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**INNOVATION POLICY INSTRUMENTS**

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# Innovation Policy Instruments

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## Abstract

The Lisbon Agenda that was launched in 2000, and had a set time-period of ten years. The purpose of the Lisbon Agenda was to make the EU the most competitive, knowledge-based economy in the world, and at the same time preserving, or even improving social cohesion and maintain environmental sustainability. The Lisbon Agenda had a large number of goals, in both quantified and qualified measures, in different areas. The main instrument that was put forward was the open method of co-ordination (OMC) that includes indicators, benchmarking, peer pressure, and best practise demonstrations.

The forthcoming Lisbon Agenda will certainly need new approaches, and new instruments. One of the areas of instruments that can be further explored is innovation policies where the use of R&D and human capital is enhanced. Human capital is a natural part of a knowledge-based economy, and has positive impacts on growth, and jobs in the economy. Innovation policy instruments are diversified and are integrated in many areas of an economy and on many levels, which make them ideal for the next Lisbon Agenda. The instruments can have a general or specific characteristics and some span over the two characteristics.

Keywords: Lisbon Agenda, innovation policy instruments, beyond Lisbon 2010

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## 1. INTRODUCTION

The European Union (EU) is lagging behind the US, and other major regions of the world in many areas. The most important aspect is possibly the progress of becoming a knowledge economy which at the moment has been too slow in EU. Even though the EU is making progress there are still a lot of challenges ahead, in order to catch-up with the US and parts of Asia. The main picture is a lack of investments in R&D, internet penetration, and so forth.

The Lisbon Agenda that was launched in 2000 was a response to this development, and had a set time-period of ten years. The purpose of the Lisbon Agenda was to make the EU the most competitive, knowledge-based economy in the world, and at the same time preserving, or even improving social cohesion and maintain environmental sustainability. The Lisbon Agenda had a large number of goals, in both quantified and qualified measures, in different areas. The main instrument that was put forward was the open method of co-ordination (OMC) that includes indicators, benchmarking, peer pressure, and best practise demonstrations.

In 2005, the results that so far had been reached were evaluated in mid-term reviews. The findings were not positive. The EU was still lagging behind other major regions, and in some areas had the gap even widened. Due to the lacking results, the Lisbon Agenda was forced to change some of the implementation processes. The many quantitative goals were reduced, and only the goal to dedicate three percent of GDP to R&D stayed in its original shape. The main goals were now on growth and jobs. The member states were to formulate national reform programmes, and use these as their main instrument in order to reach the goals (“The Lisbon agenda from 2000 to 2010”, 2006).

The importance of the context of the Lisbon Agenda is still very valid, and will be even more so if the EU continues to lag behind other major economics in the world. The next step is now to reconsider and formulate a new Lisbon Agenda. If the EU wants to reclaim some of its lost ground, there is no time to waste since the economic world is moving fast.

The forthcoming Lisbon Agenda will certainly need new approaches, and new instruments. One of the areas of instruments that can be further explored is innovation policies where the use of R&D and human capital is enhanced. Human capital is a natural part of a knowledge-based economy, and has positive impacts on growth, and jobs in the economy. Innovation policy instruments are diversified and are integrated in many areas of an economy.

The purpose of this report is to investigate which innovation policy instruments that exist and how they can be used in the process of the beyond Lisbon 2010.

The report has the following structure: section 2 includes some of the thoughts about the next step in the Lisbon Agenda, which is followed by a short introduction to growth theory in section 3. The fourth section explains briefly innovation policy instruments. The fifth and the sixth section discuss general and specific innovation policy instruments respectively. In the last section of this report the conclusions are presented.

## **2. BEYOND LISBON 2010**

Calls have been made to set up a strategy for the developments connected to the Lisbon agenda that goes further than 2010. For example, the High Level Group on Key Technologies says that Europe needs a long-term vision (30-50 years) and a transition agenda for creative system disruption. The group is asking for a research policy that compared to the US and Japan has a differentiation rather than imitation approach, building on the European strength in current, potential and emerging sectors. The global competitiveness in research can be enhanced by global cooperation in basic research areas where cooperation has been found to be successful. Competition has proved more viable and efficient in the innovation front. The report further stresses how important the interface between science and society is for increased competitiveness. These are; the absorptive capacity for innovation and the knowledge transfer mechanisms that bring knowledge to the market as commercialised products (Key Technology Expert Group, 2006).

Eurochambres, the organization for chambers of commerce, raised their fears that there will not be any program of economic goals after 2010. Eurochambres recommends in spite of the shortcoming of the Lisbon strategy for the EU to prepare a new multi-annual programme, this time using more forceful instruments of implementation than the open method of co-operation (Eurochambres, 2007).

## **3. ECONOMIC GROWTH THEORY**

In this part there will be a brief summary of economic growth theory: endogenous growth theory and evolutionary growth theory. This will give an insight about what the theory predicts about economic growth and what instruments that affects it.

### **3.1 Endogenous growth theory**

In the neoclassical growth theory, long-run growth is determined by the savings rate and traditional an exogenous rate of technical changes (Solow, 1957). The obvious weakness of these models is that nothing within the model determines the long-term growth rate. A higher savings rate could boost the growth for a period but because of the decreasing returns to capital there is an upper boundary where increased investments (determined by savings) will not affect the long-run growth rate. Endogenous growth models were developed in the 1980s as a response to the oversimplified and sterile exogenous models of Solow type.

The endogenous school of growth theory distinguished itself mainly by emphasising that growth is an endogenous outcome of an economic system. Endogenous growth theory builds on microeconomic fundamentals where firms maximize profits given their production function and consumers maximize utility given their budget.

Romer (1990) builds his argument for endogenous growth mainly on three points. Firstly he claims that the technological change, which is the improvement of technology by the use of new knowledge, is one of the main drivers in growth. The technological change is an incentive for capital accumulation. The endogenous part of the model comes from Romer's second point being that the technological change is mainly the result of individuals acting on market

incentives. Firms, for example, develop new products to earn extra profits. The third point is that technologies, once developed, is applicable repeatedly at no additional cost. According to Romer, policies should subsidise the accumulation of human capital, this will in turn foster technical change and capital accumulation resulting in economic growth (Romer, 1990).

The fact that technology spills over between agents in the market is one of the main arguments behind innovation policies. The spillover effects imply that the benefits of new technology are larger than the private one reaped by the firms. Innovation policies should protect the private returns to encourage investments and subsidise research and development in order to raise investments to a socially optimal level. Many economists (among others Lucas 1998 and Grossman and Helpman, 1991) claim that spillovers across actors and firms are characterised by increasing returns. That is, the more firms and actors that integrate in R&D the larger the positive spillover effects will be.

### **3.2 Evolutionary growth theory**

In evolutionary theory the role of diversity creation and selection, or competition, are emphasised as main drivers of innovation. Another important point is the path dependency of innovation.

Structural-evolutionary (SE) theory is a set of theories that tries to capture long-term economic growth as the result of evolutionary dynamic concepts. Real world concepts affect the processes under which technologies evolve under the influence of a stream of innovations. Therefore factors such as uncertainty and selection are taken into account. When technology is given, neo-classical theories and endogenous theories has served well in questions such as resource allocation. When technology is expected to change endogenously, the SE approaches may be more suitable (Lipsey et al. 2005).

SE approaches are taking views on both the firm and the market that are different to that of the standard neo-classical ones. SE-theories say that it is reasonable to believe that maximizing behaviour by the firm is a reasonable assumption when it concerns simple choices under fairly predictable conditions. When it comes to innovating, inventing and diffusing new technologies, uncertainty is in the picture and then the firm is rather profit oriented and markets are not directed by an invisible hand but rather path- dependent. These views have important policy implications. Ortodox economists generally take a very sceptical view on technology enhancing policies and see them as distorting and that informed profit maximizing firms perform anything that the government can do better and more efficiently. A SE-traditionalist then argues that distortion relates to optimality conditions and hence has no place in a growing economy. Support for technology enhancement policies is often taken from real world examples. For developing nations, the Asian tiger economies are often taken as examples but also the early days of the now developed nations. When looking at policies in developed countries, directed policies has often led to a technological lead for nations for example it can be said that many groundbreaking technologies of the twentieth-century has been developed assisted by public funds, in many cases from the US department of defence (Lipsey et al. 2005).

## 4. INNOVATION POLICY INSTRUMENTS

The innovation concept has many features. Innovation can be classified as radical or incremental. The later involves gradual improvements in existing and current technologies. Radical innovations entail the introduction of new technologies and discontinuous change (Murphy and Gouldson, 2000).

To make an innovation arena work, many different aspects has to be included. There must be (i) science, both hard and soft aspects (ii) product development, with technological and social aspects and (iii) entrepreneurship, which plays a vital role. There cannot exist any innovation without any entrepreneurship. These factors create together a system in which the change process is cyclic in nature (Berkhout et al., 2006).

Budgetary and monetary policies and a countries trade are getting less autonomy due to the globalisation process and the liberalisation of financial markets. Hence, labour market policy, social policy, infrastructure policy, education policy and not least, innovation policy is becoming even more important and these are essential factors for sustainable economic growth. If regions or firms do not have any innovation and learning, they will be unable to establish sustainable growth. Innovation represents a potential source of dynamic comparative advantages by enhancing a firms or workers learning abilities (Lundvall and Borrás, 1997).

To make the distinction between tacit or codified knowledge is important for innovation policy. When knowledge is tacit, it is stickier and does not flow as easily across borders within organisations or in space. Knowledge stays tacit if it is complex or changeable in quality, if e.g. understanding social relationship is crucial, skilful physical behaviour is needed or several different human senses is needed at the same time (Karlsson and Johansson, 2005). There would be little incentives for firms, regions and nations to invest in R&D, if all knowledge were easily transformed into information that everyone could access the technology gaps between regions and countries would be minor and temporary (Lundvall and Borrás, 1997).

When new policies are to be implemented in the EU, several dimensions have to be taken into account, vertical and horizontal. In the case of innovation polices, the vertical dimension, where European, national and regional instruments and strategies must be harmonised with the new policy. They should mutually complement and support each other to yield innovativeness in the EU. In the horizontal dimension, different policy areas must be co-ordinated to bring positive synergies to enhance the learning ability in the system (Lundvall and Borrás, 1997).

To implement an innovation policy is complicated and according to Lundvall and Borrás (1997) there are three main features that one should take into account before implementing the policy:

- Policies concerning the transformation pressure (competition policy, trade policy, and the position of general economic policy).
- Policies concerning the ability to innovate and handle change (human resource development and innovation policy).

- Policies constructed so that they are able to take care of the misfortunes in the transformation process (social, labour market and regional policies with redistribution objectives).

## **5. GENERAL INSTRUMENTS**

The formulation of the general instruments gives the framework for the specific instruments. One important question to lighten is if the EU is to give priority to general or specific instruments. To classify the innovation policy instruments into general and specific instruments can be problematic since the instruments can both have the characteristics of being general and specific, where the term specific indicates that an instrument is designed to influence a specific technology area or a special group of innovation agents. The EU needs to be more general in their instruments in for example: the property rights, patent system and a common admittance of pharmaceutical products.

### **5.1 Institutions**

The institutional framework of economies is a critical factor not only for innovation but also for economic growth and development more generally. The formal institutions are the general rules that are guiding the behaviour of economic agents. They have two basic roles: first, they define the property rights of economic agents, and second they determine the level of transaction costs in the economy.

The formal institutions represent a structured system of laws that is imposed by representative forms of governance (Stiglitz, 2000). The formal institutions play an important role for innovation, since they support the efforts of the technological advance. They also reduce uncertainty and opportunism. The formal institutions are of great help when actions need to be coordinated within a nation or a region.

The institutions can be classified into internal and external institutions. External institutions, routines and behaviour regularities are those shared by the population. Internal institutions are the shared solutions or mental models to solve the problems of social interaction. This can be further explained from a firm point of view, where the internal institutions come from the decision-makers within the company and the external institutions is restrictions from outside the company (Mantzavinos et al, 2004).

Even though the main formal institutions are important there exist also a large number of intermediate institutions such as trade associations, professional associations of engineers, and chambers of industry. These can act as learning laboratories for their respective firm and industry. These intermediate institutions work well in Germany and Japan and have a strong position in contrast to the UK were they tend to be weak. For these institutions to work properly they need to come from within the nations or the regions (Morgan, 1997).

Intellectual property rights such as patents, copyrights, trade secrets, and registered trademarks are the base for building and extending the markets for new technologies, i.e. innovations. The specification and enforcement of private rights to market a firm's product is vital in almost all

industries, partly because it is becoming easier and cheaper to copy new technologies. Intellectual property rights are in the long run promoting economic growth, technology transfer and local innovation (Maskus, 2000). The intellectual property rights have the characteristics of being negative, i.e. they are rights that limit other parties in their behaviour, they stop pirates, imitations, counterfeiters, and in some cases limit third parties that have independently reached the same ideas from using them without a licence from the right-owner (Cornish and Llewelyn, 2003).

In most countries a patent is potentially powerful during 20 years. However, it has to be renewed every year. When the patent is granted it is only granted in that specific country. In Europe, the European Patent Office (EPO) has the authority to grant the patent in the whole of EU or in a selective number of member countries, if it is a request from the applicant (Maurseth, 2002).

Patents provide the inventor with a monopoly on his invention for a given time period. In theory, and often also in practice, patents solve the problem of fully appropriating the returns when R&D is successful and generates an invention. Patents obstruct a wider use of the invention and restrict the diffusion of technological knowledge. Thus, patents may be an impediment, especially when the returns from knowledge diffusion are high. Some authors even reject the patenting of academic research in order to stimulate commercial applications, and argue instead that the public expenditures for fundamental scientific research should be increased.

The EU is missing some of the important platforms that are needed for innovations to reach the market, including institutions. The EU, compared to the US, have severe problems in reaching the firms with university spillovers and have a low rate of university spinout companies (Klomp and Roelandt, 2004). There exist different systems in the EU for fostering patenting through universities many member states have weak incentives and institutions for universities to commercialise their innovation. This is regulated, exception for academic researchers (called the "lärarundantaget"), in Sweden, which states that teachers, researchers and PhDs is the owner of the patents even if they are developed at their workplace at an university. One way is of course to sell the patent and receive financial compensation. In the US universities the patents belong to the universities.

How competition in the different markets for goods and services affects the level of innovation within the EU and its different member states is an important aspect. The incentives for innovation increases, if there are more agents in a market because the social return on innovation can be assumed to increase with competition. A monopolist has limited incentives to innovate particularly in terms of new products, since the monopolist will compete with himself and risks only carrying extra R&D costs without being able to increase his monopoly profit. Thus, a monopolist risks hurting himself by being innovative.

The intensity of competition has an ambiguous effect on the willingness to innovate. In competitive markets, there are no losses for innovative entrants, since they have no monopoly profits to loose. The difference in profits from innovation in competitive and monopolistic markets is known as the Arrow effect. However, innovation has spillover effects, since competitors may profit from each others R&D-efforts. Hence, the higher the spillover risks, the lower the incentives to innovate. With fewer competitors, there are fewer potential free riders,

and, thus, the incentives to innovate are stronger because firms can appropriate relatively more of the returns from their own R&D-efforts.

The structure of the actual industry will determine which of the effects that will dominate. An 'even' industry consists mainly of firms with comparable productivity levels. A higher intensity of competition in such an industry will stimulate innovation because the positive Arrow effect dominates the reduced spillover from R&D. Firms in even industries will concentrate on incremental innovations. In 'uneven' industries, with substantial differences between leading and lagging firms, a higher intensity of competition will lead to fewer innovations. The Arrow effect is too small in such markets to compensate for reduced spillover effects. Thus, potential entrants will not make a sufficient return on their drastic innovations.

"The Porter hypothesis" suggests that countries that have stricter environmental regulations than other countries will increase their innovations within the field and will therefore become a net exporter of newly developed environmental technologies. There have been some case studies that indicate that more stringent regulations have resulted in innovations but they do not provide a general consensus of the impact that environmental regulations have on innovations. This phenomenon is difficult to test empirically due to lack of data. It has however been found that regulatory compliance cost have a positive effect on patenting of environmental technologies (Jaffe and Palmer, 1996).

Environmental regulations in any form, command-and-control or market-based, have the potential for inducing or forcing some amount of technological change, since by their very nature, they induce or require firms to act in ways they would not otherwise choose. It is, however, impossible to say by how much the firms will change their behavior. Empirical evidence and theoretical findings suggests that market-based instruments are likely to have greater, positive impacts over time than command-and-control approaches on the invention, innovation, and diffusion of environmentally-friendly technologies (Jaffe et al, 2002).

There is a fine line between too much and just right amount of institutions. University systems may provide stable and efficient conditions for interactive learning. However, they may also become a hinder in the process and lower the learning and innovation capability. Institutions might also become a constraining factor since there is interdependence between the institutions. All single institutions have its own fixed place in the system and if one institution changes it will bring instability since the whole structure of system changes. This yields that either no changes at all are taken or only minor changes are taken that does not shake the structure. Thus, institutional rigidity hinders new institutions that are needed for implementation of new ideas and innovations. On the other hand, a weak formal institution, which arises due to too little institutions, is also negative for the innovation capacity in a nation or a region (Boshma, 2005).

Another type of institution that is important for innovation is the social institutions, which refer to repeated patterns of behaviour, such as habits, routines and conventions. Innovation is strongly dependent upon the social institutions, and their variety of routines and social conventions (Morgan, 1997).

The existing literature suggests the following policies:

- Support the growth of intermediate institutions
- Further develop EPO
- Focus on the relationship between university spillovers and firms

## 5.2 Infrastructure

Infrastructure and in particular transport infrastructure has for a long time been a major policy issue within the EU. Special interest has been devoted to, on the one hand, provision of better transport connections between the different member states to stimulate trade by decreased transport costs, and, on the other hand, improvement of the infrastructure in less favoured regions within the community in order to make EU more coherent. Plans for trans-European transport networks (TENs) have been presented and approved. Some of the links in the trans-European networks have also been built but the speed of implementation has generally been all too low due to a lack of funding and political will. The investments in TENs have to a large extent been motivated by a wish to implement the common market i.e. improve the mobility of goods and people. In general, the importance of infrastructure for research and development (R&D) and innovation seems to have been neglected.

Research has shown that knowledge flows tend to be spatially bounded and that an extension of functional regions by means of shorter travel times may stimulate knowledge production (Ejermo, 2004; Gråsjö, 2006) as well as productivity growth (Andersson & Karlsson, 2007). Studies have acknowledged the importance of “networks” in the innovation process. Infrastructure plays an important role in the networks and in their capability of the internal communication (Cooke, 1996).

Innovations depend on the geographical infrastructure and its capability of mobilising technical resources, knowledge and other inputs needed in the innovation process. This infrastructure includes sources of knowledge, such as networks of firms, concentrations of R&D and business services. Once the infrastructure is established, it enhances the capability of innovation, since the region will develop and specialise toward a technical or industrial sector (Feldman and Florida, 1994).

Ebadi and Utterback (1984) find that there exists a positive relationship between the frequency, centrality and diversity of communication and technological innovation, at the individual level, where the frequency of communication has the largest impact. At the firm level, the same patterns were found, and also network cohesiveness was found to have a positive impact.

The innovations in information and communication technology (ICT) have increased during the last years and have brought positive effects on productivity. This process has differed considerably between countries, which is partly due to the capital market structure in different countries (Houben and Jakes, 2002). ICT and innovation tends to be closely related. Firstly, ICT is itself a technological innovation. Secondly, ICT also affects innovation in a broader sense since it supports the creation of new and better applications and production processes. According

to this view, ICT is supporting the productivity of all inputs, and can therefore be capable to increase the total factor productivity (TFP). Labour productivity can be enhanced by ICT through a direct approach, capital deepening, and through an indirect approach, by enhancing innovation (van Leeuwen and van der Wiel, 2003).

Some empirical evidence support the belief that clusters tend to bring a higher level of innovations which is partly caused because clusters create economies of scale, facilitates face-to-face interaction and shorten interaction distances in general. Product innovations are strongly connected to clusters within a region. One important feature of these clusters is the technological infrastructure (Feldman and Florida, 1994).

Knowledge flows in Europe is a key issue. Knowledge flows have different characteristics and can be (i) transaction based, (ii) transaction-related or (iii) pure knowledge spillovers (Karlsson & Johansson, 2006). However, knowledge flows tend to be bounded in space, irrespective of the type. Several studies have confirmed the need to improve the transport infrastructure in Europe to improve the accessibility to new knowledge for regions outside the metropolitan regions and also to improve the knowledge exchange between the metropolitan regions in Europe. Another instrument to speed up knowledge flows in Europe is to encourage a higher rate of spatial mobility among knowledge handlers (Zucker, Darby & Armstrong 1998; Zucker, Darby & Brewer, 1998; Almeida & Kogut; Möen, 2000).

Concluding remarks on infrastructure policies:

- Continue to invest in TENs, in order to improve the knowledge accessibility for regions surrounding metro regions
- Improve and expand the infrastructure since it enhances the knowledge production and productivity growth, it is also beneficial for networks
- Continue with the investments in ICT and promote the use of ICT

### 5.3 Incentives

Incentives such as intellectual property rights have already been discussed earlier in the report. Incentives systems can either rely on the private sector and its investments, or it can rely on public expenditure. The incentives can also be a mixture of private and public spending. The incentives aim at augmenting the R&D-efforts, which will enhance the rate of innovation. The incentives are based on the fundamental role that diffusion of knowledge plays in technological progress and economic growth.

Tax-based subsidies to R&D leave the choice to the private sector, of how to conduct and pursue R&D-efforts. R&D-efforts are expensed and can therefore be subject of tax subsidies, compared to fixed investments. There exists evidence that the tax system has an impact on R&D-efforts. The tax-based system has some flaws compared to government financed or firm financed R&D-effort. Fiscal incentives seem to be ineffective in raising private R&D-efforts since the response elasticity is very low. Thus, it would take a large tax cut to reach the socially desirable level of

R&D spending. Another problem faced by the firms is when the financial incentive system change often and thereby causes uncertainty for the firms (Hall and Reenen, 2000).

Behavioral additionality is a measure to determining how firms change their R&D behavior as a result of government policy instruments. It differs therefore from the traditional evaluation which focuses on determining the amount of additional spending on R&D that result from a government intervention. The behavioral additionality has so far been underdeveloped which is to be considered as a flaw since it contains many advantages. Behavioral additionality provides policymakers with a useful vocabulary, reveals qualitative changes in firm conducted R&D and reveal the procedure firm choose when conducting the R&D when participating in a government funding programmes (OECD, 2006).

As in the case of fiscal incentives, the financial subsidies to R&D aim to correcting the underinvestment in private R&D-efforts caused by market failures such as incomplete returns to knowledge investments. Another factor that influence is the fact that knowledge is partly a public good with characteristic such as non-excludability, or incomplete financial markets. The main reasons behind financial subsidies to R&D-efforts are incomplete R&D assessments and financing constraints in the firms. Financial subsidies can increase the R&D-efforts in firms, since they decrease the market uncertainty for new products by increasing the expected return from the R&D-efforts (Czarnitzki and Toole, 2006).

The government has the same difficulties as a bank when handing out financial subsidies. The government faces adverse selection, problems with monitoring the quality, reliability, credibility, asymmetric information and general lack of information. The design of the financial subsidy can easily result in a selection which is directed towards the worst performing firms within a sector.

Governments can stimulate private investments in R&D by subsidies. The problem is however, that a subsidy often generates little additional R&D-investments. Public subsidies to R&D-investments run the risk of only reducing the private costs of R&D-projects, which would have been undertaken anyhow, i.e. they crowd-out non-subsidized investments in R&D. Subsidies may also be given to R&D-investments whose returns are too low from a social point of view. Often no cost-benefit analyses are made and it is genuinely difficult to evaluate the social returns of individual R&D-projects. Firms may also take advantage of the system by presenting other costs to the government claiming that they are R&D-costs. Subsidies can, however, also be positive and alert firms, in particular SME's, and their co-operation with public organisations such as universities. Hussinger (2003) finds that that public funding increases firms' R&D expenditure. However, the size of the effect depends on the assumptions imposed by the particular selection model.

If subsidies are effective, they lead to an increased demand for R&D-personnel and thus to wage increases for such personnel, if they are in short supply. It is an open question, whether there is a shortage of R&D-personnel within the EU. Certainly, the situation differs between the different member states but at least in the case of high level R&D-personnel, the labour market is global and it should be possible for the different countries to recruit enough personnel given that the offers are attractive enough.

Concluding remarks on incentives policies:

- Develop the behavioral additionality
- Subsidies from the public sector should target specific groups of firms, where the subsidy produces positive externalities

## **5.4 Education and training**

Human capital is an important factor when explaining innovation and economic growth. This can be seen in the human capital index given by the Lisbon Agenda. The index is used to rank the European countries and involves four dimensions (i) endowment, (ii) utilisation, (iii) productivity, and (iv) demography and employment.

### **5.4.1 Higher Education**

It is important to analyze the role of higher education in promoting innovation and the effects of education on labour productivity. Empirical research has convincingly shown that education raises labour productivity. However, the link between higher education and innovation is weak. A possible explanation might be that only a minor part of the workers with higher education moves into innovative jobs.

Although it is hard to establish a link between higher education and innovation at the macro level, there should be such a link at the micro level through R&D. The reason is that graduates with an engineering, technical, or science education are the most important input in R&D-production. Since R&D has substantial positive external effects, the supply of this type of graduates is of crucial importance for EU's innovative capacity.

Engineering, technical, and science studies have lost substantial popularity in recent decades in many member states. Thus, the supply of graduates in these fields has decreased relative to other fields. Assuming a stable level of demand for graduates from engineering, technical and science studies, this should have resulted in higher wages for such graduates compared with graduates from other fields. However, empirical studies indicate that the relative wages for graduates from engineering, technical and science studies have remained the same or have even been falling. This implies that the labour demand for other types of graduates must have increased so much that any wage pressure due to a reduced supply of graduates from engineering, technical and science studies has been offset, given that the demand for such graduates has not decreased. The general conclusion seems to be that there is no general shortage of graduates from engineering, technical, and science studies within the EU.

A related issue is the quality of the engineering, technical and science education offered by universities within the EU. Here the problems are obvious. What the EU needs is that a sufficient number of universities are given opportunities within a competitive race to develop to elite universities that can compete with the best universities in the US and which are open for top-students from any country in the world.

An often-used motivation for government intervention in higher education is that education generates positive external effects similar to the R&D case. In the presence of positive social effects, governments should subsidise education up to the point where the social and private returns are equalized. However, in contrast to R&D, external effects of higher education are notoriously difficult to measure empirically and most reliable estimates that the social returns to higher education equal the private returns, i.e. the individuals taking higher education are able to appropriate all the benefits of higher education. Thus, there is no argument for further increases in the public expenditures on higher education at the current level of education subsidies within most of the EU-15 states. The EU is limited, in its education formulation, by its social policies; this is one major difference that exists between the education system in the EU and in the US.

One important aspect of the markets for higher education within the EU is that the union does not function properly due to lack of competition. As a consequence of the policy-induced structure of the higher education sector, publicly financed institutions of higher education are able to take advantage of a kind of monopoly situation, which is essentially unchallenged because non-subsidized potential entrants cannot compete with the subsidized “monopolists”. This situation undermines the quality of higher education within the EU and is harmful for investments in human capital. It also explains why so few, if any, universities in the EU can compete with the leading elite universities in the US. Making universities into self-governing institutions and reducing barriers to entry in the market for higher education, by creating a level playing field can stimulate entry, foster competition, make institutions of higher education more efficient, and provide students with more educational choice.

The returns from investment in education are found in the following table. Table 5.1 shows that Europe and OECD countries have a low rate of return in their investment in education, from a social view. From a private perspective, OECD countries are far below the rest of the world. It is therefore important that the private investment in universities increases and become profitable so that universities receive financial resources to develop.

**Table 5.1 Returns to education by level, in percentage.**

<u>Region</u>	<u>Social</u>			<u>Private</u>		
	<u>Primary</u>	<u>Secondary</u>	<u>Higher</u>	<u>Primary</u>	<u>Secondary</u>	<u>Higher</u>
Asia*	16.2	11.1	11.0	20.0	15.8	18.2
Europe/Middle East/North Africa*	15.6	9.7	9.9	13.8	13.6	18.8
Latin America/Caribbean	17.4	12.9	12.3	26.6	17.0	19.5
OECD	8.5	9.4	8.5	13.4	11.3	11.6
Sub-Saharan Africa	25.4	18.4	11.3	37.6	24.6	27.8

Source: World bank statistics

**5.4.2 Primary and Secondary education**

The primary and secondary education is both included in the concept of human capital. Human capital is in the new growth theory the main source of innovation since it allows individuals to produce and adapt technological change. A high ratio of human capital generates economic growth since more human capital makes it easier to absorb technologies from other countries and

develop it further, which is important from the secondary education level and up. The primary education is a prerequisite for the other education levels and should therefore also be included as an important factor. It is important to separate the quantity from the quality in all levels of education (Barro, 2001).

Countries that are less-developed with lower average income tend to have a higher return on their investment in primary and secondary education. Higher education is more vital for the growth in OECD countries. However, a general finding is that the initial average level of education i.e. the stock of human capital, measured as the literacy rate or primary and secondary enrolment ratio, has a positive impact on economic growth (Blundell et al, 1999). When evaluating 21 OECD countries Gemmel (1996) found a positive relationship between investment and the ratio of the labour force with secondary education.

### **5.4.3 Other sources**

Firms that invest in human capital do this by investing in on-the-job-training. The training increases the productivity of the employees since they become more efficient. On-the-job-training can be any activity undertaken at the firm that increases the productivity of the employees. These activities can be formal, workshops and specific education and informal training, such as learning-by-doing (Kalaitzidakis, 1997).

On-the-job-training is needed the most when firms adopt new technologies or if the firm is experiencing a large change in their environment such as a shift from low to high skill jobs. This is found in many OECD countries. According to several surveys conducted in firms, the appropriate skill of the employees is an important factor when adopting innovations and technologies (Acemoglu, 1997). On-the-job-training can affect the demand for labour due to their observed abilities, such as education but also due to the unobservable abilities (Kalaitzidakis, 1997).

In an imperfect labour market, future employers will benefit from the on-the-job-training that the employees receive. This externality is between the today's employer and future employers and will lead to that too little on-the-job-training will be conducted. When many firms adopt an innovation the employees expect a higher return from their skills and are more eager to get involved in on-the-job-training. The probability of innovation and training will therefore increase by the thickness of the labour market. There exist also a relationship between the employee and the current employer which arises due to incomplete contracts and credit market imperfections. The later problem can be solved by, for example, penalties for workers that leave the current employer (Acemoglu, 1997).

Lifelong learning is a concept that is broader than the education period or the knowledge acquired at the working place through, for example on-the-job-training. It is continuous spectra of the learning process that takes place at all levels in the society, formal, non-formal and informal. Since it is increasing, the stock of human capital it is beneficial for the innovation level in a nation or in a region. The reason behind the need of lifelong learning is the rapid changing technological environment and the structure of the economy that puts pressure on the employees.

Concluding remarks on educational policies:

- EU should focus on investment in higher education since this yields a higher payoff than investment in primary and secondary education
- Invest in universities within metro regions
- Invest in good universities so that they become in a position where they can compete with the best universities
- Continue to promote on-the-job-training and life-long learning

## **5.5 International Trade**

### **5.5.1 Exports**

Innovation has a positive impact on exports since it improves the quality of the products and also the variety of products, which enhances the demand. Disruption, such as strikes, in the production process causes lost sales. A successful innovation improves normally both the trade volume and the balance of trade.

Trade and growth theory have predicted a mutual causation between exports and innovations. According to the prediction of product-cycle models of international trade innovation is the driving factor behind the exports of industrialised countries. Lachenmaier and Wößmann (2006) find that innovation activity caused by specific obstacles or impulses that is influencing the firm, in turn affect the export share. The export share in their study was raised up to approximately seven percentage points. The study was conducted using German manufacturing firms.

Basile (2001) found that capability to innovate is an important competitive factor, when analysing Italian firms, which explains the heterogeneity in the export behaviour. He found that innovating firms have systematically higher export intensity than non-innovating firms. A devaluation of the exchange rate reduces the importance of technological competitiveness, since firms that are not innovative can enter the foreign market. Once firms have established themselves on the market and export they continue doing this after the exchange rate returns to the previous level.

There are three main channels of which a firm participating in the export market can raise their productivity growth: (i) learning by exporting, (ii) exposure to international competition, and (iii) increases in product specialisation which allow for exploitation of scale economies. Firms that start to export are more willing to increase their investment in R&D and training in order to be able to absorb foreign technologies and best practices. Entrance into the export market is also associated with an increase in the number of advanced technologies that are used, in foreign sourcing for advanced technologies and in the information about technology improvements. Lastly, entrance into the export market partly explains the improvements in the novelty of the innovations that are introduced (Baldwin and Gu, 2004). Even though this study was conducted in Canada, roughly the same patterns should be found in Europe. In a firm-level perspective

Andersson and Johansson (2007) find a strong relation between regional export networks and the frequency of product innovations.

### **5.5.2 Imports**

The import of foreign technology and the domestic technical development show an interdependent relationship. Countries should adopt the technologies from other countries and then increase the value by own R&D-efforts. This introduction of new technologies can arise from, as mentioned before, imports of foreign technology, or from foreign entrepreneurs, such as immigrants (Johansson and Westin, 1987). The importing countries must be able to adapt the new technologies, and thus have the sufficient amount of human capital and institutions that are able to change its current situation (Freeman, 1995).

The competition arising from import can stimulate economic growth, since it reduces the market power for domestic monopolistic innovators. The domestic innovators are forced by the import competition to choose between either quickening their pace of innovation or being replaced by foreign innovators. The downside is that it possibly reduces the return of domestic innovation and can therefore drive some innovators out of business (Baldwin, 1992). Import competition makes the domestic firms to perform more efficient in order to keep their market power. Import share and inward foreign direct investment (FDI) share have both positive impacts on product and process innovations. FDI is one way to operate on a foreign market (Bertschek, 1995). The competition in goods and services has indeed increased in the EU, since the common market has been established; the competition from foreign countries has also been increasing.

Jane Jacobs popularized the concept of import-substitution. Import-substitution arises when less developed regions import more developed products. As the producers increase their knowledge about the new products they find ways to replace these imports with locally produced goods. Along with this process, new knowledge and products are imported which will further stimulate the process (Jacobs, 1984). Jacobs's concept has been tested and confirms the intuition behind it, a growing meshwork of skills is a necessary condition for urban dynamics (Johansson and Westin, 1987).

Firms that conduct in import have internal economies of scale, knowledge about the local market and a wide network. The import does also give rise to new knowledge that stimulates product and market renewal. Importing firms locate themselves in a region with a large market, since many importing firm have the same strategy, they tend to allocate together. You get a cumulative relationship arising from internal economies of scale, market potential and import stimulation. Thus, importing firms give rise to externalities that the surrounding region benefits from (Regioner, handel och tillväxt, 1998).

Concluding remarks on international trade issues:

- Allow import competition from non-members countries to enhance the competition, in order for the member countries to specialize in more advanced production
- Stimulate regional milieu with rich import and export networks

## 5.6 The Labour Market

Labour market policies are normally not aimed at influencing innovations but may nevertheless have important consequences for firms' innovative strategies. Labour market policies affect the firms' capacity to appropriate the gains from innovation activity since these policies affect the cost of implementing innovations. The relationship between job protection and innovation is not straightforward. The impact of job regulation depends on the system of industrial relations, and the unique characteristics of each industry (Bassanini and Ekkehard, 2002).

Labour market flexibility contributes to innovation, since such flexibility facilitates the introduction and implementation of new production methods. The labour market flexibility increases, if workers can be easily (re-)assigned to different tasks, and if workers can easily change jobs. Investment in human capital through general on-the-job-training allows employees to adjust to changing circumstances more easily. On-the-job-training can also be firm-specific and in this case the employees are not better prepared for a changing environment.

Measures to combat income inequality distort the performance of the labour market, because workers become less willing to adapt to the dynamics of the labour market. Policy measures, such as long and generous unemployment, disability, and sick benefit payments induce workers, who loose their jobs to stay out of the labour market permanently, and to let their labour skills and their human capital whither away and thus creating hysteresis.

However, labour market flexibility is important for innovation but flexibility is accompanied by greater inequality and uncertainty. Currently, in particular within EU-15, income inequality is kept within rather limited bounds, and risks are insured mainly through public arrangements. Government intervention to reduce or compensate for inequality, and uncertainty can to a certain degree be motivated by general welfare arguments, but it can easily turn into government failure, as it distorts the functioning of the labour markets, and reduces the incentives to accumulate human capital. Only by increasing the effectiveness of government intervention, i.e. by avoiding institutional failure, can the labour market flexibility be increased without sacrificing the income protection of workers.

Labour market flexibility includes aspects, such as security of employment, and variation of working hours. Security of employment diminishes the flexibility in the labour market, and can therefore harm the innovation capability of a firm. On the other hand, when the employees feel secure, they are willing to take more risk in their job, which can result in more innovations.

The labour market for insiders is heavily protected in many member states, implying that the outsiders are confronted with greater economic risks, because they work part-time, in flexible jobs, have fewer social insurance rights, face pension breaks, and so forth. Labour market restructuring usually causes elderly workers to leave the labour market permanently. The way many pension systems are constructed, it does not make sense for elderly workers to accept lower wages to preserve jobs. Pension risks are in many countries shifted to younger generations through collective agreements that are legally binding for all workers. Sustaining the insiders' market power through fiscal means, promotes inflexibility, and reduces the innovative capacity of many member states. With excessive protection of insiders, the labour market will be characterized by sclerosis rather than flexibility. If possible, policy should be aimed at empowering the outsiders to make the labour markets more flexible. Also in the labour markets, there is a need for backing the challengers.

Labour can be mobile in a geographic, educational and occupational aspect. If the labour is mobile in any of the aspects it increases the labour market flexibility. Labour mobility increases the knowledge spillovers through different national and transnational networks. This phenomenon may be especially important in spatial clusters.

Trade unions can either be positive or negative towards technological changes and improvements, which influence the mentality of firms and thus their innovation capability. Trade unions can affect innovations through other channels, such as, their effects on relative factor prices and profitability. In North America a survey was conducted which found that unions have a negative impact on R&D-efforts. However, the same patterns cannot be found in European countries. A clear-cut relationship between trade unions and innovations has been hard to find (Menezes-Filho and van Reenen, 2003). Studies have shown that contrasting strategies adopted by unions in different countries have been explaining factor to ways jobs have been reconfigured (Hyman, 1999).

Concluding remarks on labour market policies:

- Enhance the flexibility of the labour market, even though this might cause larger income equality and uncertainty
- Apprehend elderly workers
- Increase the labour mobility
- Force trade unions to be positive towards technological changes

## 5.7 The Financial markets

The issue of how important the financial market is have been widely debated and there is no general consensus found. There have been many studies conducted in this field and for a long time. Adam Smith (1776) found that financial intermediates, like banks, increased the trade. In the general equilibrium theory constructed by Arrow and Debreu, in the 1960s, the optimal allocation is reached without any help from financial markets. The conflict can also be seen in more recent study, where Barnebeck et al (2003) do not find any consistent relationship between financial markets and economic growth. Levine (2003) does on the other hand find that countries

with a well functional financial market grow faster than countries with a dysfunctional financial market.

Capital markets seem to fail in their support to innovation within EU. One reason why firms under-invest in innovation is information problems between them and the financial institutions. Financial institutions cannot reliably predict whether the firm applying for financial capital is a fair risk or not. Problems of asymmetric information increase the capital costs of firms and financial capital may be rationed. Capital market failures reduce the level of innovation within the EU and put a break on investments in innovations.

The build up of market power in the banking sector as a result of recent trends towards concentration in the financial sector yields problems in the capital markets. This reduces the accessibility of the capital market for smaller firms and, thereby, harms innovation. The market concentration has possible worse consequences in the EU than in for example the US, since there are many member states that hardly had any new credit suppliers for small firms. One can assume that greater financial integration within the EU will spur growth via innovation through larger financial efficiency (Padoan & Mariani, 2006).

There are national differences within the EU as regards to the financial capability of different member states, where the UK and the Netherlands are the most well-performing countries. Even though the development in this sector is progressing, there still exist problems. The EU has a weaker “capital chain” in all the stages, than the US, and the EU also have fewer “business angels” and other sources for venture capital, and financial markets in different member states are also harmed by their fiscal policies.

Concluding remarks on financial market policies:

- Enhance competition within the financial sector
- Improve alternative financial aid for venture capital such as “business angels”

## 5.8 Companies

New firms play a disproportional large role when it comes to introducing innovations, i.e. new goods and services. Thus, entrepreneurship plays a critical role for productivity growth and for the renewal of economies. However, there are many examples of market failure in the markets for entrepreneurship in the EU. The public sector is a major producer of many types of services in many EU countries limiting the scope for potential entrepreneurs. In other cases, public regulation still protects incumbents making it difficult or impossible for potential entrepreneurs to enter the market.

The importance of ownership structure has been investigated thoroughly and different results have been found. Some report important implications for the firm efficiency while other has found it to be irrelevant. The ownership structure can also influence the risk behaviour of a firm

which affect the performance of the firm. The influence of equity ownership structure on corporate risk taking and the firm performance is ambiguous.

Hill and Snell (1989) found that diversification, investment in R&D, capital intensity and ownership structure are factors that influence the productivity of firms. Ownership structure can affect firms both directly and indirectly through diversification of strategy, capital intensity and R&D expenditure. R&D expenditure affects productivity through product and process innovations. To involve in R&D brings high returns, from a successful innovation, but also high risk, from the high failure rate of innovations. Stock holders benefit from a high return and can diversify their portfolios; the option is less attractive for risk-averse managements how has to bear the potential failure i.e. there exist conflicting interests. Thus, there exist a positive relation between stock concentration and firm productivity since it encourages R&D-efforts. Such findings for Sweden are reported in Johansson and Lööf (2007).

The corporate governance regime is influencing innovations through various channels. The corporate governance of innovating firms has three main problems that they need to deal with. These are novelty, visibility and appropriability and vary between different sectors. The national corporate governance system contains firm specific perceptiveness and industry-specific expertise that holds the necessary capacity to deal with novelty and visibility. Therefore, the prerequisites differ for firms among countries. There is no general corporate governance structure that works within all fields since it varies with the innovation characteristics within the sector (Tylecote and Conesa, 1999).

In many EU countries, the start-up of firms is still surrounded by much regulation making it both time-consuming and expensive to start new firms. The average number of procedures to start a firm within EU-15<sup>1</sup> is nine compared to four for the US. Furthermore, the time to start a new firm within EU-15 is on average nine times longer than in the US, and the costs are on average three times higher. There is also in many parts of the EU a lack of venture capital making it difficult both to start and to expand new firms (Djankov, et al., 2002).

Concluding remarks on company related policies:

- Reduce the public regulation for services and the protection of incumbent firms
- Reduce the firm start-up bureaucracy friction

## 6. SPECIFIC INSTRUMENTS

Specific instruments are innovation policy instruments that are targeting a given area in the economy, such as for example high-intensive R&D firms. One problem that exists with the specific instruments is that it is hard to make contra- factual analysis e.g. it is hard to say what

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<sup>1</sup> Luxembourg is not included.

would happen if the company for example would not have received the subsidy. One way to solve this is to make matching studies.

## **6.1 Systems of Innovations**

It is important to recognise that systems of innovations are an analytical tool that is used to describe and understand a complex situation. Since it is an analysing where the analyst selects a part of the reality that she wants to investigate, with the ambition to explore patterns.

Policy making at the national level is influenced by many factors including influences from various vested interests and preparations for upcoming elections. What EU gains in variety and diversity, it loses through a lack of cohesion and central policy decision-making. This is clearly illustrated by the European innovation system that is characterized by (i) a multitude of actors at different territorial levels, who have significant competencies and resources at their disposal to promote innovations, (ii) considerable differences in the measures member states apply for internal coordination in innovation policies, (iii) large institutional differences regarding member states' publicly funded R&D-systems, and (iv) significant variations in innovative performance, industrial structure, and patterns of technological specialization among regions, and member states (Kaiser and Prange, 2005).

To reduce the influence of this policy failure it is necessary to reduce the number of objectives in the future but also to involve policy makers at the national level in the member states to be much more actively involved in the formulation of these objectives. Rather than concentrating on all areas of the economy, the EU should focus on a limited number of areas and it must acknowledge the very large variation between the different member states. Thus, the optimal policy mix varies substantially between the different member states. It is also necessary to deal explicitly with actual goal conflicts to give guidance to policy makers. There might also be a need to let more policies be implemented at a European level to avoid the problem with not all member states going in the same direction with the same efforts.

In practice, EU is a complex of different innovation systems. While some regions of the EU are strongly integrated in knowledge transmission, others continue to be peripheral and excluded from major technology transfer flows (Archibugi and Coco, 2005). The recent enlargements from EU-15 to EU-27 have increased the variety of innovation systems. One of the core issues that must be addressed at both the level of member states and the level of EU therefore is how to integrate the different regional and national policies and rules concerning innovations e.g. patents and institutions, into a more coherent and integrated system.

Systems of innovations can be found on all levels of the economy such as having a national, regional and sectoral perspective. The basic characteristics of national systems of innovation are the institutional set up related to innovations and the underlying production systems. It is therefore not surprising that national innovation systems are crucial for the description of the institutions that are devoted to innovations. The core of the institutions is those actors that produce, adapt and diffuse new technical knowledge. The links between the institutions are flows of knowledge, financial, human, regulatory and commercial (Niosi, 2002).

Regional systems of innovations can be hard to implement since it requires more established systems and the whole industrial fabric has to be integrated within a regionally defined administered space. However, the regional systems of innovation can be useful in identifying main relationships since large countries have had more problems than smaller countries in doing so. Therefore, it seems natural to bring the analysis to an even smaller geographical level (Braczyk. et al., 1998).

Asheim and Isaksen (2002) find that a regional innovation systems with a rich institutional infrastructure, involving research and higher education institutions, technology transfer agencies, organizations that foster firms innovation capacity, business associations, finance institutions, etc., hold important competence to support regional innovation. Hence, the institutional infrastructure helps local companies to increase their co-operation, competence building, and innovation activity.

Sectoral innovation systems involve a multidimensional, integrated and dynamic view of sectors. A sectoral system is proposed to be constructed upon a set of products and economic agents involved in market and non-market interactions for the creation, sale and production of those products. The system has specific characteristics within its knowledge base, technology, input and demand. The interactions are shaped by the institutions and the change within the sectoral system arises from co-evaluation of its elements (Malerba, 2002). Since the sectors differ from country to country and also within the country one can find a large variety in the sectoral innovation systems.

Concluding remarks on innovation systems:

- When forming European innovation systems, representatives of member countries need to be more involved
- Integrate the different regional and national policies and rules concerning innovations e.g. patents and institutions, into a more coherent and integrated system
- Invest in regional innovation systems

## **6.2 Research and Development (R&D)**

Research and experimental development has been defined by the OECD to “comprise creative work undertaken on systematic base in order to increase the stock of knowledge, including the knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications” (OECD, 1994).

The returns from R&D come in the form of economic rents gained from an imperfectly competitive market that innovations and new products create. The temporary monopoly profit, which may arise from a product’s superiority, provides incentives for further investments in R&D (Romer, 1990).

R&D can be disaggregated into two separate parts namely applied research and development and basic research. Basic, or scientific, research aims at new findings not directly intended for the market in the short run. Applied R&D is more market oriented. The time horizons and the risks involved are larger for the basic research projects but the potential benefits are also of greater magnitude. Basic research is primarily conducted at universities, research institutes or at large firm's central R&D units. Because of the risks involved in basic research, financing is largely public or jointly public and private (Malecki, 1997). In basic research, where the outcomes are vaguely defined and the risk is higher compared to applied R&D economies of scale is present. Horizontally integrated research units covering several products and markets can by setting wider production goals achieve scale efficiency, this in combination with e.g. sharing of fixed costs is one reason why many firms have concentrated their research activities to special R&D units.

A trend in high technology industries is that R&D-intensive firms cluster within a region and becomes specialised in this industry sector, famous examples are the Silicon Valley in the US or the more recent Sofia Antipolis in France. Clusters in research driven industries are often connected to universities. In theories of regional specialization, two fundamental reasons for specialisation stand out, these are technology and scale effects and durable regional characteristics. Scale effects can be both internal and external. As pointed out by Marshall in the 1920s external scale economies, because of specialisation or agglomeration, arise in for three reasons. Agglomeration creates a specialised labour market, specialised neighbourhood firms (input suppliers) and information spillovers (Johansson & Karlsson, 2001).

Empirical results from the US shows that extra investments in university R&D only have substantial effects on knowledge output if the universities are located within the largest metropolitan areas (Varga, 2001). The reason is that the presence of a "critical mass" of agglomeration in the metropolitan area is needed in order to get substantial regional economic effects of academic research. Even though Varga only studies the US there are no reasons to believe Europe to behave different. This indicates that the EU in the future ought to allocate extra funds for university R&D among universities in the metropolitan regions in Europe to stimulate innovation.

Andersson and Karlsson (2006) showed that accessibility to knowledge could partly explain the variation in growth performance between regions. The growth is in this case defined as value-added per employee and knowledge accessibility is assumed to transform into potential knowledge flows. This is related to the second fundamental reason, durable regional characteristics is capturing durable capacities such as accessibility to local and external markets and size. Durable capacities are factors of production and in particular regionally trapped factors, these are the same reasons for specialisation as pointed out by for example Heckser, Ohlin and Porter. In later years, increasing returns has become increasingly popular as an explanatory factor of specialisation and agglomeration (Johansson and Karlsson, 2001).

Innovation models and its development is a process that can be divided into four generations. The first one is the traditional linear model; the second-generation model had a focus on the flow of information arising from the market. In the third-generation models, investments in innovation are related to the strategy and goals of the company. These models put emphasis on product and process innovation, technical improvements, and less emphasis on the market and organisational

innovation, non-technical. The fourth-generation involves rethinking innovation and the underlying concepts, and includes a clear feedback path (Berkhout et al., 2006).

According to Berkhout et al. (2006) the technological research is driven by new scientific insights, which work, as push factors. The research is also driven by pull factors such as functional requirements in product development. Hence, new functional requirements, and new scientific insights are driving the dynamics of technological research. The implication is that engineers and scientists must have a platform where they can meet in order to inspire each other. To attain this, research must be organised in new ways. A good example is the Technological Top Institutes (TTI) in the Netherlands where such a platform has been created. The European Commission have discussed an implementation of the TTI concept at a European level.

Concluding remarks on R&D policies:

- Support cluster formation
- Support R&D co-operation between firms, universities and the public sector
- Public support to the development of knowledge centers should consider where knowledge-intensive firms are already established

### **6.3 Commercialisation**

The commercialisation of a product is the process from idea to business concept and then to the market. This process is undertaken in an uncertain, volatile, and demanding environment. The commercialisation is a crucial step in transforming R&D-efforts into economic growth. Two main factors act as thresholds in the commercialisation process. These are limitations in the companies' absorptive capacities, and the transfer mechanisms from invention or innovation to commercial product.

Because of firms focusing on development of products close to the market and publicly funded research often being basic in its nature, a gap has arisen between the two. One of the challenges in bridging this gap is that the knowledge produced at universities largely is tacit and can hence only be transferred to companies by interaction by firms and universities. For researchers to be willing to participate in commercialisation of research results, there has to exist incentives to do so (Allen, 2005).

In the past decade, the universities in partnerships with firms have played an increasingly important role in the innovation and commercialisation process. Public-private partnerships have existed for a long time and they are recognised as an important factor in innovation systems. The important role in alliances is to over bridge the gap between public and private research often referred to as the death valley of innovations (Nordfors et. al., 2003). An important factor in the process of commercialise innovations from universities are the existents of science parks, technology parks etc.

Concluding remarks on commercialization policies:

- Create incentives for researchers at universities to commercialize their innovation
- Promote public-private relationships
- Invest in science parks

## 6.4 General procurement

Most of the purchases made by the public sector institutions are restricted with bureaucratic procedures. The regulations in Europe follow the EU law. It is illegal, in EU, to favour domestic over foreign firms. The process involves a lot of bureaucratic work and is therefore very costly and it is also an area where a more efficient system saves a large amount of money. This could be done by using the internet and make the procurement electronically. For the internet based procurement to function there need to exist a coherent system of product classification between the private and the public sector.

The products and services that are under general procurement are today not standardised. This is hard for the individual countries to accomplish but this might be achievable at the Union level. If the products would be standardised into product classifications it would make the general procurement much easier within the EU and the competition would be enhanced. The feature of the products of being compatibility is also important in general procurement, especially in the ICT sector. It has the same features as in the standardisation aspect and enhances the competition. A lot of public procurement is in the military sector where standardisation and compatibility can be harder to achieve.

Concluding remarks on general procurement policies:

- Explore the possibility of an internet based public procurement
- Have a coherent product classification system at the union level

## 7. CONCLUSIONS

In the process of creating the next Lisbon Agenda, innovation policy instrument should be an important factor. The EU is lacking in the process of becoming a knowledge economy and innovation policy instrument has a clear position in this aspect.

The innovation policy instruments are involved in many features of the economy and on many levels, which make them ideal for the next Lisbon Agenda. The instruments can have a general or specific characteristics and some span over the two characteristics. In the next Lisbon process the following aspects should be taken into consideration:

General innovation policy instruments:

- Further develop EPO
- Focus on the relationship between university spillovers and firms
- Provide platforms that facilitate university-industry R&D interaction
- Improve and expand the infrastructure since it enhances the knowledge production and productivity growth, it is also beneficial for networks
- Continue with the investments in ICT and promote the use of ICT
- Develop the behavioral additionality
- EU should focus on investment in higher education since this yields a higher payoff than investment in primary and secondary education
- Invest in universities within metro regions
- Continue to promote on-the-job-training and life-long learning
- Enhance the flexibility of the labour market, even though this might cause larger income equality and uncertainty
- Increase the labour mobility
- Enhance competition within the financial sector
- Improve alternative financial aid for venture capital such as “business angels”
- Reduce the public regulation for services and the protection of incumbent firms
- Reduce the firm start-up bureaucratic

Specific innovation policy instruments:

- Integrate the different regional and national policies and rules concerning innovations e.g. patents and institutions, into a more coherent and integrated system
- Support cluster formation
- Support R&D co-operation between firms, universities and the public sector
- Create incentives for researchers at universities to commercialise their innovation
- Promote public-private relationships
- Explore the possibility of an internet based public procurement
- Have a coherent product classification system at the union level

The following figure gives an overview over the instruments divided into general, specific and at which level they can be used at union level or sub-union level. It is however hard to make this kind of classification. There are large differences between the member countries in the EU and in particular the regional differences. There are both member states that are run as central states and federal states. Thus, the regions in these two classifications have different sovereignty and therefore different powers.

	Sub-union level	Union Level
General	Institutions Companies The Financial market The Labour market	Institutions Infrastructure Inventives International Trade The Labour Market
Specific	Systems of innovation R&D Commercialisation	Systems of innovation R&D General Procurement

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