norden

NORDIC ECONOMIC POLICY REVIEW

NUMBER 2 / 2015

norden

Managing Editor
Professor Torben M. Andersen, Department of Economics,
University of Aarhus, Denmark.

Special Editors for this volume
Professor Torben M. Andersen, Department of Economics, Aarhus University and
Professor Jesper Roine, Stockholm Institute of Transition Economics, Stockholm
School of Economics.

Papers published in this volume were presented at the conference "Whither the Nordic Welfare Model" hosted by the Ministry of Finance, Finland, October 2015. This project was financed as part of the Danish presidency flagship program "The Nordic 'supermodel'?"

Nordic Economic Policy Review

Whither the Nordic Welfare Model?

Torben M. Andersen, Jesper Roine, Bernt Bratsberg, Knut Roed, Michael Svarer, Michael Rosholm, Tuomas Takalo, Otto Toivanen, Guttorm Schjelderup, Julian V. Johnsen, Katrine V. Løken, Helena Holmlund, Nabanita Datta Gupta, Bent Jesper Christensen, Andreas Bergh, Johanna Mollerstrom and Kalle Moene

TemaNord 2016:503

Nordic Economic Policy Review
Whither the Nordic Welfare Model?
Torben M. Andersen, Jesper Roine, Bernt Bratsberg, Knut Roed, Michael Svarer, Michael Rosholm, Tuomas Takalo, Otto Toivanen, Guttorm Schjelderup, Julian V. Johnsen, Katrine V. Løken, Helena Holmlund, Nabanita Datta Gupta, Bent Jesper Christensen, Andreas Bergh, Johanna Mollerstrom and Kalle Moene

ISBN 978-92-893-4450-0 (PRINT)
ISBN 978-92-893-4452-4 (PDF)
ISBN 978-92-893-4451-7 (EPUB)
http://dx.doi.org/10.6027/TN2016-503
TemaNord 2016:503
ISSN 0908-6692

Layout: Hanne Lebech
Cover photo: PUB, UNIT/NCM

Print: Rosendahls-Schultz Grafisk
Printed in Denmark

www.norden.org/nordpub

Nordic co-operation

Nordic co-operation is one of the world's most extensive forms of regional collaboration, involving Denmark, Finland, Iceland, Norway, Sweden, and the Faroe Islands, Greenland, and Åland.

Nordic co-operation has firm traditions in politics, the economy, and culture. It plays an important role in European and international collaboration, and aims at creating a strong Nordic community in a strong Europe.

Nordic co-operation seeks to safeguard Nordic and regional interests and principles in the global community. Common Nordic values help the region solidify its position as one of the world's most innovative and competitive.

Nordic Council of Ministers
Ved Stranden 18
DK-1061 Copenhagen K
Phone (+45) 3396 0200

www.norden.org

Contents

4. Economics of Innovation Policy[1]

Tuomas Takalo, Hanken School of Economics and HECER and Otto Toivanen, KU Leuven, Aalto University and CEPR

Abstract

We argue that the design of innovation policy in the Nordic countries should better acknowledge i) the uncertainty related to outcomes of innovative activities, ii) the benefits of agglomeration, iii) the effects of being small open economies, and iv) the impact of digitization. All these call for a predictable institutional environment that allows research-resources to agglomerate through a bottom-up process and to flow to their best, often unexpected, uses. Indirect innovation policies such as e.g. basic research, education, competition policy, and financial and labor market regulations may be more important than direct innovation policies such as intellectual property and government support for private R&D, especially in small open economies where benefits from direct support of private R&D and strong domestic intellectual property rights are low.

[1] Tuomas Takalo, Hanken School of Economics, E-mail: tuomas.takalo@gmail.com. Otto Toivanen, KU Leuven and CEPR, E-mail: otto.toivanen@kuleuven.be. We thank Ari Hyytinen, Markku Stenborg, Matti Pohjola, Jesper Roine, Petri Rouvinen, and the seminar participants at the NPER conference in Helsinki for useful discussion and comments. Toivanen thanks the Bank of Finland for hospitality. The usual caveat applies.

4.1 Introduction

The key driver of economic growth is innovation (see, e.g., Aghion and Howitt, 2009). This consensus on the policy goal – to foster innovation – has not lead to agreement as to the means to achieve it. Recent books written by academics for the wider audience illustrate the large variation in policy advice: Lerner (2009a) and Acemoglu and Robinson (2013) argue that governments should focus on creating the right institutional environment for the private sector to work. Mazzucato (2013) and Atkinson (2015) make strongly the case that governments should take an active role in choosing the direction of research, development and innovation activities. The objective of this article is to discuss what economic research suggests as to what innovation policy should look like and what role the government should take.

At the heart of the economic approach to innovation policy is the concept of market failure which creates a wedge between social and private returns to innovative activity.[2] The main market failure in the area of innovation is the imperfect appropriability of the returns to research and development (R&D) investments, as innovative firms and individuals cannot capture all benefits that their innovations provide, but share them with consumers and other firms and users (Nelson 1959 and Arrow, 1962).[3] Financial market imperfections in relation to the funding of R&D investments are often mentioned as another important market failure (see Hall and Lerner 2010 and Kerr and Nanda 2014 for surveys). As a result of these market failures, the private sector is likely to invest too little in R&D activities.[4] Roughly speaking, the private sec-

[2] Some scholars such as Nelson (2009) and Mazzucato (2013) forcefully argue that market failure allows a too narrow role for the government, and advocate the systems of innovation approach instead. We primarily view this difference as a semantic one. For example, in the cases that Mazzucato (2013) brings forth to argue for an active government, the government acts to correct market failures such as missing markets, imperfect competition, imperfect information and other systemic problems that are not solved by market forces.

[3] We will use the words "R&D", "invention", and "innovation" almost interchangeably albeit they do involve subtle but important differences. See, e.g., Carlino and Kerr (2015) for a discussion.

[4] R&D projects may also generate negative social externalities (e.g., competition at the marketplace may lead to business stealing and duplication of R&D costs). While in theory these adverse effects of R&D investments could result in overinvestment in R&D, in practice underinvestment due to imperfect appropriability and financial market imperfections is a much more likely outcome. For example, Jones and Williams (1998)

tor should take care of activities where social welfare mainly consists of private profits, and the government should provide those activities with high social returns but low or non-existing private profits, and in the possibly large grey area in-between, the government may design policies that complement innovation in the private sector and steer the private sector to choose actions that are closer to the social optimum.

The starting point of our analysis is the fundamental challenge of innovation policy: how to encourage the development of new innovations while achieving the potentially conflicting goal of ensuring maximal diffusion of those innovations? We stress four features that shape innovative activity and the government's role in it. First, there is considerable uncertainty as to who will succeed in research and in commercializing that research and when. The endemic informational problems in innovation create scope for both positive and negative unintended consequences of government policies.[5]

The second feature which we stress is agglomeration. Evidence (e.g., Jaffe,1989, Cowan and Zinovyeva, 2013, and Carlino and Kerr, 2015) suggests that agglomeration of innovative activities leads to higher productivity, and should thus be encouraged. In our view the best option to foster agglomeration is to invest in high-quality basic research and to build an institutional environment that channels, in a bottom-up manner, human and financial capital to those geographic and intellectual areas that show signs of success.

Our third key feature is the universal good nature of knowledge.[6] This is a two-edged sword for the Nordic countries: On the one hand, it means that the Nordic countries should actively suck in new knowledge generated by the more than 99% of human population living elsewhere.

---

estimate that the socially optimal level of R&D in the US would be 2–4 times the actual one, despite all the policies of promoting innovation that are already in place.

[5] Holmstrom and Myerson (1983) provide an important analysis of how incomplete information affects the social planner's problem of which policy to choose.

[6] Admittedly there is evidence that knowledge spillovers are still to some extent local (which provides a rationale for favoring agglomeration within countries, as discussed in the previous paragraph). At the same time, there is plenty of evidence of increasingly strong international knowledge flows (see, e.g., Griffith *et al.* 2011). As an early example, the first Finnish telephone company was established in Helsinki in 1877, only in a year after Bell got his patent on the telephone in the US.

On the other hand, this means that a large part of the wedge between social and private welfare, i.e., the very basis for an active government role in supporting innovation, disappears.[7] Almost without exception, the existing literature on innovation policy takes a "large country" approach. Some policy conclusions, however, may change markedly when a small open economy approach is adopted.

Fourth, the design of innovation policies should take into account that we are only in the early phases of digitization that is increasing international knowledge flows and bringing other large but unknown changes to us. The best way to prepare for the future is to provide a sound institutional structure that allows the economy to adjust. This calls for increased flexibility at all levels of the institutional set-up, and especially in education.[8]

This takes us to the main point of this article: the most important innovation policies are likely to be "non-innovation" policies that determine the institutional environment for innovation but are not directly aimed at promoting innovation. Education, basic research, financial and labor market regulations, competition and regional policies, and bankruptcy laws are examples of "indirect innovation" policies that may affect innovation more than direct innovation policies such as intellectual property, and government support for private R&D.

The remainder of the paper follows the above themes, In Section 1 we discuss direct innovation policies. Section 2 is devoted to indirect innovation policies. We offer conclusions in Section 3.

---

[7] A large part of the wedge between social and private welfare is consumer surplus. In the case of, say, Astra pharmaceuticals, most of the consumer surplus generated by Astra's new drugs resides somewhere else but in Sweden and should be ignored when designing an innovation policy that maximizes the social welfare in Sweden. Also, technological spillovers contributing to the welfare wedge partially flow abroad.

[8] For research on the impact of digitization, see, e.g., Greenstein *et al*. (2013) and Goldfarb *et al*. (2015). Brynjolfsson and McAfee (2015) and Bessen (2015) popularize this research.

4.2 Direct innovation policies

4.2.1 Intellectual property rights

Intellectual property has many facets that have been extensively analyzed (see, e.g., Menell and Scotchmer, 2007, for a survey). Intellectual property attempts to solve the fundamental tradeoff of innovation policy by legal means, as it confers an innovator a temporary exclusive right to her innovation. This right provides a possibility to monetize innovation and thereby enhances the incentives to innovate. After the right expires, the innovation and protected knowledge becomes freely usable. The basic disadvantages of intellectual property right are the reduced consumer surplus and technological spillovers that follow when the property right is in force. Basic economic theory (see, e.g., Takalo,2001, for a summary) suggests that as a result of these trade-offs, there should be an inverse-U shaped relationship between social welfare and the strength of intellectual property protection.

Somewhat puzzlingly, however, to date there is little evidence that stronger intellectual property generates more innovation (see. e.g., Boldrin and Levine, 2008 and Lerner, 2009b). As a necessary condition for a welfare improving intellectual property policy is that it enhances incentives to innovate, this suggests that weaker intellectual property rights would be optimal.

Over the recent decades economic research of intellectual property has focused on cumulative innovation, which has produced a more nuanced view of the intellectual property system. On the positive side, the intellectual property system has created a market for knowledge (for evidence, see, Branstetter *et al*., 2006, Serrano, 2010 and Galasso *et al*., 2013) that in some circumstances may have facilitated knowledge transfers and financing of innovations. But the literature has documented another major draw-back of the intellectual property system: the boundaries of intellectual property rights are inherently imprecise and are ultimately defined by courts. From an innovator's point of view this leads to a threat of intellectual property disputes, which acts like as a tax on innovation. As a result, the basic theoretical result of the positive effect of stronger intellectual property on innovation may be overturned when innovation is cumulative and boundaries of intellectual property imprecise (see, e.g., Bessen and Maskin, 2009), potentially explaining the puzzling empirical results.[9]

Even when these more complex effects are acknowledged, stronger intellectual property rights are hardly welfare improving. If anything, recent empirical research suggests that social costs related to imprecise boundaries of intellectual property rights are rising and, at least in the US, may exceed the social benefits of the intellectual property system (Jaffe and Lerner, 2004, Boldrin and Levine, 2008, Bessen and Meurer, 2008, and Turner *et al*., 2013).[10]

For a small open economy, an optimal intellectual property system would probably warrant strong intellectual property rights in the rest of the world but weak intellectual property rights at home (Scotchmer 2004a). This would allow the country's own citizens and firms to use and experiment with innovations developed elsewhere more easily but exporting firms would nonetheless have incentives thanks to strong intellectual property rights abroad. The drawbacks of the strong intellectual property rights would be borne by citizens and firms abroad.

4.2.2 Government funding of private R&D

Public funding of private R&D through subsidies, soft loans, and tax incentives is a widely used policy tool. OECD countries spent almost USD 50 billion of taxpayers' money on supporting private R&D in 2013.[11] Governments have also adopted more tools over time, especial-

---

[9] Some recent empirical papers attempt to test the predictions of the basic theory of intellectual property, and the theory of intellectual property with cumulative innovation separately: See Izhak *et al*. (2015) for the basic theory, and Williams (2013), Sampat and Williams (2015), and Galasso and Schankerman (2015) for cumulative innovation. The findings of these studies support those of the earlier ones: A positive causal effect of stronger intellectual property on innovation is difficult to come by.

[10] An important exception is Aghion *et al*. (2014) who show that countries with stronger intellectual property regimes may benefit more from reforms that enhance competition in the marketplace.

[11] We arrive at this figure by multiplying Business Enterprise R&D (BERD) measures in 2010 PPP USD by the percentage of BERD financed by government, obtained from OECD Main Science and Technology Indicators www-site (accessed 16 September 2015). The same figure for the 5 Nordic countries was a little over USD 1billion.

ly introducing R&D tax credits (e.g., Finland introduced tax credits for 2013–2014, and Sweden in 2014).

The basic mechanism of most of these support schemes is similar in that the government pays some fraction of the marginal cost of R&D.[12] Lowering the marginal cost means that a supported firm invests more, at least partially closing the gap between the privately and socially optimal levels of R&D. There is also a hope that additional finance by the government would attract new firms to start R&D, but recent research shows that existing policies merely lowering marginal costs of R&D are not effective policy tools to this end (see Czarnitzki *et al*., 2015 and Lach *et al*., 2015). Extrapolating the results from the literature on corporate taxation (e.g., Devereux and Griffith, 1998), it is likely that average R&D cost, and not the marginal one, is what matters for the firms' discrete decisions on whether to start investing in R&D or not.

These financial support policies have also important differences. First, subsidies can be tailored for each project for which the government receives an application (for research that makes use of this, see Takalo *et al*., 2013a), whereas every eligible firm can make a claim for tax credits.[13] One thus needs to trade off the propensity of firms to apply and receive support with the government's ability to tailor the support to the particular project. The application process for subsidies also means that the government may become a focal point for information on emerging agglomeration patterns.

Second, tax incentives in their purest form only work for firms that are profitable and pay taxes. This severely hampers their effectiveness in encouraging start-up innovation. Many countries like Norway and the Netherlands have therefore resorted to "subsidy-like" tax incentives where the R&D-performing firm gets what amounts to a discount on labor-related social costs and taxes. A further problem with tax credits, especially if they have a cap, is that a large part of government expendi-

[12] This is the case e.g. in all the European countries whose schemes we are familiar with.

[13] In several European countries the probability of applying for an R&D subsidy is usually below 10%, and below 20% even for R&D performing firms (see Czarnitzki *et al*. 2014). One should however note that the uptake of R&D tax credits is not universal either. Busom *et al*. (2012) report a usage rate of less than 50% in Spain for R&D – performing (i.e., eligible) firms, and in the Netherlands the usage percentage is round 80% for firms with > 10 employees and round 40% for smaller firms (Verhoeken *et al*. 2012).

ture consists of transfers to firms investing beyond the cap, with no incentive effect.[14] For this reason some countries (e.g., US) give tax credits on incremental R&D. This in turn distorts firms' investment decisions over time.

Given the amounts of tax euros channeled to private sector R&D through these policy tools, it is no surprise that a vast empirical literature studying their treatment effects exists.[15] Takalo *et al*. (2013b) emphasize that the extent to which government support increases private R&D do not directly map into social benefits. The reason is that a firm equates the private benefits of R&D with the marginal cost of R&D, but ignores consumer surplus and knowledge spillovers. For example, a small increase in an investment in an R&D project creating large consumer surplus and spillovers may be socially much more beneficial than a large increase in R&D in a project with small (but still positive) consumer surplus or spillovers.

In small open economies, one should pay attention to the share of consumer surplus and spillovers flowing outside the borders where they do not benefit the local tax payers (Conti 2015 and Czarnitzki *et al*., 2015). While existing policies typically impose restrictions on offshoring of government funded projects, the open-economy view could call for more radical changes in policy-thinking. For example, if the outflows of consumer surplus and spillovers constitute a large share of the welfare effects of R&D beyond private profits, private R&D without support may be close to the socially optimal level from a national point of view. For another example, while the standard theory suggests that R&D projects waiving (strong) intellectual property should be prioritized when granting R&D subsidies, in a small open economy the argument is weaker in the case of exporting firms. These open-economy considerations also suggest that the benefits from international coordination of

[14] For example, both the Finnish R&D tax credit scheme (that was in place 2013–2014) and the Swedish one introduced in 2014 have such a cap.

[15] For literature surveys on the effects of R&D subsidies, see David *et al*. (2000), Klette *et al*. (2000), Garciá-Quevedo (2004), Cerulli (2010), and Zúñica-Vicente *et al*. (2014), and on the effects of R&D tax incentives, see Hall and van Reenen (2000), Mohnen and Lokshin (2010), and European Commission (2013).

R&D support policies could be large (see Czarnitzki *et al*., 2015 for a welfare comparison of national versus EU-wide support policies).

4.2.3 Other innovation policy tools

Prizes and contests are an old way of supporting innovation (see Scotchmer, 2004b) but over the past century they have been relatively little used. Using Maurer and Scotchmer's (2004) classification of prize types, *targeted prizes* are posted ex ante by a sponsor (e.g., a public agency) who has identified a problem to be solved. The prize is awarded to the first entity that solves the problem. For example, the Clay Mathematics Institute announced in 2000 a USD 1,000,000 prize for the first solution for each of seven unsolved mathematical problems.

Blue-sky prizes are awarded ex post for innovations that the sponsor considers valuable. A blue-sky prize could be granted in an ad hoc manner each time the sponsor observes a particularly valuable innovation, or the sponsor can commit to grant the prize. The Nobel Prize is the most well-known example of blue-sky prizes, and the Finnish Millenium Technology Prize another. The incentive of effects of blue-sky prizes are probably quite small, and they should be seen more as a marketing tool.

In contrast, targeted prizes could constitute an efficient innovation policy tool. If the rewarded solution is put in the public domain for free use, the prizes completely solve the ex post problem of diffusion of innovations. The problem with targeted prizes is that the sponsor should know ex ante what should be invented.

Setting up contests for targeted prizes helps to aggregate information from innovators, as the sponsor can compare the proposals. Modern information and communication technologies have enabled both the public and the private sector to set up innovation prize platforms (such as Challenge.gov) where not only solutions but also problems are posted. Such crowdsourcing, another manifestation of the changes brought by digitization, provides a new avenue to identify the right problems for prizes and set up contests.

Another tricky task with prizes is to make sure that they reflect the social value of innovations so that they are of proper size. Estimating a proper size for a prize is difficult since this not only depends on the value of an innovation but also the costs of creating it. Kremer (1998) proposes an interesting public patent-buyout solution to the problem of eliciting information: The patent authority could auction a patent right and use information revealed by bids so as to give an appropriate reward to the patent applicant. To preserve incentives in the auction, a patent grant should de facto be granted with a small probability, otherwise the invention could be put in the public domain. Shavell and Van Ypersle (2001) propose a simpler, but less perfect, mechanism to relate the size of prize to the value of innovation, reminiscent of the royalty-based licensing fees.

Being monetary rewards, prizes are vulnerable to misuse and ex post opportunism (e.g., once the problem is solved, why should the sponsor give the reward).[16] Furthermore, contests inherently involve duplication of R&D costs when the participants race against each other to obtain the prize.

Nonetheless, targeted prizes provide an underused tool of innovation policy. For example, there are numerous diseases that are more prevalent mostly in the Nordic countries. Posting a correctly designed prize would be a simple means to complement (the small) market incentives.

Public procurement and production also provide tools for innovation policy. Governments can provide services to complement private sector innovation, work in partnerships with private entities, buy innovations from private contractors, or directly produce innovations themselves. Such public procurement and production of innovations and complementary services have been widely used thorough the economic history (see, e.g., Scotchmer, 2004b and Mazzucato, 2013), but still may have some untapped potential for innovation policy (Edler and Georghiou, 2007).

In theory, some public innovation support services, direct public production and procurement share the benefits and costs with targeted prizes. On the one hand, the ex ante incentives to innovate can be inefficient, since the decision of what to invent and what information to produce is made by the government. On the other hand, nothing prevents efficient diffusion of innovations ex post. However, a part of public procurement

---

[16] A classic example of these problems is the Longitude prize (see., e.g, Sobel, 1995).

and production is concentrated on nationally strategic sectors such as defense with the purpose of *minimizing* the diffusion of research results.

Promotion of *research joint ventures* (RJVs) and other forms of R&D cooperation is a widely used tool of innovation policy in industrialized countries. RJVs allow participating firms to internalize technological spillovers and thereby they should enhance R&D efforts. Therefore, RJVs are, for example, prioritized in subsidy allocation decisions in several countries, and constitute a block exemption under the EU competition law. There is some evidence (e.g., Branstetter and Sakakibara, 2002) that RJVs have the stated beneficial effects in enhancing spillovers and R&D efforts. There is however also evidence that RJVs are primarily motivated by cost sharing (Röller *et al*., 2007) and lead to product market collusion (e.g., Hellman and Sovinsky, 2010 and Duso *et al*., 2014).

4.3 Indirect innovation policies

4.3.1 Education

There is rather little robust empirical evidence on the relation between education and innovation.[17] One exception is Toivanen and Väänänen (2015) who find a positive causal impact of education on invention. This suggests that indeed, a policy reaction to Jones's (2005) advice of "having more inventors in order to become richer" as a society is to increase investments in (engineering) higher education.

A key insight from innovation research is the skewed distribution of innovative outcomes, with a low median but a high mean value of innovations (e.g. Pakes, 1986 and Lanjouw, 1998). To us, this seems to call for an education system that generates a wide-skill base and allows different skills to be combined in possibly unexpected ways, i.e., an education system that encourages individuals to acquire a variety of skills and allows individuals with specialized skills to easily match with each other.

[17] There is a very large literature on the causal effect of education on individual wages.

It is well known that innovative activity is concentrated geographically and that high-quality universities play a central role in this agglomeration process (see Audretch and Feldman, 1996, for a seminal paper, and Carlino and Kerr, 2015, for a survey of the empirical evidence). Top universities contribute to the agglomeration of innovative activity in many ways. One important channel is the supply of educated individuals on which innovative activity depends: For example, Moretti (2004) finds a 0.5 percentage point increase in the plant-level productivity as the consequence of a 1 percentage increase in the share of college graduates in the population of a metropolitan area in the US.

As small open economies, the Nordic countries greatly benefit from the knowledge and innovations created elsewhere. While innovation continues to exhibit locational economies of scale also in future, digitization and modern ICT are making knowledge flows less dependent on geography (Griffith *et al.*, 2011), suggesting a crucial role for education in enhancing absorptive capacity of the countries.

4.3.2 Basic research

There is plenty of anecdotal evidence of successful private sector innovations that are based on research in government funded laboratories and universities, often without a direct commercial objective in mind (see, e.g., Mazzucato, 2013). But just as in the case of education, there is little in terms of rigorous causal evidence.[18] Basic research done at high-quality universities is a source of significant local knowledge spillovers to the private sector (e.g., Jaffe, 1989, Breschi *et al.*, 2006, and Carlino and Kerr, 2015). As innovative firms seek to benefit from these spillovers, they locate close to universities (e.g., Jaffe, 1989, Anselin *et al.*, 1997, and Abramovsky *et al.*, 2007). This forms another important channel through which universities contribute to agglomeration of innovation (Carlino and Kerr, 2015). In small open economies in particu-

[18] Sveikauskas (2007) offers a survey of the scant literature, and Hausmann (2012) and Akcigit *et al.* (2014) recent contributions.

lar, one should not discount the importance of high-quality basic research as a pull-factor of foreign R&D (e.g. Belderbos *et al*., 2014).

Any government needs to make decisions on how to allocate the resources devoted to basic research. Despite difficulties created by incomplete information, the government may well be in a position to make high-level decisions regarding allocation of resources across different fields of basic research (e.g., health vs. environment). But it should delegate resource allocation decision-making within research fields to its leading experts and allow, through that same system, reallocation across fields as a function of outcomes. Such a bottom-up approach would hopefully lead to a limited number of large, active research centres within each field that would compete against each other for top researches and funds. This should not only improve the quality of basic research but also seed up commercialization of that research (Goldfarb and Henrekson, 2003).

4.3.3 Taxation

The principles of good (corporate) taxation (see Mirrlees *et al*., 2011, pp. 22) minimizes negative effects on welfare and economic efficiency, has low administrative costs; is distributionally fair, and transparent. In cases where production or consumption of goods and services is associated with large externalities, it is theoretically justified to make exceptions to these principles. However, in practice corporate tax incentive schemes tend to become complex and unpredictable and increase tax planning and avoidance (see Mirrlees *et al*., 2011).[19] If tax incentives are used to as an innovation policy tool they should be simple, and focused on innovation or their financing incentives directly. As also concluded by the European Commission (2013), it is therefore much easier to justify, say, R&D tax credits rather than, say, IPR boxes from an innovation policy point of view.

[19] For example, in Finland corporate taxation changes almost annually (e.g., R&D tax credits were in force in 2013–2014, and business angel tax relief was introduced for years 2013–2015).

Just as there is evidence of countries competing in terms of the level of corporate taxation (Devereux *et al*., 2008), they are also likely to use various R&D incentives for the same purpose. In particular, competition for intellectual property revenues is tempting since intangible assets are relatively easy to reallocate from one location to another based on tax considerations (see, e.g., European Commission, 2013 and Griffith *et al*., 2014). In our view, introduction of IPR boxes at best amounts to a Prisoner's Dilemma – game among countries where the detrimental Nash equilibrium should be avoided by international cooperation.

In contrast, tax competition for innovative corporations and individual inventors might be beneficial for the Nordic countries: Danish evidence (Kleven *et al*., 2014) suggests that small open economies with relatively homogenous populations may benefit substantially from tax schemes that give temporary preferential treatment to foreign high-skilled individuals. Akcigit *et al*. (2014) find that top-inventors are sensitive to top income tax rates in choosing where to locate. Taxation of individual inventors should also affect their incentives and individuals' career choices.

Similarly, the effects of (average) corporate taxation are larger at the extensive margin than at the intensive margin: the possibility to make money is one of the key drivers of (high-growth) entrepreneurship (Lerner, 2009a and Isenberg, 2013). The example of earlier successful entrepreneurs and their role as business angels are vital in the creation of a culture of entrepreneurship and risk-taking. However, a large gap between corporate and personal tax rates is conducive for tax planning and avoidance efforts, and successful entrepreneurs and associated capital gains will almost by definition increase income inequality.

4.3.4 Other indirect innovation policies

Besides the policies listed above there is a variety regulatory policies that have a significant impact on innovative activity. We discuss briefly here some selected regulatory policies.

Competition policy is an important part of an innovation infrastructure (Shapiro, 2002, Encaoua and Hollander, 2002, and Segal and Whinston, 2007). According to an extensive literature, there appears to be an inverse-U relationship between market structure and innovation activity created by two opposing forces: On the one hand, competition is bad for innovation since it reduces the returns to successful innovation; on the other hand, competition is conducive for innovations since it forces the firms to innovate so as to escape competition.[20] This suggests that liberalization of protected and regulated industries might promote innovation. Intensified competition in an upstream industry may also increase innovation in a downstream industry. For example, liberalization of financial services sector not only generated frantic innovation in the industry itself but also in the real sector (Amore *et al*., 2013 and Chava *et al*., 2013).[21]

Trade policy matters for innovation for several reasons. In particular, countries that are open to trade will reap a larger part of international knowledge spillovers and the potentially greatest benefit of innovation investments made elsewhere: new goods and services. While this is uncontroversial, we need to understand much better what shapes international knowledge flows. For example, cultural aspects such as ethnicity may importantly shape international knowledge flows (Kerr, 2007). Trade also increases competition, thereby possibly changing incentives to innovate (Bloom *et al*., 2015).

In general, the beneficial effects of enhanced competition and trade openness on innovation appear to be the largest in countries like the Nordic ones where firms are closer to technological frontier and where corruption does not distort competition (Dabla-Norris *et al*., 2013 and Aghion *et al*., 2013).

From the innovation policy point of view, well-functioning *labor markets* would encourage risk taking and reallocate labor from declining industries and regions to rising ones. Also the efficiency of direct innovation policy tools may depend on the functioning of labor markets. For example, R&D subsidies and tax credit may affect only the wages of

---

[20] The classic references are Kamien and Schwartz (1975) and Aghion *et al*. (2005). Kilponen and Santavirta (2007) document the existence of the inverse-U relationship in Finland. However, Hashmi (2013) finds a negative relationship between the intensity of competition and innovation in the US.

[21] Some financial innovations clearly generated negative externalities.

R&D personnel if the supply of R&D personnel is inflexible. (e.g., Goolsbee, 1998 and Wolff and Reinthaler, 2008).

Unfortunately the empirical literature on the relation between labor market regulations and innovation is rather unsettled. On the one hand, the Danish-type flexicurity with relatively weak employment protection but relatively high unemployment benefits might be particularly conducive for start-up formation and radical innovation but, on the other hand, weak employment protection may deteriorate employees' incentives to innovate in established corporations (see, e.g., Acharya *et al.*, 2013, Bozkaya and Kerr, 2013, and Griffith and Macartney, 2014 for different results).

As mentioned in the introduction, *financial market* imperfections constitute an important rationale for an active innovation policy. R&D activities are inherently opaque, human capital intensive, and involve soft information. As a result, innovative start-ups have difficulties to access to outside finance due to informational asymmetries and lack of collateralizable assets (Hall and Lerner, 2010 and Kerr and Nanda, 2014).

It is notoriously difficult to identify the existence of such financial constraints (see Hall and Lerner, 2010 for various empirical strategies): The fact that some firms suffer from lack of finance may just indicate the financial markets work as they should, and are denying funding of bad projects. Furthermore, even in theory it is difficult to identify the right policy response to these financial market imperfections: Informational asymmetries may even lead to *overfinancing*, which would call for a punitive taxation of start-up finance (e.g., de Meza and Webb, 1987, Boadway and Keen, 2005, and Takalo and Toivanen, 2013).[22] Despite these challenges, two broad conclusions emerge. First, bank lending remains an important source of outside finance, even for start-ups (Robb and Robinson, 2014, Kerr and Nanda, 2014). Bank lending and associated credit constraints are also procyclical (Aghion *et al.*, 2012).

Second, the evidence suggests that private sector equity investing is conducive for innovation (Hall and Lerner, 2010 and Kaplan and Lerner,

---

[22] As illustrated by the dot-com boom and bust at the turn of the millennium, and ongoing financial and economic crisis that begun from the US subprime mortgage markets, this kind of over-financing is not just a theoretical curiosity, and may have severe macroeconomic consequences.

2010). Equity investors have both incentives and human capital for ex ante screening, interim monitoring and value-enhancing advice Furthermore, because innovative investments are complex and risky, optimal financing contracts become complex, too: Investors need to have both a share of upside returns in case of a success and control rights in case of a failure (Kaplan and Strömberg, 2003). Whether private sector equity financing markets work efficiently or not appear to matter more for countries close to technological frontier, such as the Nordic countries (Aghion and Mayer-Foulkes, 2005 and Dabla-Norris *et al*., 2013).

Based on these conclusions, there seems to be a case for policies that improve early-stage equity financing in the Nordic countries. But the right policy is hardly based on public equity investing in commercial projects. Rather one should create the right environment for private sector equity investors. More generally, if there is need for public innovation finance beyond R&D subsidies, the public sector should not mimic private innovation finance but invest differently, operating when liquidity in financial markets dries up and focusing on projects where the ratio of social returns to private returns is high.

Besides the many issues discussed above (e.g., taxation, education, basic research, and labour markets), the legal environment matters for private sector investors, For example, Hyytinen *et al*. (2003) show how a strengthening of the Finnish investor protection legislation enhanced the role of equity finance in the Finnish corporate finance environment.

But again, identifying the right policies to improve legislation is not easy. For example, while a lenient *bankruptcy legislation* clearly encourages entrepreneurial risk-taking by reducing the cost of failure, it also discourages financing of entrepreneurship. The evidence on which of the two opposing effects dominates remains inconclusive (see, e.g., Acharya and Subramanian 2009, and Cerqueiro *et al*. 2014, for conflicting results) and likely depend on the institutional context. There is little research on the Nordic countries regarding the matter, but Koskinen *et al*. (2007) find that weakening of strong creditor rights in corporate bankruptcy in Finland boosted corporate investments and firm valuations.

4.4 Conclusions

The wide consensus that innovation is important for economic growth and thus human well-being is based on a solid theoretical and empirical basis. The theoretical basis for innovation policy is also solid: Because of consumer surplus and technological spillovers which are not captured by innovating firms and individuals, there is too little innovative activity in the private sector. Unfortunately the empirical knowledge of the efficacy of different innovation related policies remains controversial.

The central feature of innovation is uncertainty, and sound innovation policies acknowledge the limited ability of even the best-informed agents to make good choices in tomorrow's increasingly digitized, interconnected world. To us, this clearly suggests an emphasis for a bottom-up approach, rather than vice versa, where resources flow to those sectors and regions that show signs of success. It may well be that the best governmental innovation policies are the least headline-grabbing ones, focusing on building the right infrastructure for better informed agents with stronger incentives, be they academic researchers or corporate inventors.

But in building the better innovation infrastructure the governments should be bold. The Nordic countries stand to continue to do well but only if they maintain and improve a good basic education system, high-quality universities, and an open, competitive and sufficiently flexible environment that enables experimentation and growth of those who succeed in innovation. Sparse public resources can be used more efficiently if the local economies of scale in innovation are better recognized. Since a large part of consumer surplus and knowledge spillovers generated by innovations coming from a Nordic country almost by definition reside elsewhere, the role for more targeted national innovation policies may be more limited than has been thought previously: as examples, domestic intellectual property protection might optimally be weak instead of strong, and direct support to private R&D should be targeted to those projects generating high domestic spillovers, including consumer surplus, rather than those projects aiming at conquering the world.

References

Abramovsky, L., Harrison, R. & Simpson, H. (2007). University Research and the Location of Business R&D, *Economic Journal*, 117, C114-C141. http://dx.doi.org/10.1111/j.1468-0297.2007.02038.x

Acemoglu, D. & Robinson, J. (2012). *Why Nations Fail?* Deckle Edge.

Acharya, V., a& Subramarian, R. K. (2013). Bankruptcy Codes and Innovation. *Review of Financial Studies*, 22, 4949–4988. http://dx.doi.org/10.1093/rfs/hhp019

Acharya, V., Baghai-Wadji, R. & Subramarian, K. (2013). Labor Laws and Innovation. *Journal of Law and Economics*, 53, 997–1037. http://dx.doi.org/10.1086/674106

Aghion, P., Akcigit, U., & Howitt, P. (2013). *What Do We Learn From Schumpeterian Growth Theory?* NBER Working Paper No. 18824.

Aghion, P., Askenazy, P., Berman, N., Cette, G., & Eymard, L. (2012). Credit Constraints and the Cyclicality of R&D Investment: Evidence from France. *Journal of European Economic Association*, 10, 1001–1024. http://dx.doi.org/10.1111/j.1542-4774.2012.01093.x

Aghion, P., Bloom, N. Blundell, R., Griffith, R. & Howitt, P. (2005). Competition and Innovation: An Inverted-U relationship. *Quarterly Journal of Economics* 120: 701–728.

Aghion, P. & Howitt, P. (2009). *The Economics of Growth*. Cambridge, MA: MIT Press.

Aghion, P., Howitt, P., & Prantl, S. (2014). *Patent Rights, Product Market Reforms, and Innovation*. mimeo.

Aghion, P. & Mayer-Foulkes, D. (2005). The Effect of Financial Development on Convergence: Theory and Evidence. *Quarterly Journal of Economics*, 120, 173–222.

Akcigit, U., Baslandze, S. & Stantcheva, S. (2014). *Taxation and International Mobility of Inventors*. NBER wp. 21024.

Akcigit, U., Hanley, D., & Serrano-Velarde, N. (2014). *Back to Basics: Basic Research Spillovers, Innovation Policy and Growth*. NBER wp. 19473.

Amore, M., Schneider, C. & Zaldokas, A. (2013). Credit Supply and Corporate Innovations. *Journal of Financial Economics* 109, 835–855. http://dx.doi.org/10.1016/j.jfineco.2013.04.006

Anselin, L., Varga, A., & Zoltan, A. (1997). Local Geographic Spillovers between University Research and High Technology Education. *Journal of Urban Economics*, 42, 442–448. http://dx.doi.org/10.1006/juec.1997.2032

Arrow, K. .J. (1962). Economic Welfare and the Allocation of Resources for Invention. In Nelson, R. R. (ed.), *The Rate and Direction of Inventive Activity: Economic and Social Factors*, pp. 609–625. Princeton, N.J.: Princeton University Press.

Atkinson, A. B. (2015). *Inequality: What Can Be Done?* Cambridge, MA: Harvard University Press. http://dx.doi.org/10.4159/9780674287013

Audretsch, D. & Feldman, M. (1996). R&D Spillovers and the Geography of Innovation and Production. *The American Economic Review*, 86, 630–640.

Belderbos, R., Van Roy, V., Leten, B., & Thijs, B. (2014). Academic Research Strengths and Multinational Firms' Foreign R&D Location Decisions: Evidence from R&D Investments in European Regions. *Environment and Planning A.*, 46, 9290–042. http://dx.doi.org/10.1068/a45536

Bessen, J. (2015). *Learning by Doing: The Real Connection between Innovation, Wages, and Wealth.* New Haven, CT: Yale University Press.

Bessen, J. & Maskin, E. (2009). Sequential Innovation, Patents and Imitation, *RAND Journal of Economics*, 40, 611–635. http://dx.doi.org/10.1111/j.1756-2171.2009.00081.x

Bessen, J. & Meurer, M. J. (2008). *Patent Failure: How Judges, Bureaucrats and Lawyers Put Innovators at Risk*. Princeton, NJ: Princeton University Press.

Bloom, N., Draca, M., & Van Reenen, J. (2015). Trade Induced Technical Change: The Impact of Chinese Imports on Innovation, Diffusion and Productivity. *Review of Economic Studies*, forthcoming.

Boadway, R. & Keen, M, (2006). Financing and Taxing New Firms under Asymmetric Information. *FinanzArchiv*, 62, 471–502. http://dx.doi.org/10.1628/001522106X172661

Boldrin, M. & Levine, D. K. (2013). The Case against Patents. *Journal of Economic Perspectives* 27: 3–22. http://dx.doi.org/10.1257/jep.27.1.3

Bozkaya, A., & Kerr, W. R. (2013). Labor Regulations and European Venture Capital. *Journal of Economics & Management Strategy* 23, 776–810. http://dx.doi.org/10.1111/jems.12077

Branstetter, L., Fisman, R., & Foley, F. (2006). Do Stronger Intellectual Property Rights Increase International Technology Transfer? Empirical Evidence from U.S. Firm-Level Panel Data. *Quarterly Journal of Economics*, 121, 321–349. http://dx.doi.org/10.1093/qje/121.1.321

Branstetter, L., & Sakakibara, M. (2002). When Do Research Consortio Work Well and Why? Evidence from Japanese Panel Data. *American Economic Review*, 92, 143–159. http://dx.doi.org/10.1257/000282802760015649

Breschi, S., Tarasconi, G., Catalini, C., Novella, L., Guatta, P., & Johnson, H. (2006). Highly Cited Patents, Highly Cited Publications, and Research Networks, mimeo.

Brynjolfsson, E., & McAfee, A. (2015). *The Second Machine Age: Work, Progress and Prosperity in a Time of Brilliant Technologies*.

Busom, I., B. Corchuelo, & Martinez Ros, E. (2012). Tax Incentives or Subsidies for R&D. UNU-MERIT Working Paper Series 2012–056. http://dx.doi.org/10.2139/ssrn.2330222

Carlino, G., & Kerr, W. R. (2015). Agglomeration and Innovation. In G. Duranton, V. Henderson, and W. C. Strange (eds.), *Handbook of Regional and Urban Economics*, 5, 349–404. Amsterdam: Elsevier. http://dx.doi.org/10.1016/b978-0-444-59517-1.00006-4

Chava, S., Oettl, A., Subramanian, A., & Subramanian, K. (2013). Banking Deregulation and Innovation. *Journal of Financial Economics* 109: 759–774. http://dx.doi.org/10.1016/j.jfineco.2013.03.015

Czarnitzki, D., E. Huergo, M. Köhler, P. Mohnen, S. Pacher, T. Takalo, & Toivanen, O. (2015). *Welfare Effects of European R&D Support Policies*. mimeo.

Cerqueiro, G. D. Hegde, M. F. Penas, & Seamans, R. C. (2014). *Debtor Rights, Credit Supply, and Innovation*. TILEC Discussion Paper No. 2014–011.

Cerulli, G. (2010). Modelling and measuring the effect of public subsidies on business R&D: a critical review of the economic literature. *Economic Record* 86, pp. 421–449.

Conti, A. (2015). *Evaluating Government R&D Grants to Startups: The Case of a Small Open Economy*. mimeo.

Cowan, R. & Zinovyeva, N. (2013). University Effect on Regional Innovation. *Research Policy*, 42, 788–800. http://dx.doi.org/10.1016/j.respol.2012.10.001

Dabla-Norris, E., Ho, G., & Kyobe, A. (2013). *Reforms and Distance to Frontier*. IMF Technical Note to Staff Discussion Note 13/08. Washington, D.C.: International Monetary Fund.

David, B. Hall, & Toole, A. (2000). Is public R&D a complement or a substitute for private R&D? A review of the econometric evidence. *Research Policy* 29, pp. 497–529. http://dx.doi.org/10.1016/S0048-7333(99)00087-6

De Meza, D. & Webb, D. C. (1987). Too Much Investment: A Problem of Asymmetric Information. *Quarterly Journal of Economics*, 102, 281–292. http://dx.doi.org/10.2307/1885064

Devereux, M. & Griffith, R. (1998). Taxes and the Location of Production: Evidence from a Panel of US Multinationals. *Journal of Public Economics*, 68, 335–367. http://dx.doi.org/10.1016/S0047-2727(98)00014-0

Devereux, M., Lockwood, B., & Redoano, M. (2008). Do Countries Compete over Corporate Tax Rates? *Journal of Public Economics*, 92, 1210–1235. http://dx.doi.org/10.1016/j.jpubeco.2007.09.005

Duso, T., Röller, L.-H., & Seldeslachts, J. (2014). Collusion through Joint R&D: An Empirical Assessment. *Review of Economics and Statistics*, 96, 349–370. http://dx.doi.org/10.1162/REST_a_00367

Edler, J. & Georghiou, L. (2007). Public Procurement and Innovation – Resurrecting the Demand Side. *Research Policy*, 36, 949–963. http://dx.doi.org/10.1016/j.respol.2007.03.003

Encaoua, D. & Hollander, A. (2002). Competition Policy and Innovation. *Oxford Review of Economic Policy*, 18, 63–79. http://dx.doi.org/10.1093/oxrep/18.1.63

European Commission (2013). *A Study on R&D Tax Incentives*. Final Report. TAXUD/2013/DE/315. FWC No. TAXUD/2010/CC/104.

Galasso, A. & Schankerman, M. (2015). Patents and Cumulative Innovation: Causal Evidence from the Courts. *Quarterly Journal of Economics*, 130, 317–369. http://dx.doi.org/10.1093/qje/qju029

Galasso, A., Schankerman, M., & Serrano, C. J. (2013). Trading and Enforcing Patent Rights. *RAND Journal of Economics*, 44, 275–312. http://dx.doi.org/10.1111/1756-2171.12020

Galasso, A. & Schankerman, M. (2015). Patents and Cumulative Innovation: Causal Evidence from the Courts. *Quarterly Journal of Economics*, 317–269. http://dx.doi.org/10.1093/qje/qju029

Garciá-Quevedo, J. (2004). Do public subsidies complement business R&D? A meta-analysis of the econometric evidence. *KYKLOS* 57, pp. 87–102. http://dx.doi.org/10.1111/j.0023-5962.2004.00244.x

Goldfarb, B. & Henrekson, M. (2003). Bottom-up versus Top-down Policies towards the Commercialization of University Intellectual Property. *Research Policy*, 32, 639–658. http://dx.doi.org/10.1016/S0048-7333(02)00034-3

Goldfarb, A., Greenstein, S., & Tucker, C. (eds.), (2015). *The Economic Analysis of the Digital Economy*. Chicago, IL: Chicago University Press. Edward Elgar Publishing. http://dx.doi.org/10.7208/chicago/9780226206981.001.0001

Goolsbee, A. (1998) Does Government R&D Policy Mainly Benefit Scientists and Engineers? *American Economic Review*, 88, 298–302.

Greenstein, S., Goldfarb, A., & Tucker, C. (eds.), (2013) *The Economics of Digitization*. Cheltenham, UK: Edward Elgar Publishing. http://dx.doi.org/10.4337/9781784710408

Griffith, R., Lee, S. & Van Reenen, J. (2011). Is Distance Dying at last? Falling Home Bias in Fixed Effects Models of Patent Citations. *Quantitative Economics* 2, 211–249. http://personalpages.manchester.ac.uk/staff/rachel.griffith/PublishedPapers/GriffithLeeVanReenen2011.pdf, http://dx.doi.org/10.3982/QE59

Griffith, R., & Macartney, G. (2014). Employment Protection Legislation, Multinational Firms and Innovation. *Review of Economics and Statistics*, 96, 135–150. http://personalpages.manchester.ac.uk/staff/rachel.griffith/PublishedPapers/GriffithMacartneyREStat.pdf, http://dx.doi.org/10.1162/REST_a_00348

Griffith, R., H. Miller & O'Connell, M. (2014). Ownership of intellectual property and corporate taxation. *Journal of Public Economics*, vol. 112, pp. 12–23. http://dx.doi.org/10.1016/j.jpubeco.2014.01.009

Hall, B. & Lerner, J. (2010). The Financing of R&D and Innovation. In B. Hall & N. Rosenberg (eds.) *Handbook of the Economics of Innovation*, 609–639. Amsterdam, Elsevier. http://dx.doi.org/10.1016/S0169-7218(10)01014-2

Hall, B. & Van Reenen, J. (2000). How effective are fiscal incentives for R&D? A review of the evidence. *Research Policy* 29, pp. 449–469. http://dx.doi.org/10.1016/S0048-7333(99)00085-2

Hashmi, A. R. (2013). Competition and Innovation: The Inverted-U Relationship Revised. *Review of Economics and Statistics,* forthcoming. http://dx.doi.org/10.1162/REST_a_00364

Hausmann, N. (2012). Un*iversity Innovation, Local Economic Growth, and Innovation*. US Census Bureau Center for Economics Studies Paper No. CES-WP-12-1.

Helland, E. & Sovinsky (Goeree) M. (2010). Do Research Joint Ventures Serve a Collusive Function, mimeo. UZH.

Holmstrom, B. & Myerson, R. (1983). Efficient and Durable Decision Rules with Incomplete Information. *Econometrica*, 51, 1799–1820. http://dx.doi.org/10.2307/1912117

Hyytinen, A., Kuosa, I., & Takalo, T., (2003). Law or Finance: Evidence from Finland. *European Journal of Law and Economics*, 16, 59–89. http://dx.doi.org/10.1023/A:1023932325783

Isenberg, D. (2013). *Worthless, Impossible and Stupid: How Contrarian Entrepreneurs Create and Capture Extraordinary Value*. Harvard Business School Publishing, Boston, MA.

Izhak, O., Saxell, T., & Takalo, T. (2015). *Patent Duration, Breadth, and Costly Imitation: Evidence from the US Pharmaceutical Market*. mimeo.

Jaffe, A. (1989). Real Effects of Academic Research. *American Economic Review*, 79, 957–970.

Jaffe, A. B. & Lerner, J. (2004). *Innovations and Its Discontents: How Our Broken Patent System is Endangering Innovation and Progress, and What to Do About It.* Princeton, NJ: Princeton University Press.

Jones, C. (2005). Growth & Ideas, ch. 16 in Handbook of Economic Growth 1B, Aghion P. & S. *Durlauf (eds.), Elsevier B.V.* http://dx.doi.org/10.1016/S1574-0684(05)01016-6

Jones, C. & J. Williams, (1998). Measuring the Social Return to R&D. *Quarterly Journal of Economics*, 113, 1119–1135. http://dx.doi.org/10.1162/003355398555856

Kamien, M. I. & Schwartz, N. L. (1975). Market structure and innovation: A survey. *Journal of Economic Literature* 13: 1–37.

Kaplan, S. N. & Lerner, J. (2010). It Ain't Broke: The Past, Present, and Future of Venture Capital. *Journal of Applied Corporate Finance*, 22, 1–12.

Kaplan, S. N. & Strömberg, P. (2003). Financial Contracting Theory Meets the Real World: An Empirical Analysis of Venture Capital Contracts. *Review of Economic Studies*, 70, 281–315. http://dx.doi.org/10.1111/j.1745-6622.2010.00272.x

Kerr, W. R. (2007). Ethnic Scientific Communities and International Technology Diffusion. *Review of Economics and Statistics*, 90, 518–537. http://www.people.hbs.edu/wkerr/KerrRestat08_EthProd.pdf, http://dx.doi.org/10.1162/rest.90.3.518

Kerr, W. R, & Nanda, R. (2014). Financing Innovation. Forthcoming in *Annual Review of Financial Economics*. http://dx.doi.org/10.2139/ssrn.2519572

Klette, T. J., Møen, J., & Griliches, Z. (2000). Do Subsidies to Commercial R&D Reduce Market Failures? Microeconomic Evaluation Studies. *Research Policy* 29 (4–5): 471–495. http://dx.doi.org/10.1016/S0048-7333(99)00086-4

Kleven, H., Landais, C., Saez. E. & Schultz, E. (2014). Migration and Wage Effects of Taxing Top Earners: Evidence from the Foreigners' Tax Scheme in Denmark. *Quarterly Journal of Economics*, 333–278. http://dx.doi.org/10.1093/qje/qjt033

Koskinen, Y., Korkeamäki, T., & Takalo, T. (2007). Phoenix Rising: Legal Reforms and Changes in Valuations in Finland during the Economic Crisis. *Journal of Financial Stability* 3, 33–58. http://dx.doi.org/10.1016/j.jfs.2007.02.002

Kremer, M. (1998). Patent buyouts: A Mechanism for Encouraging Innovation. *Quarterly Journal of Economics* 113, 1137–1167. http://dx.doi.org/10.1162/003355398555865

Lach, S., Neeman, Z., & Schankerman, M. (2015). Government Funding for R&D Start-Ups, mimeo.

Lanjouw, J. (1998). Patent Protection in the Shadow of Infringement: Simulation Estimations of Patent Values. *Review of Economic Studies*, 65, 671–710. http://dx.doi.org/10.1111/1467-937X.00064

Lerner, J. (2009a). *Boulevard of Broken Dreams. Why Public Efforts to Boost Entrepreneurship and Venture Capital Have Failed – and What to Do about It*? Princeton University Press, Princeton, N.J.

Lerner, J. (2009b). The Empirical Impact of Intellectual Property Rights on Innovation: Puzzles and Clues. *American Economic Review (Papers & Proceedings)*, 99, 343–348.

Mazzucato, M. (2013). *The Entrepreneurial State*, Anthem Press.

Maurer, S.M. & Scotchmer, S. (2004). Procuring Knowledge. *Advances in the Study of Entrepreneurship, Innovation and Growt*h, 15, 1–31, edited by G. Libecap. Amsterdam: Elsevier. http://dx.doi.org/10.1016/s1048-4736(04)01501-2

Menell, P. S. & Scotchmer, S. (2007). Intellectual Property. In M. Polinsky and S. Shavell (eds.), *Handbook of Law and Economics*. Amsterdam: Elsevier.

Mirrlees, J., Adam, S., Besley, T., Blundell, R., Bond, S., Choate, R., Gammie, M., Johnson, P., Myles, G., & Poterba, J. (2011). *Tax by Design*, Oxford University Press, ISBN 978-0-19-955374-7.

Mohnen, P. & Lokshin, B. (2010). What does it take for an R&D tax incentive policy to be effective? In Ghosal, V. (ed.), *Reforming Rules and Regulations*, pp. 33–58. Cambridge, MA: MIT Press. http://dx.doi.org/10.7551/mitpress/9780262014687.003.0002

Moretti, E. (2004). Workers' Education, Spillovers, and Productivity: Evidence from Plant-Level Production Functions. *American Economic Review*, Vol. 94, No. 3, 656–690. http://dx.doi.org/10.1257/0002828041464623

Nelson, R.R. (2009). Building Effective "Innovation Systems" versus Dealing with "Market Failures" as Ways of Thinking about Technology Policy. In Dominique Foray (ed.), *The New Economics of Innovation Polic*y, Edward Elgar: Cheltenham, UK: http://dx.doi.org/10.4337/9781848449169.00007

Nelson, R.R. (1959). The simple economics of basic scientific research. *Journal of Political Economy* 49, pp. 297–306. http://dx.doi.org/10.1086/258177

OECD, (2011). *OECD Science, Technology and Industry Scoreboard 2011*. OECD Publishing. http://dx.doi.org/10.1787/sti_scoreboard-2011-en

Pakes, A. (1986). Patents as Options: Some Estimates of the Value of Holding European Patent Stocks. *Econometrica*, 54, 755–784.

Rob, A. & Robinson, D. (2012). The Capital Structure Decisions of New Firms. *Review of Financial Studies*, 27, 153–179. http://dx.doi.org/10.1093/rfs/hhs072

Röller, L.-H., Siebert, R., & Tombak, M. (2007). Why Firms Form (or Do not Form) RJVs? *Economic Journal*, 117, 1122–1144. http://dx.doi.org/10.1111/j.1468-0297.2007.02069.x

Sampat, B. & Williams, H. (2015). How Do Patents Affect Follow on Innovation? Evidence from the Human Genome. NBER Working Paper No. 21666.

Schankerman, M. & Serrano, C. (2010). The Dynamics of the Transfer and Renewal of Patents. *RAND Journal of Economics*, 41, 686–708. http://dx.doi.org/10.1111/j.1756-2171.2010.00117.x

Scotchmer, S. (2004a). The Political Economy of Intellectual Property Treaties. *Journal of Law, Economics, and Organizations* 20, 415–437

Scotchmer, S. (2004b). *Innovation and Incentives*. Cambridge, MA: MIT Press.

Segal, I. & Whinston. M. D. (2007) Antitrust in Innovative Industries. *American Economic Review*, 97, 1703–1730. http://dx.doi.org/10.1257/aer.97.5.1703

Sobel, D. (1995). *Longitude: The True Story of a Lone Genius Who Solved the Greatest Scientific Problem of His Time*. New York, NY: Walker.

Sveikauskas, L. (2007). R*&D and Productivity Growth: A Review of the Literature*. Bureau of Labor Statistics Working Paper 408.

Shapiro, C. (2002). *Competition Policy and Innovation*. OECD Science, Technology and Industry Working Papers, 2002/11, OECD Publishing.

Shavell, S. & T. van Ypserele (2001). Rewards versus Intellectual Property Rights. *Journal of Law and Economics*, 44, 525–547. http://dx.doi.org/10.1086/322811

Serrano, C. J. (2010). The Dynamics of the Transfer and Renewal of Patents. *RAND Journal of Economics*, 41, 686–708. http://dx.doi.org/10.1111/j.1756-2171.2010.00117.x

Takalo, T. (2001). On the Optimal Patent Policy, *Finnish Economic Papers*, 14, 33–40. Takalo, T., Tanayama, T. and Toivanen, O. (2013a). Estimating the benefits of targeted R&D subsidies, *The Review of Economics and Statistics*, 95, 55–272.

Takalo, T., Tanayama, T., & Toivanen, O. (2013b). Market Failures and the Additionality Effects of Public Support to Private R&D: Theory and Empirical Implications. *International Journal of Industrial Organization.* 31, 634–642. http://dx.doi.org/10.1016/j.ijindorg.2013.02.002

Takalo, T. & Toivanen, O. (2012). Entrepreneurship, Financiership, and Selection, *Scandinavian Journal of Economics*, 114, 601–628. http://dx.doi.org/10.1111/j.1467-9442.2011.01685.x

Toivanen, O. & Väänänen, L. (2015). Education and Invention, *Review of Economics and Statistics*, forthcoming. http://dx.doi.org/10.1162/REST_a_00520

Turner, J. L., Bessen, J., Neuhäusler, P., & Williams, J. W. (2013). The Costs and Benefits of the United States Patents, Boston University School of Law, *Law and Economics Research Papers* No. 13–2014.

Verhoeven, W., van Stel, A., & Timmermans, N. (2012). *Evaluate WBSO 2006-2010: Effecten*. Doelgroepbereik en uitvoering. https://www.rijksoverheid.nl/documenten/rapporten/2012/04/02/hoofdrapport-evaluatie-wbso-2006-2010

Williams, H. (2013). Intellectual Property Rights and Innovation: Evidence from the Human Genome, *Journal of Political Economy*, 121, 1–27. http://dx.doi.org/10.1086/669706

Wolff, G. B. & Reinthaler, V. (2008). The effectiveness of subsidies revisited: Accounting for wage and employment effects in business R&D, *Research Policy*, 37, 1403–1412. http://dx.doi.org/10.1016/j.respol.2008.04.023

Zúñica-Vicente, J., Alonso-Borrego, C., Forcadell, F., & Galan, J. (2014). Assessing the Effect of Public Subsidies on Firm R&D Investment: a Survey. *Journal of Economic Surveys*, 18, 36–67. http://dx.doi.org/10.1111/j.1467-6419.2012.00738.x