Impacts of Innovation Policy: Synthesis and Conclusions

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Impacts of Innovation Policy: Synthesis and Conclusions

Compendium of Evidence on the Effectiveness of Innovation Policy Intervention Project

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This report is part of the Compendium of Evidence on the Effectiveness of Innovation Policy Intervention Project (shortly the Compendium) led by the Manchester Institute of Innovation Research (MIoIR), University of Manchester. The project is funded by the NESTA – an independent body with the mission to make the UK more innovative.

The Compendium is organised around 20 innovation policy topics categorised primarily according to their policy objectives.

Reports are available at http://www.innovation-policy.org.uk. Also at this location is an online strategic intelligence tool with an extensive list of references presenting evidence about the effectiveness of each particular innovation policy objective. Summaries and download links are provided for key references. These can also be reached by clicking in the references in this document.

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Executive Summary

This report synthesises key findings and insights from the *Compendium of Evidence on the Effectiveness of Innovation Policy Intervention Project*. The *Compendium* compiles and appraises available evidence about the impacts of a range of innovation policies. In total, the *Compendium* consists of 18 separate reports on innovation policy instruments and one report on policy mix and interplay. Overall, nearly 800 evaluation reports and academic papers were reviewed. The Manchester Institute of Innovation Research produced the *Compendium*, with sponsorship from NESTA.

Innovation policy is defined as public intervention to support the generation and diffusion of new products, processes or services. This encompasses a broad array of policies, programmes, and initiatives. The *Compendium* focuses on instruments that are directly targeted to encourage innovation or which indirectly have strong effects on innovation while addressing other policy purposes. To organise the analysis, a typology of innovation policy instruments was developed. This typology distinguishes between supply-side instruments (influencing innovation generation) and demand-side instruments (influencing those requesting, buying or applying innovations). The typology also organises instruments according to seven major innovation policy goals: (1) increasing research and development investment; (2) augmenting skills; (3) enabling access to expertise; (4) strengthening system-wide capabilities and exploiting complementarities; (5) enhancing innovation demand; (6) improving frameworks for innovation, including regulation and standards; and (7) facilitating exchange and dialogue about innovation. We allocate instruments to these categories based on primary innovation effects, although we recognise that instruments often have multiple policy objectives and impacts. Additionally, the effectiveness of any innovation policy instrument is influenced by a variety of design, implementation and contextual factors. The *Compendium* reviews available evidence about the performance of specific measures against rationales and policy objectives, keeping in mind the limits of evaluation and assessment methodologies. This offers insights as whether instruments achieve policy goals, what effects they have in their particular circumstances, and what caveats are applicable.

Our analysis across the breadth of innovation policy instruments in the UK and major developed economies finds that they are based on the following mix of rationales. Supply-side instruments typically seek to address market failures which constrain access to information or other resources and which would otherwise lead to underinvestment in research and innovation. Supply-side instruments may also address public or system failures such as lack of connectivity or institutional rigidity. Demand-side instruments usually seek to address deficiencies in the ability and willingness of potential users to demand and apply innovation as well as improving the linkage and interaction between demand and supply. Many innovation policy measures on both the supply and demand sides also aim to mobilise innovation to contribute to other policy goals, including regional development, sustainability, and social inclusion.

In its reports, the *Compendium* reviews measures to increase private investment in R&D and innovation. These include both fiscal instruments (such as tax incentives) and subsidies (also known as direct support measures). Fiscal measures are often targeted generally, for example increasing R&D investment across a range of eligible businesses and sectors, while direct subsidies may target specific sectors, technologies or types of firms. The evidence reviewed suggests that fiscal measures have some positive effects on incremental and process innovation,
but there is no evidence that they stimulate radical innovation or overall productivity gains. Direct subsidy measures are found to have relatively stronger effects for low technology sectors, smaller companies and less advanced regions. Available evidence about the overall effects of direct subsidies, including on innovation output, economic performance and sustained behavioural change, is inconclusive, in part because most evaluations focus on innovation inputs. Those studies that have looked at outputs report contradictory findings for the impact of direct measures on R&D output and productivity, although a few studies have found some effects on firm behaviour and job creation. These effects depend greatly on the management of programmes and appear most likely to be enhanced if coupled with training, consultancy, and other complementary support measures.

The Compendium also looked at measures to improve access to finance (which could facilitate R&D and innovation investment) such as publicly supported venture capital and government backed loan guarantees. Our review of evidence on venture capital schemes reveals that innovation is not their primary target and that such measures are not evaluated in terms of their innovation impacts. Where innovation impacts have been reported, we observe that such studies generally do not correct for selection bias (e.g. more innovative firms are prone to be chosen for support). Indeed, some recent studies show that venture capital follows – rather than initiating – innovation. Evidence on credit guarantee schemes indicates that they help business growth, sales and employment, although without impacts on firm productivity, R&D or investment intensity. There is some evidence of adverse selection, supporting struggling or under-performing firms, which could potentially be disadvantageous to more innovative competitors.

For innovation policies which affect the skills base, the Compendium differentiates among measures for skills development, improving access to expertise, including access to foreign workers through immigration schemes, and labour legislation. The Compendium also reviewed evidence on the effectiveness of measures for technical services and advice and support for the exploitation of intellectual property (IP). Such measures are vital contributors to the capabilities of innovation system, although drawing general evaluation conclusions from the available evidence is difficult due to the wide variety of measures and differences in context. Nevertheless, the existing evidence shows a positive association between innovation performance and expenditures on both formal and informal training. Skills development programmes are found to address market failures whereby individuals or enterprises may sub-optimally invest in training from a broader social and economic perspective. Although there is less available analysis on how labour legislation effects skill development and retention, it is found that strong employment protection laws are linked to enterprise investment in skills enhancement and to incremental innovation. Immigration schemes have differential effects, according to our review of international evidence, with employer-led schemes addressing the needs of a given pool of employers, while points-based schemes more broadly shaping the availability of skills supplied by foreign workers. The evidence shows that the retention of highly educated immigrants within defined skill categories and the positive selection of immigrants in terms of ability have positive impacts on innovative capacity in high-income countries. Innovation management advisory schemes, which provide firms with mentoring, advice and networking across a range of innovation-related activities, are generally found to generate significant positive effects for assisted firms and for broader regional and national economies. There is less conclusive evidence about the innovation impacts of schemes to support IP management by firms and public organisations.
Various studies find a range of effects for similar measures, with no evidence linking support interventions to changes in IPR behaviour.

The *Compendium* examined evidence about the effectiveness of **cluster policies**, **network policies** and **support for R&D cooperation**. In general, evaluations of these measures to strengthen system-wide capabilities find positive intermediate results in building linkages and exploiting complementarities. Such programmes work best in facilitating further improvements when clusters and networks already exist, but do not always succeed in building clusters or networks from scratch. It is less clear whether these measures result in greater investment in innovation, improved innovation performance, and sustained changes in innovation related learning. Positive economic benefits are found for participating firms from R&D collaboration, although less is known about broader spillover effects. The variety of cluster and network policies complicates drawing general conclusions about effectiveness, although it does seem that positive effects are more likely with capable management and leadership and where there is sufficient latent potential for participation.

**Demand side policies** which stimulate the use of innovations to address specific challenges have been highlighted in recent years. Many case studies and some quantitative analyses show the importance of **public procurement for innovation** through such measures as forward commitment procurement, procurer networks, awareness measures, procurer training, and the bundling of demand. The conceptual literature suggests that these policies can be valuable and can tackle specific deficiencies of public procurement for innovation. However, knowledge about the effectiveness of these policies is still emerging, in part because of their novelty and fragmented deployment. In contrast, measures to support **private demand** are relatively common in environmental, energy or transport domains. Nonetheless, evidence for their effects is mixed: price-based mechanisms appear to support incremental innovation, while command and control mechanisms can help to trigger more radical innovations. **Pre-commercial procurement** schemes are a combination of supply side (support for the innovation generator) and demand side (grants built on a clear definition of a public need with some intent to subsequently purchase the innovation) mechanisms. These programmes, largely based on US models, generate positive short-run innovation and economic effects for participating firms. However, mixed results are found for the diffusion of supported innovations and in terms of long run implications for firms.

The *Compendium* recognises the importance and increased policy awareness of **framework conditions and market creating mechanisms**. The *Compendium* reviews evidence of the impact of **regulation** on innovation. Overall, it seems that environmental regulation of business shows positive aggregate effects on innovation activity. What is less clear, however, is the scope and scale of the potentially negative effects on innovation activity due to regulation, especially on smaller firms for which compliance costs are relatively higher. While the effects of **standardisation and standards** on growth are overwhelmingly positive, the evidence for their effects on innovation is ambivalent. We observe that standards support innovation (allowing novel complementarities, creating markets) yet can also limit it (non-complying novelties are hampered). The capacity of firms to actively contribute to standardisation is an important conditioning variable, with smaller and peripheral firms potentially disadvantaged in this regard.

Finally, the *Compendium* reports on the effects of **foresight** activities which are an important contributor to **innovation policy dialogue**. The existing evidence suggests that foresight
exercises have broadly positive effects on innovation policy design. Evaluations of foresight exercises stress the importance of a range of pre-conditions to make foresight effective in creating awareness, increasing consensus and improving reflection in innovation policy. The available evidence focuses on foresight processes that contribute to specific instruments and priorities, with less known about the effects of foresight processes on system-wide policy discourse. Additionally, there are no systematic analyses that examine the effects of innovation policies based on foresight activities.

The Compendium reveals how far evaluation methodology has come – and what its limitations are – in identifying the effects and preconditions for innovation policy instruments to operate effectively and efficiently. A wide range of innovation-related evaluation studies is now available. Yet, the Compendium also finds many evaluation gaps. The available evaluations tend to emphasise narrowly defined and easily measured effects, with far less attention to behavioural and longer term outcomes. Unintended and detrimental effects tend not to be deeply probed, and evaluations are often insufficiently explicit about underlying rationales, causal assumptions and context conditions. Furthermore, while the importance of innovation and innovation support measures has grown, with innovation policy measures now implemented across a whole range of policy areas, such measures are either not fully evaluated or not evaluated in terms of their innovation effects. Nonetheless, a series of insights can be drawn from the current body of available research and assessment on the effects of innovation policy, and – with appropriate caveats – there is significant potential for policy learning. The Compendium not only exploits this existing evidence on innovation policy but also highlights deficiencies in evaluation approaches and methods that can be used to improve the future production of evidence for innovation policymaking. In particular, and in addition to more explicit attention to rationales, assumptions, and context, we stress the importance of a more systematically linking innovation policy intervention (including indirect innovation policies) to longer term behavioural effects and to economic growth, job creation and societal challenges. Moreover, while innovation policy evaluation evidence is available from a series of countries, there is great national variability in approaches. Opportunities for greater international learning, coordination and collaboration in evaluation could thus usefully be explored and exploited.
1 Introduction

This report is a synthesis of the main findings and insights from the *Compendium of Evidence on the Effectiveness of Innovation Policy Intervention Project*. This project brought together, assessed and synthesised available evidence on the effectiveness of innovation policy. Eighteen reports on innovation policy instruments and one report on policy mix and interplay have been produced. All reports were discussed in stakeholder seminars in either London or Manchester.

The *Compendium* is mainly targeted at policy makers and those responsible for designing and implementing innovation policies and programmes. It will also be useful for academics, evaluators, users and other stakeholders. With this summary report, innovation policy specialists in ministries and agencies can obtain an initial overview as they make choices about appropriate innovation policies, programme designs and instruments. They may then consult the reports that are most relevant for their specific situations. The summary report, however, is also intended to inform non-specialists in innovation policy so they may develop an understanding of the rationales and effects of those policies that have an impact on innovation capabilities and performance, and to learn about the nature and limits of the evidence concerning their performance.

The purpose of this report is twofold. First, it pulls together overall lessons regarding the effectiveness and impacts of the innovation support measures covered in the *Compendium*. Second, the report offers observations and insights about the state of evidence and its production on the effectiveness of policies in this domain, including a consideration of evaluation methods, approaches and gaps. This provides a basis for deliberation on improved policy design and implementation as well as the production of evidence to support innovation policy making in the future.

Collating available evidence about the performance of policies is useful but also has clear limits. Existing evidence on the effectiveness of specific policies is highly context dependent. Unless the specific contextual circumstances are considered, drawing lessons from particular policy and programme assessments is problematic and uncertain. Instead, the evidence and insights about innovation policy impacts identified in this series of reports is best used to prompt and inform debate, questioning and reflective action: analysts and decision-makers may draw many lessons from the significant body of work amassed in the *Compendium*, but this must be integrated within their own context and the specific objectives they have. This synopsis will discuss this in more detail.

The report is structured as follows. It first outlines the conceptual starting points of the *Compendium*, outlining the typology of policy instruments and mapping them against the primary and secondary innovation policy goals. It then provides a short overview of the data basis of the *Compendium* (Section 3). The main section of this report (Section 4) summarises the evidence regarding the impact of the innovation policy instruments covered. This section is organised according to the main policy goals rather than listing the reports sequentially. This allows consideration of groups of instruments that are designed to address the same overarching goal: this is in line with our initial understanding that it is not the instrument per se, but the goal that is pursued which forms the entry point of interested stakeholders. Section 5 draws some overall lessons as to the state of play of evidence production for innovation policy making. The final part (Section 6) closes with general reflections and recommendations for innovation policy practice and evidence production.
2 Conceptual starting points

For the purpose of this study, we have defined innovation policy as all public interventions that seek to support the generation and diffusion of innovation. Deliberately, this is a very general definition, which does not take into account different rationales for policy and different target groups.

The policy instruments analysed in the Compendium were selected and ordered following the basic rationale that the entry point for many of its users will be a policy problem – or a policy goal – i.e. policy makers and other stakeholders would seek input when they are seeking prior experience and evidence to support a specific policy goal. To bring some order to the variety of policy instruments and to select the most relevant one, we developed a two-dimensional taxonomy.

First, we distinguish between those instruments that intervene at the supply side and those that intervene at the demand side of innovation. Innovation policy is geared towards generating innovations in firms, but this can be done by supporting or shaping the supply side, the firms themselves, or the demand side and the context in which firms operate in order to incentivise and enable firms indirectly. The study thus includes both supply and demand sides, and – as far as the available evidence permits – the deliberate combination of the two.

Second, within the broad dichotomy of supply versus demand side, we have identified seven major innovation policy goals within the basic realm of our innovation policy definition. These goals were defined in consultation with the Compendium advisory board. On the basis of these, a set of instruments, perceived as being the most typical and critical for achieving these goals, was selected for discussion.

This goal-driven approach also allows the inclusion of a range of instruments that are not primarily geared towards improving innovation capabilities and activities, but are designed for other policy goals (transport, energy efficiency, etc.). However, in support of these goals, the instruments can affect innovation behaviour and performance. This is especially true for instruments that are geared towards improving the skills base and the demand conditions for innovation. Traditionally, such policies were not designed for, nor evaluated against their impact on innovation activities per se. Nevertheless, it is important to discuss innovation policy in such a broader, inclusive approach, to overcome the detrimental narrow compartmentalisation of innovation policy. Further, many of the objectives have multiple goals, while several of the instruments serve multiple goals. Hence, while the individual reports deal with broad groups of instruments and/or goals, the allocation of instruments is generally based on their primary goal. Finally, the taxonomy cannot take account of the interplay of instruments, thus the Compendium contains a specific report on policy interrelationships and mixes of instruments.
Table 1: Instruments and goals

<table>
<thead>
<tr>
<th>Report Title and Instruments</th>
<th>Overall orientation</th>
<th>Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiscal Incentives for R&amp;D</td>
<td>●● ●●</td>
<td>○○ ○</td>
</tr>
<tr>
<td>Direct Support to R&amp;D and Innovation in Firms</td>
<td>●● ●●</td>
<td>● ●</td>
</tr>
<tr>
<td>Access to Finance, Publicly Supported Venture Capital and Loan Guarantees</td>
<td>●● ●●</td>
<td>● ●</td>
</tr>
<tr>
<td>Policies for Training and Skills on Improving Innovation Capabilities in Firms</td>
<td>●● ●●</td>
<td>● ●</td>
</tr>
<tr>
<td>Innovation and Human Resources Migration and Employment Protection</td>
<td>●● ●●</td>
<td>● ●</td>
</tr>
<tr>
<td>Support Measures for Exploiting Intellectual Property</td>
<td>●● ●●</td>
<td>○○ ○</td>
</tr>
<tr>
<td>Entrepreneurship Policy</td>
<td>●● ●●</td>
<td>○○ ○</td>
</tr>
<tr>
<td>Technical services and advice</td>
<td>●● ●●</td>
<td>○○ ○</td>
</tr>
<tr>
<td>Cluster Policy on Innovation</td>
<td>●● ●●</td>
<td>○○ ○</td>
</tr>
<tr>
<td>Policies to Support Collaboration for R&amp;D and Innovation</td>
<td>●● ●●</td>
<td>○○ ○</td>
</tr>
<tr>
<td>Innovation Network Policies</td>
<td>●● ●●</td>
<td>○○ ○</td>
</tr>
<tr>
<td>Measures to Stimulate Private Demand for Innovation</td>
<td>●● ●●</td>
<td>○○ ○</td>
</tr>
<tr>
<td>Public Procurement Policies</td>
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<tr>
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<td>○○ ○</td>
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<tr>
<td>Innovation Inducement Prizes</td>
<td>●● ●●</td>
<td>○○ ○</td>
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<tr>
<td>Standardisation and Standards</td>
<td>●● ●●</td>
<td>○○ ○</td>
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<tr>
<td>Regulation</td>
<td>●● ●●</td>
<td>○○ ○</td>
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<tr>
<td>Technology Foresight</td>
<td>●● ●●</td>
<td>○○ ○</td>
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</table>

presents the list of reports, organised according to the major goals of innovation policy. It displays the two level logic of our conceptualisation of innovation policy. It orders the reports first according to whether they target the supply or the demand side, and then sets out their goals (e.g., to increase the level of R&D expenditure, increase non-financial capabilities, improve connectivity, etc.). The report on policy mixes is not listed (Edler et al., 2013).
### Table 1: Instruments and goals

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</tr>
<tr>
<td>Technology Foresight</td>
<td>★★★</td>
<td>★★★</td>
</tr>
</tbody>
</table>

1 Stars denote the relevance of the overall orientation and the stated goals of innovation policy to the various innovation policy instruments and respective Compendium reports that cover these instruments (★★★: strong relevance, ★★★: moderate relevance, ★★★: minor relevance).
3 Scope and method of this report

The Compendium reports are based exclusively on existing available evidence. The reports reviewed formal evaluation reports, academic analyses of evaluation evidence (primarily from peer-reviewed journals), and other relevant documents. Each individual report has details on the search strategy. In total, more than 1,400 items were reviewed, including nearly 200 evaluation reports (Table 2).

Table 2: Overview of the literature reviewed in the Compendium study

<table>
<thead>
<tr>
<th>Evaluation Reports</th>
<th>Academic Analyses with Evaluation Evidence</th>
<th>Other Documents (conceptual papers, other reports)</th>
<th>Total reference items</th>
</tr>
</thead>
<tbody>
<tr>
<td>197</td>
<td>584</td>
<td>621</td>
<td>1402</td>
</tr>
</tbody>
</table>

4 Discussion of effectiveness and impact of innovation policy

The following section summarises the instruments covered by the Compendium. It is organised according to the main goals of the instruments as outlined in Section 2. All sections are structured in a uniform pattern: they outline the basic rationales underlying the instruments, summarise the nature of the available evidence and subsequently the effects of the instruments and provide commentary on overall lessons, tensions and problems associated with the instruments.

4.1 Increasing input for innovation and R&D

Almost all supply side measures implicitly or explicitly include an element of increasing R&D spending as one of their objectives. However, for a number of policy measures, such as tax incentives (Köhler et al., 2012) and direct measures for R&D (Cunningham et al., 2012), increasing R&D spending forms the primary objective. The impact of these measures are summarised in this section. Further, this section includes schemes, such as venture capital schemes and loan guarantees (Ramlogan and Rigby, 2012a), which are primarily aimed at enhancing innovation and accelerating business growth, also contribute, indirectly, to more innovation activity.

4.1.1 Increasing R&D and innovation inputs: Basic rationale

Policy measures that aim to increase R&D spending typically emphasise neo-classical market failure rationales for intervention. According to this rationale, the R&D investment of private firms is lower than the socially desirable level. This under-investment in R&D arises as firms cannot appropriate the benefits of their R&D investments fully on their own: knowledge created will spill-over to other actors and it is not in the interest of the firm to finance knowledge

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2 Annex 1 provides a full overview of evaluations, academic papers and reports reviewed across all reports of the Compendium.

3 This section builds on Köhler et al. (2012), Cunningham et al. (2012) and Ramlogan and Rigby (2012a).
creation that benefits others. Furthermore, R&D is risky and firms often limit their R&D investment in order to manage their risk. Therefore, government support is needed to incentivise private R&D to a socially desirable level, with the hope that increased R&D will lead to new products, new sales and more employment. When considering targets for support, the marginal benefit of supporting SMEs is thought to be higher than the marginal benefit of supporting larger companies. Also, helping exporting companies (and thus creating more jobs) and catching-up are complementary rationales.

The above rationale is also addressed by cooperative or demand-side programmes, albeit as a secondary objective. However, these measures tend to focus, respectively, on objectives such as collaboration with a University or mission orientation and the support of societal missions through increasing R&D expenditure.

4.1.2 Increasing R&D and innovation inputs: Existing evidence

While the instruments grouped under this goal mainly support the increase of R&D expenditure and innovation inputs (input additionality), the overall effects are larger and extend to increased and improved outputs (output additionality) as well as to persistent changes of behaviour in order to improve R&D and innovation performance (behavioural additionality). Evaluations of those measures in principle can and should look at all three effects.

Direct measures

As one of the earliest types of innovation policy instrument, there is a substantial stock of evidence on the performance of direct measures, both in the form of evaluations and scholarly studies. The amount of recent evidence is increasing and academic studies are becoming more prevalent in the evidence pool (see tables at Annex 1, 2 and 3 in Cunningham et al. (2012) for a comprehensive summary of the evidence). Much of the evidence tends to focus on assessments of input and output additionality, whilst behavioural additionality and longer term effects are more neglected even if they have recently received more attention. Similarly, there is limited evidence for any unintended effects arising or for overall welfare effects (including societal costs, spill-over effects, etc.).

There are many evaluations for direct measures and the range of approaches used tends to produce broadly similar types of evidence. However, when examining the academic literature on direct measures, we find that the magnitude of effects associated with specific schemes (or groups of schemes) is not independent from the methodology used in those studies. For example, a number of macro-economic studies which examine the effect on the relationship between public and private spending on R&D as a result of direct measures, but which apply different econometric approaches, find different or even contradictory results even when using the same or similar datasets (Cunningham et al., 2012: p30-31). For this reason, the use of such econometric studies on aggregate data should be treated with some caution when attempting to discern the impact of specific instruments.

Fiscal incentives

As in the above case, there is also a substantial and increasing body of evidence comprising evaluations, reviews and academic studies (Köhler et al., 2012). The evidence for fiscal measures is often focused on, or limited to, the econometric analysis of the additional investment in R&D undertaken by firms (input additionality). It is much rarer to encounter
evidence that deals with the intended or unintended effects arising from this type of instrument, such as improved or increased R&D outputs and innovation (output additionality) or changes in the way firms are performing R&D and innovation (behavioural additionality). Moreover, again, overall welfare effects (including societal costs, spill over effects, etc.) are typically not captured (Köhler et al., 2012: p18). Finally, meta-evaluations comparing different countries tend to produce more reliable results for fiscal incentives.

**Access to finance and venture capital**

For these support instruments, the evidence base is much more restricted. However, in evaluations of these measures, output effects, such as effects on employment and turnover are more commonly encountered, with some consideration given to export performance (internationalisation) in a small number of schemes. Furthermore, similar to the above two types of measures, general welfare effects have not been studied in this measure type.

### 4.1.3 Increasing R&D and innovation inputs: Effects

**Direct measures**

The effects of direct measures on input, output or behaviour in general depend very much on the specificities of the individual schemes and on the operational (country, regional, etc.) contexts. The majority of evaluations of direct measures find that firms invest more on R&D and innovation activities because of the intervention, but the scale of this input additionality differs considerably between country cases. Moreover, in general stronger effects are found in micro-level studies.

Public support in general does lead to complimentary, additional private support, even if a few evaluations find some crowding-out of private investment through public intervention. Further, the effects on input additionality are generally stronger in smaller firms (although there are contradicting studies and arguments), in low technology sectors and in less advanced regions. Prestige or halo effects, whereby the receipt of funding in one scheme improves the chances of obtaining additional funding from other public and private sources because of the prestige gained from the first award, are also increasingly identified in the literature.

Overall, the picture for impact on R&D output and on productivity is not always positive but a limited number of studies that look at job creation in general find positive effects. Furthermore, the small number of evaluations of direct measures that examines the change of behaviour are almost exclusively positive.

Finally, there are a number of evaluation studies that indicate that the overall success of these programmes can be increased by rigorous selection processes combined with monitoring, systematic pre-application support, stronger interaction between programme management and participants, minimal bureaucracy and prolonged scheme duration (for a comprehensive review see OECD, 2011). There are also a number of studies that show that the provision of complementary services (such as advice, training on aspects of business and management practice, support for marketing, etc.) and the combination of direct measures and fiscal incentives can increase the likelihood of successful outcomes.
Fiscal incentives

Again, effects are dependent on the specificities of the individual schemes and on the operational (country, regional, etc.) contexts. Most evaluations provided evidence that firms invest more on R&D and innovation activities as a result of the instrument and the scale of this input additionality varies across country cases and different designs of tax incentives: there is some evidence to suggest that long-term impact is stronger than short-term impact. Again, micro-level studies uncovered stronger effects in general. Fiscal measures are largely non-discriminatory as regards content of research, type of company or industrial sector supported. Nonetheless, the scope of input effects varies considerably, depending on the country, the period considered and the econometric method applied. There is no clear cut relationship between design features and effects, thus existing evidence does not allow a conclusion as to whether any specific design of fiscal incentive is in general superior. The picture regarding the effects on outputs (generally measured simply as patents) and performance is less clear. The few studies that have analysed the output additionality of fiscal incentives find positive effects for process innovation and incremental innovation, they are inconclusive about the triggering of radical (new to the world) innovation and they do not find positive effects on labour productivity.

Access to finance and venture capital

Evidence on credit guarantee schemes indicates that they help businesses to grow (as would be anticipated). Several evaluations show a direct causal effect on output (sales) and employment. However, the evidence also indicates that some schemes did not have an impact on firm productivity, R&D or investment intensity. In such circumstances, schemes may actually be supporting firms that are struggling or under-performing and may be ultimately stifling innovative forces. Overall, however, credit guarantee schemes have not been particularly directed at the support of innovation activities.

As in the previous section, the notion of behavioural addtionality is of lesser significance and is very rarely studied for measures stimulating access to finance.

4.1.4 Increasing R&D and innovation inputs: Tensions, pre-conditions, lessons

Overall, the studies analysed in our review suggest that there is a constant need for policymakers to check the continued relevance of the rationale and objectives of measures that aim to increase inputs for R&D. This is particularly important where these measures have been in operation for a considerable time period, which may increase the likelihood of inertia and the development of closed networks of beneficiaries. On the other hand, there are also benefits associated with the long-term stability of support.

Direct measures

Sound implementation forms one of the most critical factors for success. For example, the selection of the firms to be supported is very important but also poses considerable risks. As noted above, this class of instrument in particular tend to benefit those firms which already have experience (particularly of the selection process) in the same or similar programmes. This leads to a closed shop of participants which can only be overcome by pro-active pre-application support by programme management and closer monitoring.
Fiscal incentives

There is considerable risk of windfall gain, which requires a high degree of sophistication in design and rigorous monitoring. A number of studies highlight the risk of a ‘race to the bottom’ for long-running fiscal incentives where high incentives are given but returns diminish quickly over time. However, only a limited number of studies provide evidence on the performance and potential deficiencies of long running incentives.

Again, success is strongly associated with sound implementation, albeit with the same associated risks concerning the selection of firms to be supported.

Access to finance and venture capital

Similar to the findings for the other two classes of measures covered in this section, evaluations of government supported venture capital funds highlight the importance of the design of the compensation arrangements in the sharing of risk between investing bodies and the organisations in which investments are made. On the other hand, the desirability of clarity, simplicity, reduced time lags and less bureaucracy are also highlighted in the reviews. Therefore, there is a fine balance between sound selection and monitoring and simplicity and reduced burdens on participants.

4.1.5 Increasing R&D and innovation inputs: Overall conclusions

The success of measures which seek to increase input for innovation also depends on factors external to the programme which might be difficult to understand and certainly manage. These factors include the interaction with general framework conditions (e.g. general tax policies in the case of fiscal incentives), the interaction between similar measures aiming at the same or closely complementary objectives and the interaction between these measures and measures addressing different objectives. There is a particular, albeit small, stream of research that investigates the positive effects of the combination of direct measures and tax measures as well as different combinations of loan guarantees and venture capital support (Edler et al., 2013).

In general, increasing R&D expenditure alone is not enough: R&D is not the only input required for innovation (particularly for service innovation) but the set of direct and indirect measures reviewed in this section often only focus on increasing R&D. Current evidence does not sufficiently explain the quality and quantity of outputs created with given inputs (output additionality) and certainly does not explore how inputs are converted to sustained and persistent outputs through learning and behavioural changes (behavioural additionality).

4.2 Improving and increasing the supply of skill

4.2.1 Introduction – relevance and scope of coverage

Based on the longstanding view in economics that skills can be a driver for economic growth at the level of the firm (Becker, 1964; Bowles et al., 2001), there has been growing awareness over recent years that the combination of innovation with the development and accumulation of skills can also provide the ‘twin engines of growth’ (Lloyd-Ellis and Roberts, 2002). Consequently, governments have taken up the role of subsidising the creation of new

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4 This report builds on Jones and Grimshaw (2012) and Jones (2012).
knowledge through publicly funded scientific research and support for higher education and better quality schooling, together with the coordination and/or investment in vocational education and training (Jones and Grimshaw, 2012). This has seen the widespread introduction of innovation policy initiatives in many countries aiming to expand the tertiary education sector and increase R&D expenditures. This also explains the recent policy focus on expanding ‘Human Resources in Science and Technology’ (HRST) and the shift towards a so-called knowledge-based innovative economy as the mechanism for successful competitive growth. In particular, such policy initiatives have focused on satisfying rising demands for specific skill-sets including conceptual problem-solving and analytical reasoning (Brown et al., 2001; Gallie, 2009).

The Compendium report on improved skill for innovation (Jones and Grimshaw, 2012) focuses on two major sub-types of policy support for training: a) levy schemes (earmarked levies given as grants to employers for approved training; training levy rebate schemes; levy exemption schemes and tax incentives for approved training) and b) collaboration/partnership schemes between industry and tertiary education providers (which tend to focus on higher-level skills acquisition).

Furthermore, it is also increasingly recognised, that even in high-income developed countries, despite the introduction of various education and training policies, innovation may still be hampered by a limited domestic capacity in particular skill sets. Thus, countries may seek such skilled individuals from outside their national boundaries. In this context, high skill international migration policies and labour legislation may also become, or be seen as, part of the innovation policy toolbox on innovation (Jones, 2012). Although these impact on labour markets and human resources, they have not, historically, been designed with innovation in mind, in the sense of explicitly supporting innovative capacity at either the national, regional or the firm level (Jones, 2012). Such policies reflect regulatory and juridical frameworks that have evolved through highly complex country specific sets of arrangements, including judicial law, regulatory mechanisms, collective bargaining and custom and practice.

4.2.2 Enhancing skills: Basic rationale

The importance of the role of human resources in innovation processes derives from human capital hypotheses that the more knowledge (in terms of bundles of skills, competencies and experiences) individuals acquire, the more they enhance their cognitive abilities leading to efficient productive activity in the workplace.

In terms of the skill development policies (support of the development of HRST), there are some strong rationales underpinning the role and support of training by firms. Firstly, there appears to be a positive association between firms that can be classed as ‘innovative’ and the level of their expenditures on formal and informal training activities when compared to non-innovative firms. Secondly, the existing evidence suggests that firms benefit from a significant positive effect by developing their ‘knowledge pool’, particularly with respect to the organisation’s legacy of past innovations and the technical competences of owner-managers in SMEs (Jones and Grimshaw, 2012: p4).

More specific policy-oriented rationales point towards: the need for better incentives for the development of high-skill mixes in firms; a clear positive effect on innovation by the presence of intermediate technical skills and a firm’s investment in ‘technicians’; innovative performance is associated with the ‘making’ rather than the buying of skills as (in-house) skill development enhances absorptive capacity; and the evidence of experience with sector-specific inter-linkages.
between training and innovation supports the need to further reinforce institutions such as sector skill councils.

However, the review finds that a major disincentive to training (especially in SMEs) appears to arise from the fact that neither employers nor employees can be sure of receiving an adequate return on the investment in human capital due to market imperfections. Also, the effects were limited to those on the firms undertaking the training or the recipients of training (e.g. in terms of their career paths, etc.).

Concerning the rationales for policies seeking to increase the influx of skilled migrants, it appears that, in many of the countries examined, the overarching objective of migration policy in the medium term is to ensure the right scale and right type of high-level skills/expertise to satisfy immediate or future labour market needs for the achievement of high productivity and growth (Jones, 2012: p4).

4.2.3 Enhancing skills: Existing evidence

Very few studies emerged that were specifically focused on demonstrating an empirical causal relationship between skill formation policies and innovation or on the impact of policies specifically targeted at training and skill formation for innovation; most studies were concerned with the effect of training on productivity and/or profitability and on the work environment. This may be because data regarding on-the-job training and probably most in-company training schemes are under-reported and fragmented.

A particular conceptual problem is that the complex nature of training and skills development has been somewhat obscured by the application of a simplified dualist categorisation of training as either general or firm-specific, making it difficult to extrapolate a real-world connection with innovation performance. Moreover, there are few robust impact assessments or evaluation studies of levy schemes and the true impact – in terms of on-going skill formation, business performance and productivity and innovation – cannot therefore be elaborated. Similarly, the theoretical and empirical literature on university-industry collaborative approaches is very wide: much of it is descriptive, hypothetical and not particularly illuminative of the processes by which universities affect the rate and direction of technological change in industry. Consequently, the report's authors were not aware of any empirical studies that have undertaken an impact evaluation of the sort of high-skill, collaborative activities described above with respect to the contribution to innovation or productivity.

It should also be noted that the analysis of the effects of training schemes and incentives is hampered by the following factors: difficulty in assessing the quality of training programmes and the (potential) links to job prospects in advance; loss of invested resources if employees take up new jobs or are 'poached' by competing firms; 'asymmetric information' in the labour market for skills due to the lack of certification making it difficult to 'inform' other market parties of the additional capabilities obtained; and it is difficult to finance education and training since it is an intangible and uncertain investment good that by its character cannot serve as collateral.

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5 For more details on this duality see Jones and Grimshaw (2012: p11).
Turning to migration policies, the USA, Canada and Australia do use a variety of models to evaluate their effectiveness. Measuring impact with regard to labour legislation is currently difficult as it does not contain indicators specifically designed to measure the impact of legislation on human resources development, (e.g. investment in training) and how that subsequently impacts on innovation.

A wide range of criteria are available for measuring the success of skilled migration schemes but only in a few cases, notably Australia and Canada, have there been systematic attempts to collect the necessary data or carry out full evaluations and follow-ups (Jones, 2012: p16). Frameworks for evaluation are only now being developed in many countries. Moreover, policy reviews and studies typically focus on aggregate level indicators (or proxy indicators) of innovation (e.g. patents filed, patent citations, etc.). Thus, generally the evidence is hampered by the difficulty in linking skilled worker immigration with direct metrics of innovation. Large scale longitudinal data sets on worker occupations, migration, skills levels, salary scales and economic variables are also lacking.

### 4.2.4 Enhancing skills: Effects

Overall, the successful skills and training incentives schemes evaluated were shown to be flexible, demand-driven, and often accompanied by an information campaign and technical assistance to smaller firms. However, it should be noted that here, success was measured in terms of delivering training, and not on its effects on innovation. In general, the literature reviewed suggests that the innovation related general effects of levy-based training schemes is that they: increase the volume of training; support the development of a wider network of infrastructure in skill and training; be suitably adapted so as to provide targeted assistance or exemptions for SMEs; and are designed around either a universal model or around highly differentiated reimbursement schemes as appropriate, for example, in terms of general versus specific skills, or in particular sectors of the economy.

With regard to migration policies, a range of different policy approaches have been adopted to meet labour market needs. These can generally be described as criteria-based points accumulating systems, employer-led systems and hybrid systems, showing the following main effects:

- **Point-system regimes** have more capability in recruiting highly qualified immigrants, with the potential to contribute to research, innovation and economic growth.
- In general, employer-led schemes have been typified as direct policy vehicles for economic growth and for enhancing the competitiveness of firms by responding directly to employers' needs for specific human capital.
- Hybrid systems address the need to target more precisely specific skill needs, to combine employer-selected immigration with points for job offers and continued employment (rather than in the first job at entry).
- Systems of labour legislation, in their most general sense are concerned with protecting workers interests, ensuring labour stability and achieving the cooperative modus operandi between workers, employers and other social partners.

Despite the lack of evaluation evidence in terms of innovation performance of migration policies and labour legislation, some of the review findings suggest there are clear benefits for high-
income countries in adopting policies to both attract foreign students and to retain them once they have completed their studies, although these are clearly generic observations. Some studies indicate that aspects of employment protection in certain contexts – coordinated labour legislation and collective bargaining frameworks in open economies (the review uncovered significant differences across countries) link well to certain types of innovation (incremental).

Also some empirical evidence suggests that while, strong labour laws may contribute to dampening economic growth, the area of laws that protect employees against dismissal are an exception and may promote economic growth particularly in innovation-intensive sectors (Jones, 2012: p25).

By way of examples in the migration policy area, systematic empirical results are now emerging in the USA of strong immigrant contributions to patent applications and the creation of technology firms, growing international co-authorship of academic articles and increasing collaborative work in science and technology, although this appears to have worked only within a wider economic framework conducive to innovation. With regard to particular policies and schemes, there are examples for which some positive impacts have been shown (Jones, 2012: p11). These include the US temporary professional visa (H-1B) scheme which in conjunction with a set of accompanying measures, had significance in attracting the most highly skilled; the Australian changes made to the country’s immigration selection policy for raising the skill composition of immigrants, which contributed to an increase in GDP per capita, the high skill recruitment policies in Canada with positive effects on economic growth, and broad Dutch policy and regulatory activities involving all social partners that focus on ameliorating the impact of contingent employment contracts and maintaining and enhancing networks to retain essential knowledge and skills.

4.2.5 Enhancing skills: Tensions, pre-conditions, lessons

The following preconditions or contributory factors were found to be associated with successful training schemes and incentives:

- Strengthening market valuation of training and competences: a transparency and competence-based skills validation system would encourage both validation of prior learning and incremental addition of new modular skills, by providing greater assurance of later market valuation.
- Capitalisation allowing firms to collateralize and amortize knowledge could allow the projection of skills depreciation and upgrade costs, and give some warning of obsolescence and natural loss through aging. If clearly defined competences are linked to productivity outcomes the question of which party should finance training are greatly simplified.
- Transparency of labour contracts would bring out currently hidden employee assets and employer benefits. At a further stage, development of a set of transparency-based system skills can be treated as a leased asset for accounting purposes, allowing the employer to use depreciation accounting while the employee can more easily recover costs of acquiring or upgrading skills.
- A competence-based skills system could reduce artificial distinctions between formal and informally acquired knowledge. Identification of investment patterns: if training is recorded as an investment with relatively predictable outcomes it becomes possible to recognise patterns of ‘over’ or ‘underinvestment’.
- Discouragement of ‘unfair’ rents, reduction of information ‘noise’ and discrimination could reduce discrimination on the basis of prejudice and ascribed characteristics, benefitting marginalised groups and individuals enhancing entry to and mobility within labour markets.
The following lessons were felt to apply from the analysis of skills development and training incentives, notably levy schemes: compulsory systems have the advantage of an economy-wide approach but may require the strong engagement of social partners to establish a lasting reputation; the careful positioning of a levy scheme within the wider skill formation system is fundamental to its design since there may be a positive opportunity to develop the wider training infrastructure through new agencies in the public and private sectors; schemes can be targeted, e.g. with special provisions for SMEs or for sectors such as construction or social care; given the tendency for employers to favour skills tailored to the needs of their business, some schemes are notable in that they usefully incorporate incentives to encourage the development of general, transferable skills (Jones and Grimshaw, 2012: p16).

The general conclusion concerning policies for high-level skills formation (e.g. university-industry collaboration and partnerships) was that it is unclear as to whether these sorts of schemes are sufficiently similar in their design and operation to facilitate lessons for cross-national policy transfer in order to improve policy interventions in different national contexts.

Finally, the review of training incentives policies noted that: strengthened industry/HEI collaborations characterise many of the recent national policy initiatives but the question of how these are impacting upon innovation requires detailed investigation; targeted partnerships offer innovations in training provision and contribute to the wider goal of adapting and delivering high level skills for fast-changing industry needs; more flexible pathways between educational institutions and workplace training programmes appear to have positive outcomes for adaptability and the raising of skill levels; longer-term programmes of financial investment and the principles of governance of skill formation systems help in generating stability and certainty, encouraging fuller participation by the relevant stakeholders; while the innovation impact of training levies is uncertain, country evidence suggests they set a minimum floor for training investments which may be valuable where there is wide variation in skill development by sector.

A major factor limiting the impact of migration policies on innovation capability concerns the fact that issues of cultural diversity, difference in cognitive behaviours and ways of doing and learning are as yet poorly understood in host countries which may inhibit foreign born high-skill migrants from fully using, creating and disseminating their knowledge and skills. As a desirable pre-condition to support the innovation capabilities of these policies, the adoption of forms of mediation, work organisation and knowledge exploration that actually promote innovation at the firm level by aligning the objectives of workers and firms would seem a prerequisite and also a policy challenge.

A further challenge associated with their implementation is the matching of supply and demand as used by the point-system countries; this appears constrained in some countries by the absence of tools with which to make detailed analyses of the skills bundles needed both in sectors and across sectors which can be used to strategically assess current and future skill requirements. Generally, the policy approaches adopted aimed at gaining all the net positive effects associated with high skilled labour for the host country. However, none appear to be embedded in specific national innovation policy instruments or tools. Finally, labour legislation systems are currently not configured with innovation in mind, in the sense of supporting innovative capacity at the firm level.
The overall lessons from the review of migration policies indicate that the retention of highly educated immigrants within skill categories and the positive selection of immigrants in terms of ability appear to positively impact on innovative capacity in high-income countries. However, systematic empirical evidence and data are lacking to demonstrate this impact fully.

Concerning labour legislation, findings are mixed. There are some studies indicating that aspects of employment protection in certain contexts are linked well to certain types of innovation, and some evidence suggests that the employment protection aspect of labour legislation may encourage investment in human capital, since longer-lasting employment will increase the expected returns to education and training, retain skilled workers and encourage internal mobility thus maintaining and adding to the knowledge bases of both individuals and firms. However, overall evidence here is inconclusive, as there are studies that show a negative effect of strict labour regulation on innovation.

Finally, labour legislation may potentially comprise a significant and proactive part of cross-cutting policy toolkits for promoting innovative growth but as yet there is currently no clear view of which parts of labour legislation fit with which parts of innovation policies and at what level.

### 4.3 Improving access to expertise

One key objective of innovation policy is to provide firms with access to expertise that helps them in various stages of their development. Among the many schemes that have been developed, the *Compendium* identifies three major strands of support measures: (1) non-financial measures to support entrepreneurship development, (2) measures to assist firms in exploiting intellectual property (IP) and most broadly, (3) measures to advise firms on innovation management and adoption issues.

#### 4.3.1 Access to expertise: Relevance and scope of coverage

The report on support measures for exploiting intellectual property ([Rigby and Ramlogan, 2012](#)) focuses on policies that help inventors and other commercial actors to become aware of, and make use of, the IP system. The scope of the study is primarily on studies of support measures to assist users in navigating and benefiting from IP, rather than on overall assessments of IP systems. Two types of support measures are examined. First, measures targeted at universities and public research organizations, including support for technology transfer offices ([Rigby and Ramlogan, 2012](#): pp12-26) and second, government initiatives directed at private sector organisations through information provision and various kinds of consulting and assistance services ([Rigby and Ramlogan, 2012](#): pp26-33). Over 70 studies are discussed.

The study on instruments in support of entrepreneurship policy ([Ramlogan and Rigby, 2012b](#)) distinguishes entrepreneurship policy, which is focused on business actors and individuals, from SME policy which is more broadly focused on improving the business and competitive environment for such companies ([Ramlogan and Rigby, 2012b: pp6-7](#)). The key activities of entrepreneurship policy include assistance with access to finance, reducing barriers

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6 This section builds on [Rigby and Ramlogan (2012), Ramlogan and Rigby (2012b) and Shapira (2013)].
to entrepreneurship, information and technical assistance, entrepreneurship skills development and training, and the dissemination of best practices. Measures may focus on varied targets, e.g. cultural and behavioural change, addressing information deficiencies, mentoring and technical advice, and multi-instrument schemes (e.g. combining financial incentives and behaviour change). (See Ramlogan and Rigby 2012b: pp12-29.) More than 60 studies are examined, including a review of evaluations of 21 entrepreneurship promotion measures.

**Technology advisory services** (Shapira, 2013) provide information, technical assistance, consulting, mentoring, and other services to support enterprises in adopting and deploying new technologies. Such services are typically but not exclusively targeted at SMEs. The ability to engage with companies at an individual as well as group level through extension staff, field offices, and dispersed technology centres, is an important component of technology advisory services, although there are some efforts to provide complementary services through online means. The organisation and operations of technology assistance services vary by country and region: in some cases there are national systems, in other cases services are organised locally; services may be provided through universities, non-profit organisations, technology centres, and private companies, with support from a mix of public and private revenue sources. There is considerable variation in the range and intensity of services offered. Technical assistance is not usually coupled with direct financial support, although there are exceptions.

### 4.3.2 Access to expertise: Basic rationales

**Support measures for exploiting IP** are typically justified as a result of market failures including information asymmetries and institutional failures within current IP systems (Rigby and Ramlogan, 2012: p11). Measures are also justified through government objectives to leverage public sector research and diffuse IP for technological innovation, economic growth, and social development. The primary justifications for entrepreneurship promotion are market failures such as the lack of awareness, information problems, and access to resources. Addressing these failures may then generate positive externalities. There can also be a parallel rationalization to increase level of entrepreneurship where it is below the “social optimum.”

There are two major rationales for public support in providing technology advisory services (Ramlogan and Rigby 2012b: pp10-11). First, there are market failures where investment in new technologies may be economically and socially sub-optimal. These failures may be generated by a combination of reasons, including lack of information awareness and expertise among firms, difficulties in choosing between technologies, lack of access to finance or inability to justify investment in new technology, expensive or weak private consulting availability, and lack of support from major customers. Such issues typically affect mature SMEs. Second, there are system and institutional failures, where the needs of existing SMEs (as opposed to new technology start-ups) receive low priority by universities (focusing on basic research and partnerships with larger companies) or by policy programmes (which target advanced science and technologies rather than more routine technology assistance needs). Public policies for technology advisory services seek to address these market and system failures by providing dedicated services to SMEs to address their technological needs and opportunities. Immediate intended effects include encouraging investment in new technologies, training, lean production, collaboration, strategy and market development, with longer-term effects on innovation and productivity. Policies also seek to generate broader effects such as retaining and creating employment, supporting business growth and competitiveness, stimulating economic development and promoting exports.
4.3.3 Access to expertise: Existing evidence

For **IP support measures**, there are many studies that examine and assess efforts to promote university patenting, technology transfer offices, and spinoffs, but relatively few studies that evaluate measures to promote the use of IP in the private sector. The university IP and technology transfer studies include a mix of econometric and case study methods. The review finds evidence that policy-induced system changes have fostered an increase in (university) patenting ([Rigby and Ramlogan, 2012: pp15-17]), but concludes that insufficient literature exists to assess the effectiveness of private-sector support schemes and their economic impacts ([Rigby and Ramlogan, 2012: p30]). This may reflect the complexity of IP and the difficulty of attributing change to direct IP support measures, given the many other factors that can influence the results of acquiring and deploying IP. However, the report does highlight work that considers good practice in private sector IP support, including ease of service identification, competence of staff, and timely delivery of support and information ([Rigby and Ramlogan, 2012: pp 31-32]).

There are many studies across a variety of **entrepreneurship support instruments**. Most available studies appear to relate to older schemes; more recent initiatives have yet to be fully and publicly evaluated ([Ramlogan and Rigby 2012b: pp12-29]). Varied methods are used including reviews of programme reported data, surveys and interviews with stakeholders. Some studies include control groups, and also use econometric methods.

Over the last ten years, a large body of literature has been developed which examines the effects of **technology advisory services**. The methods used in evaluations include surveys, case studies, centre reviews, and econometric studies. In several cases, quasi-experimental control group evaluations have been conducted, comparing assisted and non-assisted firms, controlling for the performance of firms prior to programme entry. As with the evaluation of entrepreneurship support, there can be issues related to self-reported impacts, selection bias, and attribution (since multiple factors, including service assistance, may lead to reported impacts). These problems are more in evidence in simple evaluations, but are addressed in relatively robust ways in more complex studies, especially those with control groups.

4.3.4 Access to expertise: Effects

Evidence identified in the report on **IP support measures** suggests that efforts to foster university patenting have indeed led to increases in this metric ([Rigby and Ramlogan, 2012: pp15-17]). The economic effects of this are uncertain, and there may be some negative effects on open science ([Rigby and Ramlogan, 2012: pp18]). Measures to promote private sector patenting are varied, but the report could find no clear evidence that they have either succeeded or failed.

Mixed evidence is reported for programmes which seek to promote **entrepreneurship** through cultural and behavioural change ([Ramlogan and Rigby 2012b: pp13-15]): differences may stem from the selection of methods. However, positive results are reported from schemes for entrepreneurial education for students (compared with more general entrepreneurial education schemes). Several studies report results for business growth in established SMEs from advice and technical assistance programmes ([Ramlogan and Rigby 2012b: pp15-20]): most report positive effects (on factors such as sales, employment), although other controlled studies report null effects. Reported efforts to foster self-employment do not seem to have had much effect. In other cases, the observed effects on entrepreneurship declined over time. Several studies on coaching and mentoring are discussed ([Ramlogan and Rigby 2012b: pp20-24]), but there seems to be no consensus on any positive effects. Only a few studies consider combined
interventions (e.g. financing and mentoring): some appear to be positive in terms of economic returns, while others find no effects (Ramlogan and Rigby 2012b: pp24-29). The report also suggests that no strong effects can be identified from programmes which combine entrepreneurship and locational interventions (e.g. incubators), although it did not comprehensively examine this particular programme type.

Generally, studies on advisory services find that technology advisory services do provide positive benefits for participating firms. The types of benefits achieved include reductions in costs, improved quality, reduced waste and improved environmental performance, higher productivity, and new product development and innovation. Levels of investment involved (by both the public sector and private participating firms) are typically not high. Similarly, the net benefits achieved are typically relatively modest, although such incremental improvements add up and can make the difference to SME survival or decline. In some instances, there are examples of significant and fundamental improvements for participating firms, but this is not the mode. Controlled studies generally tend to show lower net effects. Broader benefits to the economy are typically estimated through leveraging and multiplier assumptions about gross value added, although studies generally admit that it is difficult to precisely estimate broader effects and spillovers. Studies do not generally find unintended effects. For example, while concerns have been raised about negative impacts of publicly-supported technology advisory services on private consultants, the studies that have examined this do not find such effects. Indeed, private consultants are often engaged by public technology advisory services allowing them to serve and market to SMEs that would not otherwise have employed their services.

4.3.5 Access to expertise: Tensions, pre-conditions, lessons

Tensions in measures to foster greater university IP use primarily concern conflicts with other university goals and missions such as research openness, the mix between basic and applied research, the private exploitation of knowledge generated by public investment, and the priority to be given to focusing on IP and the more advanced firms that can absorb IP versus other enterprises and communities (Rigby and Ramlogan, 2012: pp32-34).

Fewer tensions are inherent in measures to support private sector use of IP, including concerns about advantaging one group of firms over another. There are preconditions for any successful IP promotion strategy. These include having the ability to actually generate and acquire IP, an efficient and well-regulated IP system, and enterprises (either start-up or existing) with the absorptive capability to make use of IP (Rigby and Ramlogan, 2012: pp31-32).

As regards entrepreneurship support, arguments about market failure are weakened by the fact that the private sector does supply support activity, although often support through private consultants is affordable only to more well-established businesses and entrepreneurs and may vary in quality. There is also an argument that entrepreneurship cannot be induced, it is “genetic” and hence public resources for entrepreneurship promotion are likely to be ineffective. Additionally, positive results may be influenced by selection bias. The report does find that there is a wealth of material about programme design and best practice, although it is apparent that programmes are not always well-designed or integrated. One limitation is the reliance on self-reported impacts in many studies, which may lead to positive bias. Another limitation is that entrepreneurship support may be only one of many factors resulting in business success or otherwise, making specific attribution difficult. A common issue is that a wide variety of somewhat different measures falls within the rubric of entrepreneurship
support: these often are not comparable, and they are operated differently in different circumstances (Ramlogan and Rigby 2012b: pp30-32).

**Technology advisory services** are typically funded at relatively modest levels, but there have been tensions in sustaining funding support and particularly in balancing the mix of public and fee income. Efforts to increase the amount of service costs paid by participating firms appear to allow leveraging and reduce pressure on public funds; however, as targets for private fee income are increased, technology services tend to go "up market" to serve mid-size and larger firms that can afford to pay higher levels of fees. There is also a tension in technology advisory services in selecting who to serve and how, e.g. many firms, less intensely or fewer firms, more intensely. Some evaluations suggest that more intense and customised services provide improved results; at the same time, there is often policy pressure to serve as many firms as possible, which means that service assistance is less intense than may be desirable. Programmes typically seek to address this challenge by providing initial assistance and then referring companies to qualified private consultants and other public services. Many studies discuss the preconditions for effective programme performance, including professional and industrially experienced staff, good outreach and branding, effective systems to diagnose enterprise needs, flexibility, and the ability to maintain a long-term perspective. However, challenges are often raised between providing short-term assistance (e.g. helping a firm better operate its existing technology to save costs) which has immediate and measurable effects and providing support for strategic development, mentoring and innovation which takes much more time and whose effects are harder to measure.

### 4.4 Generating and exploiting connections and complementarities

#### 4.4.1 Connections and complementarities: Relevance and scope of coverage

We identify three main types of policies that support the connection and collaboration of actors: collaboration programmes, cluster polices and network programmes. There is a broad variety of programmes and instruments to support collaboration for R&D and innovation (Cunningham and Gök, 2012) encompassing collaboration, science-industry research centres, collaborative research and exchange programmes, and collaborative knowledge exchange projects. Collaborative science-industry research centres differ in approach and focus, with variation by organisation and legal models, including university-based or non-profit affiliations, and diversity along national, regional, sectoral and technological dimensions. Collaborative research and exchange programmes, such as R&D consortia, may involve a range of configurations of research organisations, firms, sponsors, objectives and methods. Collaborative knowledge exchange projects can involve the linking or embedding of associates from one organisation with another, but also vary widely in design, organisation and operation.

Similar to collaboration programmes, since the late 1970s, both clusters (Uyarra and Ramlogan, 2012) and networks (Cunningham and Ramlogan, 2012) of innovation actors have become important components of technology and innovation policy in many countries since both are viewed as potential drivers and facilitators of innovation activities and, hence, economic growth. Although both terms are often used interchangeably, we view clusters as geographically

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7 This section builds on Cunningham and Gök (2012), Uyarra and Ramlogan (2012) and Cunningham and Ramlogan (2012).
discrete entities, whilst networks can be less dependent upon the proximity of their participants. Typically, clusters involve a variety of types of actors, industry, suppliers, users, knowledge producers, intermediary organisations, etc. Networks may share this diversity of actors although they may be restricted to more simplified configurations of companies linked by similar interests, academics or centres of research activity, or industry and public sector researchers.

Academic and policy interest in clusters has emerged from the observation that many industries tend to cluster and that ex-post analyses indicate that certain clusters demonstrate high levels of economic and innovation performance. However, despite the popularity of the cluster concept and the widespread use of cluster policy, the question of whether public support of clusters is effective, particularly for innovation, is an open one. Although many studies have focused on the characteristics of industrial clusters, cluster performance or on how to best support cluster development, they stop short of trying to understand the extent to which cluster policy is delivering tangible economic impacts.

Both clusters and networks allow for rapid learning and facilitate the reconfiguration of relationships between suppliers (in the case of companies) and producers of knowledge (other companies or research institutions); they can also stimulate the development of additional cooperative activities including training, technological development, product design, marketing or facilitate knowledge pooling, skills sharing, the sharing of facilities, equipment or datasets and the co-development of programmes of joint research. Also, they contribute to the establishment of ‘critical mass’ effects with regard to specific scientific or technological goals, for example.

### 4.4.2 Connections and complementarities: Basic rationale

The rationale for government support for policies that connect actors in R&D and innovation are based on market and system failures. For instruments to foster collaborative R&D and innovation, market failure justifications suggest that underinvestment in R&D occurs for reasons of information asymmetries, mismatched expectations and objectives, transaction and cooperation costs, and barriers raised by intellectual property and indemnity management. Related system failures include several related to university-industry cooperation including misalignment of university and enterprise strategies, time scale and capacity mismatches, lack of capability, university financial regimes and constraints, and long payback periods. As a result, while firms and research organisations have many strong reasons to collaborate, these market and system failures can lead to levels and types of collaboration that are less frequent and appropriate than economically optimal and socially desirable.

Collaborative R&D and innovation policies and programmes seek to overcome market and system failures in several ways. These include generating positive effects on innovation, competitiveness, and economic and social development by linking human and capital resources to do research that can otherwise not be done and generating higher quality and more effective outcomes from public investment in research. Policies and programmes also seek to expand the number of companies able to exploit research, change behaviour in university and public research organisations to give greater attention to applied research opportunities and needs, foster knowledge exchange and skills transfer, share risk and costs, and accelerate the pace of research and knowledge diffusion. Evaluations tend to focus on intended effects rather than exploring unintended impacts (such as sub-optimal collaborations and transaction costs).
However, some studies highlight concerns that redirecting university research to industry collaboration can lessen performance in basic scientific discovery.

The public policy goals of cluster policies are varied and highly context-specific, but include fostering knowledge spillovers, innovation, regional development, supporting SMEs, attracting FDI, increasing employment, etc. Over the longer term, such policies often seek to foster self-sustaining and dynamic regional economies.

Government intervention to facilitate the establishment or continued development of networks can be prompted by lack of, or insufficient awareness of, the opportunities they present. It can also be used to overcome barriers to network formation (e.g. fear of unfair appropriation of the benefits accruing). Governments are able to offer knowledge sharing frameworks which provide a level of security and reinforce the mutual trust upon which successful cooperative arrangements rely. Intervention can also be used to guide firms towards network membership in order to overcome technological “lock-ins”, to enter a new area or to change management practices.

The major benefits of network membership are as presented below (and may share these benefits with clusters):

- Increased scale and scope of activities
- Shared costs and risks
- Improved ability to deal with complexity
- Enhanced learning effects
- Positive welfare effect (increased R&D efficiency and overall R&D expenditure)
- Flexibility (in hierarchies)
- Efficiency (of knowledge transfer)
- Speed (of response to opportunities).

Several types and models of cluster policy have been developed since the early 1990s. Typologies revolve around mega-, local, and knowledge-based clusters, the debate between existing clusters versus the creation of new clusters and narrow versus broad cluster policy approaches. Another typology focuses on cluster instruments, e.g. actor engagement, collective services, and collaborative R&D – which clearly overlaps into network policy frameworks.

4.4.3 Connections and complementarities: Existing evidence

Evaluation on collaboration programmes is abundant. More than 35 studies are identified that evaluate the effects of collaborative R&D and innovation programmes, nearly 40 academic articles on collaboration (including the role of support), plus a range of general methodological articles and indicator reports. Evaluations use a range of methods, including surveys, case studies, and econometric studies. However, they often fall short of conceptualising and measuring effects beyond the input–output dichotomy and the analysis of the collaboration project funded, rather than a broader approach on learning and sustainable cooperation practice beyond the projects included in the programme evaluated.

The review of cluster evidence examined a variety of studies, which used a range of approaches, although some of the focal issues within certain studies were guided by the sponsors or the participants in order to present positive results (e.g. studies as cluster promotion rather than as evaluation). In terms of the approaches used, participatory evaluation (involving the self-assessment of effects by stakeholders and participants) was the most commonly employed.
Other approaches included: case studies, econometric studies, surveys, cost benefit studies, network analysis, benchmarking, and others. Some of the studies used controls. The focus could be either on processes or end results.

Despite the above caveats, there were a sufficient number of cluster studies available, a few of which can be considered as independent evaluations. One observation here is that the field might benefit from the use of meta-evaluations, given the variety of specific clusters and cluster conditions. One of the major points to arise was that there seems to be no clear and unambiguous evidence that over the long term clusters are able to generate strong and sustainable impacts in terms of innovation, productivity or employment, although it should be noted that the majority of studies cited (including those with controls) did find some evidence of impact of cluster participation on firm performance, including growth and productivity – but with no proof of long term effects.

Overall, there was generally a low or patchy availability of evidence on the performance of network policies. One of the critical issues concerns the timing of evaluations: several evaluations/reviews found it difficult to make quantitative assessments of network effects, largely because many of the outcomes that could be used as proxies for this measure, such as patenting behaviour, had yet to materialise. In many cases there was also no baseline of existing capabilities and networking from which progress could be measured.

There was also little evidence (especially quantitative) to explain which forms of network most contribute to innovation or, indeed, whether networks do and, precisely how, they lead to innovation. The available evidence of the ‘success’ (and likewise, the rationales and objectives) of many network support programmes tends to focus on the creation and the behaviour of a network per se, with an implicit assumption that it will generate a range of positive effects and impacts on innovation, rather than looking directly for the evidence that such impacts have been achieved. Thus, evaluations of networks tend to focus on the ‘process’ rather than the outcomes and impact on innovation. In addition, evaluations tend to focus on specific aspects of network behaviour rather than covering the complete set of potential variables. The majority of evaluations also tend to focus on the necessary preconditions for the creation and support of networks rather than the innovation effects themselves.

There is, nevertheless, some evidence that networks can have very positive effects on the stimulation of learning processes and the enhancement of skills level, although these effects are noted only within the participants on not on the wider system in which the network operates.

### 4.4.4 Connections and complementarities: Effects

The studies on collaborative R&D and innovation policies and programmes all suggest positive impacts in terms of input additionality, i.e. collaboration in research and innovation between research organisations and firms stimulates added investment, time, and attention (Cunningham and Gök, 2012: p17). The studies also indicate increased collaboration among firms. Output additionality is harder to discern and is defined differently among the studies. The output effects noted included learning, changes in attitude, broader collaboration, creativity, and in some cases increased internationalisation (Cunningham and Gök, 2012: p18). Overall economic benefits to participating firms, including employment and increased value added, are positively reported, as are R&D-related outcomes such as increased patenting. Studies mostly focus on participating firms; it is much harder to measure broader indirect effects and spillovers to other firms and industries. Impacts for collaborating universities are also less well evaluated.
The overall picture in the cluster policy domain is less specific and demonstrates an immense variety and diversity of effects. Indeed, what is presented is rather a large and diverse ‘gallery’ of cluster policies and effects rather than a single or coherent ‘picture’. Thus, cluster policies and instruments are affected by many factors and conditions, akin to the ‘Anna Karenina’ principle (Diamond, 1999): any one of a multiplicity of factors can lead to cluster failure, whereas there is no single factor that will lead to cluster success. That said, the report highlights a number of cluster-specific conditions that can contribute to the success of clusters: for example early private sector involvement, effective cluster management, and support services. In fact these are, not surprisingly, similar contributory success factors as were identified in the networks report (Uyarra and Ramlogan, 2012: p36). However, we are not aware of which other, non-cluster specific policies, might be important.

Policy instruments that facilitate network formation and development (network brokers or other intermediary organisations) are often successful in achieving their broad objectives – this underlines the rationale for government support for network formation and management (Cunningham and Ramlogan, 2012: p4). Finally, networks supported by policy fail for a variety of reasons, most importantly lack of demand, trust, commitment and excessive bureaucracy seem to be identified as major causes (Cunningham and Ramlogan, 2012: p22).

In the existing literature on networks, strong network management and leadership, coupled with transparent and efficient administrative processes are overwhelmingly cited as essential contributory factors for network success. It is also essential that network participants actively manage their networking relationships; experience and network management competencies can strongly influence the gains to be made from network participation. However, this suggests that those with prior experience of networking will benefit more than those that are new participants, i.e. that network participation is a learned ‘skill’ (Cunningham and Ramlogan, 2012: p23).

4.4.5 Connections and complementarities: Tensions, pre-conditions, lessons

Research and innovation collaboration policies and programmes may exhibit tensions related to technological orientation and focus (e.g. “picking winners” versus more generic pre-competitive research), types of firms (smaller firms are often policy targets but may generate far less research income for research organisations than if they work with larger firms), and career development (of applied researchers and industry brokers in institutional contexts that prioritise fundamental research). Studies do highlight preconditions for successful collaborative research and innovation programme development including appropriate programme design, stable expectations and management, differentiation of funding according to specific features and phases of collaboration, flexibility, low administrative burden, competent management and staff, and the development of longer term relationships and trust (Cunningham and Gök, 2012: p22).

One of the main ‘problems’ cited for the evaluation of cluster policies is that there is very little agreement on what a cluster is and how it can be defined. Instead, there are a range of definitions in play. In practice, this inhibits the creation of baselines and counter-factual comparisons that may be used to determine the ‘success’ or impact of any single cluster and mitigates against separating the cluster from the wider innovation environment. Similarly, the heterogeneity of the cluster participants precludes a clear determination of their desired outcomes and aims for any analysis at the level of the individual participant. A more specific
problem with regard to the evaluation of cluster initiatives concerned the lack of availability of data and the problem of attribution.

The general literature tends to affirm the importance of geographical agglomeration and spatial linkages in regional and national innovation development. However, the evidence is less clear so far as to whether explicit policies to foster clusters can reinforce or create dynamic regional agglomerations. Some cluster efforts appear to be successful (although ‘success’ is defined from a very broad set of criteria) while others are not successful. Often, informal or implicit policies are more important in forming clusters than direct or explicit cluster policies.

Overall, the following broad lessons regarding policies for cluster development were put forward: early private sector involvement is important for fostering market oriented clusters; effective cluster management is important; and support services within clusters are important (Uyarra and Ramlogan, 2012: p36).

These lessons also find strong resonance in the review of network evaluations and studies.

The review of the material related to network support also reinforced the view that ‘organic’ development (as opposed to policy driven ‘artificial’ development) offered a better chance of network (and, for that matter, cluster) success. There was a strong suggestion that established (informal) networks, or pre-existing connections and relationships form the optimal basis for the establishment of more formal policy-led initiatives for the creation or development of networks (Cunningham and Ramlogan, 2012: p24).

Typical conditions which might require the introduction of specific facilitating policies for network formation/development include:

- Insufficient awareness of benefits
- Little willingness to cooperate
- Weak internal ‘cluster’ structures
- Under-developed innovation potential
- Obstructive government regulations
- Limited access to information

The range of network types covered by the review makes it difficult to draw specific lessons: there was significant heterogeneity in terms of the objectives of the programmes, the form of support provided, the intended network participants and actors, and the nature of the networking activities supported. Consequently, it was not possible to define a set of variables and to indicate what works and what does not work in regard to policy instruments. These factors, together with the need to be sensitive to the context within which policy interventions operate, mean that there is no ‘one-size-fits-all’ recipe for the design and implementation of network support instruments.

An interesting conclusion was that government intervention can act as both a positive and negative force affecting the sustainability of particular networks and network infrastructures due to the unpredictability of network development paths (Cunningham and Ramlogan, 2012: p22). In the absence of a bottom-up process of self-determination (the ‘organic’ growth of networks), top-down initiatives that select target industries, technologies or scientific fields, may not succeed.
4.5 Improving and increasing demand for innovation

4.5.1 Demand for Innovation: Relevance and scope of coverage

In the last five to ten years, the demand side has been re-discovered in the policy discourse and in policy making. Innovation policy on the demand side has been defined as all public action

- to induce innovation and/or speed up the diffusion of innovation
- through increasing the demand for novel products and services, defining new functional requirements or improving user involvement in innovation production (user-driven innovation).

Policies can be distinguished between measures that support private demand through tax incentives and subsidies (Edler, 2013) on the one hand and policies that support public procurement of innovation (Uyarra, 2013). A hybrid instrument between demand and supply is pre-commercial public procurement (Rigby, 2013) as it is based on a concrete public need (demand), but does not include a commitment to actually buy the innovation, and a public subsidy is given to the supplying firm for the R&D efforts to design a response for the need. Further, there are a range of awareness and training measures that improve the ability and willingness to ask for or buy innovations, and many regulations change the conditions on the demand side and thus the attitude and behaviour vis-à-vis innovations. Finally, innovation inducement prizes (Gök, 2013) are considered in this section as they aim to develop specific technologies to satisfy specific, clearly defined public needs and also most often involve a degree of pre-commercial procurement.

4.5.2 Demand for Innovation: Basic rationale

Despite some differentiation between measures, the basic rationale for demand side measures rests on three pillars. First, there are a range of market and system failures on the demand side such as information asymmetries, lack of interaction between user and producer, lack of awareness, lack of capabilities to define needs or respond to innovation. Second, a focus on demands enables innovation activities to be steered towards contributing to public policy goals and to induce the supply side to contribute solutions to clearly defined problems. Importantly, the vast majority of measures targeting private demand is not designed with a view on innovation, but innovation is a means to a further policy end such as sustainability, health etc. Thirdly, as demand conditions are an important part of framework conditions for firms, demand measures also seek to make innovation systems attractive markets for incumbent firms, as test or lead markets for innovations which subsequently allow a roll out of innovations beyond these early markets.

The review has further established the importance of differentiating between measures that improve the responsiveness of demand to the innovations that are offered (responsive demand) and the signals that are sent to the market in order to develop an innovation based on them (triggering demand). For pre-commercial procurement schemes (PCP), which are based on a

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9. There is a variety of goals of innovation inducement prizes. For this report they represent an example of an instrument that is driven by a concrete need, but then support the supply side directly to provide a solution.
public need, there is an additional supply side rationale, as the scheme directs funds towards risky, innovative activities that often do not attract finances in the crucial phase towards a prototype. This is especially true for the US variant with its focus on SMEs, where the Small Business Research Initiative SBRI increases access to public funds and provides visibility and market test.

4.5.3 Demand for Innovation: Existing evidence

The evidence for the effects of demand based policies is biased, limited and slightly problematic. As the support of private demand is most often geared towards the generation and, more importantly, the diffusion of products and services in order to contribute to specific policies, existing evidence is mainly limited to the diffusion of those products and services and, in some cases, the societal benefit that results from this diffusion (reductions in emissions, shorter transportation times, etc.). There is very little evidence as regards the stimulation of further innovation.

The evidence concerning policies to support the public procurement of innovation is even more limited. While there is much work – mostly case study based –, on the way public procurement can contribute to innovation, the policies to actually support this are very novel and as yet not analysed sufficiently. Furthermore, evaluation concepts to capture behavioural additionality on the demand side, the subsequent additionalities on the supply side and the contribution of the innovation that is generated for the public policy itself are largely lacking. Moreover, the effects on the market are hard to define, as a change in demand might trigger unpredicted solutions, which makes the establishment of a baseline on the supply side impossible. Finally, the relative importance of the intervention for the diffusion cycle is hard to establish. Most often the intervention supports changes in demand rather than establishing altogether new demand, and the consequences for innovation down the line can take a very long time. For all policies that intend to support the uptake and diffusion of innovations through supporting public procurement, we can note that there is very limited evidence on the repercussions of diffusion on the subsequent innovation activity triggered by an accelerated diffusion for innovation.

For the hybrid measures relating to pre-commercial procurement, systematic evidence is only available for the American variant, SBIR: the range of European schemes designed in recent years have either not yet been assessed or assessed only very qualitatively and tentatively. The Compendium does include a short discussion [Edler, 2013] of measures that are geared towards raising the awareness of innovation but none on those that target the ability of users due to a lack of evidence. Finally, the evidence on the effectiveness of innovation inducement prizes is very limited with only a few sources studying the creation of innovation output.

4.5.4 Demand for Innovation: Effects

The effects of demand on innovation are well analysed in the academic literature: sophisticated demand encourages innovation activities on the supply side. However, as regards policies to support private demand, Kemp and Pontoglio (2011) demonstrate in the area of eco-innovation that there is no clear empirical indication as to the question which demand instrument work best for the stimulating and diffusion of innovation (Kemp and Pontoglio (2011), Johnstone et al. (2010, p. 144) find, furthermore, that instruments have different effects on different technologies – and in different countries (because of the different existing overall
policy mixes and context conditions of countries). Some differentiation can be done, though. The available evidence suggests that price-based measures (e.g. subsidies and tax incentives) to support demand for innovation contribute significantly to diffusion and to further innovation activities. Price-based mechanisms seem to work well for triggering further incremental innovation, while for radical innovations additional command and control mechanisms are more effective. In a narrow understanding of innovation, measured by patent output, supply side measures are more effective than demand side measures.

The various policies in place to support **public procurement** are, in principle, appropriately designed to tackle the deficiencies of public procurement [Uyarra (2013)]. It has been shown that public procurement does contribute to innovation activity to a considerable extent and that the policies, in principle, tackle the appropriate deficiencies of public procurement practices in relation to innovation, such as lack of user-producer interaction, lack of capabilities and awareness in public bodies, etc., and use of inappropriate procurement procedures. Existing analyses of a few of the relevant initiatives and policies show (limited) positive effects on the actual target group, the public bodies and their capabilities. One example is the Netherland network of public procurers that supports the capability building in public procurement and has led to better procurement practices (Tazelaar 2008). A small number of case studies demonstrate the feasibility of schemes rather than demonstrating systematically positive effects. The European Lead Market Initiative, a combination of various demand-based and supply-oriented means, has been successful in those areas in which overall market conditions (supply side) and general awareness were high. However the evaluation (CESS/Oxford Research 2011) concludes that it has been hugely under-financed, lacking the critical mass to make a real difference.

Overall, the effects of the hybrid schemes relating to **pre-commercial procurement** in the US have been largely positive as regards overall economic effects (e.g. Committee for Capitalizing on Science Technology and Innovation 2007) and effects on additional R&D (Audretsch et al. 2002, but less so on employment (Link and Scott 2012)). Despite some criticism of the rigour of the evaluations of the US scheme, the overall picture is that it has contributed to firm growth and innovation activities and, in a more limited way, to employment. However, there have been no systematic attempts to compare PCP schemes to other ways of supporting public procurement or demand more generally.

The limited number of studies on innovation **inducement prizes** generally indicate i) positive prestige effects for sponsors and participants which also leads to more innovation output and ii) increased public and sectoral awareness. The existing literature suggests that the design issues are relatively more important for the effectiveness of innovation inducement prizes than most of the other innovation instruments. There is also a growing evidence base which suggests the use of such measures offers an opportunity for experimentation in innovation policy.

### 4.5.5 Demand for Innovation: Tensions, pre-conditions, lessons

The literature on demand-based measures shows a range of common challenges. In open markets, the innovation effect is not confined to the constituency in which the incentive is implemented and financed. There is clear statistical evidence for this in relation to private demand measures, as foreign firms delivering to domestic markets benefit in equal measure [Peters et al. (2012)]. Demand side measures must carefully consider the link between the contribution to the societal need and the innovation effect on the supply side. However, this
should not result in a ‘buy local’ policy superseding the innovation dimension, as the overall benefit from establishing forefront innovation demand conditions increases the attractiveness of a location for foreign investment and triggers innovation-driven competition at home. Furthermore, to be most successful, support for demand needs sustainability as effects take time and it needs to be tailored to the specific demand conditions in the target market. The rate of learning on the demand side, the inclination to invest in the next generation of innovation and the readiness of the supply side to deliver the required innovation all differ between markets and over time. Supporting demand runs the risk of huge deadweight loss if those market considerations on the demand and supply side are not carefully taken into consideration. This is a general feature of all public procurement measures: they are still experimental and are not rolled out systematically; the sense of experimentation has not been matched by adequate implementation strategies (Uyarra, 2013).

As regards the pre-commercial procurement schemes, the US case, where SBIR is run directly in various departments and agencies, with a clearly dedicated budget rather than administered through a separate innovation agency, shows considerable mobilisation of public demand and an integration of innovation based PCP back into the missions of the departments. In European schemes that are administered by central agency, this mobilisation and commitment of other departments and agencies has proved to be challenging. The scheme also struggles with the danger of deadweight loss, as the likelihood of projects to be chosen depends on their potential business case, which in many cases would suggest a trajectory without public support.

4.6 The meaning of framework conditions: standardisation and regulation

4.6.1 Standardisation and regulation: Relevance and scope of coverage

Regulatory frameworks influence the activities of actors, by prescribing which actions are permissible and which are not (command and control regulations) and they give direction to technological and procedural specifications that allow for the complementarity and exchange needed to create and sustain markets (standards). Neither regulation nor standards are designed primarily to allow for, or even, trigger innovation: for both, the relation to innovation is ambivalent. Regulations, except for intellectual property rights, are in general not designed with innovation in mind, and standards can both enable complementary innovation as well as inhibit variety as the basis for further innovation. In recent years, however, the meaning of these framework conditions for innovation has gained a new interest for policy makers, especially in conjunction with the intensified discussion of demand conditions and the importance of test or lead markets.

4.6.2 Standardisation and regulation Basic rationale

Regulations are based mainly on achieving certain primary economic, social and institutional goals (safety, health, environment, market competition) (Blind, 2012). Only one type of regulation, intellectual property rights, is designed directly to encourage knowledge creation and innovation by addressing the classical market failure argument of limited appropriation of the benefits of new knowledge and innovation. However, regulations impact on innovation, either intentionally or unintentionally, by altering the demands and constraints on actors’

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10 This section largely builds on Blind (2012) and Blind (2013).
behaviour. Actors have to comply, and by doing so, change their behaviour, their processes and the functionalities of products and services. Compliance costs reduce budgets for innovative activities and price regulations often reduce the likelihood of those innovations which are price sensitive. However, the compliance itself may trigger adaptation innovation. Particularly in the field of environmental technologies, regulations have been deliberately designed to trigger innovations towards more sustainable technologies and practices. However, regulations are normally assessed against their societal goals, rather than their contribution to innovation. The report on regulations focuses on those regulations for which some evidence for the connection with innovation activity exists.

The rationales for standards in relation to innovation are more limited, but again ambivalent. The functions of standards are broad. In relation to innovation their main importance lies in the market creation function (Blind, 2013). Standards help build focus and cohesion in emerging technologies and markets and codify knowledge so it can diffuse and be applied. Open standardisation processes enable and shape competition between and within technologies. Finally, standardised measurement helps to demonstrate functionality to customers. Standards can lead to lock-in, although they can be shaped to avoid lock-in by allowing for an interface between old and new technologies. In addition, standards have effects on the demand side, as they help to create network effects, reduce information asymmetries and risks.

### 4.6.3 Standardisation and regulation: Existing evidence

As the stimulation of innovation is not an objective for regulation and for standardisation activities as such, evidence on the link between regulation/standardisation and innovation is less clear-cut and broad. There is a lot of analysis as to the effect of IPR on innovation, and we have reasonable but very mixed evidence for the effects of environmental regulations. Furthermore, evidence is very sector specific, lessons from regulation studies can hardly be generalised. In other areas of regulation, although ex ante impact assessments include the innovation dimensions, evidence is more varied in its extent. One major problem is the lack of innovation data, which is often reduced to patent statistics, and the poor operationalisation of regulations and the way firms cope with them internally. This severely limits the value of impact assessments, as regulations are dealt with in many different strategic ways.

### 4.6.4 Standardisation and regulation: Effects

There is a mixed, ambivalent picture for regulations: It appears that, broadly speaking, economic regulations have a slightly positive net effect on innovation, but with enormous variation between types of regulations and between different sectors. Institutional regulation (antitrust regulation) and environmental regulation, in particular, are largely positive. This has been shown, for example, for the US automotive industry (Atkinson and Garner, 1987) and Goldberg 1998, even if some studies suggest that environmental regulation lead to short term and incremental innovation rather than long term and radical innovation (e.g. Smith and Grotty 2008). The majority of studies support the Porter hypotheses of positive long term effects of demanding, forefront regulations. Other regulations, such as market entry regulation and competition enhancing regulations more generally, have ambivalent effects, as very high intensity competition squeezes the profits of the innovator and imitation becomes more attractive. Furthermore, unintended effects can arise from institutional regulations such as strict bankruptcy laws which enhance the security of investors but divert activity to less innovative, less risky activities. In addition, regulation impact is time dependent: immediate
compliance costs often lead to a reduction of innovation activity in the short run but to increased innovation in the long run. Importantly, as shown in the chemicals sector, economic regulations can have negative effects on small companies with less capacity for compliance and positive effects on large companies who can use them to their advantage (e.g. Ashford and Heaton (1983). IPR, designed to boost innovation, must be seen as much more differentiated: while in some areas IPR are still critical, in others, such as software, their overall net impact appears to be negative. A key feature across all types of regulation is the negative effects of policy and compliance uncertainty.

Empirical evidence shows that the contribution of standards to growth and innovation is generally positive and substantial. According to econometric studies done at the country level, standards contribute to economic growth in a range from 0.2% (Canada) to 0.9% (Germany), and are thus responsible for a good share of growth rate overall (DIN 2000, DIN 2011, Standards Council of Canada (2007)). For Germany, analyses over time show that the share of GDP growth due to standards ranges from 10% to 25%. At the firm level, standards contribute to 0.5% and 4% of annual sales revenue. In survey based studies, a majority of responding firms see standards as a contributor to innovation due to their information function, while a minority see standards as an impediment for innovation. This appears to be especially true in the ICT sector, where interoperability based on standards allows a variety of business models. There is a strong positive correlation between standards and patenting (e.g. Konrad and Zloczysti (2010). Importantly, empirical analysis found that standards always carry both an informative, pro-innovation and constraining, innovation hampering element (e.g. Swann and Lambert 2010). As standards are based on industry-driven standardisation processes, empirical studies also found an overall positive relationship between the involvement in standardisation processes on the one hand and R&D intensity (the more R&D intensive, the more likely firms are involved (Blind and Mangelsdorf 2013)). Conversely, there is no linearity between involvement and innovation turnover, as companies above a certain share of innovation-related turnover in all turnover start to reduce their involvement in standardisation (Blind et al., 2011). Overall, the relation between standards and innovation is a positive one, whereas there is limited evidence for causality. Finally, standards play a crucial, mostly supportive role in the research process, conducive to bridging its different phases (Gauch and Blind 2006).

4.6.5 Standardisation and regulation: Tensions, pre-conditions, lessons

There is a growing awareness among policy makers in OECD countries about the role of regulation and standards. Regulations, however, are not designed to boost innovation; they are often not even designed with innovation impact in mind. Ex ante and ex post assessment of regulation must become more aware about the innovation effect, and their design and implementation need to be highly sensitive to the complexity of innovation effects, differences over time and for different sectors. It also appears that clear expectation and implementation management can reduce negative effects and accelerate the positive long-term effects of many regulations on innovation. Regulatory bodies across all policy areas need to embrace the innovation agenda and coordinate efforts with long term innovation effects in mind.

Equally, standardisation has been recognised as a major framework condition for market creation. The European lead market initiative explicitly recognises this, encourages the development and use of standards in lead market creation and future impact assessment will try to define the role of standards and standardisation on market creation. However, as standards are largely based on industrial negotiations and involvement, there is a close
relationship between effects and involvement. This makes the question of the political economy of standards pertinent, our understanding of the impact of standards needs to take into account the very process of standardisation itself and the role public bodies and private firms play in this process. Politics determines outcomes and effects to a large degree. Policy can contribute to a pro-innovation effect of standards in a variety of ways, from initiating standardisation processes, influencing processes, ensuring inter-operability and the promotion of network externalities by restricting IPR in standards to promoting performance standards over design standards (variety). Furthermore, as involvement in standardisation helps firms to reap the benefits of innovation and avoid negative consequences, innovation effects depend on a broad, inclusive discourse. However, all standardisation policy needs to find the balance between the information, interoperability and focusing function that helps innovation, and the constraint on variety and experimentation that can hamper innovation.

Finally, both regulation and standards have a legacy issue, older standards and older regulation tend to be detrimental or neutral to innovation rather than supporting it. Thus, as important as transparent and predictable forward planning is the need to review the existing portfolio both of regulations and standards.

4.7 Forward planning: Foresight and innovation policy

Foresight is an approach for collectively exploring, anticipating and shaping the future. It has been applied to a range of applications and contexts, including international, national, regional, local and sectoral, with many variations in definitions and differences in implementation (Harper, 2012).

4.7.1 Foresight: Basic rationale

Foresight initiatives are generally motivated by a combination of two rationales: structural or systemic issues and deficiencies in innovation systems and issues related to determining the content and direction of innovation policies and investments. Structural or systemic aspects include conditions where innovation policy is ineffective or outdated, where there are weak framework conditions for innovation, where networks are poor, where there is a lack of mass and scale, where there is path dependency and a need to shift to new paradigms, and other issues of policy and system fragmentation. Content rationales for foresight exercises can be driven by concerns about insufficient investment in key research and innovation areas, the need to better anticipate and respond to crises and challenges, and the need to develop signals for other organizations to guide innovation activities.

Foresight exercises seek to generate impact at national level through the use of the following methods: identifying priorities for research or innovation actions, again at multiple levels; vision-development and consensus-building - building common visions between innovation actors and/or stakeholders who may not be used to working together (e.g. industry-academic, procurer-supplier or different sectors in clusters); making decisions more robust through exploration of scenarios or drawing in wider expertise; making an overall strategic review and direction of a national, regional or sectoral innovation ecosystem; and horizon scanning for the future and for shock-proofing long-term policies and strategies.

11 This section largely builds on Harper (2012).
4.7.2 Foresight: Existing evidence

Evidence for the impact of foresight activities on policy making and innovation activity is limited. The report identified the following shortcomings in relation to existing evaluations of foresight exercises and their utility in developing the evidence base for innovation impacts: (i) most evaluations are of a light nature with some involving a significant level of self-review, and (ii) evaluations largely tend to focus on the efficiency of the foresight activity and the extent to which foresight has achieved its set targets (immediate and intermediate impacts) and not higher order impacts.

In general, foresight evaluations do not cope well with the assessment of long-term innovation impacts; the achievement of innovation policy impacts materialises in the long-term and is often not easily detected or attributable among a number of factors. Indeed the results of foresight exercises can often remain in what has been termed ‘a reservoir’, waiting for the right moment in time to be taken up and implemented.

4.7.3 Foresight: Effects

Foresight activities impact on innovation policy in two ways. As a more instrumental and operational mechanism, as which foresight is more often used, the effects have been largely positive in supporting the priority setting and improving the depth of reflection on policy direction and instrumentation and the larger innovation system as a whole. This has, for example, been shown for the USA, where foresight activities have shifted from defining needs by scientific fields to defining needs by problem area and thus has resulted in changes of priority setting across a number of agencies (Bissell 2001). Another example is innovation system oriented foresight process in France (2003-2005), which “has proven to be a workable and acceptable platform for informed debate, analytical work, exploration of hypothesis, and has been an instrument to accompany the process of structural change” (Barre, 2008). The French example is a rare one on the system’s level, since in general for the more strategic, system wide advisory role of foresight, the evidence is less abundant and often inconclusive since effects are far less easily attributable.

4.7.4 Foresight: Tensions, pre-conditions, lessons

There are a range of pre-conditions for foresight activities to have a positive impact on policy design. It is important that the foresight exercise is tailored to the needs of the policy maker and is able to adapt to those needs during implementation. Further, the sponsors and those responsible for the process need to have an excellent standing in the targeted system. This also extends more generally to the policy, programme design and operation. Exercises which generate more impact are those which are more synchronised with the policy cycle and are able to deliver policy advice on time to fit the policymaker’s needs.

5 Lessons on evidence production

The Compendium did not seek to produce an analysis of evaluation practice. Such a study was done for national innovation policy across Europe in 2011 (Edler et al., 2012) and for regional innovation policy in 2012 (Reid et al., 2012). However, the extensive review of evaluation reports and academic literature to ascertain the impacts of innovation policy interventions
allows us to draw some additional overall conclusions concerning the production, use and usefulness of evidence.

**Limits of what we know**

- This study has demonstrated the extent to which evaluation activity and academic analysis is devoted to the area of innovation policy. Many evaluations and academic contributions apply appropriate methods, address underlying or causal linkages, are context sensitive and contribute to our understanding of effectiveness and efficiency of innovation policy.

- However, most of the reports in this *Compendium* conclude that there are gaps in what we know about specific instruments. The number of evaluations conducted does not correlate in a linear fashion with the depth and breadth of knowledge about a specific instrument. For example, while we have a very large number of evaluations on collaboration measures, we still do not understand the complex behavioural changes and strategic reactions within organisations that lead to the sustainable success of polices. Equally, while tax incentives for R&D are hugely popular across the OECD countries, the report on indirect measures cannot derive a conclusion on how design features and context variations impact on the effectiveness of indirect measures, and what this means for different target groups.

- This indicates a dilemma when it comes to providing lessons for policy making that go beyond the audience responsible for the management of specific measures. It appears that we are far from a pool of knowledge on the effectiveness of innovation policy that is general enough to guide the decisions of policy makers. The context specificity of policy (actor arenas, capabilities, linkages, economic performance, etc.), the interplay with other instruments, the challenges of implementation and the sensitivity of results to the methods used render the generalisation of findings extremely problematic.

**The multiple challenge of causality**

- The evaluation process is often hampered by the lack of a strong conceptual and empirical causal basis to link the innovation activity supported with the effects of the support instrument itself. Policy areas such as skills and training, and migration policies lack an empirical grounding in terms of their role in innovation. Thus, as noted above, their assessment is rarely linked to their impact on innovation but rather their success in achieving the broader framework conditions under which innovation may flourish, or at least occur (i.e. contribution to HRST). [This may be true for regulation policies as well as other broad ‘innovation framework’ policy areas]. Furthermore, there is a general assumption that skills acquisition and employment legislation, for example, can raise the capacity and quality of HRST but the links between them and innovation impacts are mainly assumed. Where assessments of firm performance are linked to the delivery of training schemes, the direction of the cause/effect relationship is unclear. Indeed, there are major methodological issues in terms of both conceptually linking and assessing how training impacts upon innovation. Here, most studies were concerned with the effect of training on productivity and/or profitability and on the work environment (possibly due to the lack of data regarding on-the-job training). A similar problem besets the literature on university-industry collaboration, much of which is descriptive, hypothetical and not particularly illuminative of the ‘actual’ processes by which universities affect the rate and direction of technological change in industry.
This points to a broader, more general challenge across all instruments: many evaluations and academic contributions do not make the “logic chart” of an intervention explicit, i.e. they do not explain, conceptually, through what kinds of multi-step mechanisms impact, outcome and outputs are intended to be achieved and what other variables interfere in the process. Implicit or simplistic causal assumptions then grossly overvalue the contribution of an intervention, e.g. they fail to understand other complementary drivers, or undervalue their contribution as they look only at the last stage of the causal chain rather than acknowledging the intermediary steps of learning and changed behaviour.

The fact that a number of policy areas (notably skills and training, migration and HRST policies, and possibly regulation), are relatively divorced (conceptually and empirically) from the ‘core’ area of innovation policies significantly hampers the evaluation of their direct impact on innovation performance.

**Limitations in the definition of impact**

- Many key output and outcome variables are often not properly defined, whereby their definition follows data availability. For example, the manifestation of innovation is often reduced to an increase in patenting and results are then generalised for “innovation performance” more generally.

- In contrast, especially related to direct measures, the issue of additionality is frequently addressed by evaluations () and is extensively examined in the broader literature. However, the same question is rarely addressed in some other types of measures (e.g., is the network programme merely creating formal networks by grant-aiding businesses which have already been ‘networking’ with each other?).

- Evaluations tend to look at the effects of interventions along the target variables, and academic analyses focus on very few selected output or outcome variables. This means that unintended effects, both positive and negative, are very rarely conceptualised and measured. In addition, the output and outcome variables are defined too narrowly, e.g. analyses of fiscal measures focus on the increase in R&D alone, but not on the effects on innovation output, R&D trajectories and behaviour, employment or exports. Similarly, collaboration measures examine the scope and scale of cooperation and interaction rather than the overall change of management practices and routines in R&D that might extend far beyond collaboration. This limitation to one specific kind of additionality (mostly input or output) constrains the usefulness of evaluations for policy learning.

- A large share of evaluations (particularly those examining an activity linked to innovation, such as collaboration, networking, clustering, etc.) tend to focus on the process aspects rather than on outcomes or impacts. Thus, this type of evaluation frequently serves as an input to programme management rather than as an assessment of longer term effects on innovation performance (i.e. of use to policy makers more widely).

- Whilst evaluations of direct measures frequently re-examine the continuing appropriateness of the underlying rationales, the same is not true for cluster evaluations which focus on the measurement of performance against stated goals.

- Many evaluations concentrate on poorly defined ‘success’ metrics which are often reduced to the level of participants’ satisfaction with the programme. In particular, such evaluations attempt to identify the preconditions that contribute to this kind of success rather than the aspects of the programme that contribute to outcomes and impacts.
Following from the above, few evaluations examine the contribution of programme design attributes to the overall impact of the programme. Thus, it is rare to find an evaluation which states “the configuration of programme X was directly related to this set of outcomes”.

**Timing**

The timing of evaluations is consistently a major issue, particularly in those that try to address several programme characteristics which span one or more phases within the programme life cycle (such as take up, programme administration, effects on participants, major activities undertaken, outcomes and results and impacts). Few evaluations appear to successfully combine these characteristics within a single assessment. This points towards the potential value of ‘phased’ evaluations at different phases of the programme lifecycle which would address particular management and sponsor requirements.

**Evaluation in isolation**

Other than the relatively limited cases of indirect (fiscal) versus direct (grant/loan) comparisons, there are few instances where evaluations have compared alternative modes of delivery or variations of the same broad type of innovation support or where different modes of support may contribute to the same policy goals. The potential of comparative evaluations is not realised, whereby differences of effects could be linked not only to contextual differences, but also to differences in design. We have some rare instances of those approaches in the area of demand support and indirect measures.

Similarly, few evaluations have addressed the issue of the contribution of the reviewed programme to the overall policy mix, or vice versa: programmes are typically evaluated in isolation (the report on policy mix and interplay, *Edler et al.* (2013) in this *Compendium* series discusses this issue in more detail).

**Academic impact analyses vs. evaluation reports**

Evaluations most often look at the effects and efficiency of one specific intervention in order to understand how the context, design and implementation of a measure led to different kinds of effects on the target group. Much of the ‘academic’ evaluation literature focuses on econometric analyses of performance outcomes such as input and output additionality. This leads to an unfortunate disconnect: while the majority of the academic literature often applies very robust econometric methods that allow sound quantitative estimates of effects, it lacks sufficient granularity to be able to make useful policy statements on the performance of individual support instruments, the meaning of certain design features and the capture of behavioural additionality. Dedicated evaluations, on the other hand, often are much stronger in context and design, however, they sometimes fail to link back to the broader academic literature, to contextualise the measure within the academic evidence of policy impact and apply simplistic concepts of effects.

**The challenge of methods**

There is no single ideal or perfect evaluation method. Although control group studies are held up by some as the preferred method, the world of business and innovation is not the same as the more controllable domain of a scientific laboratory or medical trial. For innovation programmes, control group studies add expense, burden and time, and are not always viable, which explains why they are infrequently deployed. Additionally, while
classic control studies may produce quantitative metrics, they do not necessarily produce actionable insights about how programmes really work, the role of context, how impacts are induced, and how improvements can be advanced. The triangulation of evidence through a variety of methods over time is a more promising alternative approach, although as several reports in the Compendium illustrate, there are also complexities and issues in bringing evidence together from varied sources and differing programmes.

- The variability of the (relatively restricted) set of evaluation evidence did not make it possible to make any substantive statements regarding the relative merits of various evaluation approaches in terms of identifying impacts: it was not possible to make the connection between categories of instruments, evaluation methodologies and types of identified impact. However, at a broader level, it was possible to identify some common associations between methodologies and types of instruments (for example, evaluations of network and cluster instruments typically involved participant surveys, those of direct measures attracted a higher frequency of econometric, input/output approaches, etc.).

**Limits of evaluation based discourse**

- In some areas of evaluation, for example of education policies, there is often widespread debate about the findings and implications of studies of policies and programmes. In the innovation policy domain, broader public discourse is less evident. This is not surprising given the more specialised nature of the innovation policy field. Where there is dialogue, it often occurs does not spill over from the initial, more limited governmental and business organisation settings and in academic and professional contexts. However, it does appear that the limitations in public dialogue are reinforced by the fact that many innovation instruments are not subject to evaluation processes and that evaluations are often not made publicly available or widely disseminated.

- Evaluations have varied audiences, and these audiences look for different things. Policymakers seek some overall assessment that a programme is an effective use of public resources, although interpretations of effectiveness differ (some seek specific business impacts, others look more broadly at community development). Programme managers seek insights as to what services work and why, and how they can improve those services. Potential clients seek insight as to what benefits a specific service will offer them, and do not necessarily consider the public cost of provision.

### 6 Summary and conclusion

Our review of evidence in the reports comprising the Compendium covers many areas of innovation policy. Although we have not been able to identify or access every document relevant to evaluation (including those in non-English speaking domains), we have considered a significant and large body of evidence. This review has revealed a series of interesting and noteworthy patterns.

There is an axis of well-established policy rationales that cut across the supply side and demand side approaches. Almost all instruments are justified along four pillars: a fairly limited set of (1) market failures (information and incentive asymmetries, externalities) and (2) system failures (mainly concerned with connectivity and individual and organisational capabilities) as well as the need for (3) framework conditions and public action to establish markets. In addition, with the return of a more explicit mission and challenge orientation, policy is increasingly justified.
Impacts of Innovation Policy

Edler, Cunningham, Gök and Shapira

not only with the failure rationale, but with a (4) pro-active orientation that is based on policy preferences, to accelerate and enable certain developments that are societally desirable.

Most of the instruments or policies for which we reviewed evidence in this Compendium are based on a mix of rationales. Notable exceptions are indirect measures (tax incentives) that do not favour specific areas or target groups and are largely based on market failure. Other instruments have a strong relation to innovation, but are justified only indirectly in terms of the above rationales, such as migration policies which clearly have a strong influence on the pool of expertise available in an innovation system but the logic of which is not linked to the innovation system discourse.

The mix of rationales underlying most of the instruments is very often not made explicit in policy schemes, in the same way as is the analysis of specific bottlenecks and opportunities. This makes the expectation of impact vague and contested, both on the side of policy makers, the general public and the target groups of an instrument.

There is also some commonality in the common approaches and methods used in evaluations of innovation policies and programmes. The toolkit of data collection methods includes surveys, case studies, documentary analyses, and programme reviews using a variety of analytical techniques ranging from benchmarking, economic value-added, and econometric modelling. In some domains, particularly where the subjects are individuals or individual firms, it is possible to construct control groups, mostly using quasi-experimental methods although, in a few cases, randomised designs are possible. Yet, this is not a hierarchy: while well-designed control groups are very useful, other methods are equally important to discern impacts and to triangulate results. This is particularly the case for interventions such as efforts to change innovation framework conditions or foresight exercises where assessments of value and results are intrinsically qualitative and in some cases based on informed judgement.

The effects of innovation policies and programmes show variations not only across policy domains and diverse programmes but also within specific areas. Interventions which look similar at first inspection are often actually rather different in terms of objectives, design, operation and context when more closely reviewed. Yet, some high-level aggregated patterns are discernible by broad policy goals.

- Overall, fiscal (indirect) measures and direct measures have been successful in **increasing R&D investment**. However, effects differ for different designs of measures, and basic country characteristics such as the overall tax burden and technology level of the economy. Further, tax measures especially are easily mis-used by firms and need thorough control. Fiscal incentives have positive effects for process innovation and incremental innovation, but no measureable effect on radical innovation or labour productivity. For **direct measures** the picture for impact on R&D output and on productivity is contradictory, although the few studies that look at job creation in general find positive effects. There is also no meaningful discussion on the potential long-term detrimental effect, especially of indirect measures due to an international race to the bottom.

- Policies to **increase the skills base** for innovation are not yet fully understood in their effects on innovation capabilities. There seems to be a mismatch between the importance of the issue and the policies in place and their connection to innovation policies. However, the evidence on skill development, while scarce, all points towards very positive impacts on innovation performance. Important examples, such as the levy based training schemes, are
capable not only of increasing individual skills, but of building up a whole infrastructure for training and skills with lasting benefit. As for immigration schemes, there are important differences between employer-led schemes, answering to the need of a given pool of employers, and points-based schemes, shaping the supply of foreign skills against more general criteria. A general feature of development skills is the tension between individual and societal benefit, whereby private investment in skill development might not be fully internalised and an influx of highly skilled workers might be detrimental to the training market within a country, decreasing the pressure on firms to invest in human resource domestically.

- For those innovation policy instruments that seek to provide advice to companies or grant them access to specific expertise, the results are mixed. Evidence on schemes to support the IPR management of firms and public organisations as well as the various approaches to support entrepreneurial skills are inconclusive, with different studies finding different types and scales of effect for similar measures and with no evidence linking changes in support mechanisms to changes in IPR behaviour. The innovation management advisory schemes, however, tend to have considerable effects both on capabilities and on economic benefits.

- There are many variations in the three types of policies that support complementarities and connectivity. Overall, these measures appear to be highly effective in creating the linkages they aim at, although the evidence that policies to promote cluster formation work is outweighed by that which demonstrates that clusters are desirable for innovation to occur. However, the evidence also shows that building clusters or complex networks from scratch or in the absence of initial connectivity and complementarity can be futile. Further, the secondary effects, in terms of additionalities, are much less clear cut. Support for R&D collaboration, overall, shows positive economic benefits for participating firms, while less is known for other partners. Cluster and network policies are extremely diverse, which makes a general statement on “success” impossible, especially as the number of intervening variables is abundant. However, the learning effects stemming from interaction on various levels of both instruments appears to be a major general benefit, albeit one that takes time; and evaluations have demonstrated that both instruments have a range of important pre-conditions to work, such as management capacity and leadership. The intervention rationale, while theoretically sound, seems to be over-stretched in some cases, especially in the networking case, as there are examples of network programmes that have been unsuccessful due to lack of demand.

- Policies to improve and increase the demand for innovation have received increasing attention in recent years. Support of private demand has been important in a range of policy domains outside innovation policy, especially in the area of energy-efficient technologies. Effects are mixed, but by and large, diffusion of incremental innovation has been driven by price-based mechanisms (influencing the market price through subsidies or tax credits), while for radical innovations, command and control mechanisms play an important role. The evidence on the effects of policies supporting public procurement is still poor, although the basic rationales of such policies are in line with the apparent bottleneck in public procurement for innovation: those mechanisms that have been rolled out show signs of effects going in the right direction - the problem here is the lack of roll out. The overall picture for the pre-commercial procurement schemes, where evidence is largely based on the US model, is positive for the innovation and economic benefits of participating firms but variants have different effects in terms of the uptake of innovative solutions developed in the
schemes. For all these approaches, no full scale evaluations are available that look at the overall societal benefit of adoption of innovation. They all also face challenges as the benefits on the supply side are hard to limit to the country or region that supports the demand side.

- When it comes to **framework conditions**, regulation and standardisation, we notice a huge renewed policy interest. However, the variety of regulations does not allow a simple statement on innovation effect. In principle, economic, especially environmental, regulations tend to have slightly positive effects. Many regulations, however, have ambivalent and unintended effects on innovation, worse so for SMEs with less compliance capacity, which are not taken into account when regulations are designed. The contribution of standards to growth is clearly positive while the link to innovation is more ambivalent, but still positive, as standards play an important role across the whole research and innovation chain, which is often overlooked. Importantly, the capability of firms to contribute to the standardisation process is important, but distributed unevenly through the economy.

- Foresight activities that support the **discourse which informs innovation policy** have largely had positive effects on the policy making and instrument design process, particularly where they contribute directly to prioritisation and design on an operational level. We know much less about the overall impact of larger, system-wide foresight processes. In both cases, however, foresight process have a whole range of important procedural pre-conditions that need to be met in order to work as an instrument creating awareness, increasing consensus and improving reflection in innovation policy.

**Lessons and consequences for analysts and policy makers**

Although we cannot summarise firm and clear recommendations for policy design and implementation based on the breadth and variety of all the reports in this review, a number of high level considerations for analysts and policy makers can be formulated:

- The discussions around instruments, not only in the reports, but in the associated public seminars, have shown the enormous need for evidence on “what works”. Yet, at the same time, based on the review of roughly 200 evaluation reports and 580 academic analyses we must concede the limits of transferability, as each instrument has its specific design and context issues, and evidence often differs not only for different contexts, but also because of the different methodologies applied. Therefore, the learning and transferability of lessons would improve if policy design and corresponding evaluations would make the conceptual framework (rationales, mechanisms) and context conditions for specific instruments more explicit and develop a shared core of evaluation approaches, which would allow a more explicit discussion of country and instrument commonalities and specificities.

- The timelines for policy-makers need to be brought in line with the timeline of impact. For innovation policy-makers, long-term effects are rhetorical rather than real, as agencies and departments are assessed in short- and medium-term policy cycles. Thus, many studies focus on short-term effects, while few are able to take a longer-term view. Yet, it is apparent that the full impacts of innovation policy intervention are only apparent over the longer run. This is a long-standing challenge: policy-makers often recognise this at a conceptual level, but continue to insist that programmes produce short-term results and evaluations are able to demonstrate them. Nevertheless, there may be some ways around this impasse, including greater attention to sponsoring follow-up (rather than one time) studies and more
engagement by research and other funding bodies to provide support for applied research on the longer-term impacts of accumulated innovation policies.

- Evidence production and policy design should be broadened in two directions. First, the growing demands on innovation policy and the broadening of goals and intended effects need experimentation in evaluation and a broader definition of impact in order to understand how or to what extent those broader demands are met. However, the evaluations examined in this Compendium exhibit only a minor trend towards this broadening of evaluation methodologies, for example by starting to understand the longer term and more complex impact on learning and behavioural change. If the promise that improved innovation policy will support societal challenges and economic growth better in the future is to be achieved, a more systematic linking of policy intervention to the longer term behavioural effects, to economic growth, job creation and societal challenges will be needed. Secondly, policy instruments that are developed for purposes other than supporting innovation, but which have clear implications for innovation capabilities and generation, should be supported by analyses that take such capabilities and performance into account more explicitly. By both looking at the broader impacts of innovation policy instruments and at the innovation effects of instruments designed for other goals, policy could be developed and adjusted more holistically.

- In the future, innovation policy will also be confronted with a greater need for international coordination and collaboration in policy making. Future joint or coordinated international policy measures will require complementary and comparable data gathering ex ante and appropriate international approaches to their evaluation.

More holistic evaluations are required: the report on policy mixes and interplay (Edler, et al. 2013) has shown that there are limits to the extent to which policy-makers can create maximum complementarity and provide the appropriate sequentiality of policies. This has to do with the fragmentation of responsibilities across different policy units, the bounded rationality of actors and insufficient strategic intelligence. Innovation agency models or domain-based agencies with innovation policy capacities or support appear to be better equipped to develop appropriate strategies in this respect, lowering the coordination burden. Policy-makers and evaluators should strive to pay greater attention to consideration of the impacts of the complementary or sequential use of innovation policy instruments and their interplay with other forms of policy instruments (such as tax, human capital, and other policies). This suggests the need for the greater application and consideration of portfolio evaluations which can investigate systems of policy interventions more broadly, or for the establishment of evaluation approaches which consider the impacts of multiple programmes on particular target groups over time.
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Annex 1: Number of Evaluations and Papers Reviewed

Table 3: Evaluations and papers reviewed in the Compendium reports

<table>
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<th>Report Title</th>
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<th>Evaluation reports</th>
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<td>14 - Review of Measures in Support of Public Procurement of Innovation</td>
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<td>4</td>
<td>7</td>
<td>40</td>
</tr>
<tr>
<td>15 - The Impact of Standardization and Standards on Innovation</td>
<td>68</td>
<td>19</td>
<td>3</td>
<td>46</td>
</tr>
<tr>
<td>16 - Impact of Technology Foresight</td>
<td>37</td>
<td>11</td>
<td>4</td>
<td>22</td>
</tr>
<tr>
<td>17 - The Impact of Innovation Inducement Prizes</td>
<td>28</td>
<td>10</td>
<td>2</td>
<td>16</td>
</tr>
</tbody>
</table>

* Conceptual papers, non-evaluation reports, etc.
## Annex II: Effect Summaries

### Table 4: Summary of Effects According to Main Policy Goals

<table>
<thead>
<tr>
<th>Instrument (Report Title)</th>
<th>Primary Effects</th>
<th>Secondary Effects</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main goal: Increase R&amp;D spent</strong></td>
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<tr>
<td>Fiscal Incentives for R&amp;D</td>
<td>Mostly positive input additionality, potentially increasing over timeOutput additionality (new products and processes) tends to be positive but no clear evidence on productivity</td>
<td>Almost no evidence on behavioural additionality</td>
<td>Magnitude of input additionality depends on country, period and method (i.e. context)</td>
</tr>
<tr>
<td>Direct Support to R&amp;D and Innovation in Firms</td>
<td>Generally positive input additionality, especially in macro level studies and for SMEs, low-tech sectors, less advanced regions (but there are counter-examples) Little and contradictory evidence on output additionality (more evidence when combined with other favourable factors such as recipient firm’s openness, capabilities and capacity and availability of other forms of support) Limited behavioural additionality studies, but always positive</td>
<td>Receipt of funding in one scheme improves the chances of obtaining additional funding from other (including public) sources</td>
<td>Effects vary greatly, depending on country, sectors, regions, firm sizes, etc. (i.e. context)</td>
</tr>
<tr>
<td>Access to Finance, Publicly Supported Venture Capital and Loan Guarantees</td>
<td>Very few initiatives are specifically directed at causing innovation as such. Support in the form of venture capital assistance or loan guarantees is intended in the first instance to provide the resources that firms need to grow. Programme designers expect access to finance to lead to increases in turnover and employment which will accompany innovation</td>
<td>Credit guarantee schemes help businesses to grow. Several evaluations show a direct causal effect on output (sales) and employment. Overall credit guarantee schemes have not been particularly directed at supporting innovation activities.</td>
<td>The evidence also indicates that some schemes do not impact firm productivity, R&amp;D or investment intensity. In such circumstances schemes may actually be supporting struggling firms and ultimately stifling innovative forces.</td>
</tr>
<tr>
<td><strong>Main goal: Increase non-financial capabilities. Skills in and for firms</strong></td>
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<tr>
<td>Policies for Training and Skills on Improving Innovation Capabilities in Firms</td>
<td>Effects measured were limited to those on the firms undertaking training or the recipients of training (e.g. career paths, etc.)</td>
<td>A major disincentive to training (especially in SMEs) appears to arise from the fact that neither employers nor employees can be sure of receiving an adequate return on investment in human capital due to market imperfections.</td>
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</tr>
<tr>
<td>Innovation and Human Resources Migration and Employment</td>
<td>Some findings suggest there are clear benefits for high-income countries in adopting policies to both attract foreign</td>
<td>Some empirical evidence to suggest that while, strong labour laws may</td>
<td></td>
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<tr>
<td>Instrument (Report Title)</td>
<td>Primary Effects</td>
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<td>Notes</td>
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<tr>
<td>Protection</td>
<td>students and to retain them once they have completed their studies.</td>
<td>contribute to dampening economic growth, the area of laws that protect employees against dismissal are an exception and may promote economic growth particularly in innovation-intensive sectors.</td>
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<td></td>
<td>• Some studies indicate that aspects of employment protection in certain contexts – coordinated LL and collective bargaining frameworks in open economies (there are significant differences across countries) link well to certain types of innovation (incremental), however these findings are contested with other evidence pointing in the opposite direction.</td>
<td></td>
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</tr>
<tr>
<td>Main goal: Increase non-financial capabilities: Access to expertise</td>
<td></td>
<td></td>
<td>University spin-offs, a variety of studies and impacts cited (no clear picture).</td>
</tr>
<tr>
<td>Support Measures for Exploiting Intellectual Property</td>
<td>• Re-orienting academic research from basic to applied research (on which “evidence is “mixed”)</td>
<td>• Licensing: A variety of effects and contrasts are considered, including explanations for differences in US (higher) and EU (lower) TTO revenues, with evidence that TTO strategy and negotiating capabilities account for differences rather than variations in underlying research and patenting performance</td>
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<td></td>
<td>• Effects of increased academic patenting on norms (e.g. on open information flows) of open science (increased attention to academic IPR induces some restrictions on openness and diversity of academic science)</td>
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<td></td>
<td>• May lead to privatisation and fragmentation of scientific knowledge (with evidence that increased academic patenting has made it more difficult for exploitation of knowledge).</td>
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<tr>
<td>Policies to Support Collaboration for R&amp;D and Innovation</td>
<td>• Strong positive input additionality in all studies considered</td>
<td>• Effects are clearly limited to the target group, not to broader communities.</td>
<td>Evaluations systematically looking beyond input and output additionality (i.e. behavioural additionality) are limited</td>
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<tr>
<td></td>
<td>• Output additionality is defined very differently and very broadly in the various reports included.</td>
<td></td>
<td>There are no indications for systematic analyses of unintended effects</td>
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<td></td>
<td>• Collaboration between firms has increased in all studies (this is obvious), the difference in impact may be a result of differences in the design of the scheme and the requirements for collaboration, this is unclear.</td>
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<tr>
<td></td>
<td>• Overall economic benefit (value for money, employment, GVA etc.) and the R/D related outcome (patenting, etc.) are generally very positive.</td>
<td></td>
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<tr>
<td></td>
<td>• The impact on Universities is less well evaluated</td>
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<tr>
<td>Entrepreneurship Policy</td>
<td>• Focus is on additionality/net effect and methods that examine effectiveness and impacts of policy</td>
<td></td>
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<tr>
<td>Advisory services</td>
<td>• Technology advisory services do provide positive benefits for participating firms: reductions in costs, improved quality, reduced waste and improved environmental performance, higher productivity, and new product development and innovation.</td>
<td></td>
<td>Efforts to increase the amount of service costs paid by participating firms allow leveraging; however, technology services then tend to go “up market” to serve mid-size</td>
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Manchester Institute of Innovation Research
<table>
<thead>
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<tr>
<td></td>
<td>• Net benefits achieved are typically relatively modest, although such incremental improvements add up and can make the difference to SME survival or decline. • Controlled studies generally tend to show lower net effects. • While concerns have been raised about negative impacts of publicly-supported technology advisory services on private consultants, the studies that have examined this do not find such effects.</td>
<td></td>
<td>and larger firms that can afford to pay higher levels of fees. • Tension: More intense and customised services provide improved results; but there is often policy pressure to serve as many firms as possible, which means that service assistance is less intense than may be desirable. Programmes typically seek to address this challenge by providing initial assistance and then referring companies to qualified private consultants and other public services.</td>
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<tr>
<td><strong>Main goal: Enhance systemic capabilities, complementarities</strong></td>
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<tr>
<td>Cluster Policy on Innovation</td>
<td>• The overall picture in the cluster policy domain is one of immense variety and diversity of effects. • We may have a large and diverse “gallery” of cluster policies and effects rather than a single or coherent “picture.”</td>
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<tr>
<td>Innovation Network Policies</td>
<td>• Evidence of ‘success’ (and likewise, the rationales and objectives of many network support programmes) tends to focus on the creation and the behaviour of a network per se (with an implicit assumption that it will generate a range of positive effects and impacts on innovation), rather than looking directly for the evidence that such impacts have been achieved.</td>
<td>• Networks can have very positive effects on the stimulation of learning processes and the enhancement of skills levels.</td>
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<tr>
<td><strong>Main goal: Enhance demand for innovation</strong></td>
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<tr>
<td>Measures to Stimulate Private Demand for Innovation</td>
<td>• Subsidies and tax incentives to support demand for innovation contribute significantly to diffusion and to further innovation activities. • Subsidies and tax incentives work well for triggering further incremental innovation, while for radical innovations additional command and control mechanisms are more effective. • In a narrow understanding of innovation, measured by patent output, supply side measures are more effective than demand side measures</td>
<td>• The innovation effect of demand measures spills over to foreign market</td>
<td>• Evaluations of demand based measures rarely analyse the innovation effect on the demand side</td>
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## Impact of Innovation Policy

### Edler, Cunningham, Gök and Shapira

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<thead>
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| Public Procurement Policies | - Increasing awareness through labelling and information campaigns for an innovation and security of its use accelerate diffusion, public labelling schemes are more effective than private ones  
- The combination of range of different demand-side measures can transfer markets for concrete technologies | - There are tensions between the effects on public sector on the one hand (most innovative and best solution) and economic effects within a country/region,  
- The actual subsequent innovation effect on the demand and the supply side is not systematically looked at. | - Policies to support public procurement of innovation are still not rolled out broadly, consequently, evaluations of public procurement policies are very rare, and those available fall as yet short of providing a rigorous and transparent assessment of policy impacts |
| Pre-Commercial Procurement | - Overall positive effects in terms of economic impact (but based largely on self-reporting), the contribution to firm growth can be extraordinarily high  
- There is widespread input additionality but impacts on employment are limited  
- The more IPR knowledge and publications created, the higher the retention rate of firms  
- Supported firms have been shown to be attractive to for venture capital funds | - Evaluations of European schemes are more concerned with the production of a solution, while the US scheme seems to focus more on the commercial effects on companies.  
- Probability of commercialisation at the end is higher if award thresholds are higher | |
| Innovation Inducement Prizes | - Innovation inducement prizes create prestige for both the prize sponsor and entrants  
- Prizes might also increase the public and sectoral awareness on specific technology issues  
- Prize design is crucial to the achievement of desired effects (and the limitation of undesired effects)  
- A number of studies points out that sometimes prizes should be accompanied with or followed by other demand side initiatives to fulfil their objectives  
- Prizes are also seen as a valuable opportunity for experimentation in innovation policy. | - The evidence on the impact of innovation inducement prizes is scarce due to:  
- While prizes have a relatively long history, they are only recently being rediscovered in innovation policy  
- Additional evaluation challenges exist for prizes. Measuring impact is very difficult and costly in prize competitions and, when there are measurement attempts, | |
### Instrument (Report Title)

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<td></td>
<td><strong>Main goal: Framework conditions</strong></td>
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| Standardisation         | - General economic impact: studies show that the contribution of standards to economic growth in various countries can range from 10% to 90% of the economic growth. Effects are even higher in more mature (less R&D intensive) sectors. Company level studies show that standardisation increases annual sales between 0.5% and 4%.  
- Innovation impact: High correlation between standards and patenting: CIS based studies show that standards constrain and inform innovation. |                                    | additionality is relatively more difficult to assess.  
- Non-monetary incentives and gains are more important in prizes than in other policy measures                                                                                          |
| Regulation on Innovation| There is a mixed, ambivalent picture:  
- Economic regulations have a slightly positive net effect on innovation. Environmental regulations especially are largely positive.  
- Antitrust regulation and deregulation tend to be positive.  
- Other regulations, such as market entry regulation and competition enhancing regulations more generally have ambivalent effects, with two opposing effects.  
- Labour market regulations: more flexibility (to hire and fire) allows incremental innovation and does not put a burden on employers to innovate (and thereby to risk failure and lay offs). However, rigid labour regulations favour longer term investment and more radical innovation  
- Sector specific regulations have ambivalent effects. In chemicals sector, pre-market screening has negative innovation effects on small companies, but positive innovation effects on larger firms, who are better able to deal with compliance burden. This advantage for large companies, however, has led to concentration effects (e.g. in pharmaceuticals) which in turn has decreased innovation pressures. The management and implementation of regulation has strong effects: delays in implementation are disincentives. |                                    | - The effects are – among other things –conditional to the level of competition (high competition squeezes profits of innovator, and imitation becomes more attractive)  
- Innovation effects are time sensitive; often there is negative effect in the short run, but a more positive effect in the long run. |
## Impacts of Innovation Policy

**Edler, Cunningham, Gök and Shapira**

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<tbody>
<tr>
<td><strong>Main goal: Enhance systemic capabilities, complementarities</strong></td>
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<td>Evidence is very limited due to the following reasons:</td>
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<td>Impact on innovation policy in two ways:</td>
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<td>- Evidence is mostly on the effectiveness of foresight process. Consequently, most “what works” conditions are related to the process of the exercise itself.</td>
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<td>- The effects have been largely positive in supporting the priority setting and improving the depth of reflection on policy direction and instrumentation and the larger innovation system as a whole.</td>
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<td>- The number of foresight exercises which target innovation policy as a central goal is restricted</td>
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<td>- As to strategic, system wide advisory role of foresight, there are far fewer studies on impact and the evidence here is inconclusive since effects are far less easily attributable</td>
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<td>- Most evaluations are of a light nature, some involving a significant level of self-review</td>
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<td>- Evaluations tend to largely focus on the efficiency of the foresight activity and the extent to which foresight has achieved its set targets (immediate and intermediate impacts), rather than higher order impacts</td>
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<td>- The achievement of innovation policy impacts materialises in the long-term and is often not easily detected or attributable among a number of other factors</td>
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