

The Challenges of Globalisation: Strategic Choices for Innovation Policy

Version of 2007-05-24

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1. Introduction

The vast literature on systems of innovation is rich in theoretical and empirical studies about the complexity and institutionally-embedded processes of interaction and learning at regional, sectoral and national level (Asheim and Gertler, 2005, Edquist 1997, 2005, Loasby, 2001, Lundvall, 1992, 2005, Malerba, 2004, Nooteboom, 2000) So far, however, this literature has not studied, in a comprehensive manner, the nature and types of strategic choices that public actors in systems of innovation are facing given the ever-changing social, economic and technological contexts (Lundvall and Borrás, 1998).

This chapter undertakes a first step in this direction, discussing the implications of globalization for the strategic choices for innovation policy . The specific point of departure is the set of challenges that the process of globalisation has been posing to systems of innovation in industrialised and developing countries, past and present. During the last decades we have witnessed a spur in the globalization of research and innovation activities. While new actors have emerged in the global innovation arena (notably some Asian countries) the nature of the globalization process is changing. From the international exploitation of nationally produced goods to the global generation of innovation (Archibugi and Mitchie, 1995). As a consequence, the geographical pattern of innovation activities is shifting and the boundaries between local, national and global innovation systems are becoming blurred. This new global context is posing great challenges for policy makers with regard to the nature and types of strategic choices that they need to make. When and how to intervene in the system of innovation when innovation activities are global becomes crucial, pointing out the importance of the rationales for public intervention (Chaminade and Edquist, forthcoming).

Hitherto, the discussion of the rationales for public intervention seem to have taken place at a rather abstract and theoretical level, based on the properties of knowledge and the nature of the knowledge production systems and not embedded in specific social, economic and institutional contexts (Metcalf, 1995). As results, the literature has only served as a broad guidance for public actors, too abstract to support them in the highly contextualized, reality embedded practice of policy makers.

This chapter attempts to contribute to this research gap by discussing the impact of recent globalization of innovation patterns on the strategic choices that public actors are currently facing.

For doing so, the chapter is structured as follows. First, we highlight the recent changes in the global distribution of innovation activities. The next section approaches the general problem about strategic choices for public actors in systems of innovation and reviews succinctly the policy-related literature in the field, pointing at the missing elements and uncovered issues. Particular attention is paid to the impact of globalization on the rationales of the two dominant approaches. After that, the chapter delves into the issue of uncertainty and selectivity, two core preliminary aspects for defining strategic choices. Last, the fifth section deals with systemic problems in the view of the globalisation context, and addresses the critical issue of designing a method to help public actors spelling out objectives and instruments unfolding their specific strategic choices for systems of innovation.

2. Changes in the global context

Economic globalization is not a new phenomenon, although its nature is rapidly changing. It involves the global trade of goods and services, the international mobility of labour and capital, the global location of production and, more recently, innovation activities. Generally speaking there are three forms of globalization of innovations (Archibugi and Mitchie, 1995): the international exploitation of nationally produced innovations, the global and techno-scientific strategic alliances and collaborations between firms; and the global generation of innovations (global distribution of innovation activities). Firms commercialize innovations generated nationally to increase their return to investment and internationalize their innovation activities to respond to different demand and market conditions and adapt their products to the local demand (Narula and Zanfei, 2005). Moreover, universities and other research organisations collaborate internationally to access and disseminate new knowledge. The increasing internationalisation of innovation activities during the past two decades suggests a change in the geographic patterns of innovation processes.

The global character of innovation activities has been widely analysed in the innovation literature (Archibugi and Mitchie, 1995, Archibugi and Iammarino, 1999, Archibugi and Lundvall, 2001, Cantwell, 1995, 2000, Johansson and Lööf, 2006, Narula, 2000). Despite the important

consequences in terms of knowledge spillovers and capacity building that the global location of R&D and innovation activities has (Marin and Bell, 2006), it is still a rather limited phenomenon if one looks at the aggregated numbers. Only 12% of the R&D of multinationals is performed outside of their home country, meaning that the international re-location of knowledge creation activities is still a rather marginal phenomenon. Moreover, the global distribution of innovation activities has been a phenomenon almost exclusively of the developed world. The analysis of the evolution of the technology clubs worldwide confirms this geographical concentration of innovative activities in the developed world and its stability throughout time (Castellacci, 2006).

In spite of this territorial concentration and of the relative small size of knowledge production relocation, the rapid growth of some Asian countries might be rapidly challenging the traditional patterns of economic globalization, including the global distribution of innovative activities¹. According to Schmitz, there are three indications of such dramatic change (Schmitz, 2006). Firstly, China is increasing rapidly its participation in world trade. Exports from China have increased dramatically and it is estimated that in 2050, half of the world trade will be Chinese. Secondly, there are important changes in the organization of production because there is an increased number of Chinese companies coordinating global supply chains and influencing global standards. And thirdly, there are important changes arising from relocation of innovation activities. In the last years there has been an increasing number of industry and firm based cases suggesting that some Asian regions and sectors are starting to move up the value chain, from competing in costs to competing in knowledge and innovation (Altenburg et al, 2006, Chaminade and Vang, 2006a, b, Parthasarathy and Aoyama, 2006). Furthermore, it is important to keep in mind that China was in 2005 the third country in the world in terms of gross domestic expenditure on R&D in absolute terms only after US and Japan (although as a percentage of GDP is only 1,4) and the second one in the total number of researchers, only after US (OECD, 2006).

Some countries and regions in the developing world seem to be catching-up in terms of innovation, rapidly increasing the knowledge added value of their activities (Parthasarathy and Aoyama, 2006). The most visible consequence of this dramatic change is that an increasing number of firms from developed countries are now locating R&D departments in Asian countries, notably China and India, to tap on their large knowledge base and not simply to adapt existing products to the local

¹ For example, according to the last World Investment Report (UNCTAD, 2006), in 2005, 57 of the transnational corporations listed by Fortune 500 were from developing countries as compared to 19 in 1990.

markets. In 2005, 252 new FDI in R&D projects were located in China & India while India was considered to be the second preferred R&D location in the world only after the US (The Economist Intelligent Unit, 2007)².

This trend is noteworthy in some industries and regions, such as the software industry in India, the biotech industry in China or the automotive industry in China (Altenburg et al, 2006). Asian firms, for example, seem to be rapidly moving up the value chain, starting to provide R&D services to transnational corporations and even more recently locating R&D departments in the developed world. This is clearly the case of the embedded software in Bangalore, India (Parthasarathy and Aoyama, 2006, Chaminade and Vang, 2006b). The extent and scope of this phenomenon needs further research. From the evidence available, it seems clear that there is a new emerging trend characterized by the rapid increase of the knowledge base of some developing economies. However, some case studies suggest that the innovation systems in these countries still suffer from many weaknesses that might seriously limit their growth (Chaminade and Vang, 2006b; Chaminade, Coenen and Vang, forthcoming)³.

The current location of R&D activities abroad seems to respond to a different motivation than in the past. Before the adaptation to the local markets was the main driver while now, the localization of innovation activities responds mainly to the need to gain access to local competencies and knowledge (Narula and Zanfei, 2005, The Economist Intelligent Unit, 2007)⁴.

The consequences of these emerging trends on the global location of innovation activities is yet to be analyzed more systematically. However, one might expect that the globalization of innovation activities and thus innovation systems poses new challenges to policy makers in terms of their strategic choices.

² There is not yet aggregated statistics that capture this tendency, just anecdotal evidence of firms that have located R&D departments abroad.

³ Although in the previous lines we have emphasised, as an emerging trend, the changing role of some regions and industries from developing countries, it should be noted that the globalization of innovation is a phenomenon that affects both developed and developing regions. Furthermore and as indicated in the introduction to this section, most of the flows continue to be North-North. At the same time, a large number of developing countries, e.g. in Africa and Latin America, are not a part of this emerging trend[0].

⁴ The case of Novo Nordisk, a large Danish biotech corporation illustrate this change. The firm has established a large R&D lab in China that conducts the basic research for a complete line of business worldwide to tap on the large pool of highly qualified researchers in that field available in China and to respond to the increasing scarcity of researchers in that specific scientific field in Denmark (Novo Nordisk, 2007; Boel, 2006)

2. Public action in the new global context

All in all, as we can see from the above, there is a changing globalised distribution of innovation processes. The questions are now, what implications does this globalisation have for innovation policy? And, is the relevance and importance of innovation policy eroding as a consequence of increased global innovation dynamics? In an increasingly borderless world where the flux of knowledge and information is rapidly increasing, what is the logic behind governmental investment in capacity building or governmental efforts to regulate knowledge appropriation if that knowledge is going to vanish into global-related processes?

Innovation policy is actions by public organizations that influence innovation processes, i.e. the development and diffusion of (product and process) innovations.⁵ “Influence” means to improve these processes in some respect, e.g. by trying to solve or mitigate problems related to innovation processes. To influence and govern is the *raison d’être* of policy as well as politics and policy in general. The objectives of innovation policy are politically determined, and they can be economic, military, environmental or social. In practice, innovation policy initiatives are attempts to solve or mitigate ‘problems’ in the innovation system. Such problems exist when the actions of private actors do not automatically lead to the fulfillment of the objectives. This implies that public action should not replace or duplicate private action – but supplement it (additionality) and shall address specific problems associated with the incentives for innovation (appropriability, among others).

Traditionally, governments have an important role in the development of the innovation systems. Systems of innovation are based on competence building and learning in those areas where markets alone cannot provide the conditions conducive to learning and the acquisition of competences. This is mainly because learning and adaptation do not happen in a vacuum, as they normally involve specific social dynamics embedded in an overall institutional design. Formal and informal institutions such as rules, norms, routines, or informal social patterns of behaviour shape the interactions of the different organizations in the system of innovation (Nooteboom, 2000; North, 1990). Policy also involves tackling collective problems, and not least, it involves grasping opportunities that are not being exploited by private actors.

⁵ It may be useful to make a distinction between direct innovation policies which are designed to influence innovation processes and indirect innovation policies which are designed to achieve other things – but influences innovation policies anyway. (Edquist, 2001)

These tasks are far from the individual firms' sphere of action, and hence require governmental action. Furthermore, it is precisely these tasks that render innovation policy a key element in shaping responses to globalisation in the innovation system. In an increasingly globalised context, firms are more exposed to changing market and technological conditions. In such a context, innovation policy is an important part of the responses of the system, namely because innovation policy aims at shaping the conditions for learning and the overall capacity of the firms and other organizations to attract external knowledge and to innovate.. In other words, strategically designed policy to enhance learning and adaptability in general and of firms in the context of globalisation is an important component of the system's ability to cope with new challenges and rapid change.

Having said that, however, the next question is how to design such a strategy, including how to respond to the specific systemic bottlenecks vis-à-vis the globalising economy, and how to make the most of upcoming chances and challenges. This calls for reconsidering the specific premises and rationales upon which innovation policy shall be designed and articulated? The rich literature on innovation policy rationales has so far not been directly dealing with these matters. However interesting, the current analysis of the implications of globalisation for redesigning innovation policy have only addressed the issue of new rationales in a rather superficial manner (Archibugi, Howells et al., 1999; Cantwell, 1999; Lundvall and Borrás, 1998). What do the different approaches to innovation policy say in relation to policy rationales? How are those addressing the issue of globalisation? To what extent do rationales and logics behind innovation policy design need to be reconsidered, given the major challenges put forward by the increasing globalisation of innovation processes? The next section reviews succinctly the way in which the existing approaches to innovation policy have addressed these issues, and the need to reconsider some important aspects in view of the changing conditions of globalisation.

3. Taking stock of innovation policy approaches

There is today a large economic literature dealing with the rationales of innovation policy. Generally speaking, the bulk of scholarly work has tended to follow two distinct deductive approaches. The first approach is based on the traditional economic rationale, which focuses on achieving optimal Pareto equilibrium with regard to the allocation of resources to innovation (or

invention, in the early literature⁶). For this approach the main objective of public intervention is to address the different types of market failures that prevent achieving this Pareto optimality. Early seminal works by economists like Arrow, Nelson and Machlup defined the lines of inquiry of this approach (Arrow 1962, Nelson, 1959, Machlup, 1980).

One of the building blocks of the neo-classical approach to technology policy is that knowledge cannot be appropriated by the inventor due to its indivisibility and quasi-public good nature (Nelson 1959). This is a market failure because the market alone is not able to generate the incentives to invest in innovation. The problem of knowledge appropriability can be solved by state intervention creating patent regulations which grant short-term monopolies to inventors, hence securing private returns to the inventor's investment. More generally, though, these authors argue that the role of the state is primarily to secure the market conditions that allow for an optimal level of private investment in innovation. This entails not only addressing the issue of knowledge appropriability, as mentioned above, but also issues of perfect competition, and of market dynamics in terms of technological diversity and selectivity. In other words, and to put it bluntly, for this school the role of the state is to create Pareto-optimal market conditions to achieve the highest possible level of private investment in innovation, which will in turn generate overall social welfare and social returns to the economy.

From the perspective of this approach to innovation policy, the double process of globalisation and of increased digital communication poses a further problem for the appropriability of knowledge. The advancement of digital technologies has facilitated enormously the copy and transfer of information and data across the globe. Furthermore, the globalized patterns of innovation processes mean that more and more knowledge is being transferred across borders. Knowledge, and particularly information, is becoming borderless. A problem then arises when the protection of intellectual property rights, and in particular of patents, is strictly defined in terms of national jurisdictions. In other words, the problem of appropriability is reopened in a global context where the solution to that problem (patents) is not able to cover all the relevant geographical areas. States have reacted by signing international agreements on this matter, the most important of which is TRIPS. However, enforcement and compliance are proving to be limited and difficult. More generally, innovation policies under the neoclassical approach focus on the provision of national

⁶ Please, note that in the 1950s and 1960s the main focus was on invention and the conditions for the production of knowledge. See Metcalfe (1995) for an excellent review of this matter.

solutions to problems. When activities become global the neoclassical assumptions of, for example, perfect competition or perfect information become even more criticizable.

Growing dissatisfaction about the static and optimality-oriented economic premises of the equilibrium school lead in the 1980s to the articulation of a new approach to the economics of innovation and to innovation policy. In contrast with the previous one, the evolutionary school sees technological change not as an exogenous aspect of economic growth, but as an endogenous and main explanatory factor (Dosi and Orsenigo 1988; Nelson and Winter, 1982). For evolutionary economists, the innovation process is a fruit of the firms' behaviour in an ever-changing context characterised by a high level of complexity and by institutionally-embedded processes of interaction and learning (Metcalf 1995). The evolutionary policy-maker, hence, is not interested in optimizing the conditions for achieving Pareto-equilibria of societal investment on technology, but on the innovation system's ability to adapt to changing conditions in order to maintain and enhance the knowledge and technological capabilities accumulated by firms and individuals through time. Whereas for the equilibrium economists the role of technology policy is essentially to secure adequate levels of investment in technology, for the evolutionary and institutional economists technology policy deals as well with the constant adaptability and the learning abilities of firms and institutions. Therefore, rather than market failures, the evolutionary policy maker focuses on a series of systemic failures or problems, such as, infrastructure provision, technological lock-ins, network problems, or transition problems (Smith 2000; Woolthuis and Lankhuizen 2005).

From the perspective of the evolutionary approach, globalisation is putting important pressures to the adaptability of firms and of systems in a rapidly changing context. The problem is not so much that of appropriability, since tacit knowledge is geographically 'sticky' and remains embodied in people and locally-based organisations in spite of larger mobility of firms and labour. The problem is more on the adaptability of the innovation systems as such, which is the aggregate result of adaptability of firms and other organisations, as well as institutions (rules of the game). Reaping the benefits that globalisation offers, requires a new set of skills and of resources from the part of firms, in a context where their competitive advantages might no longer be an advantage in a short perspective. The ability to establish global networks in order to tap resources from other places might be one way of keeping ahead of rapidly obsolete competitive advantages based on 'static'

assets. Innovation policy, hence, shall address the institutional and organisational bottlenecks that hinder adaptability.

The two approaches to innovation policy have interesting and alternative ways of approaching the question of what role governments and their public actors shall have in the innovation process, and therefore, what the challenges and problems posed by globalisation are. However each of them has its own limitations. Taken together, the problem of the existing literature is that there are significant blind spots about the relationship between innovation and public action, in particular the virtual lack of links between the rather abstract theoretical rationales of equilibrium and evolutionary economics with the real-world of innovation policy making. As Metcalfe put it: “Setting priorities, designing instruments, developing new institutional arrangements, monitoring and evaluating current policies are connected in only a general way to the literature [of policy rationales]” (Metcalfe, 1995: 410). It is true that during the past several decades the logics spelled out in the aforementioned equilibrium and evolutionary rationales have served policy makers as broad guidelines for public involvement. However, rather abstract nature of the rationales (focusing on the *'why'* of public action) provide in themselves relatively poor guidance to the questions of *'what'* (strategic choices for the system) and *'how'* (designing objectives and instruments). Bridging the gap of economic theory and real world policy-making requires the understanding that innovation policy strategic choices, objectives and instruments are part of the equation, rather than an add-on aspect of the innovation process. Policy makers are parts of the innovation systems. In particular, there are at least two important open issues that deserve careful attention, namely, coming to grips with the learning dimension of policy itself, and defining specific criteria for problems of selectivity and additionality in conditions of permanent uncertainty and evolution (Chaminade and Edquist, forthcoming).

4. Policy is always selective

In important parts of any modern economy, the prime means of competition is not price, but innovation (Baumol, 2002, Schumpeter, 1943). These innovations may be, for example, new products (material goods or intangible services) or new processes (technological or organizational). Pursuing these innovation processes is plagued by uncertainty. In real time, the actors involved in innovation processes - individuals, organizations such as firms and public agencies, etc - do not know if a specific innovations will be successful, how large the market for a new product will be or

if a new production process will really decrease cost of production or function at all. Genuine uncertainty prevent potential actors to act at all, since they can not even calculate the risk of doing so – and relate it to possible benefits in a later stage. If firms and other private organizations get involved in pursuing innovation processes, they try to do so in a focused manner. They concentrate on transforming specific combinations of ideas and knowledge into specific products and processes and on actions that they believe will achieve this. In other words, they are highly selective in their strategies. They are making “strategic choices”. Attempts by private organizations to innovate may be successful or not. This depends largely on whether they selected to do the “right” things or not. If they selected to do the right things in the right way, the benefits can be very large. On the other hand all resources invested may be wasted if they chose to do the wrong things – or did not do them well. These are two outcomes of selective action. It is important that society rewards doing the right things and that it does not brand or stigmatize failures too severely.

In order to design innovation policy initiatives the policy-maker needs to know the main causes or determinants behind the ‘problems’ that afflict the economy and the innovation process. Innovation policy aims at influencing innovation processes through their determinants. Hence, policy-makers are voluntarily or not, explicitly or implicitly, constantly making “strategic choices”, and they do so in a context where public resources are always limited. This is why actions by public organizations (i.e. policy – in a general sense) should focus on solving or mitigating problems that are not solved by private actors (see above, in section 2). However, the public resources available for innovation policy are so limited that public organizations can certainly not be involved in all kinds of innovation processes in all stages of their development. This means that the public resources allocated to innovation policies are generally used selectively by means of implicit or explicit strategic choices. Any public policy which is intended to solve or mitigate a societal problem must focus on the nature of the problem and on its causes – and in this way be selective in defining the ‘*what*’, the object, of public action.

The real world of innovation policy making is full of examples about how governments are selecting policy instruments, the ‘*how*’ of innovation policy. Research and development (R&D) policy instruments involve public financing of research, which means allocating economic resources between different research fields. An increase in public funding of R&D with 1 billion (Crowns or Euros) necessitates a decision about in which field of R&D the additional resources

should be used. Should they be used for electronics research or for research in the life sciences? Decisions are typically made in complex political and administrative institutional set-ups, in the understanding that those allocations will serve to stimulate and enhance levels of innovative and knowledge capacity of the economy, in areas where private investment was not enough. Another conventional instrument of innovation policy, such as a tax deduction for R&D expenditures by private firms, tends to favor those firms that have (large) R&D expenditures, and industries with a high R&D intensity. It is, therefore, a selective instrument. Likewise, public technology procurement is a much targeted innovation policy instrument, which focuses upon a certain function, such as air force attacking, high-voltage electricity transportation or telephone call exchanging. It then subsidizes the development of a system that can fulfill this function. Hence this instrument is highly selective. Last but not least, innovation-related regional policies are as well – by definition – selective because they make important innovation-related economic development strategies for that particular territory. This list of examples could be made much longer, but it shows that public policies are normally selective in one sense or another. They may be selective with regard to problems, regions, sectors, products, firms, instruments, etc.

Globalization adds an additional dimension to the discussion on selectivity, particularly when resources invested in innovation might not generate externalities in the country or region but somewhere else. As Archibugi and Iammarino (1999) acknowledge, with the increasing globalization, “the choices of public actors are strongly limited by processes they are not entirely in control of”. Shall the government encourage foreign firms to establish R&D labs in their country or shall they instead support R&D in domestic firms (that might later become also global players)? How can the government select those interventions that might have a larger positive impact in their territory when innovation activities are becoming increasingly global?

Issues such as these are addressed in a book to be published soon (Edquist and Hommen 2007, forthcoming.) This book reports on the findings of a comparative study of ten national systems of innovation (NSIs) in small countries in Europe and Asia. Theoretically, the book uses an ‘activities-based’ framework for studying and comparing NSIs. This means that it focuses strongly on what ‘happens’ in the systems – rather than on their constituents or elements – and that it, in this way, uses a more dynamic perspective. The introductory and concluding chapters address rival conceptions of NSIs with differing perspectives on their systemic properties. Empirically, the book

deals with the determinants of the development and diffusion of innovations, innovations and growth, globalization and innovation policy in the ten national systems of innovation of Denmark, Finland, Hong Kong, Ireland the Netherlands, Norway, the Republic of Korea, Singapore, Sweden, and Taiwan. To increase comparability, we used the same conceptual and theoretical framework - and even a common table of contents - in the ten case studies.

5. Uncertainty differs, and so do policy instruments

We have noted that innovation processes are plagued by uncertainty. But this uncertainty is larger or smaller for different fields or sectors, for different kinds of innovations and in different stages of the innovation process. Uncertainty seems to be larger for innovation processes in *new* fields (as compared to mature sectors/industries), for *radical* innovations (as compared to incremental innovations), and in *early stages* of innovation processes (as compared to late stages in those processes). Empirically, it seems to be the case that private organizations perform least well in situations where uncertainty is largest.

Publicly funded R&D in combination with public technology procurement has played a crucial role in developing new hi-tech sectoral systems of innovation in the USA – and thereby in the world. Examples are numerically controlled machine tools (NCMTs), commercial aircraft, semiconductors, computer hardware, computer software, lasers, and the Internet. (Carlsson and Jacobsson 1997; Mowery 2005) However, this is not labeled innovation policy in the USA, but defense policy and it is financed by the Department of Defense and the Department of Energy (which is in charge of, for example, nuclear-related technologies and large scientific infrastructural establishments). Hence, public intervention seems to be the rule in *new fields and industries*. All emerging fields of innovation are potentially interesting from a military point of view, and the US government has the resources to bet on all horses in the race!

Radical technological shifts may also occur in mature industries. In such situations the picture is quite complicated. Sometimes the incumbent private actors are able to transform their own activities along the new trajectory. Sometimes they fail. If such failures can be identified or foreseen, there are reasons to consider public intervention to secure the transformation. There seems also to be a close connection between the situations just discussed and *early stages* of innovation processes. For

example, the supply of financing for innovation processes from private sources is much more limited in very early stages of the innovation processes. The gap between the end of an R&D project and the development of a product prototype is sometimes called “the valley of death” in the USA. Public organizations supply seed capital for these early stages in the USA and in many other countries – simply because private capital is not available. The uncertainty is simply too large.

Globalization also poses new challenges to the issue of uncertainty. We have argued before that policy intervention might be more desirable in the early stages of the innovation process or in the emergence of new fields where uncertainty is higher. In those circumstances, public support might create the incentives for the firms to engage in high risk activities. But with the increased globalization, the risk that the region or country will not entirely reap the benefits from those initial investments is increasing, as firms might relocate their activities in a different country later on. Two positions seem to dominate the current debate on innovation policies in the global economy. On the one hand those that argue that government policies to maintain the competitive advantage are irrelevant and governments have no control over the behavior of international firms and research activities. On the other hand, those that defend that policy options should focus more on adaptability to the new context, since all successful innovations entail necessarily organizational change and market success, thus investing in the capabilities of the system of innovation to deal with uncertainty (Archibugi and Iammarino, 1999).

6. Concluding remarks: Implications for innovation policy

In the previous sections we have discussed the impact of globalization on the rationales for public intervention. Globalization challenges some of the underlying assumptions of both the neoclassical and the evolutionary approaches to innovation policy, particularly those assumptions that are based on national-only sets of conditions. Furthermore, globalisation adds a new perspective to the discussion of the issue of uncertainty of the innovation process. This chapter has indicated that a large degree of uncertainty may prevent private actors from getting involved in processes of innovation, given the rapidly changing market conditions at the global level and given the intrinsic uncertainties associated to operating in international markets with underdeveloped institutional

frameworks. This is particularly so for activities which require substantial initial investments, such as innovation in some new fields or in early stages of the innovation process.

This is to say that globalization is not decreasing the need of innovation policy; on the contrary, it is strengthening it. Firms are encountering rapidly changing and highly uncertain market and institutional conditions in the international context on the top of the technological uncertainties associated with inventive and innovative activities. For that reason, public action needs to focus on the adaptability of the innovation system with the overall objective to generate a national framework that is conducive to firms' adaptability and efficient exploitation of the opportunities offered by globalization. This means that public action shall focus on the different systemic elements and their real bottlenecks vis-à-vis globalizing dynamics, and in particular, the deficient and/or missing aspects in the national institutional set-up that enhances the firms' capabilities to operate in this globalized context.

Since public resources are scarce, systemic problems and bottlenecks are country-specific, and opportunities are limited, innovation policy-makers need to take important "*strategic choices*" regarding how best to enhance the adaptability of the system in order to stimulate firms to grasp upcoming prospects. Innovation policy should serve as a midwife – not provide support towards the end of life. While investments in new fields and early stage activities seems appropriate for the type of policy instruments that concern allocation of R&D resources, there are many other innovation policy instruments that might be focusing on other issues. Examples are policies supporting the balance between individual and social returns (IPR), policies creating an adequate institutional framework that facilitates local interactions (regional development) or policies transforming low tech industries into higher added value activities for the economy.

Strategic selectivity implies that policy-makers shall review thoroughly existing and new policy instruments and examine carefully the extent to which those instruments are really and successfully addressing the problems and bottlenecks mentioned above. This thorough revision of policy instruments shall not be undertaken on the basis of intuition or as a mere 'copy' of what other countries have done. It has to be undertaken on the basis of a more sophisticated set of policy rationales anchored in an ample theoretical discussion. A new rationale for innovation policy must address the blind spots of previous theoretical discussions, provide a clear set of guidelines for

policy-makers selection of instruments in specific contexts, and be able to generate an overall view of the causal mechanisms between real bottlenecks, possible policy responses to these, and innovative output. Putting up this new set of rationales is an ambitious project, both in theoretical terms and in practical terms.

Therefore, the conclusions of this chapter are mainly two. Firstly, the process of globalization poses new demands on innovation policy, because firms are confronted to a new and rapidly changing international market and new institutional conditions. Innovation policy shall therefore focus on improving the adaptability of the system of innovation, which in turn helps firms acquiring the competences and resources to face the global challenges. Secondly, the definition of rationales for public intervention (why, how and when shall governments intervene) needs to be further developed and needs to be embedded into the specific social, economic and institutional context of each country. But above all, a renewed framework of policy rationales should attempt to bridge the gap between the practice of policy makers and the theoretical discussion of governmental intervention in the innovation system. In this vein, further theoretical and empirical research is needed, addressing the critical issue of designing a method to help public actors spelling out objectives and instruments unfolding their specific strategic choices for adapting systems of innovation.

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