vital though it is, fiscal discipline isn't enough to solve Europe's problems. It must be complemented by action for growth.

That's what the Heads of State and Government will be talking about at the European Council next week. They will take as their basis the Annual Growth Survey – or AGS - adopted on 23 November 2011, in which the Commission issued clear policy guidance to Member States as part of the EU's anti-recession strategy.

The European Council will certainly underline the importance of structural reforms, like opening up closed professions, pressing ahead with the single market for services and the digital single market. As a liberal politician, and the Innovation Commissioner, I am firmly behind this agenda. Competition, I believe, is the greatest spur to innovation. And market opening is particularly critical for another reason – because it allows high-growth, highly innovative firms to flourish.

In the past, firms grew slowly and came to dominate markets for many decades. Now, we're seeing a new breed of company, able to grow so rapidly that they quickly become world leaders, able to generate disproportionately large numbers of jobs.

This is a fascinating phenomenon which is happening throughout the world, but sadly, not enough in Europe.

This has massive implications for policy. It hasn't received sufficient attention so far. If we're serious about growth, we've got to back these precocious upstarts.

That means creating a more attractive environment for venture capital, getting banks lending to smaller, riskier firms again, increasing SME participation in funding programmes, as we are determined to do in Horizon 2020 and making sure that a greater proportion of procurement budgets are spent with the so-called "gazelles."

This is still an important area of economic research and I am very glad that Dr. Erkko Autio will introduce you to the subject and highlight the particularities of the policies that can support these highly dynamic firms on which our future jobs and prosperity depend.

Of course, there is one supply side reform which is still not mentioned enough. Yet, its impact is potentially enormous. Indeed, I believe it is one of the biggest contributions we can make to Europe's growth agenda. I am talking, of course, about ERA.

Europe undoubtedly needs to get better at transforming its scientific knowledge into products and processes. This is a key priority for the Commission and the Member States – and rightly so. But we mustn't assume that knowledge transfer is our only problem. We mustn't be complacent about the strength of our science base.

In fact, Europe has a deficit e vis-à-vis the US, not in terms of scientific publications per se, but at the very upper end of quality, particularly in fast moving new fields – indeed, precisely those fields where the US has been most able to generate research-based growth.

And, of course, the competition is intensifying all the time, as China and other emerging economies enter the race. In an increasingly globalised and competitive research landscape, only genuine world class excellence can cut it – and we in Europe need more of it.

No one would disagree with this. But we must do more than pay lip service to the idea of excellence. If we're serious about it, we have to ask our selves some pretty tough questions. For example:

- Is it making the best of our excellent researchers when only a handful of research programmes in Europe are open to non-national research teams?

- Why, in some Member States, is only a very small percentage of research funding allocated on an open, competitive basis?

- How can we make recruitment more transparent so that our universities and research institutions don't act as closed shops to new and younger talent?

- How can we make funding more portable so that top scientists can work with other great minds in their fields, no matter what country they happen to be in?

- How can we justify a situation where the useful results of excellent research funded by taxpayers are not freely available to be exploited by others who can use them as a basis for innovation?

I am a practical politician. For me, ERA is not an end in itself, but the means of generating more research excellence in Europe, and ultimately more economic growth.

Just as the single market for goods, services and capital has improved the competitiveness of our industries, ERA will boost the competitiveness of our research system.

That's why I am so committed to putting in place the measures necessary to complete it by 2014.

Equally, I want to see excellence developing in places it has not existed up to now. ERA can help to spread excellence by triggering a process of "smart specialisation", with more regions and universities thinking critically about where their strengths lie and choosing to focus on those areas. The European Commission is committed to supporting this process, both through Horizon 2020, the proposed new instrument for research and innovation funding at the European level, and by developing the synergies between the Structural Funds and Horizon 2020.

And in this light, I would like to thank Ken Guy, whom I also congratulate for his new position as lead innovation expert in the OECD, for bringing us up-to-speed on how to increase the efficiency of the European science base.

Ladies and gentlemen,

While there is lot to do on the supply side, our policies on the demand side are even more underdeveloped.

This acts as a major brake on business investment in research and innovation. Companies simply won't invest unless they are reasonably confident that there will be a sizeable market for the products of their research.

So, we need to correct this imbalance between the two, and we also need to make sure they are better co-ordinated.

Otherwise, results may fall short of expectations. For example, while policies created a massive demand for solar cells in Europe, the failure to match these with appropriate supply-side measures meant that other economies seized the manufacturing opportunities presented.

You will discuss later this morning the range of policies that need to be addressed and how to combine them with public funding into integrated strategies. I would like to thank Dr Lena Tsipouri for leading us through the intricacies of the subject.

But let me address one point in particular. Innovation Union proposes that the EU and its Member States commit to increase public procurement of innovation to 10 billion Euro per year by 2020. I believe that this is a vital instrument to stimulate business investment in research and innovation. More Member States need to develop the policies necessary to reach that goal.

Liberals like me tend to downplay the role of government. But I have seen how our competitors use procurement as a lever for innovation. Even in the free-wheeling American economy, government plays a strategic role. The Canadians and others are following their lead. We mustn't get left behind.

Ladies and gentlemen,

After your work today, I am counting on you to brief your respective Ministers on the outcome of your discussions, because this seminar and the ERAC opinion that will shortly be adopted lie at the core of the top-level discussions that will take place at the European Councils on 30 January and 1 and 2 March.

The essential questions for every policy-maker in the field of research and innovation are: Where and how to allocate public funding efficiently? How to formulate and implement a consistent set of policies? And, whom to target to maximise the impact on growth and jobs in the long run?

I trust that this seminar will help you to answer these questions by learning from the experience of others. I hope that this proves useful and that you can put that knowledge into practice when you update your National Reform Programme later this year.

For my part, I expect that your work today will strengthen the evidence and insight necessary for developing effective policy guidance at EU level. The outcome of this seminar will serve as an important input to the ERAC opinion on the Annual Growth Survey that is being prepared by Dr Jana Kolar, whom I would like to thank for her efforts.

I wish you a successful and stimulating seminar!

Thank you.

Appendix 3: The Background Papers

(1) Improving the Performance of the Science Base in Europe and the Role of the ERA

Ken Guy

Introduction

The Commission presented the 2012 Annual Growth Survey on 23 November 2011. Its key message was that Member States had not done enough to enact the measures they had committed to at EU level, and it included a list of pending or future proposals that the Commission wants to be fast-tracked through the EU legislative process, all aimed at boosting growth. In particular, it called for the EU and Member States to focus on five priorities in the expectation that this would help leverage reform:[8]

- Pursuing differentiated, growth-friendly fiscal consolidation;
- Restoring normal lending to the economy;
- Promoting growth and competitiveness;
- Tackling unemployment and the social consequences of the crisis;
- Modernising public administration.

The main aim of the 2012 ERAC Mutual Learning Seminar is to stimulate discussion about the ways in which research and innovation policies can contribute to the enhancement of economic growth and competitiveness. The outcome will help guide policies capable of realising the Europe 2020 strategy. In terms of the historical development of these policies, the focus on innovation is now keener than ever due to the relevance of innovation to a multitude of societal goals (economic, social, cultural, environmental etc.), and to the perceived importance of smart fiscal consolidation in the aftermath of the financial crisis, which prioritises growth-friendly expenditure in areas such as education, research and innovation. This focus, however, is unlikely to last if the performance of national and European innovation systems fails to improve. It is imperative, therefore, that measures are put in place at both Member State and EU levels that ensure improvements in overall system performance.

This will require improvements in:

- All the sub-systems of national and EU innovation systems (e.g. the human resource base, the science base, industrial innovation and market demand);

[8] European Commission (2011), 'Annual Growth Survey 2012', Communication from the Commission, COM(2011) 815 final. http://ec.europa.eu/europe2020/reaching-the-goals/monitoring-progress/annual-growth-surveys/index_en.htm

- In the linkages between these various sub-systems within individual innovation systems (e.g. between the science base and industrial innovation);
- In the synergistic cross-border meshing of sub-systems within the overall EU innovation system;
- In the structures and processes that govern the functioning of all sub-systems and their interaction, within both national and EU innovation systems.

The 2012 ERAC Mutual Learning Seminar focuses on three topics considered essential to the improvement of overall system performance:

- The efficient functioning and operation of the science base;
- The combined use of supply and demand instruments to promote business investment in research and innovation;
- The removal of bottlenecks to the growth of innovative enterprises.

The main purpose of this paper is to stimulate discussion within the 2012 Mutual Learning Seminar about ways of improving the performance of the science base, both at Member State level and at EU level via the continued evolution of the European Research Area (ERA).

Improving Performance

Most public expenditure on research and innovation is directed towards the science base, i.e. towards higher education institutions (HEIs) and other public sector research organisations (PROs) such as government labs and academies of science. It is important, therefore, that the science base performs efficiently and delivers value for money via the transformation of financial and human resource inputs into desirable outputs. This calls not only for improvements in the performance of the research community, but also in the way in which research funding bodies administer the allocation of funds nationally and internationally via cross-border mechanisms.

Policies that improve the performance of the science base are thus those that both maximise inputs and improve the efficiency of the transformation process. Moreover, given the need for the science base to link effectively with other sub-systems of innovation systems in order to improve overall system performance, policies facilitating such linkages are also needed.

In the sections that follow, some of the policy steps needed to improve the performance of the science base are discussed, together with the main questions that policymakers in Member States should be considering when deciding on policy priorities. They are discussed under the following headings:

- Ensuring inputs;
- Funding mechanisms;
- Structural reform;
- Improving outputs;
- Facilitating linkages.

A final section then summarises policy priorities and comments further on the levels at which action is needed.

Ensuring Inputs

Strengthening and communicating arguments

In a period of scarce resources and great competition for public funds from other quarters, the first priority for all Member States involves **strengthening the arguments for a continued focus on support for the science base**, while the second involves **communicating these effectively to Finance Ministries**. Reference can be made to a voluminous body of material linking investment in science and research to increased innovation and various aspects of economic performance such as competitiveness, productivity and employment. The links are complex and certainly not straightforward, but the evidence for positive associations is convincing.[9] Reference can also be made to the recent work of Mazzucato (2012), which provides strong evidence that public funding can play a key role in stimulating industrial innovation.[10]

Policy developments in other countries that emphasise the importance of investment in the science base and innovation generally can also be referenced as examples of the way forward, especially in terms of climbing out of recessions. One historical example is Finland's focus on the development of an IT-fuelled knowledge society as a way out of the recession in the early 1990s. This paralleled the earlier private sector efforts of Japanese semiconductor manufacturers in the 1980s, who continued to invest in R&D during economic downturns in order to come out ahead of the opposition as growth prospects improved. More recently, both the UK[11] and the US[12] have demonstrated their commitment to research and innovation via the production of evidence and analyses designed to underpin future strategies.

It is also worth noting that, according to the Industrial R&D Scoreboard's latest assessment,[13] EU-based firms are likely to increase investment in R&D in the near future, with the implication that the public sector needs to keep pace if it is to remain an effective partner and source of inspiration for industrial innovation.

Key questions for Member States and for discussion during the 2012 ERAC Mutual Learning Seminar are:

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[9] A brief summary can be found in European Commission (2010), 'A Rationale for Action', Commission Staff Working Document, SEC(2010) 1161 final.http://ec.europa.eu/research/innovation-union/index_en.cfm?pg=keydocs

[10] Mariana Mazzucato (2011),'The Entrepreneurial State', Demos: London

[11] See Innovation and Research Strategy for Growth (PDF, 1.1 Mb) and the accompanying Economics paper: innovation and research strategy for growth (PDF, 2.4 Mb).

[12] See http://www.commerce.gov/americacompetes

[13] See http://iri.jrc.es/research/scoreboard_2011.htm

- Does the case for public support for research and innovation need to be strengthened in your country?
- What new evidence can be brought to bear on the issue?
- What arguments have you used that other Member States might find useful?

Maintaining levels

Policies that attempt to improve value for money via the enhanced performance of the science base are essential, but their impact is likely to be masked if they are accompanied by reduced budgets for research and innovation. **Maintaining or even increasing financial inputs will be necessary in order to maximise the perceived impact of efficiency improvements**, though increases will probably need to be accompanied and supported by cost-benefit analyses.

Key questions for Member States include:

- Are planned inputs adequate?
- Have any cost-benefit analyses been performed?
- What tactics have you used that other Member States could use to maintain or increase science base budgets?

Improving human resources

In most Member States, **improvements are needed in the supply, quality and mobility of adequately qualified scientific and technological personnel**. This requires investment in educational infrastructures and programmes and determined efforts to improve the attractiveness of science and engineering disciplines. It also requires an increased focus on mobility across borders. Increased mobility and the greater interaction of research-related personnel are increasingly seen as routes to the creation of dynamic networks, improved scientific performance, improved knowledge and technology transfer, improved productivity and ultimately enhanced economic and social welfare.[14]

There is a broad divide, however, between countries that have embraced the concept of 'brain circulation' and those that have not. Countries with strong research systems tend to have higher levels of both inward and outward mobility than those with weak systems and typically acknowledge the benefits of 'brain circulation' and increased mobility. In countries with weaker research capacities, the potential for deleterious 'brain drain' is greater and the attractions of 'brain circulation' less immediately obvious, though the benefits of the latter are increasingly being recognised in some quarters.

Without determined policy efforts, the gap between 'mobility winners' (i.e. those that have embraced the concept of 'brain circulation') and 'mobility losers' (i.e. those who have not) will undoubtedly widen.

In countries with strong research capacities, the policy emphasis needs to be on incremental changes, e.g. improved levels of research excellence along a broad front to attract mobile researchers and continued efforts to reduce the barriers

[14] See http://ipts.jrc.ec.europa.eu/publications/pub.cfm?id=3779

to both inward and outward mobility. In countries with weaker research capacities, the most important step will be to embrace the concept of 'brain circulation' rather than to resist it. More focused policy efforts will then be needed to improve research capacities in specific, narrow areas rather than across the board, and these efforts will need to be complemented by targeted policies promoting mobility via, for example, a focus on improved opportunities for young researchers and greater incentives for emigrant researchers to return home.

Key questions for Member States include:

- Are indigenous supplies inputs of human resources enough to meet demand?
- Is there a net drain brain?
- Are the benefits of 'brain circulation' adequately recognised?

Funding Mechanisms

Rationalising funding structures

There is an overwhelming need **to rationalise research funding structures via a greater emphasis on simplification and cross-border funding**.

Simplification is needed at many levels. Variations in procedures occur between funding bodies within national systems as well as between funding bodies at national, multi-national and EU levels. A greater emphasis needs to be placed on simpler, trust-based systems that acknowledge the inherent riskiness of research. Moreover, given that EU funding is accessible to researchers in all Member States, there is obvious scope for simplified EU procedures to provide a template for national bodies.

Common procedures would also facilitate the increased rationalisation of funding structures in the EU via an increased emphasis on cross-border funding mechanisms. These have obvious benefits in terms of the pooling of resources, the reduction of duplication and the matching of researchers' demands with financial supplies. Experiences with ERA-NETs and other forms of joint programming have shown the way and partially satisfied demand, but there is still much to be done to reduce the barriers to cross-border money flows in particular.

Key questions for Member States include:

- Are there any examples of simplified procedures that deserve to be shared with other countries?
- Is there any evidence that cross-border funding structures have led to marked benefits for both research administrations and researcher communities?
- What needs to be done to reduce the barriers to the further cross-border rationalisation of funding structures?

Structural Reform

Modernisation of the HEI and PRO systems

Modernisation of the higher education institution (HEI) system has been promoted for many years, especially in terms of improving research conditions and facilities and promoting the formation of critical masses of research excellence. Progress across the EU has been highly variable, however. Some countries have made significant advances in terms of the introduction, for example, of greater autonomy in the setting and realisation of priorities and transparent accounting regimes that facilitate the accurate costing of research, while changes in other countries have been minimal.

Similarly, there has been mixed progress in the reform of the public research organisation (PRO) sector. Privatisation has been embraced in some countries, and true competition for resources has replaced allocation systems based on historical precedent in others, but the rate of change has been very slow elsewhere.

There is an overwhelming need, therefore, to reassess existing modernisation strategies and accelerate the rate of progress.

Key questions for Member States include:

- To what extent has the modernisation agenda been realised?
- What are the bottlenecks to further progress?
- What lessons can be learned from experiences in other countries?

Access to advanced research infrastructures

Access to advanced research infrastructures is needed in many scientific areas in order to catalyse knowledge generation and facilitate the networking of researchers, but they are costly to develop and beyond the reach of many individual countries unless there is a significant cross-border pooling of resources. Major steps have been taken in Europe along this path, with the establishment of the European Strategy Forum on Research Infrastructures (ESFRI), the formulation of a roadmap and a new EU legal framework for a European Research Infrastructure Consortium (ERIC), adopted by the EU Council in 2009. Maintaining momentum in a period of fiscal restraint, however, will be difficult and determined efforts will be needed to safeguard commitments and find new funding mechanisms.

Key questions for Member States include:

- To what extent is funding for investment in new research infrastructures threatened?
- How can it be prioritised?
- What alternative funding mechanisms can be explored?

Improving Outputs

Improvements in research excellence and productivity

Compared to the US, the EU public research sector underperforms in both the quantity of scientific publications per researcher and the quality of output.[15]Concerning quantity, the average number of publications per year per researcher in the US public sector was 1.54 in 2007 compared to 0.70 in the EU. Concerning quality, the US share of scientific publications in the top 10% of cited publications worldwide in 2007-9 was 15.3%, versus 11.6% for the EU.

One explanation could be the relative resources available to researchers. Although there are fewer public sector researchers in the US than in the EU, funding levels per researcher in the US are more than twice as high as those in the EU. Whatever the reason, however, **public sector research performance needs to improve in both quantitative and qualitative terms**.

Key questions for Member States include:

- What are the factors constraining the performance of public sector researchers in your country?
- What steps are being taken to tackle the problem?
- What steps need to be taken at EU level?

Competitive research funding

One way of improving research performance is to stimulate the proportion of funding available to both individual researchers and institutions via competitive research funding structures that emphasise excellence as a key selection criterion. Non-competitive allocation mechanisms have their merits, especially in terms of providing 'core' or 'baseline' funding for research institutions and the researchers within them – which is especially useful for the establishment of long-term research capability – but competitive structures are frequently needed to stimulate excellence.

The balance between funds available on competitive and non-competitive bases varies significantly from one country to another, and there is little evidence available to indicate what the correct balance should be in any particular context, but to improve overall research performance, **there is little doubt that a greater emphasis on competitive research funding is required in most settings**.

Key questions for Member States are:

- What is the balance between competitive and non-competitive funding sources in your country?
- Is there any evidence that a greater emphasis on competitive funding would improve overall research performance?

[15] European Commission (2011), Innovation Union Competitiveness Report. http://ec.europa.eu/research/innovation-union/index_en.cfm?section=competitiveness-report&year=2011

- What are the barriers to the introduction of more competitive research funding structures and how can they be overcome?

Relating funding to performance

A related way of improving research performance is to link the allocation of research funding to past performance. At the level of individual researchers, track records have long influenced funding decisions either explicitly or implicitly, but the allocation of public funds for research to institutions based on their performance in explicit research assessment exercises is still a relatively new development and certainly not widespread across the EU. Even rarer are allocation mechanisms that relate research funding levels to successful valorisation activities, e.g. to the existence of collaborative links with industry, evidence of technology transfer and spin-offs, returns from IPR and licensing agreements etc. One way of improving this situation would thus be to **place a greater emphasis on allocation systems that relate research funding levels to performance levels and valorisation activities**.

Key questions for Member States are:

- Is the allocation of research funds to institutions linked to past performance in your country?
- Is there any evidence that a greater emphasis on such allocation systems would improve overall research performance?
- What are the barriers to the introduction of performance-related funding structures and how can they be overcome?

Facilitating linkages

Improved linkage structures and processes

Improvements in the performance of the science base, especially in terms of the ratio between outputs and inputs (i.e. a measure of the efficiency of the science base), are essential, but they will not in themselves be enough to improve the overall efficiency and performance of the encompassing innovation system. For this to occur **improved linkage, transfer and valorisation structures and processes are needed**.

Many countries have long-established mechanisms linking research and innovation activities, ranging from collaborative R&D and technology transfer programmes through attractive IPR regimes and support for university spin-offs, but in other Member States these links are still fragile and often exacerbated by governance systems that separate rather than unite the research and innovation worlds.

Key questions for Member States are:

- Is enough being done to ensure there are adequate linkage mechanisms in place?
- Do governance systems need to be reformed?
- What can be learned from other countries?

Increased relevance to societal goals

One way of increasing the potential contribution of research to the overall performance of innovation systems and to the socio-economic systems within which they operate is to **place a greater emphasis on research perceived to be of relevance to societal goals**.

In essence, this implies that a greater proportion of available funding should go to projects and research areas that satisfy not only excellence criteria, but also relevance criteria. Frequently there is resistance to this idea within the research community on the grounds that the future utility of many research lines of enquiry is difficult to assess in advance, with some leading to unforeseen but tremendously useful and beneficial consequences many years downstream. But in reality considerations of relevance have long influenced the funding behaviour of research funding agencies, with money increasingly allocated to programmatic areas rather than available to all researchers independent of their disciplinary backgrounds or interests.

Gearing allocation systems totally towards societal relevance would undoubtedly face great resistance from the scientific community, but skewing them in this direction is warranted when financial resources are limited and there is an overwhelming need for innovation system performance to improve.

Key questions for Member States are:

- To what extent is research funding already governed by considerations of societal relevance?
- What scope is there for increasing the relevance of research funding towards societal goals
- How could this be done?

Clusters and smart specialisation

Conglomerations of research and innovation actors and the links that develop between them can lead to the formation of innovation hotspots and regional growth poles, and many policy efforts over the past thirty years have attempted to catalyse their development, though with varying degrees of success.

Overall, however, there has been a tendency for the number of research and innovation hotspots in the world to rise as scientific and technological competences and market potential increase dramatically in countries such as the BRICs.[16] In parallel, another tendency has been for the size of successful hotspots to increase, while other 'ex-hotspots' decrease in size as firms relocate to stronger clusters and foreign locations. One potential outcome for the EU is that some hotspots will grow stronger while the overall number of hotspots shrinks.

The emergence of strong clusters in some regions at the expense of a corresponding decline in the number and strength of clusters in other regions

[16] Ken Guy (2011), 'Drivers of Change: The main drivers of change affecting the research and innovation landscape and their implications for EU policy', IPTS: Seville

could lead, eventually, to a divide between 'innovation-rich' and 'innovation-poor' regions, and 'smart specialisation' strategies are needed to counter this. The logic of cluster development argues for the heterogeneous concentration of activities in a limited number of regions and against the development of homogenous 'look alike' competence profiles in all regions. There is considerable potential, however, for clusters differentiated along thematic or sectoral lines to be distributed across multiple regions in such a way that all regions have distinctive but complementary competence profiles.

Smart specialisation strategies are needed to involve science base actors in the development of innovation hotspots, clusters and regional growth poles, but this will involve considerable consultation, coordination and negotiation across borders if the term 'smart' is to be deemed appropriate.

Key questions for Member States are:

- Have any cluster strategies been successful?
- To what extent can they be considered as examples of 'smart specialisation'?
- What needs to be done at EU level to facilitate the development of 'smart specialisation' strategies?

Cross-border research markets

One of the appealing aspects of the European Research Area (ERA) is its vision of a truly cross-border research market within the EU that would facilitate the 'Fifth Freedom' i.e. the free movement of knowledge in addition to the classical free movement of goods, services, capital and labour.[17] The evolution of the ERA involves developments along many fronts, not least the removal of barriers to mobility, the evolution of joint funding structures and shared research infrastructures, but it also involves many steps designed to improve links between the science base and the realisation of innovative potential. These include improved IPR regimes, codes of practice for research institutions and universities, and innovation-friendly standards, regulations and procurement practices.

Initial progress in the development of the ERA was slow, however, and this led to the development of the EU2020 Vision, the Innovation Union Communication and plans for **the development of a coherent legal and administrative framework for research in Europe, the ERA Framework, to facilitate the creation of a truly cross-border research market within the EU**. In turn, however, this raises many questions about the form and content of measures within the framework designed to improve the links between the science base and innovation.

Key questions for Member States are:

- What are the main barriers to the development of cross-border research markets?

[17] The need for a 'Fifth Freedom' relating to research was first raised by Commissioner Potočnik in a speech in April 2007.

- What measures can be used to link national science bases with business innovation across Europe?

Summary and Conclusions

The steps needed to improve the performance of the science base and its links with the performance of both national and EU innovation systems are many and varied. Priorities in different national contexts are also likely to differ widely.

The questions raised in this document are designed to stimulate discussion about the way forward for both individual Member States and for the EU as a whole.

An important step involves understanding the strengths and weaknesses of individual national innovation systems via an analysis of all relevant factors and indicators. Another involves an appreciation of the range and nature of appropriate policy options, both theoretically and pragmatically. This demands an element of comparative analysis, comparing practices in other countries with their potential use in indigenous contexts, and mutual learning.

The self-assessment tool suggested by the Commission in the Innovation Union Communication can be used to ascertain relative positions and progress along dimensions likely to improve the overall health of innovation systems, but the exact mix of policies needed in individual settings will be context-dependent.

Reviewing the ground covered in this document, however, it is apparent that many of the steps needed are best taken together within the framework of the continued evolution of the ERA. An important question for both Member States and the Commission, therefore, is how these steps can best be implemented.

(2) Combining supply- and demand-side measures to stimulate business investments in new technologies and innovative products

Lena Tsipouri

Introduction

Interventions to stimulate business investments in new technologies and innovative products have emerged massively after the seminal contribution of Arrow (1962) explaining that market failures were leading to socially sub-optimal investments in R&D. Initially the rationale of the linear model led to focusing on supply-side measures reducing financial risks for companies. Soon after that the idea of demand-led measures challenged the effectiveness of supply measures and triggered the supply-push and market-pull debate in theory and in policy experimentation. This interaction of theory and policy (Mytelka et al. 2002) has co-evolved and produced new forms of reconciliation between the two.

In a nutshell, forms of public support for private innovation activities can thus be divided into:

- Instruments providing additional inputs for private innovation processes thus supporting the supply side with the public provision of resources, which can take a direct (e.g. research and innovation grants, subsidised loans) or an indirect form (e.g. tax incentives, access to publicly funded scientific knowledge) and
- Instruments influencing the creation of public (e.g. public procurement) or the stimulation of private markets (e.g. subsidise users to demand innovative products) which improve business expectations and hence create incentives that trigger innovation outputs.

Supply-side measures have dominated the scene for most of the time but a resurgence of the relevance of the demand-side can be observed since the late '90s with emphasis in public procurement for innovation and product market regulation/standards.

In the following we give a brief overview of the two types of measures, discussing demand-side in more detail, as this is the emerging and policy-wise the more difficult area to address. Then we discuss how the two can interact to compose a more effective policy mix.

Supply side-measures

Supply-side policies derive from the science and technology-push argument stipulating that advances in scientific understanding determine the rate and direction of innovation. Although the linear model, which gave birth to this argumentation, has long been abandoned these arguments consider that the underlying market (and systemic) failures and appropriability risks in particular need to be eliminated through public support. Dosi (1982) attributed the prominence of this line of reasoning to several "established" aspects of the innovation process: the increasing importance of science in the innovation process, increasing complexity which necessitated a long-term view, apparently strong correlations between R&D and innovative output, and the inherent uncertainty of the innovation process. However the technology-push argument is criticised as ignoring prices and other changes in economic conditions that affect the profitability of innovations. Later work offered a less deterministic version of the technology-push argument, while still emphasizing the role of science and technology (Nemet 2009).

Supply-side policies aim at reducing the cost (and by consequence the risk) to firms for investing in R&D&I. They include: government sponsored R&D, tax incentives for companies to invest in R&D, enhancing the capacity for knowledge exchange, support for education and training and funding of technology transfer. Supply-side policies have been very popular and constitute the overwhelming majority of interventions adopted in the EU member states ever since the conception of R&D&I policies. More than 95% of measures (in terms of numbers not budgets) included in the Erawatch – Trendchart inventory[18] constitute supply-side measures. They have the advantage of being relatively easy to conceive and manage and involve less risk for policy makers than demand-side interventions. R&D grants have been the first and most widespread type of intervention at the beginning rapidly complemented with efforts to build university-industry cooperation bridges. Several schemes introduced in one country are rapidly adopted (with or without adaptations) through policy learning by other member states. Increasingly in the last two decades supply side measures are shifting away from direct, individual company grants towards R&D tax incentives and cooperation schemes (cluster and network creation) considering that these measures contribute to higher social returns of investment through higher externalities and diffusion, while at the same time diminishing distortions of competition. A wide range of variations of supply-side measures is now offered throughout the EU.

Critics of supply side policies address mainly their effect on competition, the risk that public spending may crowd-out private investment. (Goolsbee, 1998; David et al., 2000, Nemet, 2009). Criticism is enriched with specific case studies indicating that subsidies may under certain conditions decrease social welfare. Furthermore, when a percentage of the sale price is subsidized both the rhythm and final extent of diffusion may be reduced and the surplus of the innovation adopters may diminish. These results are especially relevant for diffusion policies as governments do not usually have information about the demand for

18 http://erawatch.jrc.ec.europa.eu/erawatch/opencms/research_and_innovation

the innovation and/or the new technology's production costs (Saracho et al.1994).

Demand side

Demand-side policies are those that can induce investment in technologies by enlarging markets for them. Rising expectations about future demand for new technologies increase the incentives for investments in innovation by enlarging payoffs to successful innovations. Typically demand-side policies are those addressing social concerns, where the state is an important user (public procurement) or needs to regulate markets (environment, radio-waves). In the case of social challenges, which address public goods (like climate change), there is a rationale for state intervention, which is not in contradiction with market and competition rationales.

The criticism of the supply side policies, success stories from the USA and Japan and the willingness of progressive policy makers to experiment with new alternatives have brought demand-side measures into the scene. This has practically happened in two waves, one in the early years of science and research policy and then a renewed interest in the last decade coupled with the need to address societal challenges, often global in nature, which form new markets for innovative goods and services. Energy, climate change, health services and e-government are important areas, where an early and insightful market creation can be of paramount importance for innovation. In the first wave a review concluded that demand side is not necessarily more effective than supply (Mowrey et al. 1979).

Unlike the technology push argument demand-pull proponents argue that demand drives the rate and direction of innovation. "Changes in market conditions create opportunities for firms to invest in innovation to satisfy unmet needs. Demand steers firms to work on certain problems (Rosenberg, 1969). Shifts in relative factor prices (Hicks, 1932); geographic variation in demand (Griliches, 1957); as well as the identification of "latent demand" (Schmookler, 1962, 1966); and potential new markets (Vernon, 1966); all affect the size of the payoff to successful investments in innovation. Critics of the demand-pull argument attacked it on three grounds. Methodologically, the definition of "demand" in empirical studies had been inconsistent and, overall, was considered too broad a concept to be useful (Mowery and Rosenberg, 1979; Scherer, 1982; Kleinknecht and Verspagen, 1990; Chidamber and Kon, 1994). A second line of criticism refers to the type of innovation triggered by demand-side policies (Mowery and Rosenberg, 1979; Walsh, 1984). A third angle addresses the arguments' assumptions concerning firm capabilities, expressing scepticism about: (1) how effectively firms can identify "unrevealed needs" from an almost infinite set of possible human needs; (2) the extent to which firms in general have access to a large enough stock of techniques to address the variety of needs that could be expected to emerge; and (3) how far firms might venture from existing "routines" in order to satisfy unmet demands (Simon, 1959; Nemet 2009).

Examples of government actions that raise the payoffs for successful innovations include: intellectual property protection, tax credits and rebates for consumers of new technologies, government procurement, technology platforms, lead market initiatives, regulatory standards and shares of research budgets earmarked for the development of alternative technologie[19]. Public procurement and standards are the most often encountered demand-side policies. Public demand, when oriented towards innovative solutions and products, has the potential to improve delivery of public policy and services, often generating improved innovative dynamics and benefits from the associated spillovers. Nonetheless, public procurement as an innovation policy has been neglected or downplayed for many years. Over longer time periods, state procurement triggered greater innovation impulses in more areas than did R&D. Geroski (1990, p. 183) analysed the quantitative and qualitative meaning of state demand for innovation and concluded that procurement policy "is a far more efficient instrument to use in stimulating innovation than any of a wide range of frequently used R&D subsidies". In a more recent survey of more than 1000 firms and 125 industry federations, over 50% of respondents indicated that new requirements and demand are the main source of innovations, while new technological developments within companies are the major driver for innovations in only 12% of firms (BDL, 2003; Edler et al., 2007) A major advantage of public procurement in innovation policy is that the government specifies a desired output and leaves it to the creativity of private businesses to achieve this result with the most effective and efficient technologies.

Despite the relevance and rationale of demand side, important barriers have hampered its development in the EU. Such barriers include (inter alia):[20]

- The lack of sophisticated demand tradition or incumbent 'national' industries dominating the domestic market;
- The reluctance or hesitation of policy makers to intervene in markets with insufficient information availability (mainly in the case of standards and procurement),
- The limited capacity to impose regulations autonomously, because of the necessity to harmonise most standards and regulations at European level,
- The lack of practical concepts and reliable tools regarding innovation procurement,
- The lack of support to lead market suggestions by industry, in case there are no adequate policy responses offering the necessary public funding to help such initiatives off the ground.
- The legal framework which is not adapted to the needs of these policies.

These barriers explain why demand side policies are more complex than supply-side measures to handle. Policy risks are higher because, in addition to the technological risk, policy makers need to anticipate the response of actors (e.g. in the case of tax incentives to consumers for purchasing innovative products). In

[19] The US DARPA and SBIR programmes are examples of such schemes

[20] These barriers are selected from the 2011 Trendchart Mini-reports submitted to the European Commission, DG Enterprise by the Network of Erawatch Country Correspondents

addition, in the case of procurement policies technical failures may be risky for procurers, who are not trained to use public purchasing as a means for innovation promotion. Regulation and standards have similar constraints in particular in association with responsibility to society and a trade off between early adoption of new standards (leading to first mover advantages) and health or other risks.

Overall demand-side measures have been rare in the EU and were only broadly discussed after the adoption of the Lisbon agenda, while in the USA they have been well developed since decades for radical technologies through DARPA and for incremental technologies through the SBIR. In the EU the Nordic countries were the first and are still more frequently using technology procurement in power generation and telecommunications, while Germany was a model country adopting regulations and standards that stimulated innovation in clean technologies. Since more emphasis has been put on demand-side policies, the Netherlands, Belgium and Estonia are the countries that have been more responsive to experiment with new ideas.

An overview of demand-side policies adopted in the EU may be summarised in the following conclusions:[21]

- Demand side policies are recent in all member states and they have been mostly triggered by a response to EU initiatives in the last five years. A period of discussion and maturing was necessary to learn and overcome barriers.
- Public procurement (more often in the form of pre-commercial procurement) and technology platforms are the most frequent types of demand-side policies adopted.
- The creation of new markets in the areas of environment-energy and e-government applications are the most often cited examples. However, very often these policies are triggered by different rationales (energy saving, clean technologies, public sector efficiency) and are not designed to increase private R&D (although they may). Public-private partnerships (often in biotech and health care) and technology platforms appear also as interesting case studies in a few member states.
- Few countries/regions can report active implementation of demand-side policies (Germany, Sweden, UK, Flanders, the Netherlands and the UK are the best-known examples). However, most other member states report that some kind of demand-side policy documents or discussions is launched and implementations are expected to start in the near future. Even in those member states where discussions of demand-side is limited energy and environment policies are increasing the European market for new technologies.

There is no universal agreement on a categorisation of demand-side policies. An operational taxonomy is introduced in the recent TC mini-reports, which includes:

[21] Ibid.

Demand side innovation policy tool	Short description
Public procurement	
Public procurement of innovation	Public procurement of innovative goods and services relies on inducing innovation by specifying levels of performance or functionality that are not achievable with 'off-the-shelf' solutions and hence require an innovation to meet the demand.[22]
Pre-commercial public procurement	Pre-commercial procurement is an approach for procuring R&D services, which enables public procurers to share the risks and benefits of designing, prototyping and testing new products and services with the suppliers[23].
Regulation	
Use of regulations	Use of regulation for innovation purposes is when governments collaborate broadly with industry and non-government organisations to formulate a new regulation that is formed to encourage a certain innovative behaviour.[24]
Standardisation	Standardisation is a voluntary cooperation among industry, consumers, public authorities and other interested parties for the development of technical specifications based on consensus. Standardisation can be an important enabler of innovation.[25]
Supporting private demand	
Tax incentives	Tax incentives can increase the demand for novelties and innovation by offering reductions on specific purchases.
Catalytic procurement	Catalytic procurement involves the combination of private demand measures with public procurement where the needs of private buyers are systemically ascertained. The government acts here as 'ice-breaker' in order to mobilise private demand.[26]
Awareness raising campaigns	Awareness raising actions supporting private demand have the role to bridge the information gap consumers of innovation have about the security and the quality of a novelty.[27]
Systemic policies	
Lead market initiatives	Lead market initiatives support the emergence of lead markets. A lead market is the market of a product or service in a given geographical area, where the diffusion process of an internationally successful innovation (technological or non-

22 NESTA (2007) Demanding Innovation Lead Markets, public procurement and innovation by Luke Georghiou

23 http://ec.europa.eu/information_society/tl/research/priv_invest/pcp/index_en.htm

24 FORA, OECD: New nature of innovation, 2009, http://www.newnatureofinnovation.org/

25 Commission Communication: Towards an increased contribution from standardisation to innovation in Europe COM(2008) 133 final 11.3.2008

26 Edler, Georghiou (2007) Public procurement and innovation – Resurrecting the demand side. Research Policy 36. 949-963

27 Edler (2007) Demand-based Innovation Policy. Manchester Business School Working Paper, Number 529.

	technological) first took off and is sustained and expanded through a wide range of different services[28].
Support to open innovation and user-centred innovation	Open innovation can be described as using both internal and external sources to develop new products and services29, while user-centred innovation refers to innovation driven by end- or intermediate users.[30]

Source: Technopolis and European Commission- DG Enterprise, TC mini-report guidelines 2011.

Evidence from the different categories (EW/TC database, TC mini-reports) suggests that public procurement and pre-commercial procurement are the areas most often used and experimented with in the member states. In particular procurement of innovation takes place in ICT applications (triggering radical technological changes in the Nordic countries in the past but also generating incremental innovation in adaptation and application of existing technologies in electronic IDs, voting systems etc.), environmental protection (recycling) and construction (again combined with environmental standards and climate change). Regulation is applied by larger member states and in particular in sectors like environmental protection and health, whereas standard setting has been more widely used, in particular since the proliferation of technology platforms and lead market discussions. The latter is treated in more detail in the next section, as it is often approached by a combination of demand and supply measures. There has been less experimentation in the support of private demand, in particular in the form of tax incentives inducing consumers and businesses to purchase innovative goods and services. The most widely used type of such tax incentives (or indirect subsidies) applies in the use of renewable technologies, but this refers to diffusion of innovation, while catalytic procurement, used typically for reducing prices and promote dominant designs, is used in cheap computers and other equipment in pre-paradigmatic phases. Support to open innovation and user-centred innovation is not frequent and in particular the support to open innovation is often combined with supply-driven measures for cluster creation. Awareness raising campaigns are the easiest type of demand-side measures.

Combining supply and demand

Combining supply and demand is crucial in Europe if the 3% target is to be achieved. Supply alone cannot generate the necessary resources, in particular in a time of austerity budgets; even if it could it might not be effective. Public-private partnerships can be used to generate new private investments, with the public sector playing a leverage role and contributing not only to the 3% target but more importantly to its 1/3 (public) and 2/3 (private sector) components. In addition the creation of larger markets at the European level is expected to

28 COM 2005 "Industry Policy"
http://ec.europa.eu/enterprise/enterprise_policy/industry/index_en.htm

and Mid-term review of industrial policy

29 Chesbrough (2003) Open innovation. Harvard Business School Press

30 Von Hippel (2005) Democratizing innovation. The MIT Press, Cambridge

mobilise foreign direct investments within and from outside the EU (provided that the markets develop to become sufficiently attractive).

There are two ways of looking at the need to combine supply and demand measures:

- Combine them in single interventions (in particular in the form of platform and lead market creation, where demand and supply measures are combined to achieve first mover advantages)
- Combine them by allocating resources for a balanced policy mix composed of both types of measures; the combination is then tailored to the specificities of the national context and business culture.

Combine policies in a single intervention: the lead market concept

An emerging concept, where the combination of supply and demand measures is considered as a necessary condition for success is the *lead market idea*[31]. Lead markets are attractive because they constitute the test bed for companies to produce competitively and eventually capture the world market as first movers in innovative products with high rents and appropriability. Local production then brings substantial benefits to the economy where such companies are located, in the form of job creation, taxes and investments to maintain and regenerate technological lead. Hence, national policies have every interest to create local lead markets and attract private investments in these particular sectors/technologies.

International corporations experience often major success in new technologies and products that achieved global dominance in areas where the innovation opportunities first emerged in regional markets. World-wide mass application often started in one country or region, like the fax machine in Japan in the 1970s or mobile cellular communication of the GSM standard in Nordic countries in the 1980s. The move from niche to mass application is often initiated by demand specific to one country, which turns out to exist latently in other countries as well. These countries are called lead-markets. Lead-markets lead the industry's evolution, in that they first mirror impending global technical changes and shifts of demand (Beise 1999).

In countless cases, the lead country of adoption is not the lead country of invention. This is true in two important senses. First, lead markets are those where inventions are refined to the point of mass commercialization, not where they are first introduced. Though the dominant designs for PCs, faxes, and 2G mobile telephones were first widely adopted in the US, Japan, and Scandinavia, respectively, before diffusing globally, other countries could claim to have pioneered the basic technical designs first. It was in these lead markets, however, where the globally dominant designs first stabilized and diffused on a mass scale. Second, while lead markets certainly bestow potential advantages on domestic firms, they do not exclude foreign firms from participating in the innovation process (Lehrer 2004). Hence, Policies supporting the creation of dominant

[31] The lead market concept became fashionable with its inclusion in the seminal work of M. Porter (1990)

design are crucial for extracting value from a lead market. Such policies can intervene in the areas that increase the probability of the market becoming a Lead Market: price advantage, demand advantage, export advantage, transfer advantage and market structure advantage. Operational indicators to measure and compare the Lead Market properties at international level have been identified in the literature with significant implications for innovation strategy.

The literature now tends to agree that competitive advantages are anything but based on natural endowments. In this spirit Beise (2004a) argues the origin of an international competitive advantage is not technological knowledge but the ability to adopt a specific innovation design earlier than in any other country. This gives local firms a head start in producing, gathering marketing intelligence and securing the property rights of a globally successful innovation. In countries with "lag market" characteristics, domestic innovations are less likely to get adopted worldwide. Lag markets often switch from a domestic innovation design to a foreign innovation design, which increases imports. The lead-lag market explanation of trade specialization has implications for national policies. In this model domestic innovations do not always foster exports; idiosyncratic innovations induced by lag market contexts can hamper the export chances of local firms and in the end lead to an increase in imports. It is suggested that in order to increase exports, national policies have to distinguish between a domestic lead and lag market context in each industry. While in a lead market context, traditional policy instruments that enhance the rate of innovations are effective, in a lag market context national follower strategies are more appropriate.

By developing and refining innovations in close interaction with the local environment of a lead market, a company can focus on a narrow range of preferences and feedback, lowering the risk of being locked into idiosyncratic environments, and generate true global innovations. Methods for identifying potential lead markets is are discussed in the literature (Beise 2004b). Hence, creating the conditions first to turn idiosyncratic into lead markets through awareness raising of consumers and involvement of lead users (v. Hippel 2010) and then supporting investors through supply side measures is an attractive area for policy intervention with high risks (not all potential lead markets will eventually turn into international success stories) and high rewards (those that do turn into global success are at the origin of economic development and smart specialisation).

National policy or non-governmental influences can successfully create a structure of incentives for users to adopt an innovation relating to a (manifest or latent) international environmental problem. The international dimension of the problem creates a potential demand in other geographic markets as well as the domestic market. Environmental lead markets are frequently initiated by national innovation policy measures (e.g. standards) which potentially diffuse to other countries. Policy innovation/diffusion and technical innovation/diffusion are closely interrelated.

Policy mix including demand and supply

Unlike earlier debates, about whether supply or demand policies are more effective types of intervention, the current rationale supports the combination of both. It is argued that not only demand as such, but also the interaction between demand and supply has crucial implications for innovation dynamics. Starting with von Hippel (1976)and Mowery and Rosenberg (1979, p. 148), a range of studies have argued that a major task for systemic innovation policy is the organisation of a discourse between users, consumers and others affected by innovations in order to articulate and communicate preferences and demand to the market (see also Smits, 2002). Furthermore, the scale and characteristics of demand in a given location have been recognised as major determinants of the competitiveness of locations and their innovation dynamic (e.g. Porter, 1990; Edler et al., 2007).

The core argument for such a combination derived from science policy claiming that ''better'' science portfolios (that is, portfolios viewed as more likely to advance desired societal outcomes, however defined) would be achieved if science policy decisions reflected knowledge about the supply of science, the demand for science, and the relationship between the two. In pursuing a particular societal goal or set of goals, how do we know if a given research portfolio is more potentially effective than another portfolio? (Sarewitz et al., 2007).

Both supply-side and demand-side policies have their rationale, their merits and their limitations, as described by their criticism above. Hence there has never seriously been a discussion on exclusively focusing on the one or the other; on the contrary in theory it is argued that their combination provides a winning policy mix. However, in practice supply-side continues to dominate the scene because in practical terms the design of the combination of the two types of policies is loaded with additional difficulties.

Several comparisons tend to favour one or the other type of policy using individual schemes and case studies for comparison. Examples of such comparisons suggest specific approaches. For instance, it is argued that public procurement and knowledge spillovers from universities propel innovation success equally. The benefits of university knowledge apply uniformly to all firms. However, public procurement is especially effective for smaller firms in regions under economic stress and in distributive or technological services (Aschhoff et al. 2009). In other cases the bridging of supply and demand is suggested to be left to intermediaries: To mitigate these constraints, a field of intermediary organizations has emerged to assist agricultural entrepreneurs to articulate demand, forge linkages with those that can provide innovation support services, and manage innovation processes. Different kinds of the so-called innovation intermediaries that have emerged in The Netherlands are found to be 'market facilitator' worth to be supported by public policies (Klerkx et al., 2008).

Conclusions

In conclusion one can say that:

Demand-side policies are more difficult to adopt but the *demand side matters*. Supply-side measures are easier to adopt and manage, thus policy makers naturally tend to prioritise them against demand side measures, which are more risky. It is, however, increasingly accepted that demand side measures are effective under certain conditions and are thus necessary to complement supply-side.

The combination of supply and demand- side measures is more effective than one sided policies; hence the adoption of a systemic approach is necessary in modern R&D policy development. The combination calls for striking a balance in a tailor-made policy mix, which should be mainly evidence-based and not imitative. Even more than supply-side measures, demand-side measures depend on local market conditions and thus policy learning needs to be complemented by more adaptation efforts.

Supply-demand policy combination is not an easy task. It needs excellent coordination and more top-down intervention with the risk of government failures that policy makers (rightly so) wish to avoid. Hence, *learning, experimenting and developing new tools* is absolutely necessary in order to reach a target of 2.5% economic growth despite current budgetary constraints.

Three important questions should then be answered before policy ambitions can be raised:

- Is the political will in each member state so explicit in favour of combined policies that policy makers can take the risks of experimenting?
- Are the means and tools available to do so?
- And which are the main barriers that inhibit a policy adaptation?

Appendix: Indicative Demand-side Good Practices

Standards in Germany

The state is Germany's biggest buyer, responsible for spending approximately 12% of Gross Domestic Product. In a joint statement, several Federal Ministries with responsibility for a high volume of orders have spoken out in favour of supporting new and resource-saving products and technologies when issuing calls and making purchases thereby helping to stimulate innovation. This can be done by applying existing public procurement regulations. In addition, by amending Section 97 Para 4 of the Law against Restraints on Competition, the Federal Government intends to make it clear that additional demands can be imposed on the contractor - inter alia with regard to innovative solutions.

The Federal Government's "Concept for Standardisation" aims to systematically involve standardisation in technology funding. This could help to fast-track innovations onto the market. Small and medium-sized enterprises (SMEs) in particular are to be made more aware of the importance of standardisation. Furthermore, measures are to be introduced to make it easier for SMEs to apply standards and to become involved in standardisation processes.

In the "Innovation with Norms and Standards" project, the Federal Ministry of Economics and Technology (BMWi) is supporting the efforts of the German Institute for Standardisation (DIN) to identify the need for standardisation in fields of high technology such as microsystems technology or nanotechnology. The aim is to establish excellent framework conditions for innovations and to thus encourage marketability.

Source: Trendchart Mini-report Germany 2011 (from BMWi)

Fuel Efficient Passenger Cars

High fuel prices especially in the European market, combined with a need for stronger environmental conscience, have led to innovations for fuel-efficient passenger cars, especially in the European market.

Fuel-efficient passenger cars “consume less fuel per 100km achieved or achieve high mileage per gallon”. To this end, a number of technologies have been used. In the 1990s, emphasis was placed on combustion engines, diesel or gasoline injection combustion engines or a combination of gasoline with electric motors. More recently, lightweight material is used for optimizing car design with car performance and market preferences.

In terms of policy instruments, these were adopted only in the US; in 1975, the fuel economy rule (CAFE) was introduced for new cars, imposing to car retailers in the US targets for average fuel consumption of cars sold. Loopholes in related legislation, combined with the appearance of SUVs (sport utility vehicles) have impeded the introduction of such policy instruments in other countries. On the contrary, US legislation, through the Clean Air Act, has managed to create a worldwide legislative framework for the reduction of pollutants. Europe moved a step further to introduce diesel engines, aiming to improve fuel efficiency.

Currently, fuel-efficient cars are successful, only when they are combined with demand preferences in the local market. Innovations that have failed to improve driving behaviour or which were sold at prices not justified by the market, fail to attract buyers, in spite of the savings in fuel consumption.

Wind Energy

Volatile oil prices and the negative environmental impact of fossil fuels have increased the use of wind power energy systems. Denmark leads the way with the highest use of wind energy as a share of total wind potential, followed by Germany with the largest installed wind energy capacity worldwide. Denmark is also the largest exporter of wind turbines in the world.

Wind power technology was introduced in Denmark with great variety and flexibility. The continuous improvement of small converters (55 kilo-watt generation of wind turbine generators), realised cost reductions of up to 50% that were not achievable by larger size converters due to insufficient technological knowledge. This initiative provided them with a first movers' advantage and an entry to the market five years earlier than their competitors.

Energy policies for the promotion of wind power usage vary considerably in Europe, and are often supplemented by tax incentives. Three distinct strategies are identified: - Renewable energy feed-in tariffs (REFITs), Bidding systems and Tradable permit systems for renewables. REFITs introduce a system of subsidization of wind energy, as energy utilities are obliged to pay a pre defined fixed price to wind energy producers. Wind energy producers enjoy a low market risk with a secured revenue stream, but also less competitive pressure since there are no incentives for cost reduction, as long as their financing is secured. REFITs have so far enhanced the development of the wind energy market.

Bidding systems increase competition amongst wind energy producers, as they are called to respond annually to tenders issued by the government for energy production. Lack of continuity of the process, suppressed energy prices and long bureaucratic procedures have led to failure of such systems.

Tradable permit systems for renewables is a recent trend, combining the advantages of REFITs - low market risk for energy producers – and Bidding systems - efficiency gains. The state defines quotas and issues green certificates to wind energy producers, which are tradable on the market. Energy utilities are free to choose between buying a certain number of certificates for renewables on the market or producing green electricity themselves, in order to acquire a percentage of renewable energy in their portfolio. It is rather soon to evaluate the success of Tradable permit systems, since they were introduced in the early 2000s, but it will largely depend on the trading systems and the size of quotas.

Linking demand-side and supply-side innovation policies: the case of Biotechnology

Although Germany has numerous pharmaceutical companies engaged in biotechnology research, most market innovations in biotechnology are generated in other countries such as the USA, the UK and Switzerland. While the German

government has been funding biotechnology research substantially for decades, a lack of linking research results to commercialisation was identified as a main reason for the low performance in the market. In particular, networking among the partners from public research, new technology-based biotechnology companies, large pharmaceutical companies and the organisations that determine the use of new drugs (hospitals, health insurance) was weak. In order to support a more efficient transfer of innovative treatments from the lab to the market, the BMBF has restructured its funding policy in the area of innovative pharmaceuticals development. As part of these restructuring efforts, it has launched the Pharmaceuticals Initiative for Germany. Under this initiative, existing and new BMBF measures in the areas of health research and biotechnology will be reorganised in such a way as to close the gaps in the value-added chain and strengthen R&D work on new medicines in Germany. Consideration will be given to production and marketing strategies from an early stage.

Within the Pharmaceuticals Initiative, the BioPharma programme is a particularly interesting activity from a demand-side policy view. Started in 2007, its main goal is to link different actors like researchers, hospitals, biotechnology and pharmaceutical companies, agencies and health insurances along the supply chain in order to develop and commercialise new biopharmaceuticals. Co-operation between the different partners is expected to lead to strategic optimisation, accelerated innovation processes and less failure of new biopharmaceuticals in approval and market introduction stages.

BioPharma is among the very few programmes that consider the whole value-added chain from basic research and clinical testing to production, approval and market launch. BioPharma is a competition. Consortia under the lead of a company are invited to submit concepts for how to interlink the various actors and stages to come up with commercially successful biopharmaceutical innovations. Public support is provided only to those consortiums that present the most promising concepts.

The BioPharma programme consists of two stages: At the first stage, the creation of up to 15 concepts is promoted. Idea sketches are funded with up to €100k which has to represent a maximum of 50% of the total costs of producing the concept. At the second stage, a steering committee will select those concepts from the up to 15 submitted concepts that meet the eligibility criteria best (see below). The second stage basically provides funding for realising the concept, particularly R&D projects. The projects will have to be managed by companies. Funding will be available for up to five years. A considerable share of private funds is expected (over 50%). Management support from external consultants may be funded, too. New partners can be involved during the execution of R&D projects. An important criterion is the participation of firms. No promotion is given to consortiums, which only consist of hospitals and academic institutions.

The BMBF provides about €100m for this programme. Additionally, other funds shall be taken up, e.g. from the 7th EU Research Framework Programme, foundations, of other Federal programmes in the field of biotechnology and health research.

The concepts must contain a business plan, which has to include statements on

the following topics:

- Technology platform: Quality and implementation
- Pipeline of the resulting products
- Patent basis and know-how in processes; protection of intellectual property
- New products and their application; regulative framework
- Potential: Application of the results, relevant market segment and volume, chances of refund, potential market shares
- Partners: Description, competences, roles
- Personnel: Project leaders, personnel development, management
- Plan: Continuous evaluation of practicability, proofs of concept, of technology, of market; clinical studies, health technology assessment; internal monitoring; milestones and timetable; documentation of progress; finance plan
- Productivity: Quality management, production and commercialisation
- Perspective: Business models.

In consideration of the requirements from above, the following criteria are regarded for admission on the first stage:

- Profile and performance of the partners along the supply chain
- Infrastructural conditions
- International competitiveness
- Innovation, originality, market potential

In addition, further criteria are considered on the second stage:

- Size, quality, intensity of the planned teamwork along the supply chain
- Participation and convergence of interests
- Utilisation of the results
- Expected market share
- Conclusiveness, maturity and chances of single measures and the whole concept
- Plausibility of finance planning and access to private funds
- Entrepreneurial and strategic capabilities of the management

- Efficiency of the organisation
- Integration of already existing promotional measures
- Continuation of the structures and activities after the end of the promotion period.

Source: Trendchart Mini-report (from BMBF)

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(3) Dinosaurs, Mice, Gazelles and Ecosystems: Removing Bottlenecks of Growth for Innovative Firms

Erkko Autio

Introduction

This paper has been written as background paper for the ERAC Mutual Learning Workshop. The workshop is to be held in Brussels on 24 January 2012. The paper is intended as background for the third session of the workshop, entitled: Removing bottlenecks to the growth of innovative enterprises.

This paper makes four points:

- High-growth innovative firms matter, disproportionately, for job creation and economic growth
- Policies designed to encourage the emergence of innovative high-growth firms (and high-growth firm ecosystems) are distinctively different from policies that address firms or SMEs in general
- It is possible to identify and adapt good practices when designing policy programmes to support innovative high-growth firms
- Policy frameworks should be designed to optimise National Systems of Entrepreneurship

To address the four points above, we:

- Summarise evidence on the importance of innovative high-growth firms in the economy
- Develop a theoretical framework describing essential drivers of growth in innovative firms and use this framework to illustrate and compare generic SME support policies against high-growth policies
- Discuss generic good practices, as identified in high-growth support initiatives
- (In the appendix) Introduce the Global Entrepreneurship and Economic Development Index methodology and illustrate its application in measuring National Systems of Entrepreneurship

This paper presents two frameworks to self-assess the coverage of high-growth support programmes in EU member countries. The readers are requested, as preparation for the mutual learning workshop, to use the matrices to assess the state of high-growth entrepreneurship ecosystems in their own countries: Which are the strong areas? Where are the weaknesses? Are there any innovative policy initiatives – either supply-side or demand-side policies and support initiatives – the insights regarding which could be shared with other participants of the mutual learning workshop?

The readers are requested to identify at least one innovative example of innovative high-growth support initiatives in their countries and share this experience with other participants of the mutual learning workshop.

Economic Importance of High-Growth Innovative Firms

'Stylised Facts' about High-Growth Innovative Firms

There is widespread agreement that entrepreneurship is an important economic and societal phenomenon. Dedicated theories regarding the macro-level effects of entrepreneurship remain elusive, however. Since late 1970's, new firms have been seen as an important source of new jobs (1987; Birch, 1979; Fölster, 2000; Storey, 1994). There are also persistent arguments that new firms make a positive contribution toward the economy because of their contribution toward a more efficient resource allocation in the economy (van Praag, 2007). Finally, numerous studies suggest that new firms can have an important role to play in innovation in selected sectors (Audretsch & Acs, 1991; Michelacci, 2003). Thus, the economic contributions of entrepreneurship are widely accepted. From the perspective of public policy, arguably the most important aspect of new firms concerns their contributions to job creation and job stability.

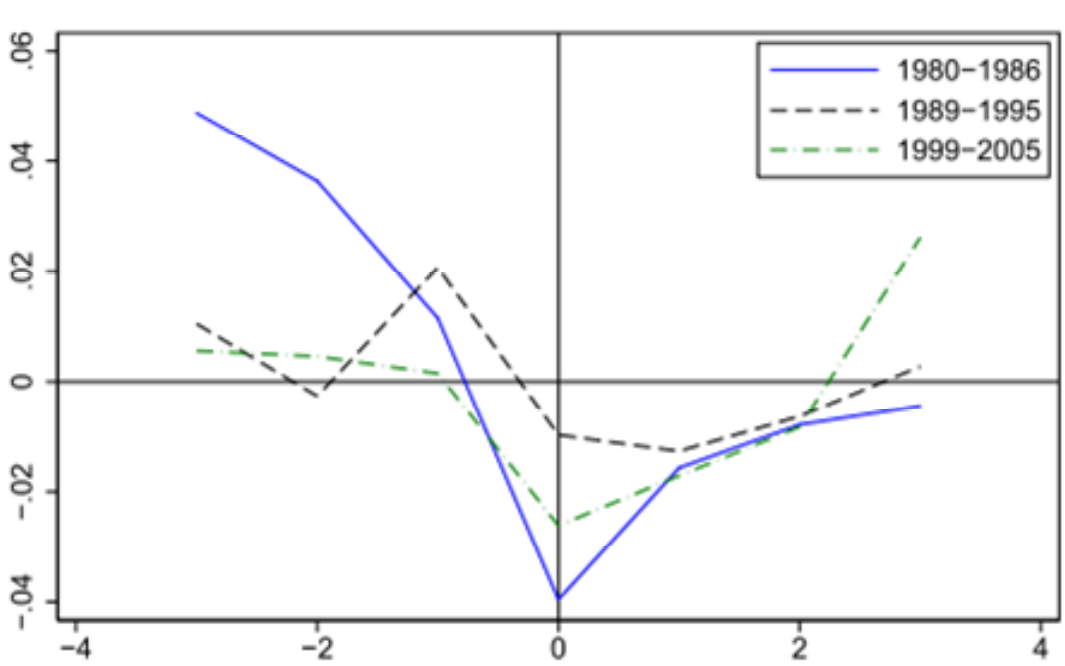
Perhaps the most influential individual finding regarding the potency of new firms in job creation was reported by Birch (1979). **Birch reported that new firms accounted for the bulk of new job creation in the USA, while large, established firms were net destroyers of jobs during the period studied**. Although Birch's findings have been the subject of significant subsequent debate and refinement, the core finding appears robust across time periods and national contexts (Davidsson, Lindmark, & Olofsson, 1998; Delmar, Davidsson, & Gartner, 2003; Kirchhoff, 1994; Picot & Dupuy, 1998). According to these studies, and depending on the phase of the economic cycle, new firms may be responsible for anything from one third to up to the totality of net job creation. Although many new firms are created as a result of industrial downsizing and re-organisation, thus representing job migration rather than genuine job creation, there seems to be wide agreement that also the genuine job creation potential of new firms is significant (van Praag, 2007). Even when accounting for the dynamic character of new firms, particularly their high mortality rates (Aghion & Howitt, 1992), the net effect appears to remain positive. Fölster (2000) found that every self-employment decision meant the net creation of 1,3 new jobs in Sweden, after the effects of various intervening mechanisms were controlled. According to the Longitudinal Establishment and Enterprise Microdata (LEEM) database, new establishments created 69% of net new jobs in the US from 1990 to 1995, and new firm start-ups which did not exist prior to 1990 created 22% of new jobs (Audretsch, 2002). Combined, these studies strongly suggest that entrepreneurs indeed have an important role to play in job creation.

A closer look reveals a more nuanced picture, however. Although entrepreneurs as a group appear important for job creation, this potential is not evenly distributed within populations of new firms. **Only a relatively small proportion of all new firms are responsible for the majority of job creation impact**. Storey (1994) found that only 4% of new firms born in any given year

accounted for 50% of all the jobs created by the surviving firms within that cohort after ten years. Kirchhoff (1994) found that the 10% of fastest-growing firms contributed to three quarters of new jobs during an eight-year observation period within a cohort of firms started in the US in 1978. According to Birch et al. (1997), 'gazelles' accounted for more than 70% of the employment growth in the U.S. between 1992 and 1996, while representing only about three per cent of the firm population. Analyses of the GEM data suggest that some 10% of all nascent and new entrepreneurs aspire to create some 70% of all expected jobs by nascent and new entrepreneurs (Autio, 2007). Summarising, various studies suggest that only less than 10% of all new firms may be responsible for anything in between 50% and 75% of all new jobs by new firms. These findings underline the need for a more nuanced approach to uncover the job-generation power of high-growth innovative firms.

A particularly notable characteristic of high-growth firms concerns their ability to end economic recessions. According to the extensive study by Moscarini and Postel-Vinay (2009), small firms regularly outpace large firms in job creation during recessionary times. Thus, the small firm sector has an important role to play in ending economic recessions. During the three previous recessionary cycles (1980-1986, 1989-1995 and 1999-2005), the bottom of the recession was always marked by the small firm sector taking over from the large firm sector in job creation. The large firm sector only re-started hiring employees when the economic re-bounce was well on its way and economic growth had turned positive. This pattern is illustrated in Figure 1.

Figure 1 Job creation by large and small firm sectors during recession cycles



In Figure 1, any values above the horizontal line in the middle signal that large firms are hiring more people than small firms. Any values below the horizontal line signal that small firms lead in job creation. Three recessionary cycles are shown. Year 0 indicates the year when the recession bottoms out. As can be seen, during the three previous recessions, the bottom of the recession has always been marked by the small firm sector taking the lead in job creation. This is compelling evidence of the importance of the small firm sector during times of economic recession.

Summarising, there is extensive evidence that: (1) innovative entrepreneurial firms matter for job creation; and (2) for any given cohort of firms, over 80% of the aggregate impact is created by a small set of innovative high-growth firms; (3) innovative, rapidly growing small firms have a particularly important role to play in turning around economic recessions. Received empirical findings can be distilled into the following list of 'stylised facts' about innovative high-growth firms (Autio & Hoeltzl, 2008):

- **Innovative High-Growth Firms Matter**: Studies show that anything from between 3% and 10% of any new cohort of firms will end up delivering from 50% to up to 80% of the aggregate economic impact of the cohort over its lifetime (Acs, Parsons, & Tracy, 2008; Audretsch, 2002; Autio, 2007; Birch et al., 1997; Henrekson & Johansson, 2008; Hölzl, 2006; Storey, 1994)
- **Innovative High-Growth Firms Are Rare**: At any given time, only a small proportion of all firms (new and old alike) end up achieving rapid growth (Henrekson & Johansson, 2008; Hölzl, 2006)
- **Innovative High-Growth Firms Are Everywhere**: Recent sectoral scoping reports by Europe INNOVA suggested that firm growth distributions are remarkably similar across sectors and countries (Hölzl & Friesenbichler, 2008). Thus, innovative high-growth firms can be found in any sector
- **Innovative High-Growth Firms Are Not Necessarily Young**: Acs et al reported, using data from all U.S. establishments and businesses, that an average 'high-impact[32]' firm was 25 years old when achieving rapid growth (Acs et al., 2008). They also found that high-impact firms exist in all firm size categories, industry sectors and in all U.S. counties
- **Innovative High-Growth Firms Innovate**: A broad characteristic of high-growth firms is that they are innovative. Two basic modes of innovation can be identified. In the 'traditional' mode of innovation, high-growth firms introduce disruptive new technologies and services that either open up new markets or replace existing products and services. In the 'business' mode of innovation, high-growth firms introduce disruptive new business models and organisational innovations that undercut and replace existing ways of doing business. Thus, in addition to the 'traditional' innovation, high-growth firm innovation also manifests itself in innovative business models (e.g., new concepts for service

[32] High impact is defined as at least 100% total sales growth over the period from 1998 to 2002 plus an employment growth quantifier of 2 or greater, see Acs et al, 2008b).

delivery), in product and market diversification (including internationalisation) as well as innovative business processes (Hölzl & Friesenbichler, 2008). Innovative High-Growth Firms grow because they are different in a way that adds value.

- **Gazelle Growth Is Lumpy**: Steady, rapid, predictable growth is rare among innovative high-growth firms. Gazelle growth may also come in many forms, such as, e.g., sales or employment growth; acquisitive or organic growth; and domestic or international growth (Delmar et al., 2003)
- **Innovative High-Growth Firms Are Volatile**: Bursts of rapid growth are often followed by periods of slow growth and sometimes even decline (Delmar et al., 2003)
- **Innovative High-Growth Firms Thrive in Specialised Factor Markets**: Because many innovative high-growth firms exploit value-adding differentiation, they are dependent on specialised factor markets, such as specialised labour markets, specialised financial instruments, and specialised business services
- **Innovative High-Growth Firms Are Not about "How Many" but about "Who"**: A core aspect of the high-growth firm phenomenon is the emphasis on quality over quantity. Growing firms is a rare phenomenon, and getting firms to grow takes rare skill (Autio, 2011)
- **Innovative High-Growth Firms Kill Recessions**. As discussed above, innovative high-growth firms have an important role to play in taking the lead in job creation during times of economic recession (Moscarini & Postel-Vinay, 2009). Therefore, the importance of removing bottlenecks of growth for innovative high-growth firms heightened during economic downturns

Drivers of Growth in Innovative High-Growth Firms

There exists a considerably body of research on the determinants of firm growth (see, e.g.,Penrose, 1959). Indeed, understanding causal influences on entrepreneurial and innovative firm growth has been one of the dominant themes of the entrepreneurship literature. Against the background of the extensive research interest in understanding drivers of growth of new and small firms, it is surprising that, to date, there exists no widely accepted causal theory of the growth of new and small firms: What drives it and how it can be achieved. Below, I have taken initial steps towards a framework that identifies generic drivers of growth in innovative high-growth firms. This summary draws on systematic literature reviews and models of new firm growth(Garnsey, 1998; Gilbert, McDougall, & Audretsch, 2006; Macpherson & Holt, 2007).

My review of the extensive body of research identified six distinctive drivers of growth in new and innovative firms: (1) motivation (giving rise to strategic choice); (2) ability; (3) legitimacy; (4) market demand; (5) resource availability; and (6) appropriability. Of the six drivers of growth, the first two are internal to the firm, and the remaining four are external to the firm. In the following, we briefly explain each of the six generic drivers of organisational growth:

- **Motivation**. Firm growth is virtually never achieved without the firm explicitly deciding to pursue it. Therefore, growth motivation is the first and necessary condition of achieving organizational growth. According to surveys, over 90% of the new firm population do not even indicate organizational growth as a major strategic goal. Growth motivation prompts firms to choose strategies that are more likely to lead to growth, and it also prompts them to invest the resources and effort required to achieve growth.
- **Ability**. Growth motivation, while necessary, is not a sufficient precondition for achieving organizational growth. If the firm is unable to manage and coordinate its internal and external activities and relationships in such a way that growth not only becomes possible, but also, feasible, growth will not materialise. As such, while there are numerous policy initiatives focused on supporting capability building in new firms, many neglect to address the motivation question. Ability without motivation is as unlikely to lead to growth as is motivation without ability.
- **Legitimacy**. New and small firms are ultimately dependent on external resources and acceptance by important stakeholders, such as customers, resource providers, potential business partners, suppliers, potential employees and so on. In order for the new or small firm to successfully start operating in a growth-oriented mode, therefore, it needs to achieve legitimacy in the eyes of its important stakeholders – i.e., cultivate an impression that the firm and its goals and actions are acceptable, worthwhile, value adding and achievable (Suchman, 1995). Legitimacy management is therefore a central precondition for establishing the new and small firm as a viable trading entity. Building legitimacy can be difficult, however, and appropriate legitimacy-building strategies will vary greatly depending on industry context.
- **Market demand**. In order for the firm to achieve growth, there needs to be demand for its products and services. Here, two basic conditions can be identified. Either the demand (i.e., market) exists or it does not. In the former situation, the primary challenge for the new and small firm is achieve market entry and positioning, either replacing or complementing existing market offerings. In the latter situation, market demand needs to be created, e.g., through skilful communication and lobbying strategies. The difference between the two situations is fundamental, as it is the difference between competing against existing players versus promoting a new market space.
- **Resource availability**. To successfully pursue and translate market opportunities into organizational growth, new and small firms need to access and mobilise internal and external resources. As internal resources are small by definition, the firm faces the challenge of accessing and mobilising resources controlled by others. The resource availability challenge is therefore closely intertwined with the legitimacy challenge, as external resource holders will not make their resources available to the new and small firm, unless they perceive the firm's activities as legitimate. For the purposes of understanding new and small firm growth, four fundamental resource categories can be identified: (1) finance; (2) human

capital; (3) social capital; and (4) business-specific operational resources. We will not elaborate on these here, apart from observing that support initiatives have traditionally focused on the provision of financial resources while tending to ignore the other resource categories. Similarly to the market demand situation, there is a fundamental difference between accessing resources embedded in existing value chains (market exists) and creating and transforming resources to service new market spaces.

- **Appropriability**. The final precondition of achieving sustained rapid growth has to do with appropriability. Here, appropriability refers to the ability of the new and small firm to appropriate a sufficient share of the returns generated through its activities such that the firm eventually becomes profitable and generates sufficient cash flow to maintain rapid growth. Appropriability can be based on several devices, such as intellectual property rights (patents, copyrights etc.); control of critical resources (e.g., access to customers); difficult-to-imitate and difficult-to-substitute skills and capabilities (e.g., effective innovation processes); or, for example, market power (e.g., monopoly position conferred by industry-leading innovation). Achieving appropriability should be a key focus of any SME-centric growth initiative.

For any high-growth support policies to effectively promote firm-level growth, they need to address one or several of the above identified drivers of organisational growth in innovative high-growth firms. Examples of demand- and supply-side policies targeted at each of the growth drivers are provided in table 1.

In preparing for the mutual learning workshop, we request that the participants think about their own National Systems of Entrepreneurship and think about policies and support initiatives that they consider relevant in addressing the growth drivers identified above. We ask you think about both supply-side and demand-side policies and support initiatives. The idea is that the participants will be able to discuss tangible examples from their countries so as to facilitate experience exchange and mutual learning.

Good Practice in Supporting Innovative High-Growth Firms

In the appendix we have provided a cursory review of the evolution of support initiatives focusing on SMEs, and, more broadly, on innovative high-growth firms. The review suggests that policy initiatives targeting SMEs and innovative high-growth firms have become increasingly sophisticated over time; different policy initiatives address different needs and market failures; and that none of the reviewed initiatives alone appease able to resolve the problem of promoting innovative high-growth firms.

Table 1 Examples of Demand- and Supply-Side Policies to Promote High-Growth Innovative Firms

Growth Driver	Demand-Side Policies	Supply-Side Policies
Growth Motivation	Fiscal incentives to pursue organisational growh (e.g., favourable treatment of trade-sale income for fast-growth firms; tax-neutral treatment of share options as managerial compensation in new firms)	Explicitly tying financial and other support to the achievement of growth milestones
	Education and media policies to increase social appreciation of high-growth performance (e.g., teaching of entrepreneurial attitudes in secondary education; media promotion of entrepreneurial success stories)	Using growth motivation as a qualification criterion in entrepreneurship support programmes
	Size-neutral treatment of capital accumulation in growing firms	
Growth Ability	Promotion of venture capital financing through funds-of-funds arrangements	Promotion of venture capital financing through funds-of-funds arrangements
	Creating incentives for the formation of competent management teams	Provision of managerial advice
	Networking programmes to facilitate experience exchange among high-.growth firms	Accelerator programmes
Legitimacy	Media strategies to promote cultural acceptance of new firms as suppliers	Initiatives to match senior executives with high-growth firms (e.g., non-executive boar member matching)
Market Demand	Government procurement to favour innovative high-growth firms	Cluster initiatives to promote the creation of new industry sectors (e.g., mobile gaming)
Resource Availability	n.a.	Supply chain -oriented networking programmes
Appropriability	n.a.	Effective enforcement of IP protection laws

Policy initiatives that focus explicitly on supporting rapid firm growth are still new, and there have been only few reports to document characteristic features of such initiatives. Achieving growth taking time, there have been no systematic attempts to study the effectiveness of such measures, although some panel data collections are under way. Finally, the theoretical understanding of firm growth in general, and new firm growth in particular, remains patchy and most models of new growth descriptive rather than causal (Churchill & Lewis, 1983; Garnsey, 1998; Penrose, 1959). Therefore, in the following we first summarise what is actually known of high-growth firms (or 'gazelles'). Then, we summarise good practice lessons, as reported in the few policy reviews in existence. This is followed by a review of drivers of entrepreneurial firm growth, as distilled from received systematic reviews of research on entrepreneurial firm growth.

As such, policy initiatives targeting high-growth firms are of recent origin and reflect the relatively recent accumulation of evidence regarding the importance of high-growth firms for job creation.

These characteristics of 'gazelles', or high-growth ventures, have important implications for the design of support initiatives. In summary, dedicated initiatives addressing high-growth entrepreneurship should (Autio, Kronlund, & Kovalainen, 2007):

- **Be selective**, particularly when addressing later stages of venture development. This is because only a small minority of all new ventures have the organizational and market potential to achieve rapid growth
- **Require strong growth motivation** from participants. Achieving growth is difficult and takes time and effort
- **Be proactive** in inviting prospective growth firms. Because high-potential firms are quite rare, there is a good likelihood that potential candidates will already be known. Therefore, it should be possible to proactively approach potential candidates
- **Consistently address managerial motivation and skills**. As ventures grow, different skill sets are required to maintain growth. The venture management needs to be ready and motivated to carry out the necessary changes and adjustments to continue to grow
- **Involve close collaboration with private-sector** service providers. Supporting high-growth ventures takes significant time, effort and skill, and public-sector compensation mechanisms rarely justify the effort required
- **Nurture an image of professionalism**, competence, and a certain degree of exclusivity. In order to attract the highest-potential ventures, the support initiative needs to project an air of professionalism and exclusivity
- **Implement sustained and focused development efforts**. Achieving growth takes time, and the support initiative should be prepared to continue to push the venture for growth
- **Involve customised management development activities** that involve experience sharing and apply an interactive approach. Each venture has specific support needs, and effective support requires extensive hands-on experience from the part of the support provider
- **Link grants and participation to growth aspiration and achievement of milestones**. Support should be tied to the achievement of specific milestones, with greater support only available once the initial milestones have been met
- **Be prepared to accept casualties**. High-growth ventures are volatile, which means that casualties are inevitable, if correctly implemented. Avoidance of casualties easily translates into avoidance of risk and acceptance of lower growth prospects
- **Involve seasoned managers who have experience in rapid growth**. First-hand managerial experience from fast-growth companies is the best basis for supporting other high-growth ventures

The above list is based on a review of high-growth policy initiatives in nine countries (Autio et al., 2007). The list was derived through the study of commonalities amongst policy initiatives in the countries concerned and thus represents a summary of observed good practices – both in terms of general set-up of the initiative as well as its implementation. However, as such, although the good practices identified focus on the *facilitation* of growth, they do not address the question of what *drives* growth.

When the good practices and growth drives are combined into a matrix, we obtain a simple tool to assess the coverage of high-growth policy initiatives. This matrix is shown below:

Good Practice	Growth Motivation	Growth Ability	Legitimacy	Market Demand	Resource Availability	Appropriability
Implementation						
Focus on growth motivation						
Address managerial motivation and skills						
Public-private collaboration						
Sustained effort						
Customised management development						
Staged support tied to milestones						
Involve seasoned managers						
General Set-Up						
Selectiveness						
Proactiveness						
Nurture image of professionalism						
Accept casualties						

This matrix can be used as a simple tool for assessing the coverage of policy initiatives designed to facilitate the growth of new and small ventures. We will use the matrix during the workshop to discuss policy initiatives presented.

Next: Ecosystem Approach?

Above, we have provided a cursory review of policies and support initiatives designed to address the problem of promoting innovative high-growth firms, with the objective of providing some background for the current interest in high-growth policy initiatives. As noted, although some lists of good practices exist, these are based on conjectures and deep case studies rather than post-hoc evaluation of the effectiveness of different support approaches. It is still too early to assess the effectiveness of growth-oriented support initiatives, although panel data collection is under way in some countries (e.g., Finland).

We conclude by offering some thoughts on where entrepreneurship and high-growth policies might be heading next. Although not detailed here, the evolution of high-growth and entrepreneurship policies roughly tracks the evolution of research understanding of the policy objects – i.e., innovative high-growth firms and entrepreneurship. During the past couple of years, there have been increasing references to 'entrepreneurship support ecosystems'. The general idea here is that different support initiatives should constitute a support system, which would seamlessly adapt to address the changing needs of innovative high-growth firms and entrepreneurial ventures, as these grow and their needs change. This is why support ecosystems are sometimes illustrated against the background of a venture lifecycle, which proceeds from firm inception to 'death valley' to break-even to early growth, to internationalisation, maturity, and so on.

The concept of entrepreneurship ecosystems reflects the growing research interest in the entrepreneurial capacity of national economies (Reynolds, Bosma, & Autio, 2005). An important concept underlying this research interest is the notion that at the national level, entrepreneurship should be thought of as a system of inter-related elements. At the national level, therefore, entrepreneurship can be defined as:

> *…the dynamic, institutionally embedded interaction between entrepreneurial attitudes, activities, and aspirations, by individuals, which drives the allocation of resources through the creation and operation of new ventures* (Acs, Autio, & Szerb, 2011)

This definition has important implications:

- National entrepreneurship is an outcome of dynamic interactions between attitudes, activities and aspirations, which is embedded in a country-specific set of institutional arrangements
- The focus of entrepreneurship policies, therefore, should be on the system, rather than its outputs
- As the outcomes of the processes emerge from dynamic interactions between systemic elements (e.g., the innovation system, education system, support system and so on), the system performance may be held back by bottleneck factors. Therefore, a key focus in designing and assessing national high-growth policies should be in identifying systemic bottlenecks that constrain a given country's entrepreneurial performance
- However, because very little is known about the interconnections and substitutability between individual drivers, entrepreneurship policies risk addressing surplus factors instead of focusing on real bottlenecks that hold back a country's entrepreneurial performance. This can result in an unbalanced or inappropriate framing of policy and wasted resources and effort

The above considerations suggest the following heuristic for the evaluation of national entrepreneurship systems

- First, appropriate techniques and measures should be developed to identify constituent elements of national entrepreneurship systems and understand their interconnections

- Once bottleneck factors have been identified, countries should be compared against relevant (i.e., reasonably similar) peers to identify policies that address the bottleneck in question
- Once identified, such policies should be evaluated and good practices identified, so that these can be adopted by the country in question

In the forthcoming mutual learning workshop, we will draw on the above ideas to frame our exchange of ideas on how to support high-growth entrepreneurship in different EU member countries.

Appendix: Evolution of Innovative High-Growth Firm Support Initiatives

Firm-centric support initiatives have a long history. The idea that policy-makers should re-direct tax income and other public funds towards individual, usually private companies is at least as old as Kenneth Arrow's (1962a; 1962b) idea of 'market failure' – the concept that left to their own devices, markets will under-invest in shared resources, and therefore, perform sub-optimally (Gustafsson & Autio, 2011). With the direct ownership by the state of important companies in a number of sectors, this idea was soon employed to justify subsidies to sectors and companies that were considered of national importance. This means that firm-centric support initiatives have been an important aspect of industrial policy for nearly 50 years.

Although the support for small and medium-sized firms (and subsequently, entrepreneurship) has a slightly sorter history, it nevertheless spans several decades. Several approaches, or perhaps flavours, can be identified in industrial policy that has focused on SMEs, and, more broadly, on innovative high-growth firms:

- "Investment Subsidy" Approach
- "Financial Support" Approach
- "Incubation" Approach
- "R&D Subsidy" Approach
- "High-Growth" Approach

In the following, we provide a brief overview of each and their underlying assumptions. We then focus specifically on high-growth support initiatives and examine them in the light of what (surprisingly little) is known about new venture growth. We conclude by exploring potential future trends in high-growth support.

Investment Subsidy Approach

The Investment Subsidy approach of SME support was perhaps the first form of industrial policy to exclusively focus on small and medium-sized firms. This approach facilitates the access of SMEs to subsidised financing for investment. As the subsidies are given to going concerns, this approach does not seek to promote the creation of new firms, but rather, the preservation and expansion of existing SMEs. Thus, rather than seeking to create new jobs, this approach is more about preserving (and sometimes relocating) existing jobs. Also, the focus on investment subsidies implied that this approach targeted mainly manufacturing SMEs, typically in relatively mature industry sectors.

Financial Support Approach

Policy initiatives did not really start addressing entrepreneurship until after the seminal observation by Birch (1979) that new firms were responsible for the majority – perhaps even the totality – of net new job creation in the US. This

finding prompted a shift in the focus of SME-centric support initiatives. Instead of (and in addition to) subsidising investment by existing SMEs, increasing emphasis was laid on facilitating the creation of new firms. This thrust was reflected in several types of support initiatives, ranging from the creation of science parks and new business incubators to facilitation of domestic venture capital industries. In the financial support approach, an important obstacle for the creation of new firms was considered to be lack of funding – a finding repeated in numerous self-report surveys[33].

New firm funding schemes range from soft loans for start-ups to the facilitation of seed- and start-up stage venture capital. This approach led to the proliferation of publicly funded or publicly subsidised venture capital funds, especially in the 1990s. Although these initiatives were quite successful in kick-starting indigenous venture capital sectors, there were also important lessons:

- Imposing sufficient discipline in due diligence proved challenging in venture capital initiatives that were directly funded from public funds. Finland and Sweden, for example, exhibited the World's leading venture capital activity in the late 1990s, when measured with the per-capital number of venture capital investments (that is, the number of investments without regard to the amount of money invested). However, in terms of individual deal size (i.e., average amount of funds invested per recipient firm), they were in par with countries such as India. Sub-optimal investment size and insufficient due diligence gave rise to poor returns.
- Especially in peripheral regions, regional policy goals often exercised undue influence on investment decisions. Rather than being based on merit, investment decisions were often made on the principle of supporting local firms regardless of their growth potential. This effectively reduced many regional venture capital funds to investment subsidies.
- Setting competitive incentive structures in public venture capital funds was difficult. This meant that the best talent soon migrated towards private venture capital funds, which were able to provide better financial rewards.

A number of challenges like the ones above, combined with the inherent difficulty of predicting and fostering success, soon revealed the limitations of the public venture capital approach. After the burst of the Internet bubble, there has been an extensive re-thinking regarding the public venture capital approach, and many countries today channel funds to the venture capital sector through a Funds of Funds approach, under which a publicly held fund of funds places investments in privately held venture funds instead of directly investing into new ventures (see, e.g., www.teollisuussijoitus.fi). At the same time, however, most venture capital funds have retreated from early-stage investment towards more predictable late stages.

[33] The obvious problem in self-report surveys is that SMEs tend to blame lack of funding for all their problems, such as incompetent management, ill thought-out strategies or inferior products and services.

Overall, although venture capital investment is an important ingredient of entrepreneurship ecosystems, the public venture capital experience thus far has shown that it alone does not resolve the challenge of promoting economic development through high-growth ventures. Although viable (private) venture capital sectors have been created, experience suggests that public subsidies (either in the form of direct investment or through Funds of Funds) are still necessary to maintain early-stage venture financing. Furthermore, there seems to be quite wide agreement that venture capital funding is no longer a bottleneck in the more advanced European entrepreneurship ecosystems at least – not even in the challenging category of start-up investment sizes between €100k and €1Million. From the perspective of promoting innovative, high-growth ventures, the public venture capital experience suggests the following lessons:

- Although venture capital plugs the gap of equity funding, it does not obviate the need for public subsidies, e.g., for innovative activities and general venture development
- Especially in the relative absence of notable success stories, venture capital initiatives do not do much to promote new venture creation. This appears to be an area where continued effort is called for
- Venture capital does not, at least alone, alleviate the market failure in R&D and technology transfer
- In itself, venture capital requires considerable skill, which is mostly learned through experience. This experience gap is not easily alleviated with transfers of public funds

Summarising, although venture capital constitutes an important element of entrepreneurship ecosystems, it alone does not appear sufficient to promote the creation and development of innovative high-growth ventures.

Incubation Approach

Alongside with the development of the venture capital sector, considerable resources have been invested to promote new venture creation. Two types of initiatives have been particularly notable: science parks and new business incubators. Of these, science parks typically operate in the vicinity of universities and seek to promote the creation of new ventures from academic research. Incubators are more general-purpose vehicles that are not necessarily restricted to research spin-offs.

Starting from early- to mid-1980's, science parks have become an ubiquitous element of European entrepreneurship ecosystems (Guy et al., 1996; Hackett & Dills, 2004). There is little doubt that science parks have been important in promoting research-based spin-offs and the idea that spin-off firms constitute an important mechanism driving knowledge spill-over from academic research to industrial practice. Although science parks have become an important facilitator of research commercialisation, their effectiveness in promoting rapid-growth innovative ventures is more debatable. At the very least, the most optimistic expectations in terms of high-growth firm creation have not been met. Although there is considerable evidence that science parks are effective in promoting the creation and survival of research-based spin-offs, the experience also shows that new venture creation does not automatically translate into new venture growth.

In parallel with science parks, also more general-purpose new business incubators have been created. Again, however, the 'incubators everywhere' experience has highlighted the lesson that new venture creation alone, while a necessary element of high-growth entrepreneurship ecosystems, does not automatically produce high-growth firms. Indeed, empirical evidence suggests that if taken too far, the promotion of new venture creation may actually hamper economic productivity, if new venture creation initiatives result in the reallocation of resources from more productive uses to less productive ones (Van Stel & Storey, 2004). From an entrepreneurship policy perspective, the 'incubators everywhere' experience has taught the valuable lesson that in high-growth entrepreneurship, quantity does not necessarily substitute for quality.

R&D Subsidy Approach

In this brief review, it is also worthwhile to note the relatively recent re-orientation of R&D subsidy initiatives to favour new and small firms. Although R&D subsidies have long been an important element of national innovation policies, the explicit focus on new and small firms is of relatively recent origin. This approach addresses the market failure in innovative activities in the context of new and small firms. The relatively recent explicit emphasis on new and small firms probably partly reflects the growth in the population of young innovative firms, as well as the traditional dominance of large firms in industrial R&D activities.

The most recent development in R&D support is the emergence of dedicated efforts to support cross-border R&D collaboration by SMEs. One example of these is the Eurostars programme. Although one might not expect there to be much demand for such an activity amongst SMEs, a recent evaluation of the Eurostars programme uncovered surprisingly strong participation by SMEs in cross-border R&D collaboration (Autio et al., 2010).

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[i] http://ec.europa.eu/europe2020/reaching-the-goals/monitoring-progress/annual-growth-surveys/index_en.htm