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THE INTERSECTION OF INTELLECTUAL PROPERTY RIGHTS AND INNOVATION POLICY MAKING – A LITERATURE REVIEW

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Countries of the World Intellectual Property Organization

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Executive Summary

Background – The existing body of work on innovation policy seemed to have failed to adequately address the role of intellectual property in innovation policy making. For that reason, the Manchester Institute of Innovation Research of the University of Manchester was requested by the World Intellectual Property Organization (WIPO) to undertake a review of academic literature since 2000 to synthesise how intellectual property rights (IPRs) are taken into account in innovation policy making and how they interact with the implementation and effects of major innovation policy instruments.

Objective – Document academic thinking on the subject in the last 15 years or so and, on that basis, draw conclusions for future work in this area.

Findings include –

- While the literature on the relationship between IPRs and innovation is enormous, the literature that focuses explicitly on the link of IPR to innovation policy and its many different instruments is very limited.
- Three types of relationships between IPRs and innovation policy were identified: (1) institutional reform, whereby IPR reforms have been implemented with a view to enhance innovation and commercialisation, for example the Bayh-Dole Act, (2) instrumental use of IPRs as a deliberate component of the design of innovation policy instruments, for example the so-called Patent Box, and, most common, (3) incidental, unintended impacts of IPRs on the effects of innovation policy.
- Such incidental impacts were in the areas of IPR management support, IPR and public procurement and in improving the interaction and connectivity between actors in the innovation system.

Recommendations to WIPO -

1. Contribute to a more balanced view of the organisational conditions needed to enhance innovation and commercialisation activities in universities, rather than take the positive effect of university ownership of patents for granted.
2. Support further a better understanding of the Patent Box as an innovation policy instrument, as this is a policy approach that is more and more common across the OECD world but still not fully understood in its implications on innovation and competition between locations.
3. Support and build up capacity of SME intermediaries as to IPR management and legal issues as well as on how to use IPR databases for technology searches.
4. Support Member States in understanding the importance of IPR especially for public procurement policy.
5. Ensure that IP administrations in Member States are aware of the role of IPR in innovation policy measures aimed at connectivity and that policy measures to support connectivity, cluster and network policies, R&D collaboration policies, and open innovation policies will need to include explicit guidance as to the use of IP in their design and implementation.
6. Finally, work towards better capabilities and awareness on both sides of the divide between IPR policy and innovation policy. Innovation policy makers must be supported in their understanding of the operational detail of IPRs helping them to understand how the features and practices of IPR interact with the performance of

innovation policy measures. Those responsible for supporting IPR regimes and practices throughout the world, especially in developing countries with their need to attract foreign competencies and move from imitation to innovation, need to realise how important strong IPR regimes and their appropriate use for innovation policy are.

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Introduction

The Manchester Institute of Innovation Research was tasked by the World Intellectual Property Organization to undertake a review as to how the academic literature has taken into account the intersection of IPR and innovation policy. According to the Terms of Reference (see Annex), the purpose of this study is to “explore to what extent, in what manner and with what objectives intellectual property has been considered in innovation policy making.” It must be kept in mind that this review is *not* about the importance of IPR for innovation per se, it is a summary of academic thinking on the role of IPR for innovation policy design and effects. The review is interested in how IPRs are taken into account in innovation policy making and how IPRs interact with the implementation and effects of innovation policy instruments, i.e. if they *reinforce*, *reduce* or *distort* the intended effects of an innovation policy measure. The basis for this review is existing academic literature on the relationship between IPR and innovation policy making. The review includes major academic output since 2000, but where appropriate refers to seminal work that has been published before that date.

As regards the coverage of innovation policy, the report focuses largely on the “areas” of interest as formulated in the Terms of Reference for this study. Some of these areas are policy instruments (government procurement, government support for firm’s R&D), others are innovation activities (open innovation) and others are policy goals (encouraging knowledge transfer). Nevertheless, for most of these “areas” we can identify a set of most important instruments which then can be clustered against an existing taxonomy of innovation policy measures (see section 3) in order to give the report a logic that corresponds to existing innovation policy concepts, to demonstrate that most of the innovation policy areas are covered in this report. We define innovation policy as all public intervention that seeks to support the generation and diffusion of a novel product, service, process or business model.

As regards the breadth of IPR, this deliverable focuses mainly on patents. This is because the academic literature on innovation *policy* and IPR has this focus, there is almost no literature regarding the relationship of other IPR such as trademarks or design rights with innovation *policy*.

This final report is structured as follows. The two following sections very briefly explain the nature and role of IPR (focus on patents, section 2) and introduce the basic logic and taxonomy of innovation policy (section 3) as a basis to understand the intervention logic and effects of innovation policy instruments in the main section. Section 4 is the main section and presents the existing evidence. It contains the innovation policy areas and instruments covered. For each policy instrument or area included in the sub-sections of section 4, we first present the basic logic of the policy instruments that are discussed, and then discuss the evidence as to the role of IPR in relation to this specific policy instrument. A final section 5 concludes with the identification of the prominent issues and trends and patterns of thinking and formulates recommendations for the consideration of WIPO in general and the innovation policy section in particular, for engaging with policy makers and innovation community for better integrating IPRs in innovation policy making.

Intellectual Property Rights (IPRs)

In a report for WIPO there is no need to explain the nature of IPR, thus we can limit ourselves to a number of basic characterisations. Intellectual property rights are major means for firms to appropriate the value of their inventions. They establish legally recognised and enforceable exclusive rights on the exploitation of specified inventions or creative work for limited times, and thus provide an incentive mechanism for innovation, enabling owners to appropriate benefits of their activities. At the same time they are a mechanism to *diffuse* technology and creative content through the exploitation of the intellectual property right itself (OECD, 2004a; Ordover, 1991; Bessen, 2005). It is important to keep those *two basic* functions of IPR in mind for this study. However, there are a range of further functions of IPR for firms.

As concerns the importance of IP for innovation activity, the four major IPRs are patents, trademarks, design rights and copyrights. Patents are by far the most important IPR related to innovative activity. They protect the exploitation of inventions that are “new, involve an inventive step (non-obviousness) and are capable of industrial application” (TRIPS², Article 27(1)), they normally grant the owner of the patent the right to exclude third parties from exploiting the patent³. Trademarks “provide exclusive rights to any sign (e.g. words, letters, numerals, figurative elements, and logos), or any combination of signs, that enables people to distinguish the goods or services of one undertaking from those of other undertakings” (TRIPS, Article 15). It has been shown empirically (e.g. Llerena and Millot, 2012), that trademarks, as a means for commercialisation, are linked to innovation and interact in complex ways with patents. Design rights (referred to in some jurisdictions as design patents) “prevent third parties from making, selling or importing articles bearing or embodying a design which is a copy, or substantially a copy, of the protected design, when such acts are undertaken for commercial purposes”⁴. Finally, copyrights protect the expression of original literary and artistic works, which in some jurisdictions now includes the protection of software (see also Blind et al, 2005).⁵ It is especially the latter aspect that makes copyright important for innovation activity.

As stated in the introduction to this report, the literature on innovation *policy* and IPR has focused mainly on patents. The use of patents has increased and broadened in the last decades. Firms use IPR initially to secure exclusive rights over their inventions, but they also use them to *signal* technological and design capacity, to build up reputation and strength in the market place (e.g. when firms are assessed in mergers and acquisition or by shareholders and financiers) (Arundel, 2001; Blind et al., 2006; Cohen et al., 2002; Somaya, 2012), increasingly also as ammunition against competitors, e.g. in bidding wars (Blind et al., 2006).

The concern about the appropriate design and implementation of IPR regimes has been a major issue in the literature since the late 19th century. As in recent decades the use of IPR has strongly increased, IPR regimes themselves have been adopted to capture new developments in the production of inventions and creative content for commercial use (for an overview see OECD 2004a). Analysis of the IPR system and its use stresses the inherent tension – from a systemic point of view – between the monopoly function and the diffusion function. The broadening of IPR coverage and use has also led to concerns that the generation of innovation,

² TRIPS is The Agreement on Trade-Related Aspects of Intellectual Property Rights, an international agreement that is formally administered by the World Trade Organisations.

³ For inventions that do not meet the criteria of inventiveness, some countries grant utility models.

⁴ See WIPO, <http://www.wipo.int/designs/en/>

⁵ <https://innovationpolicyplatform.org/content/copyright>

particularly in areas like software or business methods might be hampered and the access to important research tools and data may retard progress in innovation (ibid. 2004).

Last, in innovation studies and in policy analysis, design and evaluation, IPR is also often used as an indicator of innovative capacity and performance of organisations, regions or countries (Archibugi, 1992). This function as indicator is in itself an important generator of patent numbers and patenting behaviour in general, although patents as indicators of innovation are highly contested, as they focus on specific modes and aspects of innovation and as the practice of patent registration is often linked to strategic considerations beyond the protection of essential inventions (Blind et al, 2005).

The importance for IPR in innovation policy considerations can – conceptually – be summarised as follows. IPR – especially patents – are important for innovation policy making because:

- they are *crucial incentives* for innovation as they establish potential for commercial exploitation, both direct (by the inventor) and indirect (through licensing),
- they establish an *inherent tension* at system level between the exclusivity function (keeping the exploitation rights to the inventor, granting an innovation incentive) and the diffusion function (spreading the diffusion of an innovation that is socially desirable faster and broader than it is done by the inventing firm itself),
- they add additional burdens
 - for innovations that need interoperability or for combinatorial or architectural innovation, whereby one innovation or product relies on innovations owned by a third party (e.g. ‘standards-essential patents’)
 - for companies who see themselves in danger of litigation when innovating (increased transaction costs)
 - in increasing coordination and management costs and risks for identifying and managing IPR within firms (filing, registration, defending etc.) as well as in the management of interaction and collaboration in the innovation process (“who owns which existing and future IP”).

Before presenting the evidence as to how innovation policy making interacts with these complex functions of patents for innovation (section 4), we now briefly establish the rationale for innovation policy and situate the areas of interest of the Terms of Reference within a typology of innovation policy.

Innovation Policy: Rationales and Typology

For the purpose of this report, we define innovation policy as public intervention to support the generation and diffusion of new products, processes, services or business models (Edler et al, 2013). This is a very broad definition, that not only covers innovations that are exploited in the market place, but also those that are used in other domains (public sector innovation, social innovation). It also covers the support of innovation generation as well as the support for the exploitation, commercialisation and adoption of innovation.

Innovation policy in this understanding is mostly designed and implemented in innovation, economy or technology ministries, supported by innovation agencies. However, two important points must be made. First, the delineation between innovation and science policy is blurred,

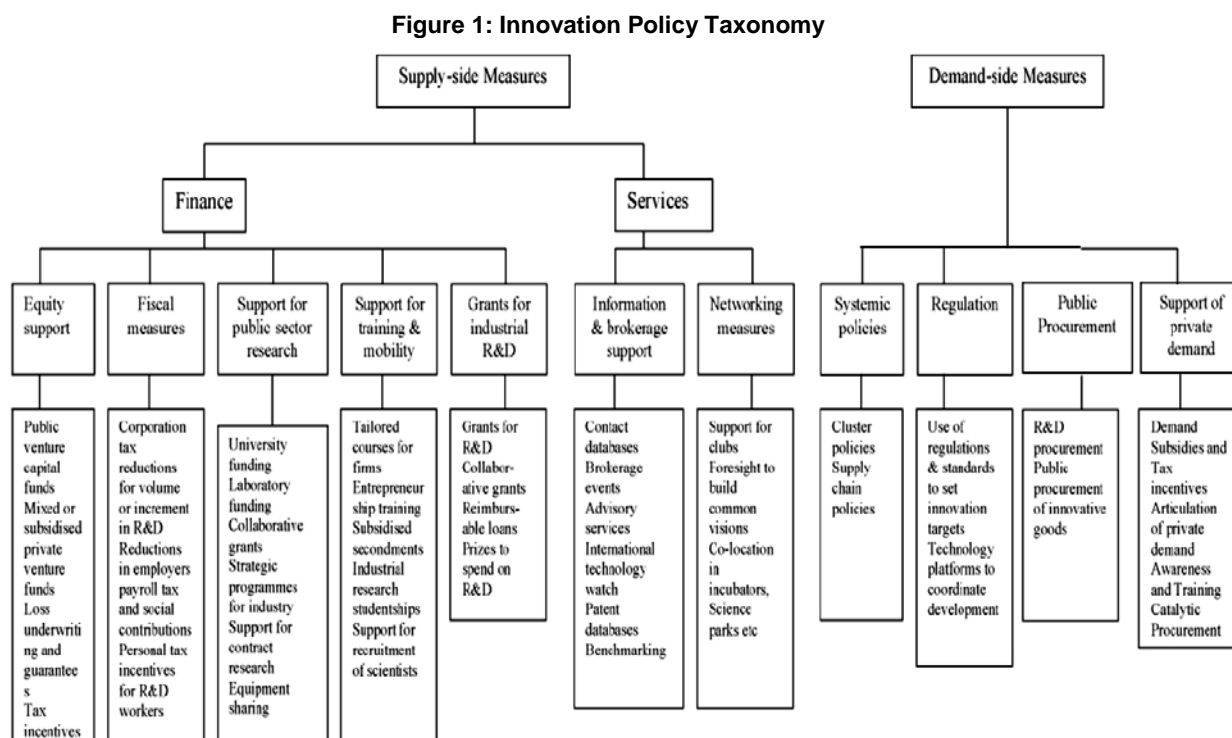
often governments and analysts speak of science, technology and innovation policy and many of the measures that are implemented by science ministries also involve production of knowledge and artefacts with the direct intent to lead to subsequent innovations. Second, many of the measures that support innovation in our definition are designed and implemented in functional ministries (energy, health, transport etc.). Thus, they are not labelled innovation policy measures, but serve the same purpose. However, in this report we cannot cover the breadth of all those policies that support innovation to achieve other policy goals (in the area of health, transport, energy and so on). This would have gone beyond the scope of this contract.

While there are numerous ways in which individual innovation policy interventions are justified, the basic rationale for innovation policy can be clustered in the following three major categories

- (1) Market failure: this is the traditional justification theoretically underpinned by Nelson (1959) and Arrow (1962). The main argument is that knowledge is defined as a public good, which means that knowledge that is produced can and will be used by other actors (an externality). The creator of knowledge cannot appropriate all its benefits alone. This leads to sub-optimal knowledge production, as private returns are lower than public returns. The need for public policy therefore is to provide incentives for knowledge production in public organisations, to give financial and other support to encourage knowledge production and innovation activities in firms and start up activities and to create framework conditions (through intellectual property rights) that grant a temporary exclusivity for the commercial use of intellectual property as an incentive for innovation generation and exploitation.
- (2) Systems failure: the generation of knowledge and innovation is a collective and interactive endeavour, it needs broad capabilities and relies on exchange, co-operation and interaction so that complementarities and specialisation can be brought together, both for the production of knowledge and innovation as well as between producers and users. It also needs supportive and stable framework conditions. However, cooperation is costly and risky, and the demands on capabilities are constantly changing. System failures are those conditions in systems that stand in the way of providing the right framework conditions for innovative behaviour (including market creation through standardisation and piloting), the appropriate capabilities to create and use innovation and the right opportunities and abilities to interact and cooperate (on the supply side and between producers and potential users of innovation). The system and its actors thus need support to overcome those failures, through build-up of capability, through provision of intermediation and training, and through programmes that support interaction and cooperation.
- (3) Societal missions and challenges: it is a primary duty of politics to provide direction for technological development and innovation in order to satisfy state needs (e.g. defence, security) and citizen needs (health, education). Thus, policy support incentivises actors to invest in knowledge and innovation production in targeted areas. This can have different expressions, such as pooling and directing efforts to achieve a defined mission (e.g. Manhattan Project), scientific and technological missions in science ministries or orientation towards specified missions in functional ministries (energy, health, transport etc.).

Against this background of intervention rationales for innovation policy, a number of innovation policy taxonomies have been developed. Given the initial list of 13 innovation policy “areas”, the best fit is a typology developed by Edler and Georghiou (2007). This typology distinguishes measures that support the supply of knowledge and innovation (supply side, that is measures to

support the supply of knowledge and innovation) and those that support the demand for and adoption of innovation (demand side measures that is measures to increase the demand for knowledge and innovation). Further, the typology differentiates on the supply side between provision of financial support and provision of non-financial support (intermediation, networking support etc.) and offers 11 broad categories of measures (seven on the supply and five on the demand side) and 39 distinct types of interventions (30 on the supply and 9 on the demand side).



Source: Edler / Georghiou 2007

The original Terms of Reference for this study contained 13 policy areas and instruments. Two out of those 13 areas, i.e. IP management within government departments and establishing focal committee or task force on innovation, have not been sufficiently covered in the academic literature and thus are not presented in this report. However, we have added two further policy areas, i.e. *technology advisory services*, as those management support services present firms, inter alia, with valuable IP advice as a means to support innovative activity, and *information and brokerage support*, which helps firms to connect with other actors and get access to external information, both with IPR implication.

Thus, the final list of policy areas and instruments covered in this report is as follows:

- Encouraging the transfer of knowledge from the research base to industry.
- Encouraging a venture capital industry and angel investors.
- Setting up/supporting science parks and incubators.
- Encouraging foreign R&D to locate in the country through investment policies and tax policies.
- Encouraging foreign scientists and technical expertise into the country through immigration policies.
- Encouraging nationals residing in foreign countries to relocate in the country, bring their knowledge and experience and to start businesses.

- (g) Tax policies for encouraging IP intensive companies to commercialize in the country, encourage private R&D etc.
- (h) Government procurement as an instrument of innovation.
- (i) Government support to the enterprise sector (direct support, grants).
- (j) Cluster policies.
- (k) Open innovation
- (n) Advisory services
- (o) Information and brokerage support

Originally included in the Terms of Reference but not considered in the report were:

- (l) Promoting Institutional IP management within government departments.
- (m) Establishing a focal point/committee/task force on innovation

These policy areas, goals and instruments of the Terms of Reference can now be characterised using this typology. This demonstrates which areas of innovation policy are covered in this report. It also helps us in ordering the different areas in section 4.

Table 1: Characterisation of the areas, goals, instruments of innovation policy covered in this report against the policy typology

Policy Areas/Instruments	a	b	c	d	e	f	g	h	i	j	k	m	o
Innovation Policy Instruments*													
(1) Equity support		■		■			■		■				
(2) Fiscal measures				■			■						
(3) Support for public sector research	■										■		
(4) Support for training and mobility	■					■							
(5) Grants for industrial R&D	■								■		■		
(6) Information and brokerage support									■		■	■	■
(7) Networking Measures	■		■							■	■		
(8) Systemic Policies										■			
(9) Regulations													
(10) Public Procurements								■					
(11) Support of private demand								■					
(12) Other: immigration policy					■	■							

Note: The strength of the shading signals the fit of a policy area to the policy instrument type
 *This follows the typology of Edler / Georghiou 2007.

The typology table shows that the areas covered by this report cover most of the innovation policy categories, except for regulation (e.g. the link between regulation and IPR for innovation is not part of this report) and private demand (where IPRs are less relevant since support is given to the private buyer of an innovation). It also shows that two areas go beyond the *traditional* innovation policy remit (immigration policy). And finally, it shows that some of the areas and instruments are very broadly defined, span a range of policy categories and are somewhat overlapping.

In the following section we present the interaction of IPR with our policy areas and instruments. For each of the areas / instruments we first outline the specific intervention rationale, the reason for policy intervention and the mechanisms with which it works, and then we present and interpret the evidence we have as to the interaction of IPR and this innovation policy area / instrument.

Innovation Policy and IPRs

In the following we summarise the evidence we found in the literature as to the relationship of IPR and the various policy interventions selected by WIPO. Each section will deal with one of these interventions separately. Each of those individual sections is structured as follows. We start with a brief outline of the **rationale for these interventions**, answering the question about the underlying assumptions as to why this intervention is needed to support the generation of innovation and how it does so. We then discuss the **importance of IPR for this specific intervention**. In some instances, this will be done in two steps, i.e. it will include a discussion of how IPRs relate to the actual structure or process that is supported (e.g. how do IPRs interact with “clusters” or with “open innovation” *in general*) before we then discuss how IPRs interfere with policies to support these structures or processes (e.g. clusters or open innovation).

Direct government support to enterprise sector

Rational for direct government support

In this section we focus on direct support for R&D firms and want to provide a better understanding around the interaction of IPRs and direct government supports to the enterprise sector. Doing so, we will first discuss the rationale for government direct support to enterprise sectors and will focus on the interaction between IPRs and innovation policies to foster direct government support to the enterprise sector

We define direct government support of firms as the provision of a payment to be spent on R&D and innovation activities – as compared to indirect support through tax incentives. Most often, this payment will be a co-financing of activities rather than a 100% funding. The rationale for the provision of direct support to the enterprise sector is based on all three rationales outlined in the introduction. While R&D conducted within firms will, directly or indirectly stimulate innovation that leads to the production of new marketable products, processes or services (Mazzoleni and Nelson, 2007), firms tend to underspend because they cannot avoid the possibility that the knowledge they create in their research activity benefits others as well. In technical terms, they cannot fully and exclusively appropriate the benefits of their R&D investments (market failure). In addition, the costs of finding and managing partners means that firms do not cooperate as much as it would be optimal for the economy as a whole (system failure). Thus, direct support is often, not always, linked with the requirement to cooperate. Finally, firms may not invest in knowledge and technologies that are most desired politically and socially, thus, thematic subsidy programmes will encourage companies to invest in the most socially desired areas (Reid et al, 2012).

The effect of R&D subsidies on firms is threefold. They make firms:

- spend more of their own R&D budget (input additionality: Cunningham et al.2008, García-Quevedo 2004, Falk, 2007, Czarnitzki and Licht (2006) Cunningham and Gök, 2012),
- produce more R&D outcomes (output additionality) such as innovative products and services (Roper and Hewitt-Dundas 2012, Cunningham et al 2012) and
- change their behaviour (behavioural additionality: Gök and Edler, 2010; 2012). The latter means that the support for R&D is linked to the idea that firms receive the money, but in

doing so will have to change the way they conduct research and innovate, most often this is related to an increase in cooperative behaviour⁶ (Hsu et al. 2009).

For those reasons, direct R&D support provides an additional incentive for R&D activity. Direct support to firms has a comparatively long history evolving from the direct support of single R&D projects within large individual firms, towards a focus on direct support to SMEs (Cunningham et al 2012). Also Köhler et al. (2012) state that although the R&D activities of larger firms generate more significant spillover effects than do those undertaken by SMEs, there has been a significant shift in direct government support towards SMEs. In this regard, as OECD (2011) mentions, SMEs are the only net creators of manufacturing jobs within the OECD countries over the last 20 years and therefore Cunningham et al (2012) conclude that limited government subsidies can have a proportionately greater impact on smaller companies rather than larger companies who have a more diverse portfolio of R&D interests and greater resources with which to support these. Bozeman and Dietz (2001) argue that an increase in R&D will, in a significant number of cases, drive the development of new products, lead to new market sales and create new employment opportunities within the individual firms supported. Finally, direct support to firms is seen as being a driver of (national) competitiveness as it improves the innovation activity of firms within a country and thus their position in global competition (Mazzoleni and Nelson, 2007, Cunningham et al, 2012).

In conclusion, direct government support to the enterprise sector tends to stimulate more R&D and innovation activity, more innovation output, and a change in behaviour of firms that is conducive to more innovation in the future. This leads to increased competitiveness not only of individual firms, but through cumulative and system effects, also of innovation systems.

Interplay between IPRs and direct support measures

There is no broad literature discussing the interplay of IPR with direct support measures per se. Most of the literature that is concerned with firm support for R&D and innovation and IPR is concerned with measures that *connect* actors in one way or the other. The role of IPR in measures that support collaboration and connectivity is discussed in other sections below. In terms of direct measures that target individual firms to make them increase R&D spending, activity and output, there is one important specific point. Stuart and Rubin (2007) as well as Leiponen and Byma (2009) have noted an important disadvantage for those firms – mainly SME – that are not able or willing to protect their IP through IPR,⁷ which exposes their innovation results to ready imitation by competitors. As a result, SMEs may be reluctant to use private resources to fund R&D activities when the threat of competitor imitation may impede a return on their investment (also Czarnitzki and Lopes-Bento, 2013). Thus, for those firms R&D subsidies might not work as well, so may need to be even higher to overcome risk aversion and would need additional support for IP and IPR management.

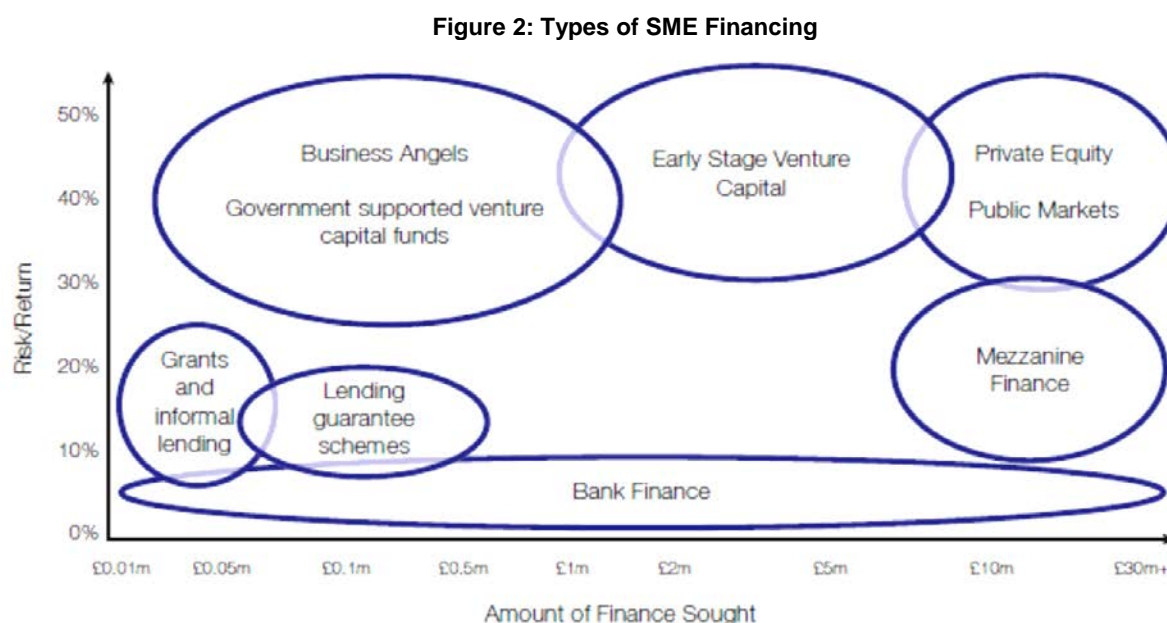
⁶ Cunningham et al (2012) highlight four major types of behavioural additionality as i) an extension of input additionality covering increased scale, scope and acceleration, etc., of the desired outcomes, ii) the change in the non-persistent behaviour related to R&D and innovation activities, iii) the change in the persistent behaviour related to R&D and innovation activities, and iv) the change in the general conduct of the firm with substantial reference to the building blocks of behaviour.

⁷ SMEs lack funds to invest in the project upfront, the amount of tax credit support may depend on the firm's taxable income at the end of the tax year, which for SMEs may be difficult to predict (Stuart and Rubin, 2007))

Encouraging venture capital industry and angel investors

Rationale: Venture Capital and angel investors as key mechanism of equity support

Firms, especially young firms, often lack sufficient equity to invest, innovate and grow. There is a range of financial instruments that are available for supporting SMEs for their innovation activities (Rowlands Report, BIS, 2009, see figure below). They range from grants and informal lending covering relatively small financing requirements and risk on the one hand to investments with risks of a more substantive nature that can be obtained from private equity or public markets on the other (Ramlogan and Rigby, 2012a).



Source: Ramlogan and Rigby (2012a)

The instruments we are concerned with in this section have been identified as key equity support measures, namely public venture capital funds, mixed or subsidized private venture funds and loss underwritings and guarantees (Edler and Georghiou, 2007). They are illustrative examples that represent the extreme ends of the spectrum of equity measures. Venture Capital schemes have a higher risk and higher return ratio, i.e. the risk of failure is high, but equally, the share of return for the investor is high. In contrast, loan guarantees are usually applied in situations of less risk and thus also smaller return expectations. While venture capital investments may involve tens of millions of dollars/pounds, loan guarantee schemes are in general reserved for smaller scale investments.

According to Edler and Georghiou (2007), loss underwriting and guarantees are the other instruments of equity support. Loss underwriting and equity guarantees are financial instruments which transfer part or all of the risk of investment from investors to the provider of the guarantee (EU Commission, 2003). The most basic justification for guarantees like the other two previously mentioned instruments is market failure in the sense that R&D projects with favourable risk-return profiles are unable to obtain external financing. Many investors have difficulties in assessing technology risk and potential future returns from R&D investments and thus avoid this type of investment.

The equity schemes are not primarily directed at innovation per se. However, in general the access to finance that those instruments provide are expected to lead to additional levels of activity, including investment in innovation, in order to lead to increases in turnover and employment. But why should governments intervene in venture capital markets?

Ramlogan and Rigby (2012a) point out two different types of market failure as the main rationale behind government intervention in capital markets. The first relates to information asymmetry. Innovators or young high tech firms know much more about their own capacities and the risks of the projects being developed than potential investors. Stiglitz and Weiss (1981) consider that such information asymmetry may lead to adverse selection, meaning that those projects and firms are selected and supported that are least risky and thus potentially high risk high profit ventures are disadvantaged. Therefore investment funds are in short supply for young firms in high technology sectors seeking resources to facilitate their growth. The second market failure relates to externalities associated with R&D and innovation. Innovation and R&D related projects often generate significant social benefits (positive spillovers). To the extent that venture capital investors are deterred from investing in innovation and R&D because they are unable to fully appropriate the returns from their investments there will be under-provision of innovation and hence unrealised social benefits (Ramlogan and Rigby, 2012a). As Murray (2007) notes, both information asymmetry and externality based market failures therefore provide a justification for a public response through subsidising venture capital.

While most policy makers assume that venture capital has a positive impact on innovation (Ramlogan and Rigby, 2012a), the empirical literature is more ambiguous and suggests a very mixed picture. There is in general a strong association between venture capital and innovation, however, the direction of causation is yet to be determined, in other words, more innovative firms are more likely to receive venture capital, or more venture capital might lead to more innovation in supported firms (Lahr and Mina 2012). Kortum and Lerner (2000) find that that presence of venture capital leads firms to innovate. Various other studies (Engel and Keilbach 2007; Hirukawa and Ueda 2008; Caselli et al. 2009; Lahr and Mina 2012; Popov and Roosenboom 2012), in contrast, find that that venture capital does not foster innovation or new innovative firms, but instead invests in firms that have already proven to be innovative. However, this does not refute the view that additional capital could still foster additional innovation.

Interplay between IPRs and Venture Capital and angel investors as a key mechanism of equity support

IPR and equity access and support in general

The reviewed literature indicates that there is a significant relationship between IPRs and the potential of equity support. In fact as Caselli et al (2009) state, IPR is an integral part of value creation in a technology-based enterprise and as such is a critical element in obtaining venture capital for SMEs. Therefore as Mario and Cardullo (2004) mention the appropriate use of IPRs system is a powerful tool for competition, stability and mitigation of risks on capital investments.

Many different scholars such as Arundel and Patel (2003), Arundel et al (1995), Cohen et al (2002), OECD (2003a) and Blind et al (2006), indicate that IPRs may improve access to capital markets, although this is rarely investigated explicitly. Blind et al (2006) state that although the main motive to patent is still protection from imitation followed by the more strategic motive of (offensive or defensive) blocking competitors, there is a special and rather specific aspect of the

strategic motives to patent to gain access to capital markets. Most of the surveys within the reviewed literature (such as OECD 2003a) indicate that if not of prior direct importance then patents as stimulating access to capital is still of considerable importance to a number of firms. On the other hand although the empirical evidence for such a relationship is mixed (as indicated earlier) then many studies see access to capital markets as a factor in the initial decision to patent or not (Kortum and Lerner, 2000, Audretsch et al., 2007, Blind et al., 2006).

Also once patents are granted, they can be considered as important assets in a knowledge-based economy (Bottazzi and Rin, 2005). It is known from the IPR-literature (Arora, 2001, Arrow, 1962, Hsu and Ziedonis, 2007) that patents signal specialisation and expertise on a technological front and signal the intangible sources of competition within the firm. Patents are a signal of being a significant partner for collaboration. Moreover, it signals to venture capitalist funds that assessment of technologies may be pursued more cheaply, and more precisely. Patents can be an efficient and cost effective way of signalling these features because they are recognized, reliable sources of information, whereas other types of announcements may be used more strategically involving the risk of false information(Christensen, 2008). Poltorak and Lerner (2002) find that strong patent portfolios increase stock prices – and thus equity.

IPR and Venture Capital Funds and loan guarantees

Venture capital funds are able to contribute to IPR process by intermediations and signalling effects (Christensen, 2008). Within the mainstream literature, venture capital funds are characterised as focused upon SMEs, high-tech firms, high growth firms, and they are particular good at screening, monitoring and advising firms. More importantly, venture capitalists are networkers, they have extensive knowledge on who-knows-what, and they may efficiently guide firms to the right external advice if they have shortcomings themselves (Amit et al., 1998, Bottazzi and Rin, 2005). At least for SMEs and/or new firms resource constraints in the patenting process may require an external partner. Firms may therefore have incentives to engage with specialised organisations such as venture capital funds and patent agents to carry through their patenting process(Christensen, 2008).

There are indications that venture capital funds are more willing to invest in firms with a patented or patentable invention (Christensen 2008). These firms may be more attractive because they indicate companies with leading edge technology. Further, to own a patent implies that a technology search has already been undertaken, reducing the likelihood that another patent will block the commercial exploitation of the technology. For small firms in particular, who need additional capital for development, the holding of a patent may be very important (Mazzoleni and Nelson, 1998). The patent also conveys information on the managerial competencies of the firm (Mann and Sager, 2007). What it does not say, however, is something on the business aspect of the patent, i.e. how the rents from the technology are to be appropriated (Heeley et al., 2007).

The relationship between Venture Capital, mixed or subsidized private venture funds, and innovation in firms is characterised by a dilemma which has policy implications: “How can they (firms) communicate to a potential buyer the value of a new idea, without disclosing the idea itself? And once they have disclosed the idea, why should a potential buyer be willing to pay for it?” (Murray, 2007;p17) Therefore, in order to get access to venture capital, innovative firms must deliberately manage their knowledge flows in a way that maximises their private returns for a given innovation (Pender, 2008). The most important policy support instrument as regards Venture Capital in the context this study is putting in place an effective IP system (Granstrand,

2005). This helps to clarify appropriability conditions and thus strengthens the incentive to innovate and the incentives to invest in an innovative SME or start up.⁸

Typically, equity is concentrated in technology-driven sectors where IPR protection can create defensible competitive advantage, e.g. biotechnology and ICT. For these sectors there is positive evidence that equity support measures, such as public venture capital funds, mixed or subsidized private venture funds and loss underwritings and guarantees, can be a positive influence on patenting and innovation (OECD, 2011). This can lead to a mutually re-enforcing cycle. Kortum and Lerner (2000) show that technological innovation may lead to defensible IP and in turn attract further equity investment. This may be provided either by institutional investors or by business angels with proven positive impacts on patenting and innovation.

As regards the specific link between loan guarantees, innovation and IPR, there is unfortunately no specific literature that we could detect since 2000.

Supporting business through advisory services

Rationale for supporting business through advisory services

According to Heseltine (2012), technology and innovation advisory services are services provided directly by specialists particularly to SMEs (see also Shapira, 2011) to support and stimulate improvements in business operations including productivity, efficiency, production, quality, waste reduction, information technology and logistics. Increasingly, such services also focus on innovation in design, products and services, and business models (Dyson, 2010). As Shapira and Youtie (2012) state, technology and innovation advisory services provide information, technical assistance, consulting, mentoring, and other services to support enterprises in adopting and deploying new technologies and in commercialising innovations. Often, these advisory services are aligned with innovation policy goals to increase R&D collaboration between SMEs, increase financial support for R&D activities, increase the firms' non-financial capabilities, enable the access to expertise and complementarities and increase the firms' awareness of frameworks, policies and institutions such as IPRs regime, regulations and standards to create economic values by creation and exploitation of intellectual properties (Ramlogan and Rigby, 2012a).

In this section we will first try to understand the rationale of innovation and technology advisory services and their role in fostering innovation policy goals. Then in the second part of this section we will concentrate on the interplay between innovation and technology advisory services and IPRs.

The major rationale for public support in providing technology and innovation advisory services are market and system failures (Shapira and Youtie (2012). Shapira and Youtie (2012) show that market failures can exist on both the demand and supply sides. Market failures on the demand-side include the lack of information, expertise and skills, training, resources, strategy, and confidence among SMEs to adopt new technologies and techniques (Luria, 2011). Market failures on the supply side involve the costs for vendors, customers, consultants, and other

⁸ Other policy instruments have little to do with IPR. One is the public provision of basic research with the potential to create positive externalities that favour industrial applications over the long run (Cappelen et al, 2012). A second one is to offer public subsidies as a form of financial compensation for the additional social returns of innovation (Mairesse and Mohnen, 2010).

business assistance sources to reach and service SMEs (Mole et al, 2008). According to Ordowich et al (2012) those market and system failures are caused 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 short-term contracting and lack of support from major customers.

SMEs typically face a series of challenges that can hinder their efforts to upgrade and adopt modern technologies and implement innovations in products, processes and services (Shapira, 2003). One of the most critical issues for SMEs is lack of capital as SMEs often find it difficult to access financial resources to invest in technological upgrading and innovation (National Academies, 2013). In some cases, difficulties in accessing financial resources are compounded by weaknesses in the ability to cost-justify new technologies or the benefit-risk relationships involved in innovation (Shapira and Youtie, 2012). Human capital challenges are also important. Most importantly in relation to advisory services, SMEs typically have limited internal know-how to manage the innovation process (Golding, 2012). SMEs typically under-invest in training and skills, and they tend to have a smaller pool of qualified personnel for selecting, operating, and integrating new technology into the firm's flow of production. In addition, few employees have the level of absorptive capacity to learn from, manage, transfer knowledge associated with the technology throughout the firm, and leverage the technology to produce innovative outcomes (Luria, 2011). This is exacerbated because SMEs often regard universities as being too complicated to deal with, while private consultants are often viewed as expensive resources (Shapira 2008). Thus, SMEs are limited in their ability to gain knowledge for upgrading from external sources (Jones and Grimshaw, 2012), and their operational daily pressures with restricted time and resources to develop appropriate innovation strategies and engage with external resources of expertise (Shapira and Youtie, 2012).

To sum up, the market and system failure outlined above, on both demand and supply sides, often lead SMEs to under-invest in technology and innovation, below an economically or socially desired level (Aboal and Garda, 2012, and Shapira et al, 2011), and they amount to an information and advice need that is not responded to in the market place. This underlies the rationale for publicly-sponsored intervention (Ezell and Atkinson, 2011). Technology and innovation advisory services tend to enable SMEs to build up their innovation capabilities. In the next part we will scrutinize the interplay between innovation and technology advisory services and IPRs.

Interplay between IPR and Advisory Services

A core task of technology and innovation advisory services is to support enterprises in adopting and deploying new technologies (Mole et al, 2008). The reviewed literature suggests that to execute the technology adoption and deployment efficiently and complete these tasks, possessing strong knowledge of IPRs and implications of IPRs issues are essential (Roper et al, 2010; Helper and Wial, 2010; Goss Gilroy, 2012). Also, in order to increase the SMEs innovative capabilities and stimulate innovation through different channels (encouraging R&D collaboration, attracting financial resources etc.), focal points and innovation taskforces should increase the SMEs awareness on the potentials of IPRs regime and advise the firms how to benefit from IPRs systems to achieve certain innovation policy goals (Ordowich et al, 2012). The reviewed literature is restricted to formulating demands for advisory systems as regards the importance of IPR for advisory services rather than giving evidence on existing practices of advisory service in relation to IPR.

As IPRs play an eminent role from basic R&D stages to commercial diffusion of technology (including licensing), technology advisors should consider advising SMEs on adoption and deployment of the right technology (Lee, 2009; Haupt et al, 2010; Agrawal and Audretsch, 2001; Brown and Vankatesh, 2005). Those authors claim that advisory services on technology adoption should increase the knowledge of SMEs regarding the licensing implications, limits, regulations, responsibilities and mechanisms (Kim, 2003). In addition, Ordowich et al. (2012) mention that it is of the paramount importance to increase the SMEs awareness of IPRs mechanisms and the potential benefits they can get through these mechanisms in terms of developing appropriate innovation strategies and engaging with external resources of expertise.

In summary, IPRs advice to SMEs should be considered as the core of technology and innovation advisory services as SMEs usually suffer from lack of relevant information about IPRs due to their day-to-day pressures (Roper et al, 2010). The limited literature on the role IPRs in technology and innovation advisory services suggest that IPRs advice should be considered as one of the major and essential domains of advisory services as it interconnects dynamically with the other areas of innovation policies as mentioned above. This, in turn, means that technology advisory services themselves build up a comprehensive knowledge of IPRs and specifically technology licensing.

Encouraging the transfer of knowledge from the research base to industry

Rational for policies to support the transfer of knowledge from the research base to industry

The body of research known as 'national systems of innovation' has been concerned with the characteristics of different systemic approaches to knowledge flows, but the most important aspect of these systems is this link between generation of knowledge and exploitation of knowledge (Aldridge & Audretsch, 2011). Knowledge transfer has many different modes and facets. This section will first give an overview of knowledge transfer modes, but then discuss the role of IPRs in encouraging the transfer of knowledge from the research base to industry with a focused perspective on licensing and Technology Transfer Offices. Subsequent sections will deal with knowledge transfer that is achieved through connectivity, through joint activity of different kinds of actors. We will first discuss the nature of knowledge transmission mechanisms, and then the place of IP in policy measures aimed at fostering this process.

For several decades, a major concern of policy makers has been the apparent underuse of results generated by strong research bases. The research base includes private sector firms, publicly funded research organisations (PROs) and universities that may be either private institutions or entirely publicly funded (Kitson, 2009). It is generally accepted that research results often feed through, with a variable and unpredictable lag, into commercial exploitation (Radauer and Walter, 2010). In Europe, the paradox of strong basic research yet the loss of economic competitiveness has been at least partly ascribed to the poor transfer of knowledge from research to exploitation. As a result, policies have been undertaken to remedy this failure, and encourage knowledge transfers to those more capable of exploitation (Conti & Gaula, 2011).

These policies have included a wide range of specific measures, including: direct funding for collaborative research programmes involving commercial and research organisations: support

for directed research programmes (rather than the traditional academic responsive research projects) (Rigby and Ramlogan, 2012b), support for problem-solving collaborations (Siegel et al, 2007) and support for industry-linked doctoral programmes as well as the institution of new licensing conditions for the use of publicly-funded research and employment conditions for research staff (Clarysse et al., 2011). These are generally grouped together as 'knowledge transfer' policies. Usually, innovation policies aimed at improving knowledge flows also have other objectives, such as increasing the rate of knowledge production (Verspagen, 2006) and steering the overall focus of research towards more exploitable areas, but this section will be restricted to the narrow transfer intention.

It is important to put knowledge transfer into context. First, there are many ways in which the knowledge generated by the research base flows into industry. These include: collaborative research teams and programmes (funded either by industry or with support from public funding) (Azagra-Caro et al. 2006): individual research contracts between firms and universities (either institutions or individual professors) (Bekkers and Bodas Freitas, 2008): *ad hoc* consultancies and exchanges of staff (mobility) (Boardman, 2008), equipment use or student research projects: donations to fund laboratories, equipment or professorial chairs, and many other formal and informal types of contact such as licensing of IP (Azagra-Caro (2007). The employment of graduates and post-graduates can also be viewed as an important means of transmission (D'Este and Perkmann, 2011). Second, relationships between universities and firms are usually long-lasting, multidimensional (finance, staff, equipment, training, etc), and depend on the build-up of trust based on personal relationships generated by past contacts (professors, laboratories, students, projects, and informal contacts) (Grimpe and Fier, 2010). Third, most collaborative research projects do not produce results (foreground) that are immediately exploitable in commercial products (Boardman, 2008). The nature of the 'knowledge' is varied (Boardman and Corley 2009). Results may include methodologies, reference data or procedures that are either not allowable subject matter or are better exploited by open dissemination. Academic literature often distinguishes 'tacit' and 'codified' knowledge in this context (Haeussler and Colyvas, 2011).

The interplay of IPR with knowledge transfer from the research base to industry

The reviewed literature highlights the role of IPRs in transferring knowledge from the research base to industry in different ways. The main debate in this section is focused on cooperation agreements and the need for and consequences of Bayh-Dole, and the way Bayh Dole is supported through Technology Transfer Offices. The following sections of this report cover knowledge transfer issues and their relation to IPR which are based around connectivity and collaboration.

Let us first discuss collaboration projects between the public research base and firms. Clearly, the treatment of IP varies enormously between different types of collaboration. Relationships that are formal enough to involve IPR agreements are only a small proportion of the whole, and even the financial flows due to IPR ownership are, for almost all universities, small in comparison with the others such as donations and bequests, even in the USA (Fabrizio and Diminin, 2008). The danger of introducing formal IP issues inappropriately is the potential loss of trust between successful informal collaborators (Geuna and Rossi, 2011).

Nevertheless, in large collaborative research projects, and those with explicit commercial objectives, formal agreements are necessary in order to define the expectations of all

participants, and to make clear the rights and responsibilities of each participant (Rothaermel et al, 2007). Publicly supported programmes usually require a formal agreement between project members (Bruneel et al, 2010). An essential feature of all collaboration agreements are those sections relating to the treatment of IP. The sometimes difficult process of agreeing to IP rights and responsibilities has the important implication that participants are forced to confront any disagreements or ambiguities at the outset of a project rather than when difficulties appear (Murray, 2010). IP frequently defines the interfaces between participants: which participants have rights only to use results for research (universities) and which participants have the rights to exploit results commercially and are responsible for protecting inventions (patenting) and monitoring and enforcing these rights (Montobbio, 2009). Moreover, consideration of IP rights may determine the membership of research consortia (Thursby and Thursby, 2002). Sometimes direct commercial competitors are reluctant to collaborate on near-market projects, so these projects tend to include participants with 'complementary' interests, while 'blue-sky' projects (developing 'enabling technologies') may include competitors (Bell, 2005). Lastly, IP is necessary in many collaborations in order to give the exploiting partner exclusivity, and the resulting confidence to commit investment funds to development of the knowledge into a commercial form - usually the most expensive part of the process (Barbolla and Corredera, 2009).

The second key aspect beyond collaboration is the actual licensing of research done in the public research base. As Andersen and Rossi (2010) state, the major supporting logic is that firms will not make the additional investments to transform basic knowledge (created by PROs and universities) into applied knowledge unless they can be assured that they have the exclusive right to do so. This is only possible if the outcomes of the research is patented and public research organisations and Universities are therefore in a position to grant exclusive *licenses* to firms (Thursby and Thursby, 2007; Fabrizio and Diminin,2008). This points to the crucial role of the Bayh-Dole Act as one of the most important policies in the US which enabled universities to keep the IPRs of the knowledge and inventions resulting from federally funded research projects and exploit them accordingly (Apple 2008). While some universities had been involved in exploiting IPRs through patent ownership since the 1920s, the Act provided the first dedicated legal framework that enabled American universities to control and license those inventions from federally funded research (Leydesdorff and Meyer, 2009). It simplified an existing complicated process by replacing the web of rules and procedures for university technology transfer to industry across the numerous government agencies funding university research with a unified framework (Sampat, 2009). As Rigby and Ramlogan (2012b) state, among the majority of European countries, a key issue had been to address the status quo in which IPRs ownership was assigned to the faculty inventor (the professor's privilege) or to firms that funded the researchers, rather than to the universities. Most, but not all of them have subsequently moved away from inventor ownership of IPRs towards university or PRO ownership. The transfer to institutional ownership occurred in Germany, Austria, Denmark, Norway and Finland during the period 2000-2007 (Heher, 2007). However, professors' privilege was preserved in Sweden and Italy, where it was introduced in 2001 (Geuna & Rossi, 2011). The impacts of Bayh-Dole have been felt across the globe, with similar policies being followed, as effective exploitation requires the private appropriation of rights, and governments are willing to forgo public ownership in return for the prospect of effective exploitation.

An important complementary aspect to collaboration agreements and especially to licensing in the aftermath of the Bay-Dole act are technology transfer offices. Technology Transfer Offices (TTOs) emerged as the principal organisational structure established by universities to facilitate

the transformation of university created knowledge into wealth generating innovations. Whilst not directly created by Bayh-Dole legislation, this organisational form quickly became the mechanism of choice for facilitating the widespread transfer of academic research results into practice in developed and developing countries (Fabrizio, 2007; Rigby and Ramlogan, 2012b). TTOs effectively serve an 'intermediary' function operating between university scientists and firms, entrepreneurs or venture capitalists, potential partners in the drive to commercialisation (Lissoniet al, 2008; Conti & Gaule, 2011). In a sense TTOs solve a double ignorance problem in that they bridge the gap between scientists, who do not know which firms can make use of their discoveries, and firms who do not know which scientific discoveries might be useful to them (Baldini, 2009). TTOs therefore facilitate commercial knowledge transfers of IPRs on results from PROs and university research through patenting technologies and licensing to existing firms or through start-up companies (Siegel et al, 2007). Thus there may be potentially important economic impacts associated with the activities of TTOs. Not only can university revenue streams be enhanced through licensing agreements and university-based start-ups (Crespi et al, 2007) or spin-offs (Lissoni et al, 2008) for example, but such activities can provide a foundation for employment creation opportunities for university-based researchers and or students and generate local economic and technological spillovers via stimulation of additional R&D investment and job creation (Conti & Gaule, 2011). Funding models of TTOs varied from country to country developed to fit respective cultural, political and economic conditions. For instance the growth and development of TTOs have been stimulated by direct government funding through the Higher Education Innovation Fund in England and Wales (HEIF). Initially, HEIF funding was awarded through a competitive process but the model evolved to a direct distribution one based on a formula funding process that takes into account institutional research capacity (quantity and quality) and TTO performance measures (Young, 2007). By contrast, the US and Australia provided no government funding for TTOs (Belenzon & Schakerman, 2007). In the US, the Bayh-Dole Act mandated that part of the commercialisation income can be used for funding the administration of the technology transfer function. The remainder rewards the inventor as an incentive to participate in technology transfer and for supporting education and further R&D (Lockett and Wright, 2005). Universities thus determine the distribution of commercialisation income with allocations for TTO operations usually ranging from 10% to 25%. In most cases, the TTO is subsidised from internal sources during early phases of operation but the subsidy is reduced over time as income is realised from license agreements (Conti and Gaule, 2011; Wright et al, 2008).

As Mowery and Sampat (2001) mention, few institutions had developed formal patent policies prior to the late 1940s in US while during the 1925 – 1945 public universities were more heavily represented in patenting than private universities. The structure of the US higher education system strengthened incentives for faculty and academic administrators to collaborate in research and other activities with industry (and to do so through channels that included much more than patenting and licensing) long before the Bayh-Dole Act's passage (Mowery et al, 2004). Nevertheless, despite the adoption by a growing number of universities of formal patent policies by the 1950s, many of these policies, especially those at medical schools, prohibited patenting of inventions, and university patenting was far less widespread than was true of the post-1980 period. Moreover, many universities chose not to manage patenting and licensing themselves (OECD, 2003b). The number of universities establishing technology transfer offices and/or hiring technology transfer officers began to grow in the late 1960s, well before the passage of the Bayh-Dole Act. Although the Act was followed by a wave of entry by universities into management of patenting and licensing, growth in these activities was apparent by the late 1970s. Indeed, lobbying by US research universities was one of several factors behind the

passage of the Bayh-Dole Act in 1980. The Act therefore is as much an effect as a cause of expanded patenting and licensing by US universities during the post-1960 period (Mowery and Sampat, 2001).

Since overall patenting in the US grew between 1960-1980, indicators of university patenting need to be normalized by overall trends in patenting and R&D spending. Mowery and Sampat (2004) consider that empirical evidence indicates that universities increased their share of patenting from less than 0.3% in 1963 to nearly 4% by 1999, but the rate of growth in this share began to accelerate before rather than after 1980. Grimaldi et al (2011) state that after Bayh-Dole universities increased their involvement in managing patenting and licensing, setting up internal technology transfer offices to manage licensing of university patents. Although "entry" accelerated after Bayh-Dole, growth in this measure of university commitment to "technology transfer" predates Bayh-Dole (Grimaldi et al, 2011). Longitudinal data on university licensing activities are less complete, but the available data indicate that in 2000, US universities signed more than 4000 license agreements, representing more than a doubling since 1991 (AUTM, 2000). Based on these trends in university patenting and licensing, many observers have argued that Bayh-Dole was a major catalyst to university-industry technology transfer.

Bayh–Dole may have also stimulated an increase in start-up activity at universities, which is accelerating due to a growing emphasis on that dimension on university technology commercialization. It is also important to note that there is an alternative view on the merits of IPRs regime that emerged in the aftermath of Bayh–Dole. For example, Kenney and Patton (2009) argue that the system in which universities maintain the legal ownership of inventions is not optimal, neither in terms of economic efficiency nor in advancing the social interests of rapidly commercializing technology and encouraging entrepreneurship. In fact, the authors argue, the practices in Universities governed by Bayh-Dole type regulation lead to results that are “contrary to the original intentions” of the Bayh-Dole act, i.e. delays in commercialisation as well as in flows of scientific information and unnecessary additional costs. The reason for that are what the authors call “structural uncertainties” (ibid., p. 1408) arising from ineffective incentives and contradictory goals for inventors, the potential licensees, the University and the technology licensing office (TLO). The university ownership model assumes a linear model of innovation, without recognising the interaction between inventor and potential licensee, with the TLO as a middleman and owner of the license but with least actual knowledge of its scientific nature and economic value. This information deficit within the TLO and the lack of interaction between inventor and potential licensee then leads to ineffective decision making, additional coordination efforts or even procrastination (ibid., p. 1419). This undermines the relationship between inventors and TLOs and leads to strategies of inventors to circumvent the TLOs altogether. Kenney and Patton argue for a model in which the inventor – who is most knowledgeable about the invention – holds the patent and the University ensures transparency and honesty and could be compensated out of licence revenue.

On the other hand, Grimaldi et al (2011) state that comparisons with U.S. experience could be misleading and should not be used to predict the evolving features of institutional IPR ownership systems in Europe. Following Geuna and Rossi (2011), there is still significant differentiation in the academic IPR ownership patterns across individual European countries and in the general regulation of universities (Verspagen, 2006; Mowery and Sampat, 2005). Most European countries have been interested by legislative changes that, even when not in line with the Bayh–Dole Act, (e.g., not granting universities the legal ownership of inventions), share with it the objective to spur the commercialization of public research results (Clarysse et

al., 2009). All of these factors (including system-level specificities governmental actions, institutional laws, local context characteristics, university level internal support mechanisms and individual scientist level factors) play a role in the process through which universities develop capabilities/competencies to transfer knowledge and technology (Clarysse et al., 2009; Grimaldi et al, 2011)

Supporting connectivity

Introduction: Connectivity, policy and IPR

Connectivity, through networks, clusters, bi- and multi-lateral cooperation, is key to innovation activity and exploitation. Most often, innovation comes about not only through a singular idea in a singular company, but through the combination of different inputs and assets. The lack of connectivity is core to the system failure rationale as a basis for many policy interventions. Thus, there is a range of policy measures that support actors to connect. This section discusses policy approaches that tackle the challenge of connectivity and how those approaches intersect with Intellectual Property Rights. Before doing so, we present general thoughts on the importance of IPR for connectivity and networking as a background for the discussion on specific policy approaches.

The network perspective on innovation emphasises the importance of connectivity of heterogeneous groups of actors and the importance of exploring and exploiting weak ties and structural holes (i.e. empty or very loosely connected spaces between organisations) for innovation (Mackinnon et al, 2004). According to Burt (2004) innovations are most likely found in what is called “structural holes” because of the heterogeneity of knowledge and the diversity or distance between innovating partners which can be considered as a source of innovation (Gherardi & Nicolini, 2002). This distance can take different forms: cognitive, communicative, organisational, social, cultural, functional, or geographical (Harmaakorpi, Tura & Artima, 2006).

The meaning of IPR for connectivity in general is best illustrated when looking at the most general form of connectivity, networking. Cunningham and Ramlogan (2012) state that in firm-to-firm networks, relationships are enhanced by the development of mutual trust. As Stephenson (2010) mentions, networks not only facilitate the transfer and exploitation of knowledge and technology, they also engender the build-up of trust between and among network partners. IPR arrangements are one possible component towards the establishment of trust and can play a substantial role by establishing the starting positions of participants and, more importantly, by providing a means for a well regulated exploitation of the network's outcomes (Rank, 2002). IPRs also have a role in clarifying the relationships between connecting partners. They are important components of collaboration agreements, the writing of which forces members to confront the problems of ownership of results. The rights and responsibilities of connected partners must include specific clauses detailing responsibilities for patenting, monitoring and maintaining rights.

Having introduced the basic role of IPR when it comes to connecting actors, we now turn to specific policies supporting connectivity and how they relate to IPR.

Information and brokerage support

Rational for information and brokerage support

One key policy concern in terms of connectivity and transfer of knowledge is information asymmetry between market participants (Ramlogan, 2012; Healy and Palepu, 2001; Bloom et al, 2008). Thus, Rigby and Ramlogan (2012b) consider that information and brokerage supports can support the reduction of information asymmetry in the market. Reagans & McEvily (2003) emphasize that the main rationale behind information and innovation brokerage support is the efficient exploitation and utilization of the combined assets of separate actors (e.g. through networks, clusters etc.) capacity to foster innovation. In this section, we will first scrutinize the rationale of information and brokerage support to foster innovation and will introduce the above-mentioned IP related areas of support. In the second part, we will focus on the interplay between IPRs and information and brokerage supports as such and will discuss the impact of IPRs on policy instruments in more details.

Innovation brokers focus on establishing ties to other disparate or disconnected groups, so they can then bring together members of the two groups who would otherwise be more difficult to connect (Burt 2004). According to Johansson's (2004), most innovations happen at boundaries between disciplines or specializations. Networks of actors by themselves do not provide competitive advantage and foster innovation, it is more how the company builds and uses them that matters (Huston and Sakkab, 2006). This means that working across boundaries or distances is a key ingredient for innovation. Partners participating in networked innovation processes on different sides of structural holes have different knowledge assets and innovation interests (Melkas & Harmaakorpi, 2008). The difference between partners is often so great that a special interpretation function is needed. This is where innovation brokerage comes in to deal with information asymmetry in the market and also to facilitate interpretation between partners (Parjanan et al, 2010). Brokers support innovation by connecting, recombining and transferring to new contexts pools of ideas that would otherwise be disconnected (Verona, Prandelli & Sawhney, 2006).

The reviewed literature attributed a great number of functions to innovation brokers like articulating innovation needs and corresponding demands in terms of technology, knowledge, funding and policy, network formation meaning facilitating the linkages between relevant actors and innovation process management, like enhancing alignment and learning of the multi-actor network (Van Lente et al, 2003). The reviewed literature further identifies gaps in innovation systems which should be covered by information and innovation brokers (Parjanan et al, 2010; Klerkx and Leeuwis, 2009). With regard to the nature of these gaps, one can identify cognitive gaps (actors from different institutional backgrounds have too much cognitive distance to adequately learn together (Nooteboom, 2000) or have different norms, values and incentive systems which hinder effective communication (Huggins, 2000)), information gaps (actors are imperfectly informed about possible cooperation partners and what these can offer, i.e. there exists information asymmetry (Bougrain and Haudeville, 2002), and managerial gaps (actors are unable to acquire and successfully implement new knowledge and technology). Furthermore, there may exist a 'system gap', which is about the fit of the innovation within the broader system and is related to issues like path-dependency, dominant designs, and system lock-in (Woolthuis et al, 2005; Smit and Kuhlmann, 2004; Hekkert et al, 2007).

To conclude, the main rationale of information and innovation brokerage is to exploit the capacity of innovation networks to foster further innovations and to avoid market failure as a

result of information asymmetry in the market. Also the reviewed literature identifies numerous gaps in innovation networks namely cognitive gap, communication gap, organizational gap, functional gap and social gap. Innovation brokerages support measures such as international technology watch, patent database, benchmarking, IP training and advisory services are designed to deal with these gaps and encourage further innovations. In the next part, we will focus on how these measures would contribute to fill the abovementioned gaps of innovation networks and to outline the role of IPRs in this process.

Information, brokerage and IPR

According to Fukuda-Parr (2006), the role of information and innovation brokers is mainly to assist the multiple players on innovation networks in coping with challenges associated with the integrated knowledge production infrastructure as well as innovation systems governance. We already identified those challenges in the first part of this section and stated that according to the reviewed literature, governments are supposed to deal with these challenges and rectify the gaps relying on information and brokerage support measure including international technology watch, patent database, benchmarking, IP training and advisory services. In this section, initially we will focus on the interplay of IPRs with information and brokerage supports.

The role of IP in brokerage first has to do with the lack of – and build-up of – trust. The main challenge of information and brokerage support actors is the institutionalization of trust between partners in different forms of innovation network setting (Klerkx and Leeuwis, 2008). The main task of the innovation brokers is to create collaborative platforms in which different actors would be able to communicate the possibility of further collaborations (Klerkx et al, 2009). This of course would need some reliable guarantees such as Non-Disclosure Agreements (NDA) or Non-Disclosure Non Circumvention (NDNC) guarantee to secure the negotiation of ideas and minimize the risk of IPRs infringements during and after the negotiation process (Aerni and Bernauer, 2006; Herring, 2010; Paarlberg and Pray, 2007). Therefore, considering the IPRs protection mechanisms is one of the major concerns of innovation brokers in designing collaborative frameworks for the actors of innovation network (Boschma, 2005). In other words, filling the gaps in innovation networks without a reliable IPRs system is almost impossible (Kingiri, 2010).

On the other hand, information and brokerage supports also serve to increase the awareness of innovation network actors of the required and available institutions, policies and public resources and on how government supports would encourage and facilitate their R&D activities (Harsh, 2008). As Juma & Serageldin (2007) write, one of the major tasks of innovation brokers is to increase the IPRs awareness of different actors on the available mechanisms, benefits and process of IPRs applications. Therefore innovation brokers are usually in constant interaction with patent offices and other IPRs authorities to refer different SMEs there (Mugwagwa, 2008).

However, as it was mentioned above, IPRs affect information and brokerage support policy measures as well. There is empirical evidence (such as that in Falvat et al, 2006 and Kingiri and Hall, 2011) that IPRs would affect international technology watch in a sense that IPRs are used to detect technological profiles of countries and firms. Innovation brokers are usually involved in international technology watch to increase the awareness of SMEs on available technology solutions and help them with the process of plausible technology transfer (Makinde, 2010). This means information brokers need to be aware of any IPRs protection and relevant exploitation mechanism of IP involved in technology transfer. This is confirmed and illustrated in an empirical study on biotechnology transfer (Kingiri and Hall, 2011). Especially in areas with a

high level of IP protection, technology transfer necessitates the engagement of information and brokerage supports with strong IPR expertise (Fukuda-Parr, 2006).

Another innovation broker function is directly related to IPRs management. Facilitating the exchange of diverse types of information between companies (Wolpert, 2002, Howells, 2006), information brokers also support patent database and IP training for SMEs. In his empirical study on the case of UK intermediaries in innovation networks, Howells (2006) defines the main task of intermediaries in facilitating the exchange of innovation between two SMEs as a knowledge broker or in creating new products by making connections between existing solutions in other sectors or technologies as a technology broker. In both of those functions, it is important that intermediaries are able to provide IPRs training and show a command of patent database in order to support the management of identifying appropriate IP and also of protecting IP during the whole process.

Open innovation

Rational for open innovation and measures to support it

The approach known as open innovation was first named by Chesbrough (2003). There are two major rationales behind the open innovation approach (see for example Lemola and Lievonon, 2008). First of all, open innovation regards knowledge residing outside the boundaries of an innovating company potentially as valuable as in-house expertise. Second, the innovating firm is not considered as the sole platform for commercialising results of R&D activities. In other words, according to the open innovation approach, the innovating firm is no longer the sole locus of innovation; nor is it the only means for creating, transferring and exploiting intellectual properties (IPs) resulting from R&D activities. This is also driven by a recent trend towards scientific and technological specialisation that has led to the increasing need for different inventions to be combined in order to generate bundles of commercially useful, exploitable IP (Vanhaverbeke and Cloudt, 2006). Therefore in this section we will focus on the rational of open innovation in industrial innovation, University-Industry collaboration and SMEs and focus on the role of innovation policy to foster open innovation. In the second part of this section, the role of IPRs in stimulating open innovation and the impact of IPRs on innovation policies to foster open innovation would be discussed.

Gassmann et al (2010) consider that in a closed innovation model external actors were often viewed with suspicion, as they could carry useful knowledge to competitors. In contrast, in an open innovation environment users, customers, suppliers, public knowledge institutions, individual inventors and even competitors are regarded as potential providers of crucial input for innovation. As Chesbrough (2003) mentions, an open innovation approach would create a platform to manage technology transfer and knowledge spillovers in R&D collaboration activities (Lee et al, 2010) and to enable innovating companies to increase their dynamic capacities by enhancing their technological skills and reducing their R&D costs. In addition, Christensen et al (2005) and Lichtenthaler (2008) point out the network externalities and additionality effect raised by the open innovation approach in R&D activities. In other words, by fostering innovation intermediation (through technology alliances, platform collaborations, networks), open innovation emphasizes the use of intra-organisational flows of knowledge and technology; taking into account the implications of this for intellectual property management, as IP can be

used as a bargaining chip in obtaining valuable knowledge or other advantages (Chesbrough, 2006; Laursen and Salter, 2004; Rothaermel and Deeds, 2004).

The reviewed literature indicates that the adoption of an open innovation approach is directly linked to the firm's attributes and market-industry situation. Lee et al (2010) state that the concept of open innovation is critical both for SMEs and large firms. The possibilities for open innovation in SMEs also lie with external sources, which are often critical to the innovation process in any type of organisation (Laursen and Salter, 2004). Where large firms focus mainly on R&D in open innovation efforts, SMEs focus more on commercialisation because, while many of them have superiorities in technology for invention, they often lack the capacity in terms of manufacturing facilities, marketing channels and global contacts to introduce them effectively to the market (Narula, 2004). Lee et al (2010) divide the open innovation process into exploration and exploitation phases. Luukkonen (2005) considers that at the exploration stage, SMEs are most likely to use external partnerships so they can concentrate on retaining high levels of internal competence in a limited number of technology areas, though they show a preference for networking with public research institutes and universities because of the fear of giving away their technology to competitors. But at the exploitation stage, SMEs attempt to create value by entering into supplier–customer relations with large firms outsourcing agreements or strategic alliances with other SMEs (Edwards et al., 2005).

Open innovation is also a strategic means for universities and Public Research Organizations (PRO) to become more entrepreneurial (EU Commission, 2014). In fact, the open innovation approach creates an appropriate incentive to stimulate scientists, academics and Knowledge Transfer Office (KTO) staff to engage in co-creation processes with the users of their knowledge. This involves recognition of the entrepreneurial engagements of academics/scientists beyond the traditional recognition of publications and scientific impact and should be anchored at stakeholder (University/PRO) level (Boutellier, 2008). In other words, open innovation would facilitate both exploration and exploitation of knowledge by increasing technology transfer and then engage more investment and financial support into R&D activities (EU Commission, 2014).

Although open innovation approaches seem to be very useful to increase the efficiency of Innovation Systems, there are challenges that innovation policy makers might face in considering open innovation approaches in their innovation policy designs (Grassmann et al. 2008). The major challenge is that ideas located beyond the boundaries of national, regional or sectoral systems of innovation have to be recognized as increasingly crucial (Chesbrough, 2003; Grassmann, 2006). Currently many of the leading corporations of small countries are reducing their R&D activities in their home markets as they seek new ideas and collaboration opportunities abroad (Enkel, 2010). To deal with this challenge Lemola and Lievonen (2008) suggest that open innovation should be fostered by innovation policies to strengthen collaboration and networking between enterprises and public knowledge organisations (research programmes are a typical measure) across regions, countries and sectors.

To sum up, open innovation is the idea of utilising external knowledge for innovation processes in firms. It includes facilitating technology transfer, organizing knowledge spillovers, empowerment of universities and PROs (to exploit their IPRs), increasing the number of research projects and creating a platform to move from mutual R&D collaboration. Open innovation increases the efficiency of knowledge production and exploitation of firms and research organisations and consequently of the innovation systems as a whole. This is the main

rationale for policy makers to create and foster conditions for open innovation. In the next section we will focus on the role of IPRs in open innovation and accordingly on the innovation policies to foster open innovation.

Interplay between IPRs and measures to support open innovation

In this part, first we will focus on the role of IPRs in open innovation as such and then we will continue our discussion on the role of IPRs in innovation policies to foster open innovation. As open innovation is about connecting actors to exchange knowledge and use external knowledge for their innovation activities, in principle all policy measures that enhance openness, transparency, connectivity and collaboration contribute to open innovation. This includes collaboration support, brokerage events, networking and cluster instruments and so on. Since many of these connecting instruments are discussed in separate further sections below, in this section we will focus on the main innovation policy challenges arising out of the open innovation paradigm.

As Chesbrough et al (2006) state, IPRs management plays an eminent and proactive role in managing open innovation collaborative platforms. In fact intellectual property was and is an important strategic element of innovation in the “closed” model, and its use was primarily defensive (Jones and Tilley, 2003). In the context of open innovation, intellectual property plays a new role which no longer only reflects the predominant defensive mechanism adopted by companies (Rothaermel and Deeds, 2004). More precisely, up until some years ago most mainstream companies had made use of their patents to block competitors and to freely operate on the market. This defensive approach was based on the notion of patent as a negative right to exclude others rather than to enable innovation (Laursen and Salter, 2004). IPRs have since become a critical element of innovation processes, since IP flows in and out of the firm on a regular basis (Jones and Tilley, 2003). In other words, as Lichtenthaler (2005) states, the increasing importance of open innovation and new technologies (where innovation business models are created from combining information spheres) is placing new and more sophisticated demands on IPR regimes. Hence there is the need to manage IP in even more sophisticated ways.

Regarding the role of IPRs in open innovation, transactions and agreements made in the context of open innovation are facilitated by effective IPRs protection as this facilitates a smoother technology transfer through licences (Chesbrough et al. 2014). Clear ownership and proprietary rights facilitate sharing of knowledge, as partners are more willing to enter into cross-licence deals and exchange their inventions, in the form of patents, know-how and trade secrets, with those of partnering companies (Simard and West, 2006). Therefore, while patent protection helps recoup the R&D costs and decrease the risks linked to collaboration via the commercialisation of intangible assets, its disclosure permits innovators to identify technologies and partners to carry out further collaborative research through open innovation platforms (Laursen and Salter, 2006). In this regard, Lichtenthaler (2003), considers that intellectual property is central to open collaborations as it represents the contribution that each partner brings into the project (known as ‘background’), which collected with that of others will represent the pool of resources that will be shared and managed in the collaborative project. Therefore, new IPR is the intended outcome of the project (‘foreground’), as results generated during the project implementation need to be appropriated and managed (Lee et al, 2010).

Nevertheless, according to as Luukkonen (2005), under an open innovation perspective the unexploited IPRs is considered to be an opportunity and not a cost to account. In fact,

Chesbrough and Ghafele (2014) even talk about an “intermediate market” for IP or a “secondary intellectual property market” (Chesbrough and Ghafele, 2014). Such a market offers the opportunity to sell or license unexploited intellectual property to companies which bring the technology to maturity and/or make different use of it. Under this new perception, intellectual property assets within the open innovation scenario should be considered as an advantage (and no longer a barrier), an opportunity (and no longer a cost) and an option for the secondary intellectual property market (Chesbrough et al, 2014).

Regarding innovation policy to foster open innovation, the reviewed literature focuses on the pivotal role of IPRs in open innovation related policies to facilitate knowledge transfer between the actors in networking and crowdsourcing activities (Inkpen and Tsang, 2005), collaboration and R&D alliances (Fontana et al., 2006), creation of independent spin-offs, selling or buying licences and being part of patent pool (Simard and West, 2006). In subsequent sections of this report we outline the relations of IPR for specific measures to increase connectivity and collaborations. The main message of the open innovation literature here is that for all measures that increase connectivity and collaboration in an open innovation fashion, policy must ensure that when a knowledge transfer is taking place, there are particular steps to follow which help actors to retain control over the owned IP and to know the prospective partner’s IP portfolio value, while ensuring the exact share of the planned results (Chesbrough et al, 2014). Innovation policy in regards to open innovation is therefore more about supporting organisations that benefit from instruments that increase connectivity, transfer and collaboration. Thus, policy needs to support organisations wishing to enter into open innovation to beware of any leak of prior acquired knowledge and take care to capture the newly created knowledge (Fontana et al. 2006) through rights registration and by adopting internal safety measures such as setting up an internal filing system to track any creation of IP assets, documenting each IP element as a proof of ownership, creating an IP database and keeping it up to date and organising regular reviews of the IP used (Lippoldt and Stryzowski, 2009).

To sum up, the reviewed literature indicates that any instruments that support open innovation must encourage and enable actors to set a clear IP strategy. This includes sharing of the IP issued from joint activities and fair appropriation of results in return on their investments. In this regard, IP protection and licensing strategies can be used to prevent exclusive appropriation of specific outcomes of collaborative efforts, while providing access to complementary innovation for mutual benefits. Therefore, flexibility in intellectual property negotiations can always help in resolving pending issues and reaching a workable agreement, so as to have more chance to succeed within open innovation partnership. Further sections will deal with more specific issues of IP and policy intervention to improve connectivity (see sections 0 and 0).

Cluster policies

Rational of clusters and cluster policies

Traditionally, clusters can be “related to various conceptual and theoretical developments around locally embedded groups of firms and other organisations, such as ‘industrial districts’, ‘new industrial spaces’ and ‘flexible specialisation’, ‘regional innovation systems’” (Uyarra and Ramlogan, 2012). As Duranton (2011) states, many studies within the literature focus on the characteristics of industrial clusters. For example, in the definition of Spencer et al (2010) clusters include a degree of specialisation in a particular industry (measured by employment), co-location of the specialized industry and other related industries, and scale or critical mass.

However, in this report we follow the most influential conceptualisation and definition of clusters which is the one by Porter, who defined clusters as 'geographical concentrations of interconnected companies and institutions in a particular field' (Porter, 1998, p.197). Thus, clusters are an agglomeration of interconnected entities, and it is often the heterogeneity of those entities that characterises clusters. Further, clusters are not simply "there", they need to be seen as evolving in a sort of life cycle consisting of embryonic, growth, maturity and decay stages (Rosenfeld, 2002).

In this section we will first discuss the economic importance of clusters, before focussing on cluster policies, their rationales and major goals in relation to innovation policies. In the next section we will explain more on initiation of clusters and role of IPRs in their constitution and finally will focus on the interplay between IPRs and cluster policies to achieve innovation policies' major goals.

The reviewed literature indicates a range of productivity and innovation benefits. Cluster advantages are associated with external economies in the form of specialised suppliers, all sorts of horizontal and vertical knowledge spillovers and better access to specialised, high productivity employees with lower search and training costs (Hospers et al, 2008). Nauwelaers and Wintjes (2008) mention that all firms must be connected to the most prolific sources of new knowledge and expertise, either directly or through multi-layered innovation networks that link the most research-intensive and/or innovative firms to others at regional, national and global levels (Uyarra and Ramlogan, 2012). There have been a number of studies that have tried to empirically demonstrate the benefits of clustering on growth, productivity and innovation. For instance, Spencer et al (2010), using a data set for 300 industries in 140 city-regions in Canada, found that industries located in areas with critical mass of related industries tend to display higher incomes and rates of growth compared with those located in non-clustered settings (Uyarra and Ramlogan, 2012). Also Beaudry and Breschi's (2003) comparative study of clustering in the UK and Italy demonstrated that clustering alone is not conducive to higher innovative performance. They conclude that benefits from clustering "arise only in clusters that are already densely populated by innovative firms and have a large accumulated stock of knowledge" (Beaudry and Breschi, 2003; p.34).

On balance, scholarly work suggests that clustering has a positive effect on innovation, even if there are vast differences between sectors, countries, and types of agglomeration (Uyarra and Ramlogan, 2012). Positive influence tends to be restricted to a limited set of industries, at certain stages of development, in certain places and under particular conditions (Martin and Sunley, 2003). In this regard, the reviewed literature suggests that R&D intensive industries, and those more reliant on tacit knowledge, tend to benefit more from colocation (Ketels et al, 2006). Overall, therefore, "it seems impossible to support or reject clusters definitively with empirical evidence, as there are so many ambiguities, identification problems, exceptions and extraneous factors" (Martin and Sunley, 2003; p.23).

Against this background, cluster policies have emerged since the 1990s to capture those cluster benefits, including knowledge spillovers, skills and tacit knowledge (through labour pools), supply chains, and other public goods effects (including social capital and reputation) (Raines 2003; Nauwelaers, 2003). Cluster policy practice extended from developed to developing countries and economies in transition (Anderson et al, 2004). As Isaksen and Hauge (2002) state, human capital and innovation issues have been strongly supported in cluster policies of countries such as Austria, Australia, Canada, Finland, France, Germany, New Zealand, Norway,

Spain, Portugal and the United Kingdom. Nauwelaers (2003) identifies three different cluster policy models: the Mega Cluster, the Local Network Cluster and the Knowledge-Based Cluster, prioritising industry competitiveness; regional institutional thickness; and innovation respectively.

The need for cluster policies is justified because the emergence of clusters and the realisation of their benefits are hampered by a range of market, system and government failures (Uyarra and Ramlogan 2012). Market failures are mainly associated with underinvestment in knowledge and technology due to the presence of externalities, information asymmetries, or network effects (Hospers et al. 2008). System failures arise from the fact that actors, due to transaction costs and information asymmetries, do not cooperate and network sufficiently enough to exploit the innovation potential of agglomeration (Uyarra and Charles, 2010). In addition, cluster policies may also be justified with perceived governmental failures, such as institutional lag in certain regions or poor performance of current programs, leading to the hope that new cluster policies will address these (Smits, 2004). Finally, some cluster policies also serve to attract foreign direct investment (Uyarra and Ramlogan, 2013), as they strengthen local competencies as a precondition for the attraction of quality FDI (De Propriis and Driffield, 2006).

As Nauwelaers and Wintjes (2008) state, studies on cluster policy tend to describe a menu, or toolbox of instruments for cluster development commonly used in clusters and that can be adapted according to their own needs (types of clusters, level of technology stages in the cluster lifecycle, spatial configuration). In this regard, the reviewed literature mentions a combination of instruments such as R&D funding, setting up of intermediaries, venture capital funds, competence centres, support to training activities, networking and identity building (Uyarra and Ramlogan, 2012). Importantly, the literature on cluster focuses on cluster performance or on how to best support cluster development, but stops short of addressing the actual implementation of cluster policy (Pitelis et al, 2006). Further, the benefits of clusters referred to in the literature relate to studies that examine the effects of clustering when it occurs 'naturally', rather than constituting a direct assessment of cluster initiatives (Uyarra and Ramlogan, 2012).

To conclude, clusters are associated with all sorts of productivity and innovation benefits arising from better access to specialised, high productivity employees with lower search and training costs, access to specialised supply chains and forefront buyers, and a generally high level of knowledge spillovers. Cluster policies are basically designed to capture these benefits by supporting the emergence and functioning of clusters against a range of market, system and government failures which limit the desired agglomeration effects. In the next section we will discuss the interplay between IPRs, clusters and cluster policies.

Interplay between IPRs and cluster policies

The literature on clusters has long debated the factors that constitute effective clusters (specifically high-tech ones such as biotechnology clusters). It has been noticed that "favourable IPR regime" is one factor next to a powerful scientific base, a culture of entrepreneurship, access to venture capital, linkages to large firms and neighbouring industries, a range of institutions, policies and infrastructures that support and promote entrepreneurship (Orsengio, 2006). In particular, Audretsch (2001) and Orsengio (2001) claim that a high level of entrepreneurship and sound incentives for exploitation of academic research, including a powerful IPR regime, are the essence of any cluster's performance to meet its innovative objectives. In fact, the reviewed literature suggests that the impact of strong IPRs regime on the performance of clusters are twofold: 1) to facilitate and support the transfer of tacit knowledge

and non-tradable competencies to enable SMEs in the cluster to build up their innovative capacities 2) to facilitate the collaboration (R&D collaboration) among SMEs in cluster or initiate private-public partnerships to generate, commercialize and diffuse new technologies and shape new technological patterns (Orsengio, 2006).

The role of IPR in clusters, especially for SMEs, is important, but ambivalent. As outlined above, the main effect of clusters is knowledge spill over and access to specialist expertise in various forms. Even more than larger firms, SMEs need to access external sources of information, knowledge, know-how and technologies, in order to build their own innovative capability and to reach their markets. The markets for goods, services, human resources and knowledge and technology (thus IPR) are important means of accessing knowledge (De Propriis and Driffield, 2006). But this knowledge sourcing through market transfers (including IPR) needs to go hand in hand with engaging in networks, particularly those that nurture the tacit knowledge and other non-tradable competencies that are critical for pursuing innovation-based competitive strategies (Aharonson et al, 2004).

Thus, it is important to understand the relative role of IPR for market based sourcing of knowledge and the informal and formal networking and cooperation in clusters. According to Barbasi, the transfer of tacit knowledge and other non-tradable assets between SMEs in clusters needs to be accompanied, supported and backed up by a strong and flexible IPRs regime (Barbasi, 2002). In fact Breschi et al (2001) mention that a strong IPRs regime would support further collaborations between SMEs in clusters and therefore would enable SMEs to build their own innovative capabilities and come up with their own IPs. Furthermore, it has been suggested that strong IPR regimes facilitate the collaboration between SMEs and other actors (with SMEs, large firms, public sector) and create private-private and private-public technology-based partnerships (Bottazzi et al, 2002). Equally, Ketels et al (2006) stress the need for IPR support strategies to benefit from networking and partnering opportunities. Orsengio (2006) then sees a re-enforcing dynamic at play, as networking and collaboration that is governed, among other things, by strong IP regimes, further attracts venture capitals to foster entrepreneurship and further public-private and private-private partnerships that then create new IPs or exploit the available ones beneficially for the partnership, thus contributing to the creation and diffusion of new technology (Cowan and Jonard, 2004). In sum, the role of strong IPRs regime is essential here to i) facilitate the collaboration between the actors inside the clusters ii) facilitate public-private and private-private partnerships to initiate new technological pattern iii) to protect the IPRs of the outcome results and create economic value by IP exploitation.

On the other hand Hanel (2006) and Gallini (2002) point out the more problematic role of IPRs within innovation networks. Generally IPRs are costly (direct and indirect costs) and spread too much information which is not favoured by younger SMEs (Gallini, 2002). As Hanel (2006) states, these two factors would hamper informal networking and openness between the younger and perhaps more innovative firms (which are more agile in their nature) and stronger firms and therefore should be considered as a negative effect of too strong IPRs system on networking (Laperche et al, 2010).

In terms of cluster *policy*, however, as with many other innovation policy areas, IPR considerations have not played an important role for many years (OECD 2004). The reviewed literature indicates that SMEs and specifically new technology-based firms (NTBFs) are not always able to use the IP system effectively and often face a number of obstacles including limited knowledge of the system, high costs and lack of adequate legal, business and technical

support for developing a successful IP strategy (Rosenfeld, 2001). Therefore empirical studies on a number of OECD countries claim that cluster policies should be deliberately designed to foster the use of IPRs (as this is the case in countries with more effective cluster policies) by those SMEs and NTBFs which were not able to use IP systems properly before (OECD, 2002; 2003b; WIPO, 2003). Studies on high-tech sectors such as biotechnology and software indicates that cluster policies (specifically in OECD countries) benefit from reliable IPRs regimes to encourage the networking of SMEs and facilitate public-private and private-private partnerships (Ketels et al (2006). However, when designing cluster policies and related IPR management or regime conditions, mechanisms should be put in place to minimise the constraining role of IPRs on clusters such as incurring further costs, unnecessary leakage of information and lead time should be considered (Laperche et al, 2010).

Further insights into IPR and connectivity can be found in the related academic literature on networks (rather than clusters). Eickelpasch, et al. (2002) found that networking programs with a sound support and management of IPR perform better than the other comparable network and collaboration-related programmes in terms of the generation of “patents and licenses, the formation of new companies and the improvement of the health of existing ones, and the creation of new products, services and processes” (Malatest and Circum Network Inc., 2007; p1). Consequently, this means that one area of potential weakness of networking measures is the lack of sound and transparent management protection of IPRs with a variety of IP ownership rules in operation at the various participating universities, and variable levels of trust and collaboration between individual networks and their university Industry Liaison Offices (Pittaway et al, 2004). As a result, strong, transparent and clear IP arrangements are required in order to support mutual trust between the network participants when it comes to the issue of commercialisation of research results. Additionally, in the case of publically funded programmes, authorities must decide to what level they should specify conditions for the treatment of IP, with due regard to the interests of taxpayers and potential exploiters of results, which may sometimes conflict.

In sum, within the time span of our review, we have not found any studies to show how IPR have been deliberately considered or integrated in cluster policies. However, the literature is clear about the importance of IPRs for cluster effects and thus there is an explicit recognition of IPR issues in cluster policies, especially when it comes to support SMEs in taking advantage of IPRs. The reviewed literature indicates that IPRs not only have incentive roles to foster cluster policies but may also hamper informal networking activities due to the barriers created by strong IPRs regimes.

Setting up and supporting Science Park and Incubators

Rationale: the basic idea for Science Parks and Incubators as networking and commercialisation support measures

Science parks and incubators are two major instruments to support innovation and entrepreneurial activity in the context of university research. Science Parks and to some extent incubators can however also be seen as a networking means, often facilitated through public support (Edler and Georghiou, 2007). Before discussing science parks and incubators in more detail, it is important to understand the basic rationale of networking and interaction. In general, networks facilitate the configuration and reconfiguration of relationships between different actors in the innovation and commercialisation process (Cunningham and Ramlogan, 2012). They can

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.

Science parks and incubators are a specific form of network and support measure. They have emerged in the context of growing interest in the need for interaction and further support of the growing policy concern with commercialisation of academic research (Ensley et al 2002). Phan et al (2005), define science parks and business incubators as property-based organizations with identifiable administrative centres focused on the mission of business acceleration through knowledge agglomeration and resource sharing. Link and Scott (2003) state that the main organizations which establish facilities such as science parks and business incubators are non-profit entities (i.e. universities and governments). It is also important to note that science parks and incubators are often the result of public-private partnerships, which means that multiple stakeholders (e.g., community groups, regional, and state governments) have enormous influence over their missions and operational procedures (Siegel, 2003).

Rothaermel and Thursby (2005) state that business incubators nurture young firms, helping them to survive and grow during the start-up period when they are most vulnerable. Aernoudt and Eriskon (2002), delineate the typology of business incubators as shown below (Table 2). They classify business incubators into five different types, namely Mixed incubators (to create start-ups), Economic development incubators, Technology incubators (focused on entrepreneurial gaps), Social incubators and finally Basic research incubators based on R&D activities. The latter one is of the specific importance for innovation as its main objective is to foster supportive measures to facilitate the emergence of spin-offs (Ensley et al, 2002). In other words, while Science Park's main objective is to facilitate the interaction between university and industry through networking measures, Business Incubators (specifically basic research ones) focus on the generation of spin-offs relying on supports from network (Tamasy, 2007).

Table 2 Different types of business incubators

	Main philosophy: dealing with	Main Objective	Secondary	Sectors involved
Mixed incubators	Business gap	Create start-ups	Employment creation	All sectors
Economic development incubators	Regional or local disparity gap	Regional development	Business creation	All sectors
Technology incubators	Entrepreneurial gap	Create entrepreneurship	stimulate innovation, technology Start-ups and graduates	Focus on technology, recently targeted, e.g. IT, speech-, biotechnology
Social incubators	Social gap	Integration of social categories	Employment creation	Non profit sector
Basic research incubators	Discovery gap	Bleu-Sky research	Spin-offs	High tech

Source: Aernoudt and Eriskon (2002)

However, Siegel and Wright (2007) point to a fundamental policy question concerning whether science parks and incubators are uniquely able to resolve an innovation market failure. In answering this question it is important to recognize the potential for complementarities and substitutabilities between science parks and other institutional mechanisms. Venture-capital

providers, for example, may be complementary to science parks and incubators, but may also be substitutes. This is why Mustar and Wright (2007), argue that there is a need to consider the spillover effects of public support for university science parks. They suggest that if the benefits of the research from university science parks spills-over to consumers and to firms other than those investing in the research, the social rate of return may exceed the appropriate hurdle rate sought by universities and local firms, even though the private rate of return may fall short of this hurdle rate (Thursby and Thursby, 2007).

The interplay of IPR and Science Parks and Incubators

The abovementioned conditions of sound IP management also apply to science parks and incubators, since, as Harris et al (2003) demonstrate, the process of establishing and operating a university spin-off always requires the negotiation of 'public' and 'private' boundaries and sharing IPRs exploitation benefits.

However, there are additional IPR considerations that need to be taken into account when it comes to science parks and incubators. As Siegel and Wright (2007) indicate, the build-up of institutions such as science parks and business incubators has to be seen in the context of the increased pressure for universities to facilitate the commercialization of the knowledge they generate. Thus, as Link and Scott (2007) have reminded us, science parks and business incubators should be considered as institutional mechanisms that specialize in facilitating the commercialization of IP. The efficient commercialization of IP through science parks and business incubators requires a significantly strong IPR framework and support to guarantee the level of knowledge spill-over and private rates of return for the main investors.

Many universities have established science parks in order to foster the creation of start-up firms based on university-owned or licensed technologies as Link and Scott (2007). In this regard, IPRs play an eminent role to institutionalise those university-industry R&D collaboration activities (Link and Siegel, 2003). Although Link and Scott (2006) emphasis the lack of well-defined constructs about what constitutes science parks, the variety of their goals, and the general lack of clear metrics for measuring their impacts and successes, the reviewed literature is concrete on the pivotal role of IPRs in science parks (Siegel et al, 2007).

Considering the history of science parks between 1970 and 1980, Siegel et al (2003) state that there were two important policy initiatives in OECD countries that are alleged to have accelerated the rate of knowledge transfer from universities to firms and that may have contributed to the sharp increase in park formations. These initiatives were targeted legislation designed to stimulate cooperation in research and development (R&D) between universities and firms and to institute a major shift, favouring universities, in the IPRs regime (Link and Link, 2003). European Union Framework Programmes and the enactment of the Bayh–Dole Act of 1980 in the United States are two examples of those changes favouring universities in intellectual property ownership (Link and Scott, 2007). Therefore IPRs are inextricable pillars of science parks which have been associated with them from the beginning.

As Rothaermel and Thursby (2005) state, business incubators' central function is to facilitate the growth of high-technology start-ups. An efficient business incubator offers access to laboratories and other research facilities, as well as business assistance, subsidized space, and connections to potential corporate partners, venture capitalists, and IPRs guidance (Rothaermel, 2002). Eligible companies then must be based on technology that is proprietary in nature, protected by copyright or patents, and must have a research and development (R&D) focus (Audretsch and

Feldman, 2004). In this regard, Dechenaux et al (2003) state that a licence from a prestigious university in terms of research would provide strong property rights for spin-offs from business incubators, putting them in a favourable position to appropriate the returns from the inventions licensed. This license is then considered to be a signal of the innovation's quality and thus higher likelihood of commercial success (Rothaermel and Thursby, 2005). This effect is further strengthened by the fact that for most patent based spin-outs, the inventor is the company founder (Thursby et al, 2001), as agency theory would suggest that inventor involvement in a start-up should decrease the probability of failure (Thursby and Thursby, 2004).

All in all, strong IPRs protection, quality signalling through an exclusive licence from a university and strong inventor involvement increase the likelihood that inventions licensed from the university positively contribute to the success of the spin-off firm. Business incubators play a crucial role here in exploiting those advantages and supporting IPR management of new firms.

To sum up, in the specific University context of science parks and incubators – potentially in conjunction with technology transfer officers (TTOs) – it is critical that firms receive support to help identifying a market for the innovation, providing IPR protection advice and IPR management support, offering business development skills, identifying surrogate entrepreneurs and venture capitalists (Franklin et al, 2001). Thus, the challenges networks face around the build-up and commercialisation of innovation can be mitigated by a sound support through incubators, Science Park administration and TTOs, giving actors within Science Parks and business incubators a potential advantage over actors in other innovation related networks.

Tax policies to encourage IP investment and commercialisation – Patent Box

Rationale: the importance of tax treatment for innovation – the main example of the Patent Box

The tax system has become an increasingly important innovation policy tool, whereby different mechanisms are used to reduce the tax burden for firms that have expenditures on R&D (for a detailed discussion see Köhler et al 2012 as well as Atkinson and Scott 2011)⁹. One specific, recently increasingly popular instrument that is linked directly to IPR is the so-called Patent Box. Patent box regimes impose substantially reduced rates of corporate tax on income derived from products or services based on inventions that are patented in the country that applies the Patent Box system. Since patents are typically the result of R&D activities, the lower tax rates represent a preferential treatment of R&D investment over other investment.

Evers et al. (2014) state three reasons that a government may introduce a Patent Box: (i) to incentivise firms to increase investment in innovative activities; (ii) to attract (or retain) mobile investments that may be associated with high-skilled jobs and knowledge creation; (iii) to raise revenue more efficiently by differentiating tax rates on more mobile income streams. In other words, this policy instrument rewards owners of patents registered in a given country in the expectation that the underlying R&D investment and the subsequent production and commercialisation is also done in the country in which the patent is held. The success of the policies on any of these terms will depend largely on how effective Patent Boxes are in changing firms' real behaviours (Bellingwout et al, 2012). Although the Patent Box was first introduced by the governments of France and Cyprus in 2003 (Evers et al, 2014) the main

⁹ Atkinson and Scott (2011) also provide an overview of Patent Box policies in different countries

discussion of this field began after the adoption by the Netherlands and Belgium in 2007, followed by Spain and Luxembourg in 2008 (Cappelen et al, 2012). In 2014, 12 European countries operated Patent Box regimes (Evers et al, 2014).

In contrast to other policy measures in this report, the Patent Box is itself an IPR related instrument. Therefore the structure of this section is different, we will report directly on the performance of the Patent Box in terms of increased innovation and the conditions which influence that performance.

Evidence on the Patent Box as tax means to spur innovation through patenting

Patent box regimes that allow R&D expenses to be deducted at the ordinary corporate income tax rate, as opposed to the lower Patent Box tax rate, may result in negative effective average tax rates and thus effectively constitute a subsidy (additional public resources for the company) to potentially unprofitable projects (Lipsey, 2010; Huizinga and Laeven, 2008; Dischinger and Riedel, 2011; Griffith et al, 2014). Evers et al (2013) state that the most prominent feature of such IP Box regimes is the tax rate, which ranges from 0% in Malta to 15.5% in France. In fact, according to Griffith et al (2014) IP box regimes are different in terms of (i) the types of IP that are eligible; (ii) the scope of qualifying income; and (iii) the treatment of expenses relating to qualifying IP income.

One key question for the effectiveness of the Patent Box is what kinds of activities are actually targeted and how big the incentive for more innovation activity actually is. On the positive side, the basic idea of the Patent Box is in line with the empirical finding that the location of firms' production activities and intangible assets (such as R&D capacity) is negatively affected by corporate taxes (Dischinger and Riedel, 2011), i.e. that firms move towards locations with lower corporate taxes. Thus, a reduction of corporate tax on patented products or services through the Patent Box *potentially* reinforces these mechanisms, i.e. companies will move their patents to locations where the tax is lower. In a simulation exercise, Griffith et al. (2014) find that Patent Boxes work to attract patents, and that those with a high expected commercial value are particularly responsive to tax reduction. However, Jacobs et al (2011) state that whether the Patent Box is an appropriate tax instrument depends on the goal of the policy and how Patent Boxes (including their revenue cost and the distortions they affect) compare with other tax instruments. For instance in considering whether the Patent Box is the best policy tool to incentivise investment in spillover-generating activities, a concern is that the policy is not well targeted at research activities (Griffith and Miller, 2011). Spillovers are likely to be largest at the point of research, especially research that is attempting to advance scientific knowledge, and including research that increases knowledge but fails commercially. However, Patent Box policy rewards companies that commercialise patented products or services, not any underlying research (and thus the spillover effect), while R&D tax credits are directly linked to the R&D activities (and expenses) within the country, helping research active firms to overcome credit constraints (Ernst et al, 2013).

Furthermore, there is a question as to the location of the R&D activity that underpins the patents (Griffith and Miller, 2010). Ernst et al (2013) consider cases where firms co-locate patents alongside the underlying inventors that created the technology. They provide evidence that lower rates of tax on patent income can attract particularly innovative projects with high earning potential (Evers et al, 2014). However, the major criticism of Patent Boxes is related to the observation that Patent Boxes have become a means within the overall tax optimisation strategies of multi-national firms (Karkinsky and Riedel, 2012). Perhaps unsurprisingly, if a

country lowers its corporate tax rate, firms are more likely to locate their intellectual property in that location (Griffith et al, 2010). As the income derived from IPRs is highly mobile and anecdotal evidence suggests that multinational firms are increasingly choosing to hold intellectual property (and the resulting revenue stream) in subsidiaries outside the home country, and thus often outside the country where the underlying research has taken place. An empirical study (Cappelen et al, 2012) suggests that the introduction of Patent Boxes leads to significant shifts in patent holdings (not necessarily R&D activities) towards those countries operating favourable regimes and away from other countries which most certainly would affect the configuration of R&D collaboration and change the flow of R&D investment. Similarly, Hong and Stewart (2010) found that locating the beneficial ownership of a patent in a tax haven allows royalty payments to be used to shift income out of higher tax jurisdictions. In sum, the location of the patent follows the optimal tax strategy and can easily be decoupled from the underlying R&D investment. Thus, while the level of commercialisation of patented products or services may rise through the Patent Box mechanism, it often fails to increase the innovation related activity in the country that grants the tax incentive. There have been attempts to condition the Patent Box with requirements to actually perform R&D and production activity within the country granting the Patent Box, but at least in one case (Ireland), the European Commission has ruled this to be unlawful (Atkinson and Scott, 2011), violating the freedom of companies to choose locations for their activities.

To conclude, Patent Box allows firms to apply a lower rate of corporate tax to profits earned from its patented inventions. This reduction in effective average tax rates encourages firms to file patents and to commercialise products or services based on those patents in the country offering the Patent Box incentive. The designs of the policies vary in many ways and are likely to be important for the precise effects of the policy. Overall, the likely effect on real innovation activities is uncertain because firms have substantial scope to separate income based on patented products and services from underlying R&D activities. While Patent Box policy can increase the level of commercial activity – and thus still support the economy as such (Atkinson and Scott, 2011) – it entails the risk of contributing to a tax race to the *bottom* without attracting or mobilising additional innovation or production activity in the country of the Patent Box. To avoid this, countries would need to find ways to increase the likelihood that underlying R&D activities and production activities are actually carried out in the country of commercialisation.

Policies to attract foreign industrial and individual capabilities

Encouraging foreign R&D to locate in the country through investment policies and tax policies

Rationale for tax and investment policies to attract foreign company R&D

In this section we will focus on the interplay between IPRs and investment and tax policies that seek to encourage foreign corporate R&D to locate in the country. In the first part of this section we will discuss the motivation of firms to relocate R&D and then the rationale for tax and investment policies to attract foreign R&D companies. In the second part, we discuss the relative role of IPR within those measures to attract foreign firm's R&D.

The globalization of companies' R&D activities has increased considerably since the 1990s (OECD 2005, UNCTAD 2005), with remarkable differences between countries in the last ten years as the rate of internationalisation depends on the home location of the companies

involved (Laurens et al, 2014)¹⁰. The empirical evidence of OECD (2011) indicates that foreign subsidiaries contribute around one-third of total business expenditure for R&D in most European countries, around 15 percent in the United States and 5 percent in Japan, reaching over 60 percent in some small economies like Slovakia and Ireland. Nevertheless, the empirical findings of Jaruzelski and Dehoff (2008) shows that the largest 1,000 companies by R&D expenditure allocate on average 55 percent of their R&D budget outside the countries where they are headquartered. Ninety-nine percent of these firms conduct some R&D in their subsidiaries abroad, and their total number of overseas R&D sites increased by 6 percent from 2004 to 2007.

The literature distinguishes two main drivers for R&D re-location: home base exploiting¹¹ or knowledge exploiting (KE) versus home base augmenting¹² or knowledge augmenting (KA) (Kinkel and Som, 2012). The former relates to companies that build up R&D capacities abroad to adapt products or services to local tastes and requirements, the latter indicates that companies engage in a global search for the leading expertise in order to produce forefront knowledge and innovation. This is increasingly linked to a global search for highly-qualified workers and lower-cost activities (off-shoring specifically) (Ambos, 2005; Couto et al, 2006; Lewin and Peeters, 2006; Lewin et al, 2009, Edler, 2004, Sachwald, 2008). The increasingly important role of efficiency and cost driven motivation leads to a rising attractiveness of low-cost locations with appropriate tax policies and investment support for the location of R&D (Kinkel, 2008).

The study of Kinkel and Som (2012), which is representative of a range of internationalisation studies (Lewin and Peeters, 2006; Maskell et al, 2007; Hutzschenreuter et al, 2007; Manning et al, 2008), shows that the main motives triggering R&D relocation activities are the reduction of labour costs (65%), access to innovative knowledge, technology or clusters (33%), favourable taxes and subsidies at the foreign location (17%), access to new markets (17%), capacity bottlenecks and lack of qualified staff (13%), and locating R&D activities closer to important customers (10%). Compared to the empirical findings of Kinkel (2008), efficiency seeking motives as labour cost and tax savings have gained relative importance in the course of the global economic crisis, whereas access to qualified personnel fell dramatically in relevance as a driver for R&D relocation strategies.

Against this background of R&D location motivations, in a world where multinational enterprises are increasingly internationalising their R&D activities, governments compete in attracting R&D activities of multinational corporations which have a high value added content and a strong knowledge spillover potential (Crisuolo, 2009; Edler, 2008). The rationale is that an excellent and accessible research base and favourable framework conditions and incentives (for example R&D tax incentives) make a country a relatively more attractive location for R&D investments than its competitors and that the forgone tax revenues would be compensated by the benefits

¹⁰ Laurens et al (2014) show that internationalisation of companies R&D (as measured with international patents) based in the USA and Asia has by and large increased considerably between 1994 and 2005 (the exception being firms located in Japan), while for companies based in Europe (especially small countries and Germany) the share of international patents has actually decreased.

¹¹ Home-base exploiting R&D labs transfer knowledge from the multinational R&D centre – in the home country or in other home-base augmenting R&D lab - to the host country lab to commercialize that knowledge. For these laboratories closeness to other corporate activities (e.g. production) and to local customers is particularly important (Belderbos, 2006).

¹² Home-base augmenting laboratories aim at creating knowledge and transfer it back to the central R&D site; for these R&D labs access to frontier research, closeness to centres of excellence and the availability of a skilled workforce, engineers and scientists are particularly important (Belderbos, 2006).

accruing to the local and national economy from receiving the Foreign Direct Investment (FDI) both through increased employment, value added and localized knowledge flows (Thursby and Thursby, 2006; Edler, 2008).

As Köhler et al (2012) state, the principal economic rationale for business R&D tax incentives (as for any government support of private R&D) is to increase business R&D expenditure in an economy. Tax incentives have become a popular policy instrument not only to increase R&D activities of businesses, but also to persuade firms to partly or completely relocate their R&D activities in another country. Köhler et al (2012), empirical findings from cross-country analysis of the OECD (2002; 2005; 2010) and Eurostat (2005) indicate that different countries have different concerns regarding their tax policies to encourage further R&D activities which generate different R&D tax incentive choices.

R&D tax incentives offer a wide range of design features to policy makers that allow a flexible use for different policy objectives (Duguet, 2010). Design features include the tax on which the incentive is based, what R&D expenditures qualify for a tax reduction (total volume of increase over a reference base; all categories of R&D expenditure or only intramural/extramural/personnel expenses; exact definition of R&D), the target group of beneficiaries, and whether unused claims can be carried over or refunded in cash (Czarnitzki et al, 2011; Köhler et al, 2012). Further, tax incentives can be targeted to specific types of R&D activities (including innovation activities other than scientific research), they can be varied by firm size, region or sector, and they can be applied differently to different types of R&D expenditures. One of the central design features (Köhler et al, 2012) is to choose either a volume-based or incremental scheme. A volume-based scheme allows the deduction for all eligible R&D expenditure in a given year. In contrast, an incremental scheme allows the deduction only of the increase in R&D expenditure during the fiscal year.

Another important choice is the definition of eligible operations for tax deductions. In fact, the definition of R&D differs among countries (OECD, 2010) and can be more or less generous. The definition of the subjects that are entitled to claim R&D tax incentives is another design element (Arque-Castells & Mohnen, 2011), as tax schemes can be targeted at specific sets of actors such as SMEs or recently created firms, university–industry collaborations (science parks and incubators), specific fields of R&D (such as biotechnology or nanotechnology) or types of technologies (such as green technologies, cf. Belgium). Corchuelo and Martinez-Ros (2009) consider that the mechanism of tax credit consumption by firms and duration of the measure itself could be the factors based on which policy makers would be able to stimulate the target R&D activities. Finally, Köhler et al (2012) list accelerated depreciation schemes¹³, special R&D allowances¹⁴, special exemptions of wage and/or social tax¹⁵ and tax credit¹⁶ as the four main types of R&D tax incentives. A further type of fiscal support to R&D that is closely related to R&D tax incentives is the Patent Box. A Patent Box grants a lower corporate tax rate on profits generated from patents that are held in a certain country (van Pottelsberghe et al, 2003). Further explanation about Patent Box are to be found in section 4.9.

¹³ Investments in machinery, equipment, buildings, intangibles used for R&D activities.

¹⁴ Enable firms to deduct more than 100 per cent of their current eligible R&D expenditures from their taxable income.

¹⁵ For employees in R&D activities

¹⁶ Allow firms to directly deduct a specific share of their R&D expenses from the corporate tax liabilities

Evidence from econometric studies (Bloom and Griffith, 2001 and Wilson, 2008) suggests that an increase in R&D activities abroad, due to, for example, tax incentives, tends to lead to a R&D decrease at home, and thus to a zero sum game and therefore strong competition between countries. While this study relies on the US situation and the mobility between US states (which is higher than between countries according to Devereux and Maffini, 2007), this competition effect might be smaller internationally. However, this might change as the degree of geographic mobility in R&D activity increases within the EU.

As multinational companies internationalize their R&D activities, new opportunities have opened up for *developing* countries to attract R&D-intensive foreign direct investment (FDI) (OECD, 2011). However, countries that fail to raise their technological capabilities in line with the needs of multinational companies run the risk of remaining marginalized from global innovation networks (Yusuf 2012). Therefore governments should invest in the technological capabilities and adopt the required innovation policies to attract more R&D-intensive FDI which would encourage foreign R&D performers to relocate their activities to the country (Jaruzelski and Dehoff 2008).

Due to the heterogeneous nature of R&D-intensive FDI, it is necessary to consider not only the different strategic motivations (see above) but also the entry modes in order to better frame its developmental impact on host economies and the policy implications for those governments (Sachwald, 2008). R&D-intensive FDI, which is of most interest in our context, can be defined as an investment involving a lasting interest and control of an enterprise residing in another economy for the purpose of conducting R&D activities (Farole and Winkler, 2012). This may occur through greenfield investments (creation of a new R&D centre overseas by a MNC or expansion of an existing subsidiary) (Gupta and Wang, 2011), through transnational mergers and acquisitions (full or partial acquisition of a domestic company active in R&D by a foreign company) (D'Costa, 2006), or through transnational joint ventures (joint ownership of an R&D centre by foreign and domestic entities).

Governments employ different kinds of measures to attract R&D-intensive FDI based on information deficits (awareness building with foreign firms about the conditions in different countries (Guimon, 2009; OECD, 2011), on perceived risk of knowledge spillover (ensuring foreign firms who seek to avoid knowledge spillovers in foreign countries) or on the provision of additional financial or non-financial incentives to offer conditions that are more beneficial for R&D than in other countries (Guimon, 2009; Farole and Winkler, 2012).

To sum up, there is a wide range of motivations for firms to re-locate their R&D activities, some of which are geared towards seeking excellent input (collaboration, well trained staff, networks), others are efficiency driven. Especially for the latter, tax incentives and FDI support schemes are crucial. In the next part we will focus on the role of IPRs in tax incentives and investment policies to attract foreign R&D.

The interplay between IPRs and tax incentives and investment policies to attract foreign company R&D

This section investigates the interplay between IPRs and tax incentives and investment policies to attract foreign R&D to locate in the country. To investigate this issue, first we will study the role of IPRs to attract foreign R&D as such and then concentrate on the impact of IPRs on R&D relocation policies through tax incentives and investment support policies.

The reviewed literature indicates that R&D relocation into developed countries is influenced particularly by access to innovative knowledge, technology, clusters and highly-qualified workers. As Kinkel (2008) states, developed countries are able to encourage R&D firms to relocate their activities by offering them access to excellent knowledge and corresponding financial support measures supported by favourable framework conditions. As headquarters are particularly anxious about potential loss of control over R&D and the risk of intellectual property (IP) theft (OECD, 2011), reliable and enforced IPRs regimes for knowledge exploitation are of particular importance (Criscuolo, 2009). A well-structured IPRs regime in developed countries offer a secure market for further investments in innovation, in which all the involved actors and stakeholders (including scientists, knowledge workers, entrepreneurs and investors) would benefit from the exploitation of IPs (Maskell et al, 2007). As Manning et al (2008) mention the IPRs regime provides a base or platform to link and integrate all the required resources of R&D activities (including scientists and experts, pool of technology, innovation clusters and other R&D firms for R&D collaboration) and make it more interesting for foreign R&D firms to consider relocation of their activities. In other words, IPRs provide a framework in which actors (including scientists, experts and entrepreneurs), resources (pool of technologies, facilities, finance, credits) and networks (clusters and districts) can fit together interactively as all these interactions should be regulated by IPRs regime principles and also all these actors should be above a certain competency level to be qualified to work under this IPRs system.

The situation is different for developing countries, where the motivation to locate R&D is usually cost and market driven (Kinkel et al, 2007; Kinkel and Maloca, 2009). Developing countries tend to have weaker IP regimes and judicial systems than developed countries, which may act as a barrier for the attraction of certain types of MNC R&D and FDI respectively (UNCTAD 2005). Differences in IPR frameworks thus make a big difference in efforts to attract those firms. For example, despite China's growing attractiveness for R&D-intensive FDI, according to Gupta and Wang (2011), the country is "notorious for its counterfeiters, pirates, and IP outlaws", and this represents perhaps the single biggest challenge that foreign direct investors face in China. Strengthened IPRs in developing countries reduces dis-incentives for firms, both multinational and local, to specialize in undertaking an R&D activity in which it has competitive advantage (Marjit et al, 2009). It also facilitates the process for local firms to switch from being imitators to potential innovators (Hemphill, 2005). Kinkel and Som (2012) call the former "the specialization effect" of strengthened IPRs in developing countries and the latter as "the switching effect". Furthermore, Marjit et al (2009) states that the multinational firm's strategic behaviour on IPR enforcement can be used as an effective instrument to subsidize contractual R&D in developing countries which is defined as "the subsidizing effect".

IPRs also play an important role to align tax policies with other innovation policies to encourage R&D relocation into the country (Billings, 2003; Jaffe and Hines, 2000). There is empirical evidence from studies on internationalisation of R&D (Criscuolo, 2009; Laurens et al, 2014) indicating that strong IPRs support secure markets for further R&D activities and therefore would stimulate R&D investments. Thus, when it comes to attracting R&D capacity of foreign firms, IPR policies and tax incentives have an additive effect: they can each enhance the effect of the other (Devereux and Maffini, 2007).

Lastly as Hemphill (2005) mentions, beyond regulatory reform, governments of developing countries should also try to ensure that an adequate skill formation in IP regulations is available in the country, for example, by sponsoring IP specific seminars and courses and by identifying specialized law firms and consultants that can be contacted by potential foreign investors.

To conclude, the reviewed literature indicates that IPRs are not a particularly important factor for attracting R&D of foreign firms, as IPR frameworks are seen as stable and not differentiated much in most advanced countries across most technologies. This is different in developing countries, where the lack of IPR can act as a barrier for knowledge intensive activities of companies. IPR thus interferes with other policies to attract foreign companies, it can enhance or diminish the appeal of tax or other investment seeking policies, and creating stable IPR conditions with enforceable rights is a key concern for innovation policy in developing countries. In addition, the normal commercial requirements of a stable and transparent tax system with low compliance costs must be present before additional targeted tax incentives to attract R&D can be effective.

Encouraging foreign scientists and technical expertise into the country through immigration policy

Rational: the meaning of immigration policy and conditions for the attractiveness of countries for foreign scientists and technical experts

Innovation systems benefit from the presence of scientists and skilled technical experts. There is a positive correlation between the level of human capital and innovation capability and performance in a country. Increasing the number of scientists enhances the quality and quantity of the workforce that contributes to the generation of knowledge and innovation. Similarly, increasing the number of skilled technical experts, i.e. individuals with a high level of skills, competencies and experiences, increases the productivity of a system. The higher their level of human capital, the better people are equipped to solve problems, both by “knowing-how” (non-codified information and tacit knowledge) (Jones & Miller, 2008) and by “knowing-what” (explicit information and knowledge) and so can more easily adapt to changes that require the integration and adaption of previous knowledge with new knowledge (Jones and Grimshaw, 2012). Therefore, attracting additional scientists and a skilled workforce into a country potentially enhances the likelihood of generating innovation, increasing the absorptive capacity and thus diffusion of innovation and ultimately productivity in a system, and thus supporting genuine innovation policy goals. (Jones and Grimshaw, 2012). In this section we will discuss the relative importance of immigration policy for innovation and the meaning of IPR in that respect. In the next section (4.11) we will focus on the importance of policies to attract nationals residing in other countries to start businesses.

The mobility of highly skilled human resources is a value-creating asset (Jones, 2012). Oettl and Agrawal (2008) consider mobility as an investment decision of both individuals and the firms hiring mobile people and part of knowledge and skills spill-overs. Mahroum (2000) states that knowledge and skills spill-overs could occur through horizontal movements of people between firms, through open communities of knowledge specialization (such as professional associations), forming as a result of social and professional interactions and also through the mobility and exchange of scientists.

The discussion about migration and innovation has in recent years centred on the overall benefit distribution for countries, as the 'brain gain' of one country is potentially the 'brain drain' of another. This is why European Union introduced sets of policies to support brain circulation (Cervantes and Guellec, 2002). These policies encourage temporary mobility rather than permanent immigration so that individuals gain experience, but return back to their home

country (Saxenan, 2002). As Robinson et al (2007) mention, fostering the brain circulation related policies in the European Union is turning the brain drain effect into brain gain effect for the home countries. In recent years, scientists and particularly PhD students and Post-Docs increasingly gain experience abroad to come back and exploit the knowledge gained in their home country (Edler et al. 2011).

Jones (2012) considers that highly skilled workers are increasingly seen to bring specialised skills, training and experience not easily replaced in the short term and often filling skills gaps/shortages in labour markets. For these reasons, among the high wage economies of Scandinavia, the EU, Oceania, Canada and the USA, competition is now intense to attract those highly skilled people that can contribute to national innovative capital (Guellec and Cervantes, 2002). In this regard, Shacher (2006) states that the importance of highly skilled workers (scientists) in any national innovation system has resulted in a range of public immigration policies emerging, now described as “competitive immigration” regimes, aimed at managing flows of the highly skilled via labour migration in order to maximise the national advantage of high income countries in the global economy. Kuhn and McAusland (2009), consider scientists as mobile producers of patentable/copyrightable ideas. As a result there is a significant competition between countries with well-developed innovation systems in attracting mobile scientists to increase innovation.

Many factors underlie national policy approaches and objectives regarding high skill migration inflows into high-income countries. Such factors are usually combined and include rectifying skill shortages, increasing overall skill levels in national human capital stock to promote productivity and encouraging the circulation of knowledge embodied in high skilled labour to promote innovation and growth (Murray, 2011). Cerna (2011) points out three current immigration approaches followed by high-income countries to gain all the net positive effects associated with high skilled labour, namely Points based systems (PBS), Employer led schemes and Hybrid schemes. In PBS, candidates are selected on the basis of certain characteristics, among them age, educational attainment, language proficiency and occupation, for which points are assigned and those having more than a threshold level of points are granted the right to establish residence (Jones, 2012) while Employer led schemes, which are applied by almost all immigrant-receiving countries, directly focus on employer needs for specific human capital (Papademetriou and Sumption, 2011). Hybrid schemes are another immigration policy solution to combine and prioritise employer demand systems with use of point systems to distinguish between entry applications (Murray, 2011).

Importantly, immigrants account for a large fraction of OECD innovative activity in general and the United States (US) in particular (McAusland and Kuhn, 2009)¹⁷. For instance, as Zakaria (2005) found, nearly one in five scientists and engineers in the United States is an immigrant, while foreign students comprised 51 percent of U.S. science and engineering Ph.D. recipients in 2003 (Bound et al, 2009). Further, there is evidence that immigrant skilled workers contribute to the generation of innovation as indicated by higher levels of patenting (Li and McHale, 2009), with Hunt and Gauthier-Loiselle (2010) even showing empirically that a one per cent increase in the number of immigrant college graduates in United States leads to a 9-18 percent rise in US patenting.

¹⁷ In the academic and grey literature (WIPO 2013) discussing the efforts of states to repatriate expatriate scientists we did not find any indication or even evidence about the importance or use of IPR. While Tejada et al (2004), Bein et al (2011) and Mohapatra et al (2009) focus on the role of scientific diaspora and the main drivers to attract them, they do not discuss the role of IPRs in this regard.

Interplay between IPRs and immigration policy for foreign scientists and experts

What is the relative role of IPR in the international mobility of skilled workers? Is there a relationship between IPRs and brain drain as McAusland and Kuhn (2009) claim? And most importantly, is there any existing link between innovation policy, immigration policy and IPR? These are the questions we are going to address based on the reviewed literature.

Unfortunately, the literature that empirically analyses the importance of different factors that influence the decisions of scientists and highly skilled experts has until now not looked at the relative importance of IPR. For example, Solimano (2008) identifies several factors that affect the mobility of different types of talent, namely a) International differences in earnings (see also Thorn and Holm-Nielsen (2006) and development gaps, b) Non-Pecuniary motivations. c) The demand for capital and talent d) Agglomeration and concentration effects. i.e. access to complementary talent in a given country (see also Ackers and Gill, 2008), e) Linguistic compatibility, networks and socio-cultural affinity, f) Policy regimes and immigration policies. Ackers and Gill (2008) add to those factors access to capital (venture funds) as well as access to leading edge technology.

As we can see, none of the empirical studies actually includes IPR as one of the contributing factors, despite the importance that access to technology and expertise has and despite the mobility motive to gain an economic advantage. This is not to say that IPRs are not important, but they have not been isolated as potential factors in empirical studies. Nevertheless, there are authors who indicate that having stronger IPR regimes would probably increase the attraction for scientist and technical experts to immigrate to the country in which they can use their skills and expertise to develop IPs and protect them accordingly (Kerr, 2008; Hunt, 2011). McAusland and Kuhn (2006) claim that the IPR regime is one of the most important policy conditions as a driver to attract scientists and technical experts to migrate to another country. Li and McHale (2009) share this view and elaborate that the existence of a strong IPRs regime guaranteeing the rightful exploitation of IP generated from innovation networks and international mobility in the country as a major concern of scientists and technical experts.

Grossman and Lai (2004) argue that when thinking about the policy needs to make a country more attractive for scientists and highly skilled experts, domestic IPR protections are not considered as part of the policy mix. Kuhn and McAusland (2009) agree and assert that one of the unrecognized factors, affecting any country's optimal IPR policy, is "bidding for brains" effect. Unless innovations are truly universal, governments have an incentive to manipulate local policy to attract footloose innovators (Hunt, 2011).

Mondal and Gupta (2008) introduce international high-skilled labour mobility, but treat IPR policy as exogenous and consider only the limiting case of perfect international labour mobility. Oettl and Agrawal (2008) empirically study the patent flows that result from international high-skilled labour mobility. To our knowledge, no existing papers model the choice of IPR policy in the presence of internationally mobile innovative talent.

However, McAusland and Kuhn (2011) studied the interactions between these issues by introducing international mobility of knowledge workers into a model of Nash equilibrium IPR policy choice among countries. Their analysis identifies a number of considerations affecting optimal IPR policy. One of these is a bidding-for-brains effect, which can generate excessive IPR protection in both sending and receiving countries, as both countries attempt to outbid each other in providing a hospitable IPR environment for internationally mobile knowledge workers.

Based on McAusland and Kuhn (2006), McAusland and Kuhn (2011) conclude that this effect may become empirically relevant as some developing nations begin to contest the developed world's attraction for their knowledge workers.

In conclusion, the main objective of immigration policy from an innovation point of view is to increase non-financial capabilities of the firms by providing further skills and expertise. Scientists and technical experts could be attracted to immigrate by a combination of different factors (as discussed by Solimano, 2008) and a number of authors claim that strong IPRs regimes would be one of them to ensure scientists on the rightful exploitation of their IP. However, we have not found any empirical evidence for the relative importance of IPR for mobilise scientists and highly skilled workers, and thus also no evidence as to any existing link between immigration policy, IPR and innovation policy. Nevertheless, a range of authors in the innovation literature make a strong logical argument that the IPRs regime may play a significant role in the attractiveness of countries for scientists and highly skilled workers. From the macro-level perspective, stronger IPRs regimes could also enable countries to win the “bidding-for-brains” game. In other words, in the global bidding war for innovative talents, stronger IPRs regime would contribute to immigration policy to efficiently achieve the goal of increasing the nonfinancial capabilities of the firm. Thus, strong IPR regimes could potentially be a cornerstone of a joint immigration and innovation policy that seeks to attract talent.

Encouraging nationals residing in foreign countries to bring their knowledge and experience to start business

Rational for attracting foreigners to start businesses in the country

Entrepreneurship has long been viewed as an engine that drives economic development, employment creation, and innovation (Fu and Lie, 2012). A range of national and local conditions as well as institutions, understood as the rules of the game, influence the emergence and development of entrepreneurship in important ways. A greater understanding of institutional differences will aid entrepreneurs, researchers, potential investors, and government policy makers trying to revitalize their economies (Busenitz, Gomez, and Spencer, 2000).

Entrepreneurship can be fostered through two different channels: immigration policies (international focused instruments) and more general government support to enterprises, in particular the financing and operation of start-ups and young businesses. While immigration policies try to attract international entrepreneurs with successful track-records of entrepreneurship or with promising innovative ideas to bring their knowledge and experience to the country, general government support to local enterprises (discussed in section 4.2) attempt to stimulate local entrepreneurs to engage into the process of innovation commercialization to contribute to the exploitation of new ideas, often based on newly generated IPs. Since we already discussed the latter to foster entrepreneurship in section 4.2, this section will focus on the immigration policies to encourage international entrepreneurs.

Although Mahuteau et al (2014) write that literature on immigrant entrepreneurs is relatively recent and small and claim that no work appears to exist on the analysis of migration policies explicitly targeting migrants with particular business skills, we want to bring some empirical evidence along with other speculative analysis to understand the nature of immigration policies in light of entrepreneurship. In fact as Clydedale (2008) mentions, many governments have introduced policies designed to attract business immigrants in order to stimulate domestic

entrepreneurial activity. Such policies assume that government agencies can identify people with previous entrepreneurial success or entrepreneurial qualities and that these people on shifting to a new environment will generate entrepreneurial activity. The reviewed literature on migrant entrepreneurs shows a line of empirical work that focuses on the effectiveness of the selection mechanism (to evaluate the candidates' entrepreneurial skills) such as the type of visa one applies for, and the institutional conditions that favour the emergence of entrepreneurship.

Shane and Venkataraman (2000) and Shane (2003) state that the study of business immigrants offers an interesting insight into the relationship between the individual and the environment in which they operate, as it involves the targeting of individuals based on their entrepreneurial abilities and their re-location into a different local environment. This has to be seen against the increasing ability of entrepreneurs to take advantage of local and national differences in terms of the conditions for the exploitation of their business ideas (Eckhardt and Shane, 2003).

However, Clydedale (2008) emphasises the barriers entrepreneurs face which need to be taken into consideration when designing immigration policies to foster entrepreneurship. Barriers for international mobility of foreign entrepreneurs include access to relevant information, ignorance of government regulations, poor understanding of local market forces and consumer behaviour, language barriers and poor business networks. The clear message here is that foreign entrepreneurs effectively have to learn to do business in the new environment as success in a home country does not necessarily translate into success in a new country (North and Trlin, 2004). As a result, efficient immigration policy is asked for that recognizes the potential entrepreneurs as well as putting in place the right support mechanism for those entrepreneurs to flourish in a new environment.

The importance of foreign entrepreneurs has been shown empirically. For example, Wadhwa et al (2007a) shows that one in four engineering and technology companies founded between 1995 and 2005 in the US had an immigrant founder. Furthermore, they state that these companies employed 450,000 workers and generated \$52 billion in revenue in 2006. This confirms Dushnitsky's (2010) claim that immigration policies could be set up in a way not only to attract scientists and technical experts but also to encourage international entrepreneurs to create further values out of the R&D outcomes and contribute to further IPs exploitation. Importantly, the empirical analysis of Wadhwa et al (2007a), Wadhwa et al (2007b) and Dushnitsky (2010) shows that efficient immigration policies need to be aligned with IPRs regime, well-structured bankruptcy laws and economic freedom to foster entrepreneurship by encouraging international entrepreneurs to locate new start-ups inside the country (Harbi and Anderson, 2010).

On the other hand according to PwC (2010), governments can then choose the appropriate tax incentives such as a low tax rate; extra or accelerated tax depreciation capital spend; no withholding tax on profit repatriation; and a special expatriate tax regime for skilled non-nationals associated with R&D projects to encourage large-scale R&D based entrepreneurial activities by expatriates. As (Maskus, 1997) states, the repatriation of professionals and entrepreneurs provides an interesting opportunity as they return and transfer new skills and use their experiences to facilitate agreements and investments within their home countries. Both China and Israel, for instance, have experienced the benefits of returning expatriates (PwC, 2010).

To sum up, the literature on immigrant entrepreneurship demonstrates that immigration policies to foster entrepreneurship are important to supplement general government support to local enterprises. Immigration policies are not just important to attract scientists and technical experts, but they are essential to encourage foreign entrepreneurs with a successful track-record to bring their knowledge and experience to the country. However, the main challenge of immigration policy is to target the right entrepreneurs who could adapt with a new business environment and commercialise their ideas. We also conclude that an efficient immigration policy to foster entrepreneurship should be supported by strong IPRs regime, relevant bankruptcy law and economic freedom. In the next section we will focus on how IPRs could incentivize foreigners to start their businesses in the country.

Interplay between IPRs and policies to incentive foreigners to start companies in the country

Most of the studies on what affects entrepreneurship focus on local entrepreneurship (Davidsson and Wiklund, 2001) within a given institutional environment without considering the variations of institutions in different national contexts.

Very few empirical studies have looked at how culture (Mueller & Thomas, 1997), intellectual property rights, bankruptcy law and economic freedom influence the motivation of international entrepreneurs to start their business in a third country (Autio and Acs, 2010; Harbi and Anderson, 2010; Peng, Yamakawa and Lee, 2009). Most of them, however, investigate entrepreneurship. On the other hand, Autio and Acs (2010) claim that strategic entrepreneurial behaviours cannot be fully understood without giving attention to the context in which those behaviours are observed. Applying real options logic, they show that a country's IPR regime has an effect on entrepreneurial growth aspirations and therefore can incentivize international entrepreneurs to start companies in the country.

IPRs offer inventors temporary exclusive rights over intellectual property and provide entrepreneurs with an incentive to innovate. Therefore, whether a country allows entrepreneurs to appropriate value from their new ideas through IPRs and how well IPRs are protected create significantly different incentives for individuals engaging in entrepreneurial activities (Hoskisson, Covin, Volberda and Johnson, 2011; see also Nelson, 1982).

As mentioned in section 4.2, a technology entrepreneur is defined as an individual involved in early-stage entrepreneurial activity that claims to use new technology in the production of goods or services (Autio and Acs, 2010). Technology entrepreneurs are particularly relevant in this context because intellectual property is the key asset possessed by this type of firm and the importance and economic value of this asset is subject to the establishment and enforcement of the IPR regime (Volberda and Johnson, 2011). In this regard, Fu and Lie (2012) empirical studies clarify that IPR protection is positively associated with entrepreneurial activity and thus should be considered as a motivation to encourage international entrepreneurs to start their business in the country. They specifically mention that stronger IPR protection encourages technology based entrepreneurship, and they add that well enforced competition policy (with low entry barriers) serves to intensify this positive relationship between strong IPR regime and technology based entrepreneurship.

In their cross-national empirical research based on using annual data from the Global Entrepreneurship Monitor during the period of 2002 and 2007 on various measures of entrepreneurship, Fu and Lie (2012) however found that instead of encouraging, stronger IPRs

adversely affect those entrepreneurs who introduce new technology among other early-stage entrepreneurs. This is largely due to the view that development and commercialization of technological invention in strong IPR regimes is generally risky (risk of infringement and further litigation) and costly and entrepreneurs are more often than not financially constrained especially at the very early-stage (still not refuting the existence of IPRs regime).

In the same direction, Foray (2007) conducted a cross-country empirical examination to see whether a country's level of IPRs protection influences the increase of entrepreneurship. Foray (2007) examines if entrepreneurs can be relocated from one country to another by changing the relative profit prospects offered by the available alternative economic activity in the new country alternative. One condition determining the expected economic benefit in a third country is the IPR regime. The empirical analysis by Foray (2007) shows that entrepreneurs respond positively to IPR protection in developed countries but negatively in developing countries. His main argument for this observation is that the more high-tech and technology-based the basis of entrepreneurship is, the more IPRs protection is appreciated by entrepreneurs. As the nature of entrepreneurship in developed countries is more technology oriented, IPR protection plays a more pivotal role in encouraging entrepreneurs to start their businesses there. As the nature of entrepreneurship is less technology-driven in developing countries, the IPRs regime is considered more of a hindrance rather than a motive to start the business (Foray, 2007). Fu and Lie (2012) confirm the correlation of strong IPRs regime with successful immigration policy in more developed countries to foster entrepreneurship, mentioning that an increase in IPR protection makes IPR-sensitive activities more attractive as these activities now yield higher payoffs in comparison to other activities and therefore would incentivized successful entrepreneurs to locate their new business in the country. This leads Mahuteau et al (2014) to indicate that IPRs regime could be considered as the backbone of any successful immigration policy to foster entrepreneurship and encourage foreigners to bring their knowledge and experience to developed countries to engage into entrepreneurial activities.

To conclude, there are different institutions aligned with immigration policies to foster entrepreneurship and encourage actors residing in foreign countries to bring their knowledge and experience to start a business. The reviewed literature indicates that IPRs regime, bankruptcy law and economic freedom – accompanied by strong competition policy - are the major institutions which support immigration policies that try to attract talent and foster entrepreneurship. Different empirical studies suggest that there is a significant correlation between stronger IPRs regime and successful immigration policies which encourage foreigners' entrepreneurship in the country. However as mentioned above, the positive effect of IPRs is largely limited to developed countries where the economy is more based on advanced technology and therefore entrepreneurship is more IP sensitive in these countries.

Government procurement as an instrument of innovation policy

Rational: Using public procurement for innovation and the need for explicit policy instruments

Public procurement of innovation (PPI) is the process by which public sector organisations buy a product or a service that is novel and that serves to help the buying organisation to perform their tasks more effectively and/or efficiently. When considering public procurement of innovation in the context of innovation policy, we must make two important distinctions.

First, one must distinguish between the everyday practice of public procurement, which is performed all the time across all public organisations and often leads inadvertently to innovation, and policy schemes that support and utilise public procurement for the sake of supporting innovation activity. In this report we are interested in the latter. Second, we distinguish between policy schemes that support public procurement of an innovation (PPI), and those schemes that do not buy an innovation, but support firms in developing solutions for public body needs, which then subsequently may or may not lead to the purchase of this innovative solution. The latter is called pre-commercial procurement (PCP).

In recent years, both policies to support PPI and PCP schemes have become increasingly important in the debate on innovation policy, as cornerstone of a leap towards demand side policies (OECD, 2011; Izsak and Edler, 2011). A range of policy tools and guidelines¹⁸ have been developed.

The main rationale for public policy instrument to support public procurement of innovation (PPI) is

- (1) to create and support markets for products and services that are seen to be of societal importance (based on departmental needs, societal challenges; strategic PPI), and
- (2) to overcome deficiencies of PPI practice, which prevent public procurement of innovation at a scale and scope that is desirable from a social and economic point of view.
- (3) Those deficiencies are manifold. They include (Edler, 2009):
 - Lack of interaction and exchange between public organisations and potential suppliers (producers do not know the future preferences of public buyers, and users do not know the innovation potential in the market), often influenced by the perception that regulatory framework conditions to ensure fair and open competition put tight limits on interaction;
 - Inability or unwillingness of public organisations to define needs, to accept the risk of innovation, to use appropriate procurement procedures to allow or mobilise innovation in the market (Uyarra et al., 2014)
 - High entry costs for being a first buyer of an innovation, often accompanied with high internal learning and switching costs.

Georghiou et al (2013) have assembled the various policy approaches to support public procurement of innovation. Table 3 below depicts the deficiencies and illustrates policy interventions to tackle them. It shows the variety of approaches. The authors state, however, that those approaches are not rolled out sufficiently. As a result, while PPI is widely seen as a high potential innovation policy instrument, public bodies are not sufficiently supported to fulfil this potential (see also Uyarra, 2013).

¹⁸ Most recently through the Innovation Procurement Platform at EU Level, <http://www.innovation-procurement.org/about-ppi/guidance/>

Table 3: Overview of policy instruments to support public procurement of innovation

Policy measures in support of innovation public procurement.

Policy category	Deficiencies addressed	Instrument types	Examples
Framework conditions	<ul style="list-style-type: none"> i) Procurement regulations driven by competition logic at the expense of innovation logic. ii) Requirements for public tenders unfavourable to SMEs 	<ul style="list-style-type: none"> i) Introduction of innovation-friendly regulations ii) Simplification & easier access for tender procedures 	<ul style="list-style-type: none"> i) 2005 change in EU Directives including functional specifications, negotiated procedure etc. ii) 2011 proposal in EU to introduce innovation partnerships iii) Paperless procedures, electronic portals, targets for SME share
Organisation & capabilities	<ul style="list-style-type: none"> i) Lack of awareness of innovation potential or innovation strategy in organisation ii) Procurers lack skills in innovation-friendly procedures 	<ul style="list-style-type: none"> i) High level strategies to embed innovation procurement ii) Training schemes, guidelines, good practice networks iii) Subsidy for additional costs of innovation procurement 	<ul style="list-style-type: none"> i) UK ministries Innovation Procurement Plans 2009–10 ii) Netherlands PIANOo support network, EC Lead Market Initiative networks of contracting authorities iii) Finnish agency TEKES meeting 75% of costs in planning stage
Identification, specification & signalling of needs	<ul style="list-style-type: none"> i) Lack of communication between end users, commissioning & procurement function ii) Lack of knowledge & organised discourse about wider possibilities of supplier's innovation potential 	<ul style="list-style-type: none"> i) Pre-commercial procurement of R&D to develop & demonstrate solutions ii) Innovation platforms to bring suppliers & users together; Foresight & market study processes; Use of standards & certification of innovations 	<ul style="list-style-type: none"> i) SBIR (USA, NL & Australia), SBRI (UK), PCP EC & Flanders ii) Innovation Partnerships & Lead Market Initiative (EC), Innovation Platforms (UK, Flanders); Equipment catalogues (China to 2011)
Incentivising innovative solutions	<ul style="list-style-type: none"> i) Risk of lack of take up of suppliers innovations ii) Risk aversion by procurers 	<ul style="list-style-type: none"> i) Calls for tender requiring innovation; Guaranteed purchase or certification of innovation; Guaranteed price/tariff or price premium for innovation ii) Insurance guarantees 	<ul style="list-style-type: none"> i) German law enabling innovation demands in tenders; UK Forward Commitment Procurement; China innovation catalogues (to 2011); Renewable energy premium tariffs (DE and DK) Immunity & certification scheme (Korea)

Source: Georghiou et al. 2013

The rationale for Pre-commercial procurement schemes (PCP schemes) is similar to PPI schemes. However, in addition, PCP schemes also tackle supply side deficiencies, i.e. the lack of risk capital for companies which seek to translate ideas into innovations. Further, in contrast to PPI schemes, PCP schemes support the supply side, not the buying organisation. On the basis of a clearly defined need, public organisations buy R&D services (via a grant or a contract) from firms in order to develop solutions (up to a prototype) for specific needs that public authority defines in a call for tender. There are a range of different PCP schemes across OECD countries. The most established and biggest one is the SBIR scheme of the US Federal government which has different variants across different Federal departments and agencies. Established schemes in Europe include the Netherlands and the UK schemes (Rigby, 2013). All those schemes work through multi-stage competition, whereby normally a first stage asks firms to design solutions, a second stage – with a lower number of competing firms – asks for development of a prototype. A third stage which is not usually financed by government (although there are exceptions, such as the UK's SBRI Healthcare) is considered to exist to develop technologies further towards commercialization (ibid, p. 7). For those schemes, the WTO and EU directives for public procurement of products and services does not apply. Evaluations of those PCP schemes suggest some economic impacts, even if methodological shortcomings are taken into consideration.

Interplay between IPRs and Public Procurement of Innovation

IP plays a role in all those public procurement practices which involve the generation of innovation, and thus potentially the mobilisation of IP in the process. It follows therefore that IP and IPR are of importance in PCP schemes, and in those PPI activities in which suppliers have to develop an innovation that subsequently is bought. This means all policy schemes supporting procurement of innovation or pre-commercial procurement of innovation need to take IP issues into consideration.

IP in the context of public procurement of innovation raises potential tensions: if the IP is with the buying organisation, firms may have limited interest to engage in innovation, as has been

shown in evaluation of PCP schemes (Rigby, 2013). It is mainly for this reason that in the European context IPR generated within a PCP remain with the firm to incentivise firms to participate, although the government retains a right to use in these cases. A key issue of concern in PCP schemes has been the question of pricing the IPR ex ante and the difficulties of so doing in order to ensure that the practice of allowing firms to retain the IP does not constitute illegal state aid.¹⁹ Outside the PCP format however, IP may be published by the public authority for future tenders or otherwise diffused and thus the innovator has no longer the exclusive right to use the IP produced. In general, if the IP is with the selling firm, the incentive to innovate is higher, it can also reduce the speed of innovation diffusion as IP is often contested and has to be defended in court – which especially for small firms can be problematic (Rigby 2013). Further, the public authority may be locked in, i.e. tied up with this specific seller²⁰ for years after the purchase as IPR limits the freedom with which the public body can approach the market for future procurement for subsequent and related products and services. In addition, if firms keep the IPR, public authorities may be less likely to combine different innovations and firms into greater innovation platforms²¹ and the knowledge and innovation that was paid for by the public purse may not diffuse as broadly and quickly as envisaged by the public body.

Based on a range of examples from procurement authorities, a European Network of Procurement authorities suggests sharing IP between vendor and buyer, so that the buying organisation can “use and apply the IP”, and the vendor can keep the IP and use it commercially. Possible approaches include²²

- Licensing, i.e. free non-exclusive licenses, where the IP holder can use the IP for other commercial purposes, while the buyer can use the IP freely
- open licenses with royalties, where the public organisation has the right to change and further use the innovation for its own purposes, and apply the innovation in future works, including contracting out to third parties, while paying royalties to the IP holder.

(m)

As concrete IP arrangements can be manifold, they need strong strategic management, with a clear idea by the buying organisation of what kind of IP will be produced and how this would impinge upon future activities of the public authority

In sum, all the above means that policy that supports public procurement of innovation and PCP must take IP into consideration and offer support for intelligent sharing agreements. IP arrangements are a concern particularly in PCP arrangements, where IP is much more likely. An ex ante evaluation of PCP in the field of security indicates that IPR issues are of concern to stakeholders, but are not seen as major obstacles to implement PCP.

Conclusion

The aim of this review was to understand the interplay of IPR with innovation policy and innovation policy instruments. We started with a set of policy areas and instruments that were

¹⁹ Apostel (2014), I am also grateful to John Rigby.

²⁰ Procurement of Innovation Platform (no year): Introduction to intellectual property in public procurement of innovation. https://www.innovation-procurement.org/fileadmin/editor-content/Guides/Intellect_Property_Rights_guide-final.pdf, accessed May 08 2015

²¹ For this point we are grateful to John Rigby who is an expert for PCP schemes (see also Rigby 2013).

²² See footnote above.

based on suggestions of WIPO and agreed in the discussion after the first interim report. As highlighted in the introduction, we need to recall that the report is *not* about the importance of IPR for innovation as such. On this, the literature is endless, as changing modes and practices of innovation and ever more sophisticated IPR strategies of firms and research organisations continue to challenge our understanding of the meaning of IPR for innovation generation and diffusion. At the macro level, the impact of IPR regimes on innovation has become a controversial and much debated public issue as well as an academic subject.

In this section we draw together the conclusions of this review, summarising the main findings and formulating policy recommendations. These recommendations are high level as the literature reviewed most often does not focus on the question of interplay between IPR and innovation policy at an operational level and thus does not develop recommendations in that regard.

The literature gap

We start by noting that the academic literature in innovation studies has not yet made a systematic effort to look how innovation policy interacts with IPR regimes and practice. There is a considerable literature regarding the effects of IPR on innovation in different sectors and for different technologies. There is also considerable work on the effect of institutional IPR reforms, mainly Bay-Dole in the US and subsequent regulatory changes in other countries, on innovation, transfer and commercialisation. Equally, the literature on innovation policy is enormous and growing. However, there is very little literature that looks at the *interplay* of *innovation policy* and *IPR*. For any researcher interested in this intersection, this poses a challenge to scan and analyse a vast amount of literature with very few instances of explicit discussion of the intersection of interest.

Those gaps need to be filled to inform a more systematic discussion both on the development of IPR regimes and management and innovation policy that can utilise the IPR system or will better understand the effects the IPR system has on the appropriateness, effectiveness and efficiency of innovation policy interventions. Areas in which we see particular need for more thorough analysis of the interplay of innovation policy with IPR are

- the systemic effects of institutional changes of IPR regimes (such as the Bayh-Dole Act) on the conditions for and direction of the generation of knowledge and the transfer of knowledge into commercialisation;
- the implications that new modes of innovation (open innovation, user-producer interaction, user driven innovation) have for IPR systems;
- the Patent Box, as this is a policy approach that is more and more common across the OECD world but still not fully understood in its implications;
- the relative meaning of IPR management in the portfolio of advisory and brokerage support that is given to companies;
- the meaning of IPR for the attraction of foreign and expatriate scientists;
- practices of developing countries to improve their IPR regimes and link IPR to innovation and science policy;
- the IPR management of public policy departments, agencies and other public organisation which has inherently policy implications;
- the way in which IPR management and strategies of different kinds of firms (size, age, technological base) in different sectors intermediate the effect of innovation policy.

Three types of relationships of IPR and innovation policy

The review has shown that we can and indeed need to distinguish three different roles that IPR play in innovation policy.

- Institutional reforms to serve innovation policy goals: we see a few instances where reforms in IPR themselves have been done with a view to support certain kinds of innovation behaviour, with the classical example of the Bayh-Dole Act that was designed to enhance the incentives of organisations to increase their technology transfer through licensing;
- Instrumental use of IPRs to serve innovation policy goals: we see instances where IPR is used as a deliberate, planned component of innovation policy. This is true for example in some pre-commercial procurement schemes, where keeping the IPR with the firm is part of the incentive of the instrument, or the Patent Box, where profit based on patented innovations gets a special tax treatment, with the expectation that more innovation is actually produced and commercialised in the location in which the Patent Box is granted;
- Incidental impacts of IPRs on the effectiveness and efficiency of innovation policy interventions: we recognise that IPR conditions and practices interfere with the effectiveness and efficiency of innovation policy instruments, without IPR conditions and practices being part and parcel of the policy design and implementation.

This distinction is important, because it reminds us of the fact that much of the role of IPR in innovation policy is not intended and it clarifies that the interplay needs to be understood from both perspectives, the IPR perspective and the innovation policy perspective.

On the basis of the review we can conclude that there are surprisingly few policy instruments which use IPR deliberately and instrumentally. IPR in most cases are not the main means of innovation policy nor are they the main hindrance for the implementation of innovation policy measures. In fact, IPRs are either ignored in policy making or they are – at best – seen as a context condition that needs to be taken into consideration to optimise the effect of an instrument. However, we have seen that IPR can be mobilised for innovation policy goals and that they indeed do play an important role in the effectiveness and efficiency of existing policy measures, especially those that seek to increase connectivity of actors.

Deliberate use of IPR for innovation policy (institutional reform and instrumental use)

The deliberate use of IPR in innovation policy to support innovation and commercialisation activity is rare, but there are two prominent examples. Perhaps the most important case has been Bayh-Dole and similar national legislation that shifted the exploitation rights and responsibilities to Universities and their technology transfer offices (*institutional reform*). The review has shown that the effect of Bayh-Dole on patenting and licensing are ambiguous. Patenting and licensing have increased, but allegedly within an already increasing trend. Further, there are a range of potential drawbacks, such as change of research rationales for University academics (more application oriented, less “open”), the limitation of the dissemination of research methods and tools that are part of patents and potential disruptions of the important interaction between inventor and potential licensee, with a danger that technology offices are a middleman that hinders rather than supports this relationship. The review has also shown that the proper and professional functioning of technology transfer offices is a crucial enabler of

transfer, more important than the actual legal framework for patents in Universities. The literature review thus points to the importance for innovation policy makers to support IPR management and support in Universities but not just through a simple change of regulation towards Bay-Dole. And it points to the need to monitor the breadth and depth of patenting within Universities in order to avoid the danger that the immediate, short term monetary benefits of patent and licensing activity in Universities do not come at the cost of long term knowledge generation. Innovation policy needs to have this balance in mind, rather than measuring its success in the number of patents coming from Universities.

WIPO could play a crucial role in contributing to a more balanced and enlightened view of the effects of institutional reform that puts universities and their transfer offices in the driving seat for commercialisation of academic knowledge and help to ensure that long term consideration of open science and basic research in universities are not sacrificed for mid-term commercialisation benefits and that academic inventors are not hindered in their efforts to engage with the market and behave entrepreneurial.

The second most important, and more recent, example of using IPR system to generate more innovation and commercialisation is the Patent Box. Here, the IPR system itself was not changed, but IPR were directly linked to monetary incentives (*instrumental use*). The review has shown that while there is some logic to the Patent Box, there are two serious drawbacks. First, there is a danger that the commercialisation of patented inventions takes place at the location of the best tax conditions, not supported by underlying R&D activity and production in the same country that grants the tax advantage. The simple solution of making the performance of underlying R&D, and even production, a requirement for the Patent Box has, as shown in the report, failed within the EU. Second, the Patent Box can contribute to a tax race to the bottom, which further incentivises multi-national firms to exploit tax conditions across the world without actually increasing their innovation activity.

Again, the role of WIPO could be to support an enlightened discourse on the Patent Box as an innovation policy instrument. WIPO could and should be a driving force in generating knowledge about the effects of the Patent Box. While there are many studies on the role of Bay-Dole Act for innovation (showing considerable ambiguity as to the net effects), there is still a lack of understanding in relation to the systemic effects of the Patent Box and its spread across the world for the competition between locations for corporate R&D and the overall tax revenue generated by firms.

Incidental impacts of IPR

By far the most important findings of this study concern the incidental impact of IPR on innovation policy measures. These can be grouped in two dimensions: IPR management support and IPR and public procurement.

IPR management as one dimension in innovation support

One major feature of innovation policy is to build up capacity for innovation generation and absorption (advisory services), for the setting up of science based companies (science parks and incubators) and for the ability to interconnect with other actors and external knowledge sources in the innovation system (information and brokerage support). The literature review has demonstrated that all those innovation policy measures need IPR management support

(especially SMEs) in order to best exploit the potential of IPR for their innovation and commercialisation activities. This ranges from being made aware of the IPR opportunities to tracking IP development within the firm and to the technical and legal means of applying and defending them. The support of skills to drive innovation should include the build-up of IPR expertise, especially in developing countries.

The role of WIPO in advising governments could be to link their IPR expertise with innovation management and brokerage expertise in countries, to build up capacity in those agencies and offices that support SMEs in countries, especially developing countries (from incubators to management advisory services). This includes expertise of agencies and intermediaries as to IPR management and legal issues as well as the knowledge of how to use IPR databases for technology searches.

IPR and public procurement practice and policy

Public procurement is an important lever for innovation. Policies that support public procurement have become more prominent in the innovation policy portfolio of OECD countries. The available literature on public procurement policies and IPR focuses on pre-commercial procurement which supports the development of solutions for problems and needs of public sector organisations. The review has shown that broad policy and consultancy activities in recent years have already led to a range of guidelines for the application of IPR in those schemes. The important policy lesson in relation to the purpose of this study is that there is a tension between (1) the incentive for a private firm to invest in the development of a solution that it then can commercialise exclusively and in the markets of its own choice, and (2) the desire of public policy organisations for a quick and efficient diffusion of knowledge and innovations that have resulted from public procurement policies or normal procurement activities.

The role of WIPO here would not be to formulate guidance for PCP schemes – very sensible guidelines are available already, especially in the EU context. WIPO could however support Member States in understanding the paramount importance of IPR especially for public procurement policy and the inherent tension between the public good and private incentives. The ignorance about the existing tensions and how they can be overcome seems to be one of the most important reasons why public procurement of innovation does not realise its potential as an intelligent policy intervention combining innovation policy goals with other policy goals.

IPR, innovation policy and connectivity

A further main theme of innovation policy – arguably one of the major themes in the last 20 years – is to support connectivity in the system, to enable flows of knowledge, people and resources and to support the joint generation of innovation. IPR play a crucial role for connectivity, and thus also for all policy measures that support connectivity, such as measures to support collaboration and cluster (and network) policies, to enable open coordination in its broadest sense, and to intermediate in order to enable actors to connect themselves. The trend towards open innovation has made connectivity and exchange even more important, and with it the role of IP and how to deal with IP in open exchange networks is crucial for innovation policy.

The review has shown the importance of IPR for connectivity, both for collaboration and for exchange, and subsequently for the commercialisation of results of joint action. One function of IPR is the reduction of ambiguity, i.e. signalling of technological competence to potential partners, which reduces search and coordination costs of partnerships, both between firms and between firms and Universities. Especially in the wake of open innovation with its broadening appeal of exchange and cooperation, IPR have increasingly become a means of exchange, a currency, establishing an “intermediate market” that enables the broader exploitation of technology. Moreover, we have seen that the signalling function of patents is important for investors in early stage innovations and companies (venture capitalists, business angels).

Another feature of IPR is that it enables formal collaboration. IPR can build up trust, as they establish a level of certainty about who owns what and who will own what. Trust is an essential requirement for connectivity, and this aspect of IPR is thus crucial for the majority of innovation policy measures.

The literature on innovation policy we reviewed in this study does not suggest that IPR support in the context of innovation policy should simply maximise the number of formal IPR in order to enable actors to play the game. Rather, the literature points towards a measure of constraint. While IPRs are one important means of communication, coordination and exchange, this review has shown that a very strong IPR regime with a large number of patents can have drawbacks for networking and innovation generation per se. IPR can reduce the ease with which firms, especially small companies (and especially in the software sector), can build upon prior knowledge, firms are often afraid of partners infringing patents and of revealing technological knowledge that they would prefer not to reveal for the fear of imitation (through powerful actors, by circumventing violation, etc.), and smaller firms are potentially overwhelmed by the cost of patenting and following up on patenting. Innovation policy needs to be sensitive to the balance of the advantages of strong IPR and good IPR management on the one hand and the potential drawbacks on the other. A simple message of maximising the application of formal IPR in the context of innovation policy is potentially counterproductive.

The policy recommendation here is straightforward, and WIPO could ensure that the administrations responsible for IPR in their Member countries are aware of the enormous positive and potentially negative role of IPR in innovation policy measures aimed at connectivity. If innovation is more and more the result of connectivity, and if IPR has become a currency in this exchange, then the case for IPR support in the connection with any connectivity support is becoming even stronger. Policy measures to support connectivity, cluster and network policies, R&D collaboration policies, and open innovation policies more generally will need to include in their design and implementation the issue of IPR in its broadest sense. Beneficiaries of those policy support measures need to be informed and required to clarify if intellectual property is about to be created through a new connection, to identify pre-existing IP, to monitor and capture intellectual property in the process and to agree on contractual and procedural arrangements as to how partners deal with IP that will be generated. This is more important for asymmetric partnerships, as smaller and less powerful actors need to be protected and informed. And lastly, venture capital schemes need to focus more on the signalling function of IPR, the implementation of those schemes would need to support both investors and entrepreneurs in the management and assessment of patents.

Attracting capacity (companies and individuals) and the role of IPR

Beyond the example of the Patent Box, the literature review has shown that intellectual property rights do not feature in the literature on policy measures to attract firms and individuals into a country. Certainly for developed countries with a strong IPR regime, IPR do not seem to be a major distinguishing context condition. The situation is different for developing countries, though. Here we have seen that differences in IPR regimes make a difference for firms in their decision to invest in R&D. IPR interferes with other policies to attract foreign companies: the IPR regimes can enhance or diminish the appeal of tax or other investment seeking policies, and creating stable IPR conditions with enforceable rights is thus a key concern for innovation policy in developing countries. To strengthen the IPR regimes in developing countries is one of the most important means of *innovation policy*, as it lowers the dis-incentives for firms to perform R&D and as it increases the options of and pressures for of domestic firms to develop and protect their own IP and develop from imitator to innovator.

The role of WIPO especially in developing countries thus should be to make a case of the importance of a strong IPR regime in the country with a strong jurisdiction, supported by intermediaries, specialised agencies that support IPR management and implementation and support foreign investors as well as indigenous firms. These are major requirements to become an attractive location for innovation and – even more important – for increasing the pressure for the system to develop more innovative capacity within the country.

Enabling a more productive interplay

The main conclusion – and policy recommendation – is to work towards better capabilities and awareness on both sides of the divide between IPR policy and innovation policy. Innovation policy makers must be supported in their understanding of IPR, not only for the big picture, but in an operational detail that makes them understand how exactly the features and practices of IPR, intentionally or unintentionally, interfere with the performance of innovation policy measures. Those responsible for supporting IPR regimes and practices throughout the world, especially in developing countries with their need to attract foreign competencies and move from imitation to innovation, need to realise how crucial strong IPR regimes are, and where and how they can become counterproductive. This report is simply a beginning in a journey of enabling a more productive interplay of IPR and innovation policy.

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Annex - Terms of Reference

Objective of the assignment

To undertake a review of academic works published on or after January 1, 2000 to date (bearing in mind that if there are works published immediately before January 1, 2000, that may have an important bearing on this exercise, they may be included) to explore to what extent, in what manner and with what objective intellectual property has been considered in innovation policy making. It is expected that such a review would facilitate a better understanding of current thinking in academia on this issue which would be a useful input to WIPO as it develops its program of work on integrating IP into innovation policy making.

Deliverables/services

- (a) A report summarizing the findings, demarking issues and trends, identifying patterns of thinking and which includes recommendations for the consideration of WIPO in general and the Innovation Policy Section in particular for engaging with policy makers and the innovation community for better integrating IP in innovation policy making.
- (b) The report may, in particular, consider the following areas of policy making and explore the relevance of intellectual property in such areas:
 - a. Encouraging the transfer of knowledge from the research base to industry.
 - b. Encouraging a venture capital industry and angel investors.
 - c. Setting up/supporting science parks and incubators.
 - d. Encouraging foreign R&D to locate in the country through investment policies and tax policies.
 - e. Encourage foreign scientists and technical expertise into the country through immigration policies.
 - f. Encouraging nationals residing in foreign countries to relocate in the country, bring their knowledge and experience and to start businesses.
 - g. Tax policies for encouraging IP intensive companies to commercialize in the country, encourage private R&D etc.
 - h. Government procurement as an instrument of innovation.
 - i. Government support to the enterprise sector.
 - j. Cluster policies.
 - k. Open innovation
 - l. Promoting Institutional IP management within government departments.
 - m. Establishing a focal point/committee/task force on innovation.
- (c) The report may also suggest possible ways WIPO may consider supporting its member states as they engage in innovation policy formulation for integrating better the IP system in such policies.