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New rationales for innovation policy?: a comparison of the systems of innovation policy approach and the neoclassical perspective

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by

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New Rationales for Innovation Policy? A Comparison of the Systems of Innovation Policy Approach and the Neoclassical Perspective

Alexandra Schröter

May 2009

Abstract

Ever since its introduction in the 1990s, the systems of innovations (SI) concept has received a great deal of attention from researchers and politicians. The systems of innovation policy (SIP) approach, which is based on the SI concept, is considered an alternative to neoclassical theory. Its goal is to provide new rationales and criteria for innovation policy, as well as concrete implications and guidelines for policymakers, that are more appropriate for innovation processes in comparison to the rationales and criteria of standard economic theory. The aim of this paper is to critically investigate to what extent the SIP approach provides additional rationales for public intervention in innovation processes compared to neoclassical theory.

JEL classification: O31, O38, P00,

Keywords: Innovation, innovation systems, innovation policy

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1. Introduction*

Ever since its introduction in the 1990s, the systems of innovations (SI) concept has received a great deal of attention from researchers and politicians. An increasing number of countries (e.g., Finland, Sweden, and Japan) have now explicitly integrated this concept into their innovation policies (e.g., Chamninade and Edquist 2006b, Lundvall 2007, Lundvall et al. 2002). The SI approach views innovation as a systemic process and therefore focuses on the interaction of actors in innovation systems. Many proponents of the approach adopt a strongly evolutionary perspective on innovation processes. The systems of innovation policy (SIP) approach, which is based on the SI concept, is considered by its proponents to be an alternative to neoclassical theory. Its goal is to provide new rationales and criteria for innovation policy, as well as concrete implications and guidelines for policymakers, that are more appropriate for innovation processes in comparison to the rationales and criteria of neoclassical economics (e.g., Chaminade and Edquist 2006a, Klein Woolthuis 2005, Metcalfe 2003). The chief criticism of neoclassical theory revolves around the key assumptions of the model of perfect competition. The static character, the equilibrium concept, and the optimality assumptions of the model are rejected as inadequate for analyzing evolutionary processes like innovation (Metcalfe 2007, Chaminade and Edquist 2006a, 2006b, Edquist and Chaminade 2006, Mytelka and Smith 2002, Edquist and Hommen 1999, Niosi et al. 1993). Hence, most proponents of the SIP approach argue that it is not possible to derive relevant rationales for policy interventions and implications for their design and implementation from the neoclassical approach. Chaminade and Edquist (2006b, 143) conclude that “standard economic theory is not of much help when it comes to formulating and implementing specific R&D and innovation policies.” For this reason, the proponents of SIP claims it to be an alternative to the neoclassical approach.

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Criticizing the unrealistic character of the assumptions and the static nature of the model of perfect competition has a long history that predates the emergence of the SIP approach. Although the standard economic approach suffers some shortcomings in the analysis of dynamic phenomena like innovations, nothing better has been developed to date. Therefore, before the SIP approach can legitimately replace neoclassical theory, it must demonstrate that it provides a superior framework for justifying and designing innovation policy.

However, no work has yet been done on the extent to which the SIP approach results in policy conclusions that go beyond those derived from standard neoclassical theory. Furthermore, the literature contains no clear definition of the rationales for innovation policy (called system failures), resulting in some confusion about the concept and its applicability.

Thus, the aim of this paper is to investigate to what extent the SIP approach provides additional insights into the issues of justification and implementation of public intervention in innovation processes as compared to neoclassical theory.[1] Since the SIP approach is distinct from evolutionary economics, this paper does not intend to add to the discussion and the sometimes ideological argument between proponents of evolutionary and neoclassical economics.

The remainder of the paper is structured as follows. Section 2 provides an overview of the conceptual underpinnings of the SI and the SIP approach, followed by a presentation of systemic failures, as discussed in the SIP literature, in Section 3. Section 4 introduces different rationales for innovation policy from the neoclassical perspective. Section 5 contrasts the SIP and neoclassical frameworks in order to reassess the additional contributions of the SIP concept in the matter of justifying and implementing policy interventions. This

[1] There is no general agreement on which theories and concepts are part of the neoclassical paradigm. In this paper, theories and concepts are defined as neoclassical if they contain the assumptions of (a) methodological individualism, (b) maximizing or satisfying behavior of individuals (utilitarism), (c) social interactions defined as exchange relationships (economic exchange approach), and if they deal with the ideas of (d) equilibrium and (e) optimality.

discussion covers rationales for government interference in private innovative activity, as well as issues concerning the preconditions for and the implementation of innovation policy. Section 6 concludes.

2. Basic Concepts of the SI and the SIP Approach

The concept of innovation systems is a recent development but it has already become popular in science and policy for analyzing the emergence and diffusion of innovations. An innovation system is defined as a "set of distinct institutions which jointly and individually contributes to the development and diffusion of new technologies and which provides the framework within which governments form and implement policies to influence the innovation process. As such it is a system of interconnected institutions to create, store and transfer the knowledge, skills and artifacts which define new technologies" (Metcalfe 1995, 462f).[2]

The fundamental conceptual underpinnings of the SI approach include the following.

- *First*, innovation is not carried out in isolation, but is characterized by a high degree of labor division and cooperation between organizations as well as between actors within organizations (e.g., Freeman 1987, Lundvall 2007; for empirical confirmation, see Christensen and Lundvall 2004). This means that innovation is based on complex interactive learning processes between actors and their environment (Smith 2000; concerning the role of interactive learning theory in the SI concept, see Edquist and Hommen 1999). Consequently, research on innovation processes should not confine

[2] There is no unanimously accepted definition of innovation systems. Given the fact that systems fulfill several functions, a variety of system concepts exist. Depending on the specific research question, the literature distinguishes between national (e.g., Freeman 1987, 1988, Lundvall 1988, 1992, Nelson 1988, 1993, Porter 1990 (note, however, that Porter does not explicitly use the concept of innovation systems)), regional (e.g., Cooke et al. 1997, Braczyk et al. 1998, Cooke 2001, Asheim and Isaksen 2002, Asheim and Coenen 2005), sectoral (Breschi and Malerba 1997, Malerba and Orsenigo, 1990, 1993, 1995), and technological systems of innovation (e.g., Carlsson and Stankiewicz 1991, Carlsson and Jacobsson 1997a). Nevertheless, the different perspectives and definitions can be understood as varieties of a generic definition of innovation systems (Edquist 1997) that involves the importance of interaction and learning between actors and the role of institutions for the generation, diffusion, and use of knowledge. Consequently, presentation of the fundamental underpinnings of the SI

its focus to single actors, but should take particular note of their interactions as well as of the rules that determine the manner and scope of the relations between actors (Hauknes and Nordgren 1998, Smith 2000, Edquist 2001, 2004, Metcalfe 2007).

- *Second*, institutions matter (Edquist 2001, 2004, Smith 2000, Chaminade and Edquist 2006, Lundvall 2007). Due to having a fairly stable set of rules, institutions coordinate and constrain social interactions (Weimer 1995, Hodgson 1996).

- *Third*, innovation is a dynamic phenomenon. In accordance with Hayek (1968), variety, selectivity, path dependency, and the unpredictability of outcomes are core features of innovation processes that also become relevant for their analysis (Smith 2000, Edquist 2001, 2004, Lundvall 2007).

Accordingly, an innovation system consists of three main components: actors, institutions (rules), and the relations between actors. In an innovation system, actors are the players of the game(North 1991), and include, e.g., firms, universities, research institutions, and politicians. They act on the basis of existing institutions, which can be understood as the rules of the game. Institutions form a set of common habits, routines, established practices, rules, or laws that structure the relations and interactions between individuals, groups, and/ or organizations (Edquist and Johnson 1997). Their main functions are to guide human behavior (Richter and Furubotn 1998) and reduce uncertainty by framing expectations (North 1991), thus facilitating cooperation and leading to a division of labor (Kasper and Streit 1998). Institutions can be specifically created or designed (e.g., laws), which are called “formal” institutions, or they can evolve spontaneously (e.g., customs, habits, or routines), which are called “informal” institutions (North 1990). Informal and formal institutions as a whole constitute a framework for the (economic) behavior of actors by setting incentives and constraints as well as by providing opportunities. They thus shape

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concept and the discussion on rationales for innovation policy in this paper, which refer to the

and steer a society's economic and technological development (see also Johnson 1992).

The relations between organizations and institutions are crucial to the innovation process. These relationships are characterized by a high degree of complexity and, in many cases, by reciprocity (e.g., Edquist and Johnson 1997). For example, actors are embedded in the institutional framework but they can also develop institutions by themselves. This refers to the development of institutions within organizations, such as rules of conduct, organizational cultures, and routines as well as to the design of institutions that are applied outside the organization, such as laws made by legislative and administrative bodies.

3. Rationales for Innovation Policy – The Perspective of the SIP Approach

According to the SIP approach, policy interventions become necessary if the system does not work well, i.e., if one or more of the main components – actors, institutions, or relations between these system elements – are inappropriate or missing (Edquist 2001, Chaminade and Edquist 2006a, 2006b). Since innovation processes are assumed to be evolutionary in nature, the neoclassical notions of economic equilibria and optimality are rejected (e.g., Edquist 2001, Chaminade and Edquist 2006a, 2006b, Metcalfe 2003, 2007, Smith 2000, Edquist and Hommen 1999). Therefore, the SIP approach uses the term "systemic failures" instead of "market failure." The following types of systemic failures are discussed in the literature.

- *Infrastructural failures* involve the physical infrastructure that actors need to function properly (such as IT, telecom, or transport infrastructure) and the science and technology infrastructure (such as universities, regulatory bodies, or libraries) (Smith 2000, Edquist et al. 1998). This kind of systemic failure may occur due to the specific characteristics of the infrastructure, such as large-scale

generic SI approach, are basically also relevant for the different variants of the SI concept.

investment, long time horizons of operation, and indivisibilities,[3] which may not generate adequate returns under standard investment appraisal methods and thus make financing very difficult (Smith 2000).

- *Capability and learning failures* describe the insufficient competencies and resources (e.g., technological, organizational, etc.) of firms that restrict their ability to learn and be innovative. Most firms are limited in their technological competencies, i.e., they possess capabilities, knowledge, and skills in their distinct domain of research and production but lack competence in even closely related areas. Therefore, (discontinuous) technological shifts due to technological developments or changes in market demand, as well as major changes in the prevailing technological paradigm, can lead to severe adaptation problems (Chaminade and Edquist 2006a, 2002b). Furthermore, capability failures may lead to transition problems.[4]

- *Transition failures* (Smith 2000) occur when firms, especially small ones, are unable to adapt to environmental changes. As a consequence, they become locked into existing technological paths and paradigms. (Smith 1999, Malerba 1998).

- *Hard institutional failures* (Smith 2000) are failures in formal institutions (e.g., the general legal system) that negatively affect innovative activity. Examples are insufficient or no protection of intellectual property and many types of regulations (e.g., tax, risk management, labor) that hamper innovation.

- *Soft institutional failures* are failures in informal institutions, such as political culture and social values (Smith 1999, Carlsson and Jacobsson 1997). These institutions are important to the innovation

[3] Although not mentioned in the SIP literature, externalities arising from infrastructure are another reason for infrastructural failure.
[4] Smith (2000) does not distinguish explicitly between capability and learning failures and transition failures. He refers only to transition failures, but argues that capability and learning problems are the reason for transition failures.

process, and thus so is their failure, since they influence, among other things, willingness to cooperate and bear risk, openness toward change, and the society's general attitude toward entrepreneurship.

- *Network failures* comprise strong as well as weak network failures. S*trong network failures* describe a "blindness" toward developments outside the network. This might be the result of long-lasting relationships or strong ties between network members, leading to a strong internal orientation and a closing off of the network. Group think, myopia, and inertia, as well as simple ignorance of new developments, may result in becoming locked into existing technological paradigms (Morgan 1986, Grabher 1993, Bogenrieder and Nooteboom 2002, Nooteboom 2000), a phenomenon also known as overembeddedness (Granovetter 1985). The weakness of strong ties is tightly linked to a lack of weak ties, which constitute bridges to new knowledge and ideas beyond the own social network (Granovetter, 1983) and span structural holes (Burt 1987). Thus, weak ties are important for innovative activities since they allow actors to stay informed about technological development and can prevent overembeddedness.

  In contrast, *weak network failures* occur due to the noncomplementarity of actors (*complementary failure*) (Malerba 1998) as well as to the lack of relations between complementary technologies or actors (Carlsson and Jacobsson 1997) in an innovation system. Both may lead to a lack of linkage between actors (Klein Woolthuis et al. 2005). Since learning and innovation are based on interaction and collaboration, noncomplementarities and missing links between complementary system elements can lead to underexploitation of resources and inefficiency. Moreover, poor connections between actors may prevent development of a common vision for future technological development and, therefore, the coordination of research and investment (Carlsson and Jacobsson 1997).

- *Lock-in/path dependency failures* are defined as the inability of firms or complete (social) systems to adapt to new technological paradigms (Smith 2000, Edquist and Chaminade 2006). There is no consensus in the SIP literature as to whether lock-in problems are a unique type of system failure or simply the result of one or more of the systemic failures discussed above (Klein Woolthuis et al. 2005). However, this type of failure, whatever its classification, occurs due to complex interconnections of existing technologies and institutions. According to Smith (1999, 44): "This means that technological alternatives must not only compete with components of an existing technology, but with the overall system in which it is embedded. Technological regimes or paradigms persist because they are a complex of scientific knowledge, engineering practices, process technologies, infrastructure, product characteristics, skills and procedures which make up the totality of a technology and which are exceptionally difficult to change in their entirety."

Some SIP proponents argue that the occurrence of systemic failure depends on the degree of uncertainty and risk in the innovation process. Chaminade and Edquist (2006a, 12) state that "markets and firms perform least efficiently with regard to new activities, where uncertainty and risk are large." As both aspects are positively associated with the degree of novelty and the scale of innovation projects, policy interventions are viewed as being particularly necessary and justifiable for large-scale and radical innovations.[5] The same authors even hypothesize that "[l]arge-scale and radical technological shifts rarely take place without public intervention" (Chaminade and Edquist 2006a, 2).[6]

[5] This view is obviously based on an inaccurate reference system, namely, a world without uncertainty. However, given a high degree of uncertainty, especially in regard to innovative projects, rational actors cope with this problem by discounting future returns on innovative activities. Consequently, uncertainty does not lead to inefficiency.

[6] This claim is obviously false. Many seminal inventions of considerable cost and high uncertainty have been made by private firms or even individuals. Famous examples are the airplane, the helicopter, the automobile, the jet engine, nylon, the diesel-electric locomotive, and penicillin (for an extensive description on the sources of pioneering inventions in the 19th and 20th centuries, see Jewkes et al. 1969).

4. Rationales for Innovation Policy – The Neoclassical Perspective

According to neoclassical theory, public intervention in the market is justified if the market process fails to efficiently allocate resources, i.e., Pareto optimality is not achieved. There are a number of reasons why the profit-oriented behavior of private actors may not result in a social optimum (Stiglitz 2000).[7] Following the seminal works of Arrow (1962) and Nelson (1959), market failures in innovation processes mainly emanate from three basic properties of R&D.

- *Uncertainty* is a basic characteristic of innovation as it is not possible to perfectly predict the cost, the duration or even the success of innovative projects. Moreover, uncertainty increases as the degree of innovation rises. Private actors cope with this uncertainty by discounting future returns of R&D. Hence, innovation policy is often justified by the assumption that these private discount rates are larger than optimal from the society's perspective, leading to an underinvestment in innovative activity.

- The problem of *externalities* arises because very often parts of or even all the results of innovative activity cannot be appropriated by the originator, thus giving rise to positive external effects for third parties. As a consequence, there is not much incentive to engage in innovation, leading to an underinvestment in R&D from a social point of view. The severity of this underinvestment problem becomes worse as the uncertainty of the innovation process increases and/or the possibility of appropriating its results decreases. Both aspects are critical, especially for basic research, which is characterized by a relatively high level of uncertainty and the results of which cannot be protected legally. Both problems, however, become less relevant with the increasing marketability of innovative products.

[7] The following paragraphs summarize the reasons given in the literature for market failure. However, there is no general consensus on the relevance of these failures to justify policy interventions. However, addressing this issue is beyond the scope of this paper.

- *Indivisibilities* in innovation processes occur when the amount of resources needed for a certain innovative activity exceed the firm's financial resources and assets. For example, a certain degree of knowledge is necessary in order to create new knowledge, but knowledge does not come cheaply. Also, certain projects require a high investment in specific assets and equipment. Because R&D activities are highly specific, they incur high sunk costs in the event of a failure, which, in turn, lowers the incentive to engage in innovative activity. Therefore, it is often argued that innovation policy may be needed to overcome such financial hurdles.

According to the neoclassical approach, inappropriability, indivisibilitiy, and uncertainty are the chief rationales for innovation policy. Moreover, there are two other types of market failure that need to be considered in this respect.

- *Information asymmetries* occur when information is unevenly distributed between transaction partners. That is, one party has more or better information than the other, resulting in the problems of adverse selection, moral hazard, and hold up. For innovation processes, asymmetric information can lead to problems involving the transfer of information and the division of innovative labor. The fact that the commercial value of new information is known only to its seller is a major problem for market efficiency and functionality. Because a rational buyer is reluctant to pay the asking price unless he or she can evaluate the real value of information, the buyer will offer a price based on the average value of this kind of information as revealed by past experience. However, if, in an effort to achieve a better price, the seller discloses the information, the seller runs the risk of receiving nothing at all as the information is no longer secret. Consequently, the proposed price will be below the true value of the new knowledge, and this will result in an inefficient transaction or no exchange at all (Arrow 1969). Furthermore, information asymmetries have a negative impact on innovation cooperation. On the one hand, in the face of unequal information,

even choosing a partner to cooperate with is risky (adverse selection); on the other hand, because the end result of the innovation cooperation is unknown, it is difficult to draw up a firm contract for cooperation. As a consequence, these types of contracts are rather soft and harbor the risk of opportunistic behavior and, thus, moral hazard, and hold up.

- *Inflexibility* is the problem of not being able to react in a timely fashion, or even at all, to a changing environment. Firms may fall prey to this problem by failing to recognize the need for adjustment and innovation due to insufficient information, ignorance, or myopia. Moreover, even if the need for adjustment is perceived, actors may be reluctant to act because of an internal resistance to change, high sunk costs due to specific investments in the current production process, or hubris. Also, of course, actors might just not have the resources or lack the competence (so-called cognitive lock-in) necessary for an adjustment to external changes.

In summary then, according to standard economic theory, uncertainty, externalities, indivisibilities, information asymmetries, and inflexibilities are the chief reasons behind inefficient use of resources and thus market failure and thus they are also the chief justifications for public intervention in the innovative process.

5. Rationales and Preconditions for Innovation Policy – The Neoclassical and SIP Perspectives Compared

The following subsections contain an analysis of SIP's criticism of neoclassical theory and investigate whether SIP is a complement to or a replacement of neoclassical economics in regard to the rationalization and implementation of innovation policy. Based on the overviews of market and systemic failures presented in Sections 3 and 4, the approaches are compared to see whether SIP adds new rationales for innovation policy or merely reinforces those already proffered by neoclassical theory. The comparison deals with rationales for innovation policy (Section 5.1) and preconditions for public intervention in market economies (Section 5.2).

5.1 Rationales for Innovation Policy – A Comparison of the SIP and the Neoclassical Framework

In this subsection, neoclassical rationales for innovation policy (market imperfections) are contrasted with SIP's rationales based on systemic failures (see Section 3). Table 1 sets out SIP's rationales for innovation policy, matching them the most similar neoclassical market failures.

Table 1: Systemic failures and corresponding market failures

Systemic Failures	Market Failures
Infrastructural failures	Indivisibilities, externalities
Capability and learning failures	Inflexibilities
Transition failures	Consequence of inflexbilities, indivisibilities, and sunk costs
Network failures (weak and strong)	Market theory is a theory of interaction: transaction costs due to asymmetric information; inflexibility and lock-in
Institutional failures (hard and soft)	Institutions taken for granted; option for policy measures (e.g., intellectual property rights, competition policy, etc.)
Lock-in/path dependency failures	Inflexibilities due to asymmetric information and indivisibilities

According to the SIP approach, infrastructural failures are caused by specific features of the infrastructure, namely, the large scale of required investments, indivisibilities, and long periods of amortization (Smith 2000). These characteristics correspond with the well-known neoclassical market imperfection due to indivisibilities, meaning that some innovation projects require huge investments or have such a long period of amortization that they are not affordable or profitable for private actors. In addition, externalities provide a further justification for public infrastructure investment, particularly science infrastructure, such as universities and publicly funded research institutions, which generate high positive external effects due to the education of the workforce as well as research and development, neither of which are often carried out by private actors. This is particularly true for basic research, whose results are an important input for applied research. Thus, from a

neoclassical perspective, infrastructural failures are not market imperfections in themselves, but the consequences of the underlying characteristics of infrastructure, i.e., of indivisibilities and externalities.

The problem of missing or limited competencies and capabilities in firms (capability and learning failures) is very similar to the inflexibility problem in neoclassical economics. Both problems involve insufficient abilities and skills of actors that may hamper an adaptation to change. Capability and learning failures as well as inflexibilities can be regarded as a reason for transition problems, which is another category of systemic failure (Smith 2000, Malerba 1998).

From a neoclassical point of view, the inability of actors to react appropriately to environmental change (transition failures) may also justify policy interventions as it can be understood as the result of sunk costs and indivisibilities. In particular, specialization can be an obstacle for the (rapid) adaptation to a changing environment. Since highly specialized capabilities, knowledge, and assets are constrained in their application, they imply high sunk costs if technological shifts occur. Indivisibilities can prevent rapid adjustment to new environmental conditions, too. For example, the necessity of integrating completely new technologies into the production process or the shift to technology-intensive production in formerly low-tech industries may require large-scale investments that exceed the financial resources of actors. Therefore, from the neoclassical perspective, the inadequate response of actors to external changes is a consequence of, rather than the reason for, market failure.

In contrast to the SIP approach, institutions are not the center of attention in neoclassical economics and are mostly taken for granted as a precondition for the functionality of the market system. Hence, they are not viewed as a cause of market failure. However, a closer look reveals that neoclassical economics sees the design of institutions as an important policy-making option. Regulation of market entry, intellectual property rights, and competition policy are practical

examples of the conscious use of institutions to set incentives and, thus, influence economic outcomes. For example, the Ordoliberal School[8] (also known as German neoliberalism) assumes that all economic activity takes place within a legal-institutional framework. Hence, the market is governed by a formal legal-institutional framework as well as by informal conventions and traditions (Eucken 1992). Since this socioeconomic set of rules is not an unalterable result of cultural evolution but subject to deliberate choice, the creation and maintenance of a legal framework that ensures a properly functioning market[9] is a central policy task in Ordoliberal thinking (Böhm 1969, 1980). Moreover, improvement of the legal-institutional framework, instead of direct market intervention, is perceived as the main instrument for enhancing market outcomes (*Ordnungspolitik*) (Eucken 1992). In addition, theoretically advanced components of neoclassical thinking, such as the new institutional economics (property rights theory, principal-agent theory, and transaction cost theory) strongly emphasize the importance of institutions. Therefore, the problem of inefficient institutions hampering innovative activities actually is addressed in neoclassical economics and, consequently, forms another rationale for innovation policy. However, in contrast to the SIP framework, the neoclassical economic rationale confines itself to formal institutions, as they are, unlike informal rules, the subject of political decision making and susceptible to deliberate influence.

The importance of interaction and cooperation between actors for the emergence of knowledge and innovation is a crucial focus of the SIP approach. Both too little and too much interaction (weak and strong network failures) provide justification for government intervention. Hence, neoclassical theory's alleged disregard of the systemic character of innovation processes is frequently criticized by the SIP camp (see, e.g., Klein Woolthuis et al. 2005, Chamninade and Edquist 2006a, 2006b, Anderson 1991). Nonetheless, arguments for policy

[8] For an overview see Vanberg (2004).
[9] The Ordoliberal School assumes that free market economies tend to be destroyed by anti-competitive behavior. Therefore, the state must create and maintain a proper legal environment

action based on interaction problems can also be derived from the neoclassical framework. Market theory is a theory of labor division and interaction. Labor division and specialization are fundamental in achieving productivity gains and progress (Smith 1776). This mode of production definitely requires interaction and coordination. Therefore, neoclassical economics can also be regarded as a "systems approach":[10] insufficient collaboration between actors is considered a severe problem for achieving optimal resource allocations.

Low levels of interaction (weak network failures in the SIP approach) can be caused by asymmetric information, i.e., lack of information about potential cooperation partners and the (prohibitively) high transaction costs associated with searching for potential partners as well as the negotiation and enforcement of cooperation contracts. Innovation cooperation is especially prone to these problems since it often necessitates highly specialized competencies possessed by only a few. Thus, it is very unlikely to know of a suitable partner for an innovation project in advance and finding one will be expensive. Furthermore, such a thin market implies that transactions occur only rarely and thus there is no standard market price. As a consequence, negotiating a collaboration contract will be costly, both in terms of effort and money. In addition to asymmetric information and transaction costs, the inflexibility of firms in terms of the disregard of the benefits or the necessity to cooperate may be another market failure that prevents collaboration.

By contrast, overembeddedness (strong network failures in the SIP approach) can result from too much collaboration, in particular with current business partners. Specific investments or the lack of alternative cooperation partners may result in becoming locked into existing relationships (Williamson 1985). Finally, sunk costs due to investment in a common communication base and codes of conduct, as well as

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that upholds competition in the face of anti-competitive interests (Eucken 1938, 1992, Böhm 1937).

[10] Metcalfe (2003) acknowledges that Marshall has already described the elements of an innovation system "in all but name" (Metcalfe 2003, 168) in his seminal work *Industry and Trade* (1919).

increasing returns to scale in their development and use, cause network members to stick exclusively to their close network ties (Arrow, 1974) and in consequence they fail to build the loose ties that could preserve their autonomy and keep them up to date with technological development.

In summary, network failures can be interpreted in a neoclassical sense as consequences of asymmetric information and the related transaction costs, inflexibilities, and sunk costs. In regard to weak network failures, low levels of cooperation can (also) be interpreted as the result of rational decision making rather than a systemic failure. That is, the degree of cooperation can be seen as the outcome of a careful consideration of its benefits and costs and can thus be perceived as being efficient. This is in strong contrast to the SIP view that more cooperation is always desirable.

Finally, technological lock-ins – regardless of whether they comprise their own category of systemic failure or are simply a consequence of other systemic failures – can also be a rationale for policy intervention under neoclassical economics. The rationale finds its basis in the idea that capabilities, decisions, and experiences in the past are determinative of decisions and actions in the present and the future. Even if the technological environment changes, this path dependency prevents actors from adapting their competencies and behavior due to a lack of information or high transaction costs (Metcalfe 1995, Nelson and Winter 2002). As a consequence, they become locked into existing and obsolete technologies or paradigms. Since institutions are also adapted to these technologies or paradigms, the whole system can become locked-in. From a neoclassical point of view, lock-in effects are the result of different market imperfections. Hence, they are a symptom rather than the cause of market failures (see also Hers and Nahuis 2004). In particular, actors might become locked-in due to lack of information about technological progress (asymmetric information) or the high search costs of obtaining this information. Moreover, indivisibilities and sunk costs due to irreversible investments

in the existing knowledge base or assets prevent actors from switching to new technologies or paradigms.

The above discussion reveals that the SIP framework does not provide any new rationales for innovation policy. Instead, the SIP approach mostly describes the symptoms of rather than the underlying reasons for market imperfections that are already part of neoclassical theory. Moreover, a closer look at SIP's line of argument shows that many of the arguments it uses to explain systemic failures originate in neoclassical economics.

5.2 Preconditions for Innovation Policy – A Comparison of the SIP and Neoclassical Frameworks

The mere presence of market or systemic failures cannot justify policy interventions in a market economy. The SIP approach and neoclassical theory agree that market intervention is only legitimate if two conditions are fulfilled. First, the market mechanism must have failed to achieve its objectives (SIP approach, e.g., Chaminade and Edquist 2006a) and must have partially or completely failed to efficiently allocate resources (neoclassical view, e.g., Stiglitz 2000), meaning that there is a problem that is not being spontaneously solved by private actors and market forces (so-called market or systemic failures). Second, public actors must be able to solve or mitigate the problem, i.e., be able to implement measures that will improve the market outcome (Fritsch 1995, Holcombe 2006, Chaminade and Edquist 2006a, 2006c). Therefore, justification of innovation policy can be regarded as a two-step procedure where identification of a market failure (or systemic failure under the SIP) is a necessary condition and the ability of the governmental intervention to solve the problem is a sufficient condition for public action. This is as far as the the SIP and the neoclassical approach agree, though, and so the following section attempts to discover whether the SIP approach is superior to neoclassical theory with regard to its implications for the operationalization and implementation of the necessary and the sufficient conditions.

The necessary condition refers to market or system failures that must be present. The crucial question is how such market distortions can be detected. What is the reference model or system that market outcomes can be judged against to see whether they are (in)efficient, and how should this benchmark be chosen? The neoclassical approach uses the model of perfect competition as a reference in the analysis of given market processes and outcomes. Hence, market failures are defined as deviations from the model of perfect competition. The standard objection to this approach, and one SIP proponents are fond of voicing, is that the model assumptions are unrealistic and lead, in the real world, to a ubiquity of market failures. Consequently, standard economic theory is considered as inappropriate and, therefore, irrelevant, for the legitimization of (innovation) policy. However, this argument overlooks at least three main aspects of neoclassical theory that make it a powerful tool for the identification of market imperfections.

- First, there is a difference between the basic theory and its application. In practice, exemptions from the strict assumptions can be and are made in order to analyze existing markets and market results. For example, instead of the "nirvana approach," which compares an ideal model with real market outcomes, a comparative institution approach is chosen. Instead of comparing ideal and real institutional arrangements and their outcomes, the comparative institution approach attempts to assess which existing institutional setting is most suitable for coping with the economic problem at hand. An ideal model is used as the standard and the existing institutional arrangements are assessed based on the degree of their divergence from those standards. The institutional setting that diverges least from the "perfect model" is selected as efficient (Demsetz 1969).[11] Hence, the "nirvana" criticism of

[11] For example, Arrow (1962) claims that the special characteristics of knowledge will prevent an ideal allocation of resources to research and development and lead to an underinvestment in these activities by private actors. However, this does not mean that policy intervention is necessary. To decide whether the private solution can be improved upon, one needs to consider the alternative, namely, the outcome of policy intervention.

neoclassical theory is often misleading and simply inaccurate as it does not take into consideration the flexibility of its application.

- Second, several theoretical advancements in neoclassical theory have relaxed some of it most heavily criticized assumptions. New institutional economics, including property rights theory, principal-agent theory, and transaction cost theory, takes into account the problems of asymmetric information and bounded rationality, thus making the theory more realistic and producing new rationales for policy intervention.

- Third, criticizing the perfect competition model's assumptions misses the whole point of having a theory in the first place. Every meaningful theory has to make some assumptions that that make it less than realistic. Therefore, the main question is whether the theory's assumptions are appropriate not whether they exist. Moreover, as discussed above, the model of perfect competition is highly flexible in actual application, meaning that exemptions from the strict assumptions can and are made when analyzing market outcomes.

In a nutshell, SIP's (and others') criticism of how standard economics identifies market failures ignores important aspects of the neoclassical approach and is therefore not convincing.

Because the SIP approach refuses to accept the neoclassical notion of optimality, it proposes a comparative institutional approach to detect systemic problems. However, this benchmarking procedure itself suffers several severe problems that need to be considered.

- First, a reference system needs to be identified, but how will the right one be selected? Systems are complex constructs and the reference system needs to be similar enough to the one being judged so that the comparisons will be useful. What criteria are appropriate in this respect, and how should these criteria be

weighted? In other words, the choice of the reference system leaves much to the discretion of the decisionmakers.

- Second, markets or institutions do not stand alone, but are embedded in a whole system of institutions. That is, institutions are complementary in the sense that the presence (and efficiency) of one institution influences the returns (and the efficiency) of another (or others) (Hall and Soskice 2001). This mutual interdependence implies some limitations for the identification of systemic problems and the design of policy measures. On the one hand, comparing two institutional frameworks and drawing conclusions requires considerable knowledge about the functions and interplay of different system components. It is especially crucial to understand the causes of systemic problems. On the other hand, even if this knowledge is given, copying a single institution from one system into another system will not necessarily have the desired result unless the whole institutional framework is also copied (Lundvall 2007). There is also the danger that changing a single, but structurally important element of a complex system without appropriately adapting complementary institutions will cause severe undesired side effects or even lead to instability of the whole system (Hannan and Freeman 1977).

The previous discussion reveals that most of SIP's criticism of neoclassical theory is invalid because it only refers to the basic model of perfect competition and does not consider possible exemptions and theoretical advancements. At the same time, the comparative institutional approach proposed by the SIP framework has severe problems in practical application, especially with regard to its knowledge requirements. Ultimately, this framework faces the same problem as the neoclassical approach with regard to the choice of an appropriate reference system. Therefore, the comparative institutional approach does not provide a superior framework for identifying systemic failures.

Once market or system failures have been detected, the neoclassical and the SIP approaches both assume that public intervention is justified only if it will improve the market outcome (the so-called sufficient condition). Neoclassical theory provides a strong framework for discovering whether this condition can be fulfilled by taking into account three main limitations on the achievement of superior market outcomes.

- First, every intervention in the market requires detailed knowledge about, for example, private and social returns, market conditions, or future technological trends and developments. However, this information is inherently dispersed and decentralized at the individual level. These information deficiencies strongly limit the scope of governmental action and lead to the "pretense of knowledge" problem (Hayek 1945), which might result in even more severe market distortions caused by public intervention.

- Second, the government itself is not immune to failure. Such failure could encompass anything from a policy failure (i.e., political decisions yielding socially undesired outcomes) to a bureaucratic failure (i.e., inefficient public administration), any or all of which could jeopardize the effectiveness of a market intervention. Government failures arise from the fact that public actors are not benevolent altruists, but self-interested private actors. As a consequence, political and bureaucratic decisions might not be based on efficiency and social welfare considerations, but on the self-interest of the decisionmaker. The influence of interest groups, the trading of votes (so-called logrolling), and budget maximization are other well-known examples of functional deficiencies in the political and administrative system that might hamper successful (i.e., yielding superior market outcomes) market interventions.[12]

[12] These problems are dealt with by public choice theory. For a detailed overview of this topic, see Mueller (2003).

- Third, public interventions come at a cost, namely, the direct cost of the measure, transaction costs, and deadweight losses caused by allocation distortions due to the intervention.

In neoclassical economics, market intervention is justified only when the benefits will outweigh the costs, i.e., if a net increase in welfare can be expected. The practical measurement of these benefits and costs and, thus, the choice of instruments is another aspect of neoclassical theory that has come in for a great deal of (SIP) criticism (e.g., Klein Woolthuis 2005, Edquist and Chaminade 2006), But although it is true that the total benefits and costs of policy measures cannot be measured directly, it is possible to compare and evaluate different instruments as they vary with regard to their information requirements, risks of government failures, and costs. Therefore, the neoclassical framework allows for the identification of superior instruments that have a net benefit and can therefore be evaluated as efficient.

Unlike neoclassical theory, the SIP approach does not consider the problems and costs associated with public action. Nevertheless, it does address the problem of decisionmakers having imperfect information. Since uncertainty is generally assumed, it pervades policy interventions as well and they can thus fail to achieve their objectives or lead to undesired side effects due to be based on faulty or insufficient information. Hence, policymaking is not perceived as an optimization process, but as a process of adaptation, i.e., a process of learning and adapting to a dynamic environment through trial and error (Chaminade and Edquist 2006a, 2006b, Bach and Matt 2005, Lundvall 2007). According to the SIP approach, government failures “probably lie in the desynchronization of the speed of adaptation of public institutions and the speed of technological and scientific change in the system”(Bach and Matt 2005, 9). Although the SIP framework accounts for imperfect information and possible policy failures emanating from it, the crucial question that lies at the heart of government intervention – Why should public actors possess more or better information about market

processes than do private actors? – is not considered in the SIP approach, much less answered. Additionally, the imperfections of political and administrative systems, which severely limit the effectiveness of all kinds of public intervention, are ignored. Although the SIP framework acknowledges the cognitive and informational constraints of political decisionmakers, it does not pay attention to other issues of government failures, such as the self-seeking of public servants and bargaining or rent-seeking behavior of private actors. Finally, the SIP framework does not consider any of the three cost dimensions that make up a constituent part of the neoclassical approach.

Since there is no weighting of the costs and benefits of policy actions in the SIP framework, market interventions are always justified if systemic failures occur. Particularly, the disregard of the "pretense of knowledge" problem and the possible selfish and opportunistic behavior of public officials is highly problematic. In other words, the SIP approach imposes no limitations on public intervention within the SIP approach, which bears the risk of legitimizing every kind of interventionist policy. The neoclassical approach, on the other hand, imposes strong restrictions on policy intervention by demanding a cost-benefit analysis, thus resulting in an efficient level of intervention. Therefore, neoclassical theory is a more sophisticated framework for the identification and justification of market interventions.

6. Conclusions

This paper investigated whether the SIP approach to justifying policy innovation in the matter of innovation adds anything new, or even anything, compared to neoclassical economics. The short answer is that it does not. In fact, the SIP framework mostly describes the symptoms, rather than the underlying causes, of market imperfections that are already part of neoclassical theory, and the framework suffers from severe shortcomings with regard to practical implementation. These shortcomings involve selecting a reference system for detecting systemic failures and the preconditions for and limitations on policy

interventions. Since the SIP concept fails to consider the costs and benefits of public action, it ends up setting no limits, and in fact, actually legitimizing all types of public intervention. In conclusion, the SIP approach neither presents new rationales for innovation policy nor does it provide a superior framework for the identification and implementation of innovation policy compared to neoclassical economics.

This is not to say, however, that the SIP approach is completely without value. The strength of the SIP concept lays in its special focus on the importance of interaction and institutions to the innovation process, factors that are present in neoclassical theory but rather obscurely.

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