Paper no. 2013/04

The Choice of Innovation Policy Instruments

Susana Borrás (Sb.dbp@cbs.dk)

Department of Business and Politics, Copenhagen Business School, Denmark

CIRCLE, Lund University, Sweden

Charles Edquist (charles.edquist@circle.lu.se)

CIRCLE, Lund University

This version: February 2013

This is a preprint version of a paper submitted to a journal for publication

Centre for Innovation, Research and Competence in the Learning Economy (CIRCLE)
Lund University
P.O. Box 117, Sölvegatan 16, S-221 00 Lund, SWEDEN
http://www.circle.lu.se/publications

WP 2013/04

The Choice of Innovation Policy Instruments

Susana Borrás, Charles Edquist

ABSTRACT

The purpose of this article is to discuss the different types of instruments of innovation policy, to examine how governments and public agencies in different countries and different times have used these instruments differently, to explore the political nature of instrument choice and design (and associated issues), and to elaborate a set of criteria for the selection and design of the instruments in relation to the formulation of innovation policy. The article argues that innovation policy instruments must be designed and combined into mixes in ways that address the problems of the innovation system. These mixes are often called "policy mix". The problem-oriented nature of the design of instrument mixes is what makes innovation policy instruments 'systemic'.

JEL: O30,O31, O32, O33, O38

Keywords: Policy mix; innovation system; innovation policy instruments; governance; regulation; public policy.

The Choice of Innovation Policy Instruments

Susana Borrás and Charles Edquist

Susana Borrás

Department of Business and Politics, Copenhagen Business School, Denmark

CIRCLE, Lund University, Sweden

Sb.dbp@cbs.dk

And

Charles Edquist

CIRCLE, Lund University, Sweden

charles.edquist@circle.lu.se

Author for correspondence

Abstract

The purpose of this article is to discuss the different types of instruments of innovation policy, to examine how governments and public agencies in different countries and different times have used these instruments differently, to explore the political nature of instrument choice and design (and associated issues), and to elaborate a set of criteria for the selection and design of the instruments in relation to the formulation of innovation policy. The article argues that innovation policy instruments must be designed and combined into mixes in ways that address the problems of the innovation system. These mixes are often called "policy mix". The problem-oriented nature of the design of instrument mixes is what makes innovation policy instruments 'systemic'.

Keywords:

Policy mix; innovation system; innovation policy instruments; governance; regulation; public policy.

Highlights

- The choice of instruments is a crucial decision regarding the formulation of an innovation policy
- the identification of the problems and their activity-related causes should be the basis for the selection of policy instruments
- Instruments are combined in policy mixes with possible complementary/synergetic/contrasting effects between them
- policy instruments must be designed, re-designed, and adapted through time to the specific problems in the innovation systems

1. Introduction

The purpose of this article is to discuss the different types of instruments of innovation policy, to examine how governments and public agencies in different countries and different times have used these instruments differently, to explore the political nature of instrument choice and design (and associated issues), and to elaborate a set of criteria for the selection and design of the instruments in relation to the formulation of innovation policy. In the everyday process of policy-making, many instruments are developed as a mere continuation of existing schemes, or with poor consideration of the expected effects. This article argues that innovation policy instruments must be designed carefully and on the basis of an innovation system perspective, so that they are combined into mixes in ways that address the complex problems of the innovation processes. These mixes are often called "policy mix". The problem-oriented nature of the design of instrument mixes is what makes innovation policy instruments 'systemic'.

Innovations are defined here as new creations of economic and societal significance, primarily carried out by firms (but not in isolation). They include product innovations[1] as well as process innovations[2]. Innovation *systems* are the determinants of innovation processes and the innovations themselves. Innovation policy comprises *all* combined actions that are undertaken by public organizations that influence innovation processes.[3] The public organizations use innovation policy instruments as tools to influence innovation processes. The choice of policy instruments constitutes

[1] Product innovations are new – or improved – material goods as well as new intangible services; it is a matter of *what* is produced.
[2] Process innovations are new ways of producing goods and services. They may be technological or organizational; it is a matter of *how* things are produced.
[3] Innovation policy thus **includes** actions by public organizations that **un**intentionally affect innovation.

a part of the formulation of the policy, and the instruments themselves form part of the actual implementation of the policy. This double nature of instruments suggests that it is important to look at how they are chosen and the praxis with regard to implementation of the policy. This article looks at the first aspect, namely the choice of policy instruments, and focuses on the formulation phase of the innovation policy.

The *ultimate* objectives of innovation policy are determined in a political process. These objectives may be economic (growth, employment, competitiveness, etc.), environmental, social, related to health, defence and security, etc. How different ultimate objectives of innovation policy should be balanced is an important political issue. The determination of innovation policy objectives is typically done in a complex process, which in democratic societies involves executive government initiatives, parliamentary discussions, public agencies, the civil society, etc. Naturally, the objectives of innovation policy have to do with the different national traditions and forms of state-market-society relations, not to mention the ideology of the government in office. The ultimate objectives of innovation policy are concerned with the important consequences that innovations have for socio-economic and political matters such as economic growth and the environment (mentioned above).

Problems to be mitigated by innovation policy must be identified and specified in innovation terms. A *problem,* in our sense - i.e. from a policy point of view – is, for example, a low performance of the innovation system, i.e. a low innovation intensity (or a low propensity to innovate) of a certain category of innovations (product, process, etc). In other words, a 'problem' exists if the objectives in terms of innovation intensities are not achieved by private or public organizations. Low innovation intensities are the problems to be solved or mitigated by innovation policy. Hence we

need to know the innovation intensities for specific categories of innovations in the context of the innovation system.

Innovation policy instruments are, of course, not intended to (and cannot) influence the ultimate objectives (e.g. growth, the environment or the health system) in an immediate sense, because these instruments can only influence innovation processes (i.e. innovation intensities). This implies that the ultimate socio-political objectives must be "translated" into concrete problems related to innovation intensities – problems which can be influenced directly by innovation policy instruments. For example, we need to know how the ultimate objectives of economic growth and environmental protection are related to (certain kinds of) innovations. The objectives expressed in innovation terms can be called **direct** objectives, which are to solve the innovation intensity "problems". The ultimate objectives can (partly) be achieved by means of fulfilling the direct objectives, i.e. in a mediated way. Hence, innovation policy instruments are selected to achieve the direct objectives – and thereby the ultimate objectives.[4]

In addition, knowing that there is reason to consider public intervention is not enough. An identification of a problem only indicates *where* and *when* intervention is called for. It says nothing about *how* it should be pursued. In order to be able to design appropriate innovation policy instruments, it is necessary to also know the causes behind the problem identified – at least the most important ones (Edquist 2001: 234-5). [5] If our car engine stops, we need to know why it has stopped before we can fix it.

[4] "Problems" and how they can be identified through empirical analyses comparing innovation systems are issues that are discussed in much more detail in sections 3 and 4 in Edquist (2011).

[5] A causal analysis might also reveal that public intervention is unlikely to solve the problem identified, due to the lack of ability. That should, of course, prevent policy intervention.

Once there is a general picture of the causes of the policy problems, then it is possible to identify, on this basis, the policy instruments that might mitigate the problems, and, most important, how to combine them into a specific mix. If the main cause of a problem is lack of adequate levels of research, then the different policy instruments for enhancing levels of R&D should be in focus. If there is lack of demand for certain product innovations, then a specific set of demand-side instruments such as public procurement for innovation and specific regulations can be used in an instrument mix that targets that specific problem.[6]

This article studies the role of policy instruments in the definition of systemic innovation policy, the types of policy instruments in innovation policy, the problem-oriented nature that defines the criteria for that design and choice, and the politics involved in that. With this purpose in mind, the next section starts by discussing the importance of the choice of policy instruments in relation to the innovation system, and the three dimensions that are crucial in this regard. Section three identifies the different types of policy instruments and defines their combination in instrument mixes, in a general sense, according to the literature of public administration. Section four takes this up into the concrete area of interest, namely innovation policy, providing examples, and discussing the specificities of policy instrumentation in an innovation system context. Section five examines in detail how these policy instruments are related to the problems that might relate to the different activities of the innovation system, in the understanding that policy instruments shall mitigate the problems that might occur in the system. Section 6 acknowledges that the choice and design of policy instruments in innovation policy is a political process, and the importance of legitimacy of instruments in the context of advanced democratic societies. Last, the concluding section

[6] These issues are often discussed in terms of "policy mixes". (See for example Flanagan and Uyarra (2011) and Serris (2004). We define innovation policy as all combined actions that are taken by public organizations and influence innovation processes (section 1). Therefore it becomes somehow inappropriate to talk about "policy mixes" and we think that "instrument mixes" captures the phenomenon of combination of instruments better.

summarizes the arguments, emphasizing the problem-mitigation approach to innovation policy instruments choice and design, conducted from an innovation system perspective.

2. The choice of instruments

The choice of instruments is a crucial decision regarding the formulation of an innovation policy. This entails three important dimensions. *Firstly*, a primary selection of the specific instruments most suitable among the wide range of different possible instruments; *secondly***,** the concrete design and/or 'customisation' of the instruments for the context in which they are supposed to operate; and *thirdly*, the design of an instrument mix, or set of different and complementary policy instruments, to address the problems identified.

Sometimes innovation policy instruments are chosen on an individual basis, meaning, on the basis of their individual features alone. Typically however, innovation policy instruments are combined in mixes, implying that the selection of instruments takes into consideration their complementary or balancing effects on the innovation system. When selecting instruments it is important to look at both the individual features and the complementary/synergetic/contrasting effects of an instrument in relation to the specific mix in which it is embedded. A crucial dimension when discussing the choice of innovation policy instruments is the issue of adapting the instrument to the specific problems in the innovation system, and, most important, to the specific features of the administrative structures. In other words, policy instruments need a certain degree of adaptation and 'customization' to the changing needs of the system and the capacities of public administrators.

One example that shows the importance of policy instrument choice is the comparison of the innovation policies in the ICT sectors of Israel, Taiwan and Ireland during the 1990s. In developing their ICT industry, these three countries focused on similar goals for economic growth and socio-economic development in their innovation policy. These three countries targeted specific goals for developing physical infrastructures, invested in education, deregulated markets (notably Telecommunications) and paid special attention to small and medium size companies, as the engines of ICT sector economic growth. But, as Breznitz indicates: "[...] their micro-level policies – those at the level of industry and firm- were distinctively different. Since the late 1960s Ireland has focused mainly on foreign direct investment (FDI)-based industrial development policies. Israel has focused on inducing industrial R&D activities through public grants, with project ideas originating solely in private industry. In Taiwan the ruling party [...] relied on such public research agencies as the Industrial Technology Research Institute (ITRI) to lead R&D efforts and diffuse the results throughout private industry" [1]:7. That is, even when the three states had very similar goals, the trajectories that they followed and the instruments that they chose for the implementation of those goals were different. This is what Breznitz calls 'micro-level policies' and what we call 'instrument choice'. The three countries above made different instrument choices for virtually the same overall goals, and all three have been rather successful in achieving them.

As mentioned above, direct innovation policy objectives must be formulated in terms of identifying problems in the innovation system, and there is no way to identify "problems" specifically enough on the basis of theory alone. Problems can be identified by means of different kinds of sources of information, namely measurements, analysis or comparative studies. The most widely used, and perhaps the most influential, sources of information for the identification of problems in the innovation system are innovation indicators. Innovation indicators come typically from a variety of

regular statistical series at national and international levels (the most famous set of international indicators is based on the 'Oslo manual' and the OECD's own statistical series), or from innovation surveys, which provide more detailed and firm-based data about innovation trends.[7]

A second source of information for innovation policy-making is foresight exercises, which produce expert-based analyses of future trends in specific technological fields. Benchmarks and best cases have also become popular in the advanced economies during the past few years. Benchmarks are typically quantitative targets set up by public agencies and governments on the basis of best cases' performance.

Last, but not least, another example of an extensively used source of information in innovation policy-making these days is independent expert assessment of innovation policy performance (e.g. evaluation of policies), which is typically done in national contexts. More recently however, international organizations have increasingly engaged in external assessment of national policies, particularly the OECD (with very influential assessment exercises of innovation policies for higher education systems), and the EU (where EU27 member states exchange best practices and peer review each other).

3. Types of Policy Instruments and Instrument Mixes

A conventional and general *definition of public policy instruments* is "a set of techniques by which governmental authorities wield their power in attempting to ensure support and effect (or prevent) social change" [2] : 21. This definition puts an emphasis on the purposive nature of policy

[7] Innovation indicators are addressed in more detail in Edquist (2011).

instruments. Policy instruments have a purpose, namely, to induce change (or to avoid change) in a particular way, which is believed to stimulate innovation, i.e. influence the direct innovation policy objectives. The purposive nature of the instruments is to remind us that the instruments are put in place to achieve some specific goals. Obviously, the instruments of innovation policy are focused on fostering innovation. However, as mentioned in section 1, innovation is rarely a goal in itself, but a means to achieve broader political goals like economic growth, increased employment, environmental protection, military capacity or public health, to name some of the most important ultimate objectives. Hence, put in other words, innovation policy instruments are intended to influence innovation processes, and thereby contribute to fulfilling these ultimate political goals by means of achieving the direct objectives formulated in innovation terms.

The Vedung definition above is interesting for a second reason: it also emphasizes the effectiveness and popular support dimensions of innovation policy instruments: "to ensure support and effect social change". As we will see in this article, the political support and the effectiveness of the instruments are very important aspects of innovation policy, as is the understanding that there are important differences and changing traditions in the combinations of policy instruments in innovation policy, the so-called instrument mixes. Strictly speaking, each policy instrument used by a government or public agency is unique. Instruments are typically chosen, designed and implemented with a specific problem in mind, in a specific policy context (innovation policy in this case), at a specific point in time, and in a specific political-ideological situation of the government. The strong contextual nature of the choice and specification of policy instruments is a crucial aspect in the design and use of policy tools However, the uniqueness of policy instruments does not impede their classification according to the logic behind public action.

Generally speaking, there are three large categories of instruments used in public policy: (1) regulatory instruments, (2) economic and financial instruments, and (3) soft instruments. This three-fold typology of policy instruments is what has popularly been identified as the "sticks", the "carrots" and the "sermons" of public policy instruments [3]. Admittedly, there are alternative classifications of policy instruments [4] [5]. However, the three-fold division used here remains the most accepted in the literature on instruments, and continues to be the most widely used in practical contexts [6] [7]. The added value of focusing on it is two-fold. Firstly, it allows us to make sense of complexity and to navigate in an ocean of different instruments in innovation policy. Secondly, it allows us to define some useful criteria for the choice and design of instruments in the formulation phase of innovation policy (in the next sections of this article).

(1) The first type, regulatory instruments, use legal tools for the regulation of social and market interactions. The logic behind this type of instrument is the willingness from the government to define the frameworks of the interactions taking place in the society and in the economy. Naturally, there are many different types, but common for them all is that these regulatory instruments (laws, rules, directives, etc.) are obligatory in nature, meaning that actors are obliged to act within some clearly defined boundaries of what is allowed and what is not allowed. Obligatory measures are typically backed by threats of sanctions in cases of non-compliance. These sanctions can be very different in nature (fines and other economic sanctions, or temporary withdrawal of rights), depending on the content of the regulation and the definition of legal responsibility. Some authors believe that sanctioning is the most crucial property of regulatory instruments (focusing on the imposition and hierarchical side of regulation). Others see the normative authority of governments as the most important feature of these instruments (hence focusing on the normative-positive side of obligatory

regulation) [8]. From the point of view of innovation policy, regulatory instruments are often used for the definition of market conditions for innovative products and processes[8].

(2) Economic and financial instruments provide specific pecuniary incentives (or disincentives) and support specific social and economic activities. Generally speaking, they can involve economic means in cash or kind, and they can be based on positive incentives (encouraging, promoting, certain activities) or on disincentives (discouraging, restraining, certain activities). Table 1 presents some examples of economic instruments according to these different sub-types.

INSERT Table 1 here

Source: [2]

As the table above shows, economic instruments are very broad in nature. In some countries there is traditionally extensive use of economic instruments providing economic means in kind, whereas in others there is wider use of economic means in cash. As we will see in section 3, economic and financial instruments have been extensively used in the field of innovation policy.

(3) Soft instruments are characterized by being voluntary and non-coercive. With soft instruments, those who are 'governed' are not subjected to obligatory measures, sanctions or direct incentives or disincentives by the government or its public agencies. Instead, the soft instruments provide recommendations, make normative appeals or offer voluntary or contractual agreements. Examples of these instruments are campaigns, codes of conduct, recommendations, voluntary agreements and contractual relations, and public and private

[8] They are often called "institutions", meaning "rules of the game" (to be distinguished from "players"). We will examine this in the next section.

partnerships. These instruments are very diverse, but generally based on persuasion, on the mutual exchange of information among actors, and on less hierarchical forms of cooperation between the public and the private actors.

The growing use of soft instruments is at the heart of fundamental transformations in the public administration of most countries (particularly visible in Europe and the US). This has been termed 'governance', meaning that the extensive use of these instruments has transformed the role of the government from being a provider and regulator to being a coordinator and facilitator [9]. What is important at this stage is to underline the fact that there has also been a rapid growth in the number of these types of instruments in the field of innovation policy, as we will see in the next section.

4. Innovation Policy Instruments

The three-fold typology of policy instruments above is applicable to innovation policy. Instruments like intellectual property rights, environmental regulations, tax exemptions, competitive public research funding, support for technology transfer offices, soft loans for innovations in specific industries, or industrial and public-private partnerships for knowledge infrastructure are widely used in innovation policy in many countries.

(1) Regulatory instruments using law and binding regulations are important in the field of innovation policy, for example the regulation of intellectual property rights (in particular, but not only, patent regulations), the regulation of research and higher education

> organisations like universities and public research organisations (most importantly the statutory nature of the organisations, and researchers' employment regulations), competition (anti-trust) policy regulations concerning R&D and innovative activities by firms in the market, bioethics and other ethical regulations related to innovative activities, and last, but not least, some specific industrial sector regulations with effects on innovative activities., Regulatory instruments are 'rules of the game' for knowledge and innovation processes in innovation policy. Because regulations are obligatory, these rules of the game are formal and compulsory and constitute an important part of the institutional set-up of a system of innovation.

It is important to keep in mind that the relationship between regulatory instruments and innovation can be *direct* or *indirect*. A direct relationship refers to the situation where regulations have been designed with the explicit purpose of positively affecting knowledge and innovative activities. An example of this is when patent and university laws are changed in order to allow universities to own patents and to create the necessary organisational arrangements to stimulate the commercialization of knowledge [10]. However, regulatory instruments might sometimes be important for innovation processes in an indirect way. This is the case when the final purpose of a specific regulatory instrument is not to foster innovation, but this happens in an indirect way, as pointed out in our definition of innovation policy in the introduction (footnote 3). An example of this is when an environmental regulation forbids a specific polluting chemical substance, or forces a reduction in industrial waste; this induces product innovations or process innovations, because the regulation forces firms to find alternative solutions. As with the other types of instruments, regulatory instruments can have an important impact on the innovation process, due not only to the way in

which these instruments are selected and designed, but also how they are implemented and enforced.

(2) Regarding the second type of instruments (economic transfers), innovation policy has traditionally made extensive use of these. This is particularly the case for instruments stimulating positive incentives in cash and in kind. One of the most widely used instruments is 'in block' public support to research organisations, primarily public universities and public research organisations. This is perhaps one of the oldest and most extended policy instruments for innovation, since history contains plenty of cases of monarchs and princes who supported the arts and sciences. This category of instrument was particularly used after the constitution of the modern state in the 19th century, and in the post-colonial era in the second half of the 20th century. Other fundamental instruments using economic incentives are competitive research funding (industrial or basic research), tax incentives for R&D performed at firm level, support to technology transfer, and support to venture and seed capital. There has been a significant trend towards selecting and designing 'market-based' or 'market-like' economic incentives in the past two decades. A case in point is the relative reduction of 'en block' institutional support to research organisations in most OECD countries, and the parallel increase of schemes using competitive research funding [11].

Another significant observation at this stage is that most of the existing economic instruments largely influence the development and diffusion of innovations (products and processes) from the supply side rather than the demand side. However, scholars and policymakers alike are starting to recognize the importance of developing instruments that influence innovation processes from the demand side. This is due to the demand side being crucial in terms of some of the most important

dynamics in the innovation process (the role of users and customers in all sorts of innovation processes), and to a series of fundamental pure public goods (for example clean air) with a rather weak demand-side (green technologies). Instruments focusing on the demand-side can help redress these specific types of weaknesses. One example is public procurement for innovation, to be addressed in section 4.

(3) 'Soft instruments' are our third main category of instruments. These instruments have been increasingly used in innovation policy during the past two decades. However, it is important to keep in mind that even if their relative importance is increasing, these instruments are largely a complement to regulatory and economic instruments. Nonetheless, they might constitute important new forms and new approaches to public action in terms of innovation.

There are many different forms of soft instruments. Examples of these are:

- voluntary technical standards at the national or international level [12],
- codes of conduct for firms, universities or public research organisations (for example, the code of conduct for the recruitment of researchers in Europe, advocating transparency in recruitment procedures),
- management contracts with public research organisations (an instrument defining an agreement between policy-makers and managers of these organisations, setting up the strategic goals for that public organisation),
- public-private partnerships sharing costs, benefits and risks in the provision of specific public goods (for example, in the field of knowledge infrastructures),
- campaigns and public communication instruments (for example, diffusion of scientific knowledge by using events like "research days" or TV documentaries).

Because innovation is a very complex phenomenon, the new instruments might be able to address different aspects of the innovation process and innovation system that the previous regulatory and economic instruments could not do properly. Sometimes, the soft instruments address 'old' issues of innovation policy, but they do so in a different way.

INSERT Figure 1 here

Figure 1: Examples of policy instruments in innovation policy

5. Innovation Policy Problems, Instrument Mixes and National Styles

When designing innovation policy, the selection of innovation policy instruments must be done in relation to the actual problems identified in the innovation system. In section 1, we stressed that a *problem* has to be identified as low performance of the innovation system, i.e. low innovation intensity for a certain category of innovations. At the end of section 1, we discussed various ways to identify such problems. We have pointed out that it is necessary to know the main *causes* of the problems in order to be able to choose appropriate innovation policy instruments. Policy instruments must be selected, customized to the nature of the problem to be solved as well as its causes, and combined in mixes with complementary policy instruments. As we will show below, innovation policy instruments are closely related to the different activities of the innovation system. These activities are identified in Appendix 1, and can be seen as the determinants of the development and diffusion of innovations. Hence the "problems" to be mitigated by innovation

policy, briefly discussed in section 1, are closely related to identification of deficiencies or bottlenecks related to these activities.

The activities are divided into four groups. The first group is the *provision of knowledge inputs to the innovation process*, which include the provision of R&D and competence building (education and training). In the group of *Demand-side activities*, we include formation of new product markets and articulation of quality requirements. In *Provision of constituents for systems of innovation*, we list the creation and change of organizations, innovation networking, and the creation and change of innovation-related institutions (rules of the game, discussed as regulatory instruments in section 3). In the final category of *support services for innovating firms*, we include incubation activities (start-ups, entrepreneurship, small firms), the financing of innovation and the provision of consultancy services.[9] [13].

Box 1: Key Activities in Systems of Innovation

I. Provision of knowledge inputs to the innovation process

1. Provision of R&D results and, thus, creation of new knowledge, primarily in engineering, medicine and natural sciences.

2. Competence building, e.g. through individual learning (educating and training the

[9] We want to stress that this list is provisional and will be subject to revision as our knowledge of determinants of innovation processes increases.

labour force for innovation and R&D activities) and organizational learning. This includes formal learning as well as informal learning.

II. Demand-side activities

3. Formation of new product markets.

4. Articulation of new product quality requirements emanating from the demand side.

III. Provision of constituents

5. Creating and changing organizations needed for developing new fields of innovation. Examples include enhancing entrepreneurship to create new firms and intrapreneurship to diversify existing firms, and creating new research organizations, policy organizations, etc.

6. Networking through markets and other mechanisms, including interactive learning among different organizations (potentially) involved in the innovation processes. This implies integrating new knowledge elements developed in different spheres of the SI and coming from outside with elements already available in the innovating firms.

7. Creating and changing institutions – e.g., patent laws, tax laws, environment and safety regulations, R&D investment routines, cultural norms, etc. – that influence innovating organizations and innovation processes by providing incentives for and removing

obstacles to innovation.

IV. Support services for innovating firms

8. Incubation activities such as providing access to facilities and administrative support for innovating efforts.

9. Financing of innovation processes and other activities that may facilitate commercialisation of knowledge and its adoption.

10. Provision of consultancy services relevant for innovation processes, e.g., technology transfer, commercial information, and legal advice.

Source: Adapted from Edquist (2005)

Although the list of activities is a preliminary and hypothetical one, the important thing to stress here is that it includes many determinants in *addition* to those commonly mentioned in the literature (typically, the creation of knowledge and financing of innovation activities). The reason for stressing this is that these additional activities also influence innovation processes. Concentrating only on R&D and financing may lead - or rather, actually leads to - a linear supply-push view on the innovation process and innovation policy.[10] Efforts must be made to avoid this if an innovation

[10] R&D does **not** automatically lead to innovations, i.e. to new product and processes, and thereby to economic growth. Knowledge is not enough – it has to be transformed into innovations in order to create growth and employment. R&D is only one of the many inputs/determinants of innovation – it is not always necessary, and it is never sufficient to achieve innovation-based growth. The other nine activities are also important.

policy that looks at the whole innovation system - i.e. a holistic policy - is to be achieved. As mentioned, our list includes also the activities in the system that influence innovation processes from the demand side.

Another relevant issue to consider when looking at these ten different activities of the innovation system in relation to the design of innovation policy, is that the innovation policy instruments might be located at different levels of government. The vertical division of powers across different levels of government affects the extent of which federal/central, regional/community or local/municipal are in charge of designing specific policy instruments. Some times the division of powers is clear in the sense that these levels of government have exclusive powers, whereas other times those powers are shared (f.ex. support to incubators is typically shared across different levels of government, but others like support and regulation of public research organizations is concentrated in one level of government). Hence, it is always very relevant to understand the idiosyncracies of state structures and multi-level division of powers when studying the way in which policy instruments have been designed and developed.

When looking at the then different activities in an innovation system, a relevant issue is to analyze is the appropriate balance between *demand*-side innovation policy instruments and *supply* side instruments, mentioned in section 4. "Science and technology" policies pursued so far have had a too strong emphasis on supply side instruments. We argue that there is a need for a new generation of innovation policy instruments, especially demand side instruments, such as public procurement for innovation. One example of demand-side innovation policy instruments is public procurement of innovation, an instrument by which a public agency places an order for a product or system that does not yet exist; innovation is necessary to make delivery possible. PPI is a very powerful

demand-side innovation policy instrument that can be used to trigger innovation, and there are many successful examples from European countries. PPI can also be very useful in mitigating the current *grand societal challenges* such as, global warming, tightening supplies of energy, water and food, ageing societies, public health, pandemics or security. It is interesting to note that China has started to give public demand an important role in economic development and in the promotion of innovation. According to the OECD, this represents a policy innovation since the Chinese government traditionally has relied entirely on supply-side policies to promote innovation. [14] [15][11].

A useful way of designing appropriate instruments, and analyzing their role in the innovation system, is to relate them to each of the ten activities. In the real world, the instruments of innovation policy are rarely used standing 'alone'. Normally innovation policy instruments are combined in specific mixes, using groups of different instruments in a complementary manner. Instrument mixes are created because the solution of specific problems requires complementary approaches to the multi-dimensional aspects of innovation-related problems [16].

Hence, the ten activities mentioned in the paragraphs above can be related to different (several or many) kinds of innovation policy instruments. This will be done here by designing a matrix of the relations between the ten activities and various policy instruments. It must be emphasised that the matrix just serves to exemplify relations between activities and instruments, and certainly does not present a complete picture. As we saw in section 3, there are many innovation policy instruments

[11] It is interesting to note that the December 2012 issue of the leading innovation journal *Research Policy* is a special issue entitled "The Need for a new Generation of Policy Instruments". One of the articles addresses the instrument of Public Procurement for Innovation (PPI).

that can be used. The matrix shows the activities and some traditional types of instruments related to them.

INSERT Table 2: Activities in innovation systems and types of innovation policy instruments

We would also like to point out that innovation policy is not included as one of the ten activities. The reason is simply that policy is a part of *all* ten activities. Part of each activity is performed by public organizations, which **is** policy (see definition in section 1). What is important is the division of labor between private and public organizations with regard to the performance of each of the activities [17]. When we have a general picture of the causes of the policy problems, then we can designate, on this basis, policy instruments to mitigate the problems. If the main cause of a problem is lack of research, then R&D should be in focus. If there is lack of demand for certain product innovations, then a demand-side instrument such as public procurement for innovation can be used. This is suggested in the matrix. Similarly, all the ten activities in Appendix 1 can be related to different kinds of innovation policy instruments. As indicated in Table 2, it may be helpful to use the ten activities as a checklist when selecting innovation policy instruments to achieve direct policy objectives – and thereby also ultimate policy objectives. The list may also be useful in assigning causes to problems.

Smits and Kuhlmann (2004) argue that the formulation of innovation policy has entered into a phase in which policy instruments are becoming systemic. In their view this is mostly visible in the area of 'cluster approach' policy instruments [18], because these instruments are managing

interfaces, de-constructing and organizing systems, providing a platform for learning, providing strategic intelligence, and stimulating demand [19]. Their point is that 'systemic instruments' might co-exist with traditional policy instruments of a traditional linear mode. In our article, policy instruments are seen in a slightly different way, in that instruments as such are not seen as systemic or not. What makes them systemic is the way in which policy instruments are combined and customized into mixes that aim at addressing the concrete problems identified in an innovation system. In other words, it is not the instruments alone that make an innovation policy systemic. It is the instrument mixes that make it systemic - if they are designed and implemented in a way that addresses the complex and multiple nature of the causes of the problems. This is argued in more detail in the previous sections dealing with the activities of the innovation system, and the identification of problems associated to those activities, that different policy instruments aim at remedy.

The focus on instrument mixes (or "policy mix") has received considerable attention from policy-makers in the past few years. In their review of the way in which this notion has been used, Flanagan et al, underline the complexity of policy instruments, and argue that the actor and the institutional context in which instruments operate are crucial in determining their effects [20]. Most of the recent efforts by policy-makers to deal with instrument mixes have sought to enhance levels of public and/or private R&D expenditures[12] [21] . This is naturally very relevant, but it only reflects one specific activity in an innovation system.

[12] In the late 2000s, the EU launched a project for monitoring and analyzing the instrument mixes of EU member states that are conducive to higher levels of R&D investments. http://ec.europa.eu/invest-in-research/monitoring/document_en.htm

A definition of innovation policy instrument mix is: *The specific combination of innovation-related policy instruments which interact explicitly or implicitly in influencing innovation intensities*. It is worth pointing out here that there are no perfect ideal-models or "optimal" policy instruments that fit all purposes. On the contrary, instrument mixes are very different and varied depending on the context for which they are designed. The very specific and unique nature of each innovation system, with its individual strengths and weaknesses, as well as concrete problems and bottlenecks, on the one hand, and the the very specific national/regional traditions regarding state-market-society relations on the other, mean that any "one-size-fits-all" attempt is irrelevant. This is to say that policy-mixes are specifically designed and implemented with specific problems and causes in specific systems in mind, and tend to follow distinct patterns of national policy styles. Innovation policy-mixes are different because the innovation systems are different, the problems are different, and the socio-political and historical contexts of policy-making are different across countries and regions.

Having said that, however, the diversity of designs, experiences and results of these instrument mixes might provide good sources for mutual policy-learning. While acknowledging differences and idiosyncrasies across countries, it is still possible to dissect and analyze why and why-not some instrument mixes are better at addressing complex problems in the innovation system than others. One last issue that is important to underline here is that differences in instrument mixes outcomes might not necessarily be related to the nature of the selection, customization and combination of different policy instruments in problem-solving oriented instrument mixes, but to their actual implementation. This is to say that the way in which the instrument mixes are put into practice is as important as their design. Policy-making and policy learning are after all largely influenced by the organizational capacity of the public administration managing and enforcing them [22].

6. The politics of innovation policy instruments

The formulation of innovation policy invariably entails a selection – of which objectives (ultimate and direct) to emphasize, which problems to address in the policy, which policy instruments to choose, etc. By definition this selection can never be politically neutral. In other words, policy instruments are not neutral devices. This is as true for any type of policy as it is for innovation policy. Having said that, it is important to consider the legitimacy of the instruments, namely the degree of popular and political endorsement of different innovation policy instruments.

In advanced representative democratic systems, political parties tend to disagree on the type of policy instruments to be chosen and how they should be designed. The same applies to the citizens and the public in general, since their implicit or explicit endorsement of policy instruments is crucial for the sustainability and effectiveness of the policy instrument. An instrument that is no longer legitimate runs the risk of being popularly contested or falling into disuse, hence making its correct implementation difficult. This might compromise its effectiveness and expected results. If contestation is fierce and widespread, governments and their public agencies might reconsider the specific contents of an instrument, or even the entire instrument as such.

Popular contestation and party politics can be particularly strong in the formulation phase of innovation policy, which is our main focus of interest here. One of the most recent examples of strong popular contestation and adversarial party politics during the phase of formulation of innovation policy instruments is the proposal for a directive on software patents in the European Union. The question of what can be patented and what cannot be patented is a fundamental issue in

innovation systems because patent rules are highly relevant regulatory instruments providing incentives to inventors. The limits of patentability have always been a topic for consideration among patent experts (patent attorneys, patent examiners and highly specialized legal practitioners), but very rarely is it an issue that interests the general public. However, in the late 1990s and early 2000s, this became one of the most hotly disputed issues in European Union politics. The proposal of the European Commission for harmonizing national regulations allowing software to be patentable across the EU was strongly opposed by the open source community, and strongly supported by big industry. The proposal for a directive "on the patentability of computer-implemented inventions" more popularly known as software patents, put forward by the Commission in 2002, was rejected by a broad opposition in the European Parliament. Leifeld and Haunss suggest that this was basically due to the fact that the discourse coalition against software patents managed to set the tone in spite of their very limited economic resources [23]. From the perspective that interests us here, namely the politics of innovation policy instruments, this case indicates that the legitimacy of an instrument is strongly related to the legitimacy and popular acceptance of the instrument, and, in the case of patents, strongly related to their effectiveness [24]

In the case above, the contending parties disagreed about the regulation as such (software patents being subject to patentability), but agreed on the overall goal of fostering innovation and thereby economic growth. There are, however, cases where contention regarding an instrument reflects fundamental differences of opinion on alternative goals. This is particularly the case of regulations related to life sciences. The rapid advance of life sciences has occasionally put the goals of economic growth and industrial exploitation in direct conflict with some pre-established fundamental values and ethical norms in the society (bioethics). Examples of politically sensitive instruments are the regulations regarding the use of embryonic stem cells in research, the

authorisation of genetically modified organisms in the environment and the market, or the limits of research testing on animals and humans. All these examples show that, although innovation policy instruments seem to be apparently 'low politics', occasional strong contestations show the essential political nature of innovation policy formulation.

Another important dimension of political contention is the nature of public action itself. In particular, whether state intervention is motivated or not, and whether one or the other innovation policy instrument should be used, have been debated intensively on the basis of political ideology and values. From our point of view, the nature of public action must be carefully analyzed and constructive discussions can be pursued on the basis of these analyses. It is not particularly interesting to argue that private organizations or public ones are the most suitable when it comes to influencing innovation processes. We want to see this empirically: specific analysis, constructive pragmatism and common sense rather than ideological dogmatism are needed to find out who shall do what and with what instruments.

7. Conclusions: Innovation Policy Instruments and Mixes

Making choices of instruments is a crucial part of policy-making. Instruments of innovation policy need to be understood as the operational forms of intervention by governments and public agencies.

Even if instruments have a purposive nature (instruments for something), it does not mean that all innovation policy instruments have been consciously chosen and designed. As a matter of fact, the selection and use of innovation policy instruments are not always based on clearly defined overall governmental objectives of innovation policy; nor are they always based on a clear identification of problems. Unfortunately, many instruments are selected by means of an ad-hoc set of decisions (or non-decisions), largely based on a continuation of previous schemes, or on lobby activity of specific interest groups, rather than on the visionary considerations of a holistic innovation policy and a critical assessment of the actual problems that need action.

In this article, we have argued that the design of innovation policy must include specifying ultimate objectives, translating them into direct objectives and, on this basis, identifying problems that are not solved by private organizations. These problems are related to low performance of the innovation system, i.e. low innovation intensity of a certain category of innovations, for which the direct objective is high intensity. In order to be able to design innovation policy instruments to mitigate the problems identified, it is also necessary to know the most important causes of the problems identified. These causes are related to the activities or determinants of the development and diffusion of innovations. The instruments are also related to these activities as outlined in the Matrix presented in section 4.

Hence, the identification of the problems and their activity-related causes should be the basis for the selection of policy instruments. The combination of instruments is a crucial part of the innovation policy: "innovation policy is what its instruments are". Some might be instruments created ex-novo, but in most cases, instruments are changed and adapted to new problems, and combined with other instruments to address the problems.

Rarely are innovation policy instruments ready or "prêt-à-porter" for the task at hand. Most of the time, if not always, policy instruments must be designed, re-designed, and adapted to the specific problems in the innovation systems and their uses. Instrument design can change over time according to changing preferences, changing objectives, and changing problems in the innovation system.

Each policy instrument is unique. Even if some policy instruments are similar in their ways of defining and approaching a problem, there will always be substantial differences not only in terms of the concrete details of how the instrument is chosen and designed, but also in terms of the overall social, political, economic and organisational context in which the instrument is applied.

This article also argues that the design and implementation of systemic innovation policy depends on the extent to which innovation policy instruments are defined, customized and combined into instrument mixes that address the 'problems' related to the activities of the system. Policy instruments on their own are not systemic unless combined into mixes that address the complex and often multi-dimensioned nature of innovation.

References

[1] D. Breznitz, Innovation and the State: Political Choice and Strategies for Growth in Israel, Taiwan and Ireland, Yale University Press, New Heaven, 2007.

[2] E. Vedung, Policy Instruments: Typologies and Theories, in: M.L. Bemelmans-Videc, R.C. Rist, E. Vedung (Eds.) Carrots, Sticks and Sermons. Policy Instruments and their evaluation, Transaction Publishers, London, 1998.

[3] M.-L. Bemelmans-Videc, R.C. Rist, E. Vedung, Carrots, sticks & sermons : policy instruments & their evaluation, in, Transaction, London, 2003.

[4] S.H. Linder, B.G. Peters, The Study of Policy Instruments: Four chools of Thought, in: B.G. Peters, F.K.M. Nispen (Eds.) Public Policy Instruments. Evaluating the Tools of Public Administration, Edward Elgar, Cheltenham, 1998, pp. 33-45.

[5] C.C. Hood, H.Z. Margetts, The Tools of Government in the Digital Age, Palgrave, London, 2007.

[6] H.A. de Bruijn, H.A.M. Hufen, The Traditional Approach to Policy Instruments, in: G.B. Peters, F.K.M. Nispen (Eds.) Public Policy Instruments. Evaluating the Tools of Public Administration, Edward Elgar, Cheltenham, 1998, pp. 11-32.

[7] L.M. Salamon, The Tools of Government. A Guide to the New Governance, Oxford University Press, Oxford, 2002.

[8] D. Lemaire, The Stick: Regulation as a Tool of Government, in: M.L. Bemelmans-Videc, R.C. Rist, E. Verdung (Eds.) Carrots, Sticks and Sermons. Policy Instruments and their Evauation, Transaction Publishers, London, 1998, pp. 59-76.

[9] J. Jordana, D. Levi-Faur, The Politics of Regulation in the Age of Governance, in: J. Jordana, D. Levi-Faur (Eds.) The Politics of Regulation: Institutions and Regulatory Reforms for the Age of Governance, Routledge, London, 2004.

[10] D.C. Mowery, A.A. Ziedonis, Numbers, Quality, and Entry: How has the Bayh-Dole Act Affected U.S. University Patenting and Licensing, in: A.B. Jaffe, L. Josh, S. Scott (Eds.) Innovation Policy and the Economy, The MIT Press, Cambridge, Ma., 2000.

[11] B. Lepori, P. van den Besselaar, M. Dinges, B. Potí, E. Reale, S. Slipersaeter, J. Thèves, B. van der Meulen, Comparing the Evolution of National Research Policies: What Patterns of Change?, Science and Public Policy, 34 (2007) 372-388.

[12] K. Blind, The Economics Of Standards: Theory, Evidence, Policy, Edward Elgar, Cheltenham, 2004.

[13] C. Edquist, Systems of Innovation: Perspectives and Challenges, in: J. Fagerberg, D. Mowery, R. Nelson (Eds.) Handbook of Innovation, Oxford University Press, Oxford, 2005.

[14] OECD, OECD Reviews of Innovation Policy: China, in, OECD, Paris, 2008.

[15] C. Edquist, J.M. Zabala-Iturriagagoitia, Public Procurement for Innovation as Mission-oriented Innovation Policy, Research Policy, ? (forthcoming 2012).

[16] P. Mohnen, L.-H. Röller, Complementarities in innovation policy, European Economic Review, 49 (2005) 1431-1450.

[17] C. Edquist, Design of innovation policy through diagnostic analysis: identification of systemic problems (or failures), Industrial and Corporate Change, 20 (2011) 1725-1753.

[18] S. Borrás, D. Tsagdis, Cluster Policies in Europe. Firms, Institutions and Governance, Edward Elgar, Cheltenham, 2008.

[19] R. Smits, S. Kuhlmann, The rise of systemic instruments in innovation policy, International Journal of Foresight and Innovation Policy, 1 (2004) 4-32.

[20] K. Flanagan, E. Uyarra, M. Laranja, Reconceptualising the 'policy mix' for innovation, Research Policy, 40 (2011) 702-713.

[21] J. Serris, Report of the CREST expert group on public research spending and Policy mixes, in, European Commission, Brussels, 2004, pp. 71.

[22] S. Borrás, Policy Learning and Organizational Capacities in Innovation Policies, Science and Public Policy, 38 (2011).

[23] P. Leifeld, S. Haunss, Political discourse networks and the conflict over software patents in Europe, European Journal of Political Research, 51 (2012) 382-409.

[24] S. Borrás, The governance of the European patent system: effective and legitimate?, Economy and Society, 35 (2006) 594-610.

CIRCLE ELECTRONIC WORKING PAPERS SERIES (EWP)

CIRCLE (Centre for Innovation, Research and Competence in the Learning Economy) is a multidisciplinary research centre set off by several faculties at Lund University and Blekinge Institute of Technology. CIRCLE has a mandate to conduct multidisciplinary research and education on the following issues: Long-term perspectives on innovation, structural change and economic growth, Entrepreneurship and venture capital formation with a special focus on new ventures, The dynamics of R&D systems and technological systems, including their impact on entrepreneurship and growth, Regional innovation systems in different national and international contexts and International comparative analyses of national innovation systems. Special emphasis is done on innovation policies and research policies. 10 nationalities and 14 disciplines are represented among the CIRCLE staff.

The CIRCLE Electronic Working Paper Series are intended to be an instrument for early dissemination of the research undertaken by CIRCLE researchers, associates and visiting scholars and stimulate discussion and critical comment.

The working papers present research results that in whole or in part are suitable for submission to a refereed journal or to the editor of a book or have already been submitted and/or accepted for publication.

CIRCLE EWPs are available on-line at: http://www.circle.lu.se/publications

Available papers:

2013

WP 2013/01
Start-up rates, Entrepreneurship Culture and the Business Cycle
Swedish patterns from national and regional data
Martin Andersson

WP 2013/02
Market Thickness and the Early Labor Market Career of University Graduates
-An urban advantage?
Lina Ahlin, Martin Andersson and Per Thulin

WP 2013/03
Implementing an R&D Strategy without Prior R&D-Experience
Recruitment as a Source of R&D-related Routines and Capabilities?
Lina Ahlin, Martin Andersson and Thorben Schubert

WP 2013/04
The Choice of Innovation Policy Instruments
Susana Borrás, Charles Edquist

2012

WP 2012/01
Is the University Model an Organizational Necessity? Scale and Agglomeration Effects in Science
Tasso Brandt and Torben Schubert

WP 2012/02
Do regions make a difference? Exploring the role of different regional innovation systems in global innovation networks in the ICT industry
Cristina Chaminade and Monica Plechero

WP 2012/03
Measuring the knowledge base of regional innovation systems in Sweden
Roman Martin

WP 2012/04
Characteristics and Performance of New Firms and Spinoffs in Sweden
Martin Andersson and Steven Klepper

WP 2012/05
Demographic patterns and trends in patenting: Gender, age, and education of inventors
Olof Ejermo and Taehyun Jung

WP 2012/06
Competences as drivers and enablers of globalization of innovation: Swedish ICT industry and emerging economies
Cristina Chaminade and Claudia de Fuentes
WP 2012/07
The Dynamics and Evolution of Local Industries – The case of Linköping
Sabrina Fredin

WP2012/08
Towards a Richer Specification of the Exploration/Exploitation Trade-off: Hidden Knowledge-based Aspects and Empirical Results for a Set of Large R&D-Performing Firms
Torben Schubert and Peter Neuhaeusler

WP 2012/09

The European Spallation Source (ESS) and the geography of innovation

Josephine V. Rekers

WP 2012/10

How Local are Spatial Density Externalities? - evidence from square grid data

Martin Andersson, Johan Klaesson, Johan P Larsson

WP 2012/11

Why Pre-Commercial Procurement is not Innovation Procurement

Charles Edquist, Jon Mikel Zabala-Iturriagagoitia

2011

WP 2011/01
SMEs' absorptive capacities and large firms' knowledge spillovers: Micro evidence from Mexico

Claudia de Fuentes and Gabriela Dutrénit

WP 2011/02
Comparing knowledge bases: on the organisation and geography of knowledge flows in the regional innovation system of Scania, southern Sweden
Roman Martin and Jerker Moodysson

WP 2011/03
Organizational paths of commercializing patented inventions: The effects of transaction costs, firm capabilities, and collaborative ties
Taehyun Jung and John P. Walsh

WP 2011/04
Global Innovation Networks: towards a taxonomy
Helena Barnard and Cristina Chaminade

WP 2011/05
Swedish Business R&D and its Export Dependence
Karin Bergman and Olof Ejermo

WP 2011/06
Innovation Policy Design: Identification of Systemic Problems
Charles Edquist

WP 2011/07
Regional Institutional Environment and Its Impact on Intra-firm and Interorganisational Innovation Networks: A Comparative Case Study in China and Switzerland
Ju LIU

WP 2011/08
Entrepreneurship: Exploring the Knowledge Base
Hans Landström, Gouya Harirchi and Fredrik Åström

WP 2011/09
Policy coordination in systems of innovation: A structural-functional analysis of regional industry support in Sweden
Magnus Nilsson and Jerker Moodysson

WP 2011/10
Urban Design in Neighbourhood Commodification
Ana Mafalda Madureira

WP 2011/11
Technological Dynamics and Social Capability: Comparing U.S. States and European Nations
Jan Fagerberg, Maryan Feldman and Martin Srhoelec

WP 2011/12
Linking scientific and practical knowledge in innovation systems
Arne Isaksen and Magnus Nilsson

WP 2011/13
Institutional conditions and innovation systems: on the impact of regional policy on firms in different sectors
Jerker Moodysson and Elena Zukauskaite

WP 2011/14
Considering adoption: Towards a consumption-oriented approach to innovation
Josephine V. Rekers

WP2011/15
Exploring the role of regional innovation systems and institutions in global innovation networks
Cristina Chaminade

2010

WP 2010/01
Innovation policies for development: towards a systemic experimentation based approach
Cristina Chaminade, Bengt-Ake Lundvall, Jan Vang-Lauridsen and KJ Joseph

WP 2010/02
From Basic Research to Innovation: Entrepreneurial Intermediaries for Research Commercialization at Swedish 'Strong Research Environments'
Fumi Kitagawa and Caroline Wigren

WP 2010/03 Different competences, different modes in the globalization of innovation?
A comparative study of the Pune and Beijing regions
Monica Plechero and Cristina Chaminade

WP 2010/04 Technological Capability Building in Informal Firms in the Agricultural
Subsistence Sector In Tanzania: Assessing the Role of Gatsby Clubs
Astrid Szogs and Kelefa Mwantima

WP 2010/05
The Swedish Paradox – Unexploited Opportunities!
Charles Edquist

WP 2010/06
A three-stage model of the Academy-Industry linking process: the perspective of both agents
Claudia De Fuentes and Gabriela Dutrénit

WP 2010/07
Innovation in symbolic industries: the geography and organisation of knowledge sourcing
Roman Martin and Jerker Moodysson

WP 2010/08
Towards a spatial perspective on sustainability transitions
Lars Coenen, Paul Benneworth and Bernhard Truffer

WP 2010/09
The Swedish national innovation system and its relevance for the emergence of global innovation networks
Cristina Chaminade, Jon Mikel Zabala and Adele Treccani

WP 2010/10
Who leads Research Productivity Change? Guidelines for R&D policy makers
Fernando Jiménez-Sáez, Jon Mikel Zabala and José L- Zofío

WP 2010/11
Research councils facing new science and technology
Frank van der Most and Barend van der Meulen

WP 2010/12
Effect of geographical proximity and technological capabilities on the degree of novelty in emerging economies
Monica Plechero

WP 2010/13
Are knowledge-bases enough? A comparative study of the geography of knowledge sources in China (Great Beijing) and India (Pune)
Cristina Chaminade

WP 2010/14
Regional Innovation Policy beyond 'Best Practice': Lessons from Sweden
Roman Martin, Jerker Moodysson and Elena Zukauskaite

WP 2010/15
Innovation in cultural industries: The role of university links
Elena Zukauskaite

WP 2010/16
Use and non-use of research evaluation. A literature review
Frank van der Most

WP 2010/17
Upscaling emerging niche technologies in sustainable energy: an international comparison of policy approaches
Lars Coenen, Roald Suurs and Emma van Sandick

2009

WP 2009/01
Building systems of innovation in less developed countries: The role of intermediate organizations.
Szogs, Astrid; Cummings, Andrew and Chaminade, Cristina

WP 2009/02
The Widening and Deepening of Innovation Policy: What Conditions Provide for Effective Governance?

Borrás, Susana

WP 2009/03
Managerial learning and development in small firms: implications based on observations of managerial work
Gabrielsson, Jonas and Tell, Joakim

WP 2009/04
University professors and research commercialization: An empirical test of the "knowledge corridor" thesis
Gabrielsson, Jonas, Politis, Diamanto and Tell, Joakim

WP 2009/05
On the concept of global innovation networks
Chaminade, Cristina

WP 2009/06
Technological Waves and Economic Growth - Sweden in an International Perspective 1850-2005
Schön, Lennart

WP 2009/07
Public Procurement of Innovation Diffusion: Exploring the Role of Institutions and Institutional Coordination
Rolfstam, Max; Phillips, Wendy and Bakker, Elmer

WP 2009/08
Local niche experimentation in energy transitions: a theoretical and empirical exploration of proximity advantages and disadvantages
Lars Coenen, Rob Raven, Geert Verbong

WP 2009/9
Product Development Decisions: An empirical approach to Krishnan and Ulrich
Jon Mikel Zabala, Tina Hannemann

WP 2009/10
Dynamics of a Technological Innovator Network and its impact on technological performance
Ju Liu, Cristina Chaminade

WP 2009/11
The Role of Local Universities in Improving Traditional SMEs Innovative Performances: The Veneto Region Case
Monica Plechero

WP 2009/12
Comparing systems approaches to innovation and technological change for sustainable and competitive economies: an explorative study into conceptual commonalities, differences and complementarities
Coenen, Lars and Díaz López, Fernando J.

WP 2009/13
Public Procurement for Innovation (PPI) – a Pilot Study
Charles Edquist

WP 2009/14
Outputs of innovation systems: a European perspective
Charles Edquist and Jon Mikel Zabala

2008

WP 2008/01
R&D and financial systems: the determinants of R&D expenditures in the Swedish pharmaceutical industry
Malmberg, Claes

WP 2008/02
The Development of a New Swedish Innovation Policy. A Historical Institutional Approach
Persson, Bo

WP 2008/03
The Effects of R&D on Regional Invention and Innovation
Olof Ejermo and Urban Gråsjö

WP 2008/04
Clusters in Time and Space: Understanding the Growth and Transformation of Life Science in Scania
Moodysson, Jerker; Nilsson, Magnus; Svensson Henning, Martin

WP 2008/05
Building absorptive capacity in less developed countries
The case of Tanzania
Szogs, Astrid; Chaminade, Cristina and Azatyan, Ruzana

WP 2008/06
Design of Innovation Policy through Diagnostic Analysis:
Identification of Systemic Problems (or Failures)
Edquist, Charles

WP 2008/07
The Swedish Paradox arises in Fast-Growing Sectors
Ejermo, Olof; Kander, Astrid and Svensson Henning, Martin

WP 2008/08
Policy Reforms, New University-Industry Links and Implications for Regional Development in Japan
Kitagawa, Fumi

WP 2008/09
The Challenges of Globalisation: Strategic Choices for Innovation Policy
Borrás, Susana; Chaminade, Cristina and Edquist, Charles

WP 2008/10
Comparing national systems of innovation in Asia and Europe: theory and comparative framework

Edquist, Charles and Hommen, Leif

WP 2008/11
Putting Constructed Regional Advantage into Swedish Practice? The case of the VINNVÄXT initiative 'Food Innovation at Interfaces'
Coenen, Lars; Moodysson, Jerker

WP 2008/12
Energy transitions in Europe: 1600-2000
Kander, Astrid; Malanima, Paolo and Warde, Paul

WP 2008/13
RIS and Developing Countries: Linking firm technological capabilities to regional systems of innovation
Padilla, Ramon; Vang, Jan and Chaminade, Cristina

WP 2008/14
The paradox of high R&D input and low innovation output: Sweden
Bitarre, Pierre; Edquist, Charles; Hommen, Leif and Ricke, Annika

WP 2008/15
Two Sides of the Same Coin? Local and Global Knowledge Flows in Medicon Valley
Moodysson, Jerker; Coenen, Lars and Asheim, Bjørn

WP 2008/16
Electrification and energy productivity
Enflo, Kerstin; Kander, Astrid and Schön, Lennart

WP 2008/17
Concluding Chapter: Globalisation and Innovation Policy
Hommen, Leif and Edquist, Charles

WP 2008/18
Regional innovation systems and the global location of innovation activities: Lessons from China
Yun-Chung, Chen; Vang, Jan and Chaminade, Cristina

WP 2008/19
The Role of mediator organisations in the making of innovation systems in least developed countries. Evidence from Tanzania
Szogs, Astrid

WP 2008/20
Globalisation of Knowledge Production and Regional Innovation Policy: Supporting Specialized Hubs in the Bangalore Software Industry
Chaminade, Cristina and Vang, Jan

WP 2008/21
Upgrading in Asian clusters: Rethinking the importance of interactive-learning
Chaminade, Cristina and Vang, Jan

2007

WP 2007/01

Path-following or Leapfrogging in Catching-up: the Case of Chinese Telecommunication Equipment Industry
Liu, Xielin

WP 2007/02
The effects of institutional change on innovation and productivity growth in the Swedish pharmaceutical industry
Malmberg, Claes

WP 2007/03
Global-local linkages, Spillovers and Cultural Clusters: Theoretical and Empirical insights from an exploratory study of Toronto's Film Cluster
Vang, Jan; Chaminade, Cristina

WP 2007/04
Learning from the Bangalore Experience: The Role of Universities in an Emerging Regional Innovation System
Vang, Jan; Chaminade, Cristina.; Coenen, Lars.

WP 2007/05
Industrial dynamics and innovative pressure on energy -Sweden with European and Global outlooks
Schön, Lennart; Kander, Astrid.

WP 2007/06
In defence of electricity as a general purpose technology
Kander, Astrid; Enflo, Kerstin; Schön, Lennart

WP 2007/07
Swedish business research productivity – improvements against international trends
Ejermo, Olof; Kander, Astrid

WP 2007/08
Regional innovation measured by patent data – does quality matter?
Ejermo, Olof

WP 2007/09
Innovation System Policies in Less Successful Developing countries: The case of Thailand
Intarakumnerd, Patarapong; Chaminade, Cristina

2006

WP 2006/01
The Swedish Paradox
Ejermo, Olof; Kander, Astrid

WP 2006/02
Building RIS in Developing Countries: Policy Lessons from Bangalore, India
Vang, Jan; Chaminade, Cristina

WP 2006/03
Innovation Policy for Asian SMEs: Exploring cluster differences
Chaminade, Cristina; Vang, Jan.

WP 2006/04
Rationales for public intervention from a system of innovation approach: the case of VINNOVA.
Chaminade, Cristina; Edquist, Charles

WP 2006/05
Technology and Trade: an analysis of technology specialization and export flows
Andersson, Martin; Ejermo, Olof

WP 2006/06
A Knowledge-based Categorization of Research-based Spin-off Creation
Gabrielsson, Jonas; Landström, Hans; Brunsnes, E. Thomas

WP 2006/07
Board control and corporate innovation: an empirical study of small technology-based firms
Gabrielsson, Jonas; Politis, Diamanto

WP 2006/08
On and Off the Beaten Path:
Transferring Knowledge through Formal and Informal Networks
Rick Aalbers; Otto Koppius; Wilfred Dolfsma

WP 2006/09
Trends in R&D, innovation and productivity in Sweden 1985-2002
Ejermo, Olof; Kander, Astrid

WP 2006/10
Development Blocks and the Second Industrial Revolution, Sweden 1900-1974
Enflo, Kerstin; Kander, Astrid; Schön, Lennart

WP 2006/11
The uneven and selective nature of cluster knowledge networks: evidence from the wine industry
Giuliani, Elisa

WP 2006/12
Informal investors and value added: The contribution of investors' experientially acquired resources in the entrepreneurial process
Politis, Diamanto; Gabrielsson, Jonas

WP 2006/13
Informal investors and value added: What do we know and where do we go?
Politis, Diamanto; Gabrielsson, Jonas

WP 2006/14
Inventive and innovative activity over time and geographical space: the case of Sweden
Ejermo, Olof

2005

WP 2005/1
Constructing Regional Advantage at the Northern Edge
Coenen, Lars; Asheim, Bjørn

WP 2005/02
From Theory to Practice: The Use of the Systems of Innovation Approach for Innovation Policy
Chaminade, Cristina; Edquist, Charles

WP 2005/03
The Role of Regional Innovation Systems in a Globalising Economy: Comparing Knowledge Bases and Institutional Frameworks in Nordic Clusters
Asheim, Bjørn; Coenen, Lars

WP 2005/04
How does Accessibility to Knowledge Sources Affect the Innovativeness of Corporations? Evidence from Sweden
Andersson, Martin; Ejermo, Olof

WP 2005/05
Contextualizing Regional Innovation Systems in a Globalizing Learning Economy: On Knowledge Bases and Institutional Frameworks
Asheim, Bjørn; Coenen, Lars

WP 2005/06
Innovation Policies for Asian SMEs: An Innovation Systems Perspective
Chaminade, Cristina; Vang, Jan

WP 2005/07
Re-norming the Science-Society Relation
Jacob, Merle

WP 2005/08
Corporate innovation and competitive environment
Huse, Morten; Neubaum, Donald O.; Gabrielsson, Jonas

WP 2005/09
Knowledge and accountability: Outside directors' contribution in the corporate value chain
Huse, Morten, Gabrielsson, Jonas; Minichilli, Alessandro

WP 2005/10
Rethinking the Spatial Organization of Creative Industries
Vang, Jan

WP 2005/11
Interregional Inventor Networks as Studied by Patent Co-inventorships
Ejermo, Olof; Karlsson, Charlie

WP 2005/12
Knowledge Bases and Spatial Patterns of Collaboration: Comparing the Pharma and Agro-Food Bioregions Scania and Saskatoon

Coenen, Lars; Moodysson, Jerker; Ryan, Camille; Asheim, Bjørn; Phillips, Peter

WP 2005/13
Regional Innovation System Policy: a Knowledge-based Approach
Asheim, Bjørn; Coenen, Lars; Moodysson, Jerker; Vang, Jan

WP 2005/14
Face-to-Face, Buzz and Knowledge Bases: Socio-spatial implications for learning and innovation policy
Asheim, Bjørn; Coenen, Lars, Vang, Jan

WP 2005/15
The Creative Class and Regional Growth: Towards a Knowledge Based Approach
Kalsø Hansen, Høgni; Vang, Jan; Bjørn T. Asheim

WP 2005/16
Emergence and Growth of Mjärdevi Science Park in Linköping, Sweden
Hommen, Leif; Doloreux, David; Larsson, Emma

WP 2005/17
Trademark Statistics as Innovation Indicators? – A Micro Study
Malmberg, Claes