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What are Innovative Opportunities?

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ABSTRACT To better understand and explain processes of economic transformation, this paper proposes a new concept, ''innovative opportunities''. Our interpretation of opportunities is based on an understanding of innovation in a business context, stressing perception and uncertainty during the choices involved in innovation processes. Based on Schumpeterian views of economic transformation, innovative opportunities refer to a set of different elements within the processes whereby actors identify, act upon and realize new combinations of resources and market needs to try to benefit from their future economic potential. To better understand and explain such processes, the proposed conceptualization of ''innovative opportunities'' consists of three elements: (1) economic value; (2) mobilization of resources; and (3) appropriability, which goes beyond existing types of opportunity conceptualizations found in the literature. The concluding discussion returns to the question of how this view of innovative opportunities modifies the existing understanding of innovation activities and industrial dynamics, and helps us identify new areas of research.

KEY WORDS: Technological opportunities, entrepreneurial opportunities, economic value, resource mobilization, appropriability

1. Introduction

The notion of opportunities is central to understanding economic transformation, as the concept points to the core of a capitalist economy, namely, the search for profit resulting from new knowledge about resources, markets and their interrelationship. However, despite the fact that the concept of ''opportunities'' has been extensively used to explore different aspects of innovation, entrepreneurship and industrial dynamics, it is still vaguely and ambiguously defined. Therefore, this paper argues that our understanding of the role played by opportunities in relation to innovation needs to be improved. The rationale for this paper is that a stronger conceptualization is warranted, and thus the paper explores the question of ''what are innovative opportunities?'' by reviewing literature and proposing a definition and conceptual elements. Innovative opportunities as a concept should help us better understand the question of how and why actors innovate in terms of identifying, acting upon

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and realizing new combinations of resources and identified market needs, within a larger economic system.

Apparently there is a consensus that opportunities are somehow related to the choices that actors make in relation to innovation. However, current debate includes a variety of concepts in different literature streams. These concepts include ''technological opportunities'' from neo-Schumpeterian economic theory, ''entrepreneurial opportunities'', as developed in entrepreneurship literature, and ''productive opportunities'', found in the knowledge- and resource-based theories of the firm. While these concepts reveal some similarities, they are diverging in terms of their basic assumptions about how they relate to innovation, the types of choice involved in opportunities, about who may act and benefit, about whether uncertainty exists or can be mitigated as risk, etc.

Our argument is that each of the existing opportunity concepts is useful but none alone captures all the relevant dimensions of technological change in an innovation context (necessary to consider in order to grasp the essential role of opportunities in economic transformation). We therefore propose a new and more comprehensive concept, one of ''innovative opportunities''. Innovative opportunities refer to a set of different elements within the processes whereby actors identify, act upon and realize new combinations of resources and market needs—in order to try to benefit from their future economic potential. The aim here is to better conceptualize these processes by addressing the nature of opportunities. Specifically, the paper conceptualizes ''innovative opportunities'' as consisting of three elements: (1) economic value; (2) mobilization of resources; and (3) appropriability. This reflects our understanding of a basic puzzle of business and innovation, which gives the dynamics of economic transformation. That is, how and why are firms working within a business context able to identify, act upon and realize ideas in such a way as to develop and use new technologies and to introduce innovations?

Outside of mainstream equilibrium theory in economics, there are many debates and research about innovations, technological change, and the impacts on businesses, entrepreneurship and the economy, with literature available from Schumpeterian economic traditions as well as many other fields like business studies, history, sociology, innovation studies, etc. Researchers differ according to whether or not their theories state that transformation processes involve primarily quantitative changes in given variables (such as prices and volumes) or whether they also consider more fundamental transformation in the content and quality of those variables and activities over time (e.g. types of markets and products). This paper only addresses a narrow topic which is central to the complex issue, asking what innovative opportunities are and how they may arise.

Our specific interest is in technological change which is developed and used for innovation in a business context. This implies that we are specifically interested in the use and development of scientific and engineering knowledge, equipments, techniques, etc., as relevant for business activities and for economic returns. This is a more specific focus than those authors interested in technological change as a general societal process, and those studying entrepreneurship and firm creation in a broader sense.

Section 2 provides an overview of the concept of opportunities—and the relation between opportunities and economic transformation—from the perspective of Joseph A. Schumpeter. The reason for this overview is that modern literature using more specific concepts of ''opportunities'' draws inspiration from this theoretical tradition, even if each field goes on to define and interpret ''opportunities'' relative to their more specific research

questions. Section 3 provides an overview of three streams of research. The first is the neo-Schumpeterian economic stream, and the concept of ''technological opportunities''. The second is the entrepreneurship literature, which has been extremely engaged in debates about ''entrepreneurial opportunities''. The third is knowledge- and resource-based theories of the firm, and the concept of ''productive opportunities''. Section 4 proposes our concept of ''innovative opportunities'', and elaborates upon their role in economic transformation. Section 5 concludes, by returning to the question of how our proposed view of innovative opportunities modifies the existing understanding of innovation activities and industrial dynamics, and helps us identify new areas of research.

2. Schumpeter's Views on Opportunities and Innovation in the Economy

This section provides an overview of Schumpeter's views on opportunities in the economy, because this paper—and most of the literature streams reviewed—arise from questions which can be posed in a broadly Schumpeterian theoretical tradition where communities of economists, business strategists, economic historians, scholars of innovation and others share an affinity with Schumpeter's views.[1] This paper is thereby in the Schumpeterian tradition, in the sense of emphasizing that innovations, entrepreneurship, creative destruction and opportunities drive capitalist development, and thereby economic growth.

This view of the importance of developing new innovations can be contrasted with the main research agenda in much of economics. Many economists consider the diffusion of known alternatives (options) rather than the development of new ones. With a few exceptions, one could say that the question of how and why new technologies are developed for use in business contexts has been poorly explored by economists. Most economists consider the price mechanism, as organized through ''markets'' of identifiable products, as central to understanding economic behaviour and thereby also economic growth. New ideas and inventions are developed outside the economy, and if proved efficient, they will be taken up in firms and thereby help move the system towards a new equilibrium.

This relative neglect of technological change is rather interesting, given empirical findings and theoretical propositions which would suggest that inventions, technical change and qualitatively new goods and services explain much of economic growth (Nelson, 1996: 9–51). Indeed, the role of technological change in promoting economic growth has been broadly accepted within economics. The growth literature of the post-Second World War period, following Solow (1956, 1957), found that the ''technological residual'' was a major factor, explaining a large percentage of growth. Other literature has stressed a variety of other factors within the neoclassical assumptions, including how technology increases the productivity of capital, or the contribution of human capital, that is, skilled individuals (Nelson, 1996; Sloman, 2001: 251–261). The difficulties arise, of course, in explaining those aspects of growth which are due to inventions, technical change and new goods and services—in combination with the specific institutional organization(s) of capitalism

[1] By this, we mean literature which shares a theoretical paradigm which stresses the qualitative transformation of business activities and the economy over time, whether or not all the authors share the same, explicit theoretical framework. Indeed, the theoretical frameworks tend to differ, given the variety of specific research questions addressed, but they share a basic theoretical paradigm.

(Abramovitz, 1986, 1989; Rosenberg and Birdzell, 1986). In other words, from this perspective, what matters in the economy is its fundamental transformation over time (Saviotti, 1996).

Proposing a new concept, one of ''innovative opportunities'', rests upon our view of the economy as changing due to internal forces which go beyond the price mechanism. The theoretical starting point here is thus one which stresses ''opportunities open to new enterprise and investment'' (Schumpeter, 1942: 113) as a key aspect of innovation and industrial dynamics. Hence, the notion of opportunities is central to understanding economic transformation, as the concept points to the core of a capitalist economy, namely, the search for profit resulting from new knowledge about resources, markets and their interrelationship. This implies that we need to know more about who is searching, why they are searching for novelty and why they think that they can make profits, that is, appropriate returns. These micro-level search processes and the driving forces behind them are of fundamental importance for understanding the mechanisms at the core of innovation and economic change. By addressing how innovative opportunities arise and how economic actors act upon these opportunities, we may gain increased understanding of the factors facilitating and obstructing renewal in the economic system.

This starting point of even asking the questions raised in this paper—and in the literature reviewed—indicates a general affinity with Schumpeter's view. By this, we mean agreement with those aspects of Schumpeter's writing that emphasized that innovation and entrepreneurship continue to disrupt the economy, and thereby fundamentally change activities and move the economy in new directions.[2] Nelson (1996: 87) argues that this is ''Schumpeter's most consistent and elaborated argument about innovation, that it fundamentally involves disequilibrium and that standard equilibrium theory in economics cannot cope with it and its economic consequences''. Schumpeter instead put forward the thesis that fundamental change in existing activities—as linked to creative destruction and various forms of innovation—would keep providing ''fuel'' to the capitalist engine. Basically, these fundamental impulses can be described in terms of different categories of innovations, namely, new goods, new production processes, new methods of transformation, new markets and new industrial organizational forms (inside the firm). Developing this view on innovation, Schumpeter (1942: 82) states that opportunities open to new enterprise and investment are actually the material the capitalist economy feeds on, and thus a key factor to consider in order to understand economic transformation. The question remains, however, of what innovative opportunities are, and how they arise over time during the unfolding of activities which constitute economic transformation. In order to investigate these questions, we will now turn to existing streams of literature, which propose different theories about different kinds of opportunities related to innovation and economic change.

3. Review and Critique of Different Concepts of ''Opportunities''

This section reviews the literature which addresses different types of opportunities, in order to discuss their strengths and weaknesses relative to understanding innovation in a

[2] Entrepreneur is here used in the sense of an agent of renewal, as found in Schumpeter (1942) and Penrose (1959).

business context. Three concepts are reviewed: (1) ''technological opportunities'', which is used frequently in evolutionary economics; (2) ''entrepreneurial opportunities'', which derives from entrepreneurship theory; and (3) ''productive opportunities'', which comes from knowledge- and resource-based theories of the firm. Our analysis of the strengths and weaknesses of each then provides the foundation upon which to introduce our concept of ''innovative opportunities'' in the subsequent section.

3.1. Technological Opportunities

The first concept which is defined and analysed here is ''technological opportunities'', which is used in neo-Schumpeterian (evolutionary) economics and in debates about designing science policy. Technological opportunities have been held forward as a key concept to capture the driving forces behind economic development.

This concept appears to have been initially developed in the context of debates over the rationale for public vs. private funding of research, as linked to the firm's ability to ''appropriate'' the returns (Nelson, 1959; Arrow, 1962). In a modern business economics textbook, Perman and Scouller (1999: 198) describe ''what economists call an '*appropriability*' problem'' as follows:

> It can be difficult for firms which invest in R&D to secure the rewards for themselves.… R&D, when successful, leads to valuable new ideas for products or processes but it is in the nature of ideas that it is difficult to keep them to yourself.… Much of the value of its efforts is appropriated by its competitors.

In much of economic thinking, the term ''appropriability'' is almost synonymous with patents and other forms of ownership of inventions and ideas. However, in the neo-Schumpeterian and evolutionary economics literature, the literature describing how firms appropriate returns to innovation shows that much more than patents are involved. Levin *et al.* (1987) were able to identify very different strategies by firms in different industries, in order to protect—and profit from—the product and process innovations resulting from a firm's investment in R&D.

Scherer (1965) explores the propensity of firms in different industries to patent, and argues that ''technological opportunity'' helps explain such differences. ''Differences in technological opportunity—e.g., differences in technical investment possibilities unrelated to the mere volume of sales and typically opened up by the broad advance of knowledge—are a major factor responsible for interindustry differences in inventive output'' (Scherer, 1965: 1121). Differences in technological opportunities in industrial sectors help conceptualize why technology advances much faster in some sectors than in others, and why the underlying knowledge may differ (Nelson and Winter, 1982; Klevorick *et al.*, 1995). Although an exact definition is not given, similar arguments can be found in Levin *et al.* (1985: 24): ''To explain interindustry variation in R&D incentives and the productivity of innovative effort, we must look to underlying differences in technological opportunities and appropriability conditions.'' Much of this literature refers to interindustry differences, where expenditures on R&D affect the incentives for private actors to develop technology—as opposed to public actors financing ''science'' as a public good.

Breschi *et al.* (2000) further develop the ''technological regime'' proposed by Nelson and Winter (1982). In a vein similar to previous papers, Breschi *et al.* (2000: 390–391) argue that the

> observed sectoral patterns of innovative activities are related to the nature of the relevant technological regime … defined by the specific combination of technological opportunities, appropriability of innovations, cumulativeness of technical advances and the properties of the knowledge base underlying firms' innovative activities.

Within this broader conceptualization of industrial differences due to scientific and engineering knowledge, they define that ''*Technological opportunities* reflect the likelihood of innovating for any given amount of money invested in search'' (ibid.). Opportunities are thus related to the firm's own R&D but also the likelihood of discovering scientific and technological knowledge developed outside the firm.

Despite common conceptual agreements that technologies differ in different industries in such a way as to fundamentally influence industrial dynamics, the concept of technological opportunities is not concisely and unambiguously defined (Oltra and Flor, 2003). Still, the rich conceptualization of technological opportunities affords us the possibility to capture the essentials of what constitutes the ''technological residual'' in economic theory which helps cause growth.

Basically, this kind of opportunities is seen as the result of advances in scientific and technological domains. The knowledge advances may or may not be the direct result of firm R&D, but anyhow deals primarily with knowledge for the supply side of the economy, leaving the demand side out of the discussion. These definitions of technological opportunities also appear to stress aspects of the technology being known and/or subject to probability analysis. The above definitions refer to the ''investment possibilities'' and ''likelihood'' of innovating. Nelson and Winter (1982: 283) are quite explicit about this, when discussing science-based industries. They see that the development of scientific and technological knowledge provides growth of ''latent productivity''. ''Innovative R&D by a firm can be interpreted as its efforts to keep up with a moving set of new technological possibilities created outside the industry.'' This discussion underlines that firms can develop and imitate technologies with a potential to increase productivity.

From our perspective of uncertain innovation processes, several key points can be drawn from the technological opportunities concept, as affecting economic growth. A technological opportunity only exists if there is a possibility to identify and use new scientific or technological knowledge, if there is a possibility to use this knowledge for creating economic value, and if parts of this value in some way can be appropriated by the actor pursuing the opportunity.

There are key points, however, where the current concept may suffer from shortcomings, relative to our interest in the unfolding of new opportunities and innovations over time.

One shortcoming is the narrow focus on scientific and technological knowledge, particularly where such knowledge is primarily outside the business context (universities, public research) or primarily ''luck of the draw'' of R&D expenditures. Some recent work, especially Palmberg (2004), has addressed the sources of technological opportunities as being broader than R&D. The problem could be that the concept as so far defined does not

take into account the uncertainty associated with the use and development of technology for a business context. A second shortcoming is the relative lack of attention to the market dimension, apart from the appropriability issue mentioned above. The ways in which customers provide value which the firms can somehow appropriate is either not well articulated or else is assumed to work as in a conventional market. Thus, innovation per se is not explicitly addressed and the measurements accrue to input rather than output factors. Finally, received theory has not clearly addressed whether technological opportunities are subject to idiosyncratic interpretations. Though, ideas such as ''latent productivity'', where the firm may find a better set of techniques, indicate that possible differences in interpretations are given limited attention.

3.2. Entrepreneurial Opportunities

The second concept which is defined and analysed here is ''entrepreneurial opportunities'', which has been hotly debated in the entrepreneurship literature.

Within the expanding field of entrepreneurship, ''opportunities'' is a central concept. It has even been argued that the entrepreneurial process consists of all activities, functions and actions related to the perception of opportunities and the generation of organizations to pursue them (Bygrave and Hofer, 1991). In contrast to the literature about technological opportunities, the literature about entrepreneurial opportunities stresses the central role of the ''market'' in defining potential opportunities.

The main ideas regarding entrepreneurial opportunities can be traced back to the Austrian school of economics (Hayek, 1945; Horwitz, 2001). Entrepreneurs identify business opportunities to create value that can be shared between different stakeholders (Ardichvili *et al*., 2003). The role of the entrepreneur, according to this perspective, is one of an actor observing market imperfections and undertaking actions leading to their elimination through purposeful action.

Thus, the main focus of this theoretical domain is on the market side, in which price differences are perceived. One important characteristic of the predominant view of entrepreneurial opportunities is that they consist of possibilities to gain arbitrage profits (see, e.g. Kirzner, 1973, 1997). Given the view of opportunities as the strivings to appropriate arbitrage profits, the explicit stressing of price differences is however hardly surprising. It can even be argued that this focus is almost exclusively put on the market side, to the extent that the resource side of an opportunity, for example, in terms of new technology, is left out of the discussion.

A shortcoming here is the difficulties of addressing true uncertainty. Straightforward price differences may constitute a pedagogical example of opportunities. Still, the use of this particular kind of profit will likely lead the observer to overlook the complexity of profits deriving from business models (Chesbrough and Rosenbloom, 2002) of a more composite nature. In particular, the market applications of new scientific or technological knowledge are rarely clear and unequivocal at an early stage, and moreover, they may emerge first after substantial market experimentation. Hence, while the concept of entrepreneurial opportunities can be used to explain new businesses based on potential arbitrage profits, it is of limited use for understanding and analysing entrepreneurship based on innovation.

Another important characteristic of this theoretical stream is the importance given to the entrepreneur, that is, an actor purposefully recognizing and acting upon opportunities.[3] A significant issue in this regard is the importance given to unique characteristics of actors, which result in diversity among firms. Due to unique characteristics, the entrepreneurs display idiosyncratic patterns of opportunity identification and pursuit. A number of different explanations for these idiosyncrasies (and hence diversity) have been proposed. Ardichvili *et al.* (2003) argue that the literature finds opportunity recognition and development processes to be influenced by (1) entrepreneurial alertness, (2) information asymmetry and prior knowledge, (3) social networks, (4) personality traits, and (5) the type of opportunity. These have so far been proposed as alternative explanations, and little research in this tradition has attended to simultaneously take several or all these aspects into account.

Perception of opportunities also forms a particularly important characteristic of this literature. Based on a recent empirical study, Shane (2000) concludes that the prior knowledge held by individuals modified the perception of opportunities that could be developed from a specific technological content.[4] In other words, the actor's (individual's) prior knowledge and perception matter for the pursuit and application of an opportunity, and not just the technology per se. Levenhagen *et al.* (1993) present findings similar to the ones of Shane (2000), however, with a broader understanding of the basis of idiosyncratic opportunity, explaining it in terms of interpretative frameworks, which arguably is more than prior knowledge as such. Based on a study of 13 software entrepreneurs, Levenhagen *et al.* (1993) found that entrepreneurs relied on internally created conceptualizations. Acknowledging a subjective view of opportunity development, it becomes clear that "… unique windows of opportunity lie open very early in emergent markets, perhaps especially so for firms which help to create them" (Levenhagen *et al.*, 1993: 147). Hence, they argue that conceptualizations matter, due to the ambiguity and uncertainty of the competitive spaces in new emerging markets, which encourage entrepreneurs to create novel products and services.

Compared to the predominant view of opportunity recognition as identification of price differences, this part of the entrepreneurship literature stresses the role played by existing interpretative frameworks in framing an opportunity. This raises the question of the extent to which factors external to the individual, or firm, fashion those opportunities. As of yet, there is not much work done on this topic within this stream of literature.

We should also note that the view of opportunities within the entrepreneurship literature is not exclusively limited to markets and arbitrage profits. A few authors also address resources as sources of opportunities. Ardichvili *et al.* (2003), for instance, suggest that unemployed resources and new capabilities or technologies can potentially generate new value for prospective customers, even though the exact value is initially fuzzy or undefined. This is clearly closer to a view of the internal aspects of the firm.

A final shortcoming of relevance here is systemic effects. Based on the above, we note that the modern literature is moving towards more comprehensive conceptions of the nature of entrepreneurial opportunities. However, despite a few promising contributions, there is still a clear lack of knowledge regarding the connection between resources and market

[3] Such opportunities are often seen in relation to new business or ventures. See Bhave (1994) and Bhidé (2000).
[4] See also Shane and Venkataraman (2000) and Eckhardt and Shane (2003).

factors as well as the various feedback mechanisms and interactions among actors within the economic system. Technological development is a relevant example of systemic aspects, such as the public and private knowledge infrastructure which affects technological development at the firm level. Frequently, the development of technology helps stimulate opportunities for the firms, and this particular type of opportunities is becoming increasingly important for economic success at the firm level (Almerida *et al*., 2003). So far, however, this literature has not extensively studied and developed models of how individual actors ''interact'' with ''systems of actors''.

Taken as a conceptualization of the micro-processes of innovation and entrepreneurship, this literature enriches our view of innovation opportunities. Some parts of the entrepreneurial view of how and why opportunities emerge—and their role in fundamental economic transformation—provide a fruitful complement to the focus in the technological opportunities debate about latent productivity, based on new resources in terms of scientific and technological knowledge. In particular the entrepreneurship literature holds a potential for enriching our understanding about the necessity of considering the market side of an opportunity, and the heterogeneity among economic actors in perceiving opportunities.

3.3. Productive Opportunities

The third concept which is defined and critiqued here is ''productive opportunities'', which comes from an internalist emphasis in the knowledge- and resource-based theories of the firm.

Penrose (1959), who is often pointed out as the pioneer of this field of study, presents a radically different view of opportunities from those so far presented, even though there are also a few similarities. The starting point for Penrose—and related theory of the firm literature—is not a market imperfection, but that opportunities arise, due to possibilities to combine the internal resources of a firm in various ways. The resources of a company can be used in a multitude of ways, and different ways of deploying the resources render different results, as measured in terms of firm growth and profitability. The possible uses of such resources are limited by the ''productive opportunity'', as perceived by managers in the firm, especially their capacity to envision alternative modes of using the resources at hand (Penrose, 1959: 31–42, 111). More specifically, key factors influencing the subjective productive opportunity held forward by Penrose are firm-specific capital, teamwork and associational experience (Kor and Mahoney, 2000). Clearly, Penrose's perspective on opportunities only gives a partial answer to how opportunities evolve over time, but it does present a notable contrast by emphasizing existing internal resources and different possible configurations of using these specific resources.

More modern literature in this general tradition does try to take into account factors both internal and external to the firm, in their definition of opportunities. A complementary view on resources and firm growth can, for instance, be found in Hamel and Prahalad's (1989) ideas about strategic intent, according to which organizations need to see opportunities regardless of their existing resource base, in order not to limit the growth possibilities unnecessarily much. Hence, opportunities do not necessarily emanate from the resources and knowledge within a single organization, but instead emanate from the firm's interactions with external world and external actors. For example, some literature has strongly argued

that one source of opportunities is the exploitation of knowledge which has been developed outside the firm (Cohen and Levinthal, 1990). Others are more explicit about the alternative choices facing the firm. Teece (1986) argues that the firm should strategically choose whether to diversify, develop alliances or choose not to develop certain types of knowledge and focus on other types of knowledge instead. Teece argues that these choices could (and should) be informed by judgements about complementary assets. Thus, he points out that opportunities are formed not only by the internal resources controlled by a firm, but also by the total stock of resources that can be mobilized in order to realize it.

This literature has also addressed a number of reasons for diverse behaviour in identifying and acting upon opportunities. Alvarez and Busenitz (2001) further develop the understanding of opportunities by stressing the important role that idiosyncratic resources play, in causing different firms to recognize and act upon different opportunities. They address the *interplay* between resources and environmental factors, thereby providing a different route to widening the Penrosian view of productive opportunities beyond the internal resource focus. Similar ideas are brought forward by Amit and Schoemaker (1993), who point to the necessity of considering the overlap between strategic assets, which are internal to the firm, and strategic industry factors found in the business environment. Teece *et al.* (1997) suggest that firms need to have dynamic capabilities, consisting of positions, paths and processes. At a certain point in time, firms have a certain resource constellation, which according to the above ought to influence the identification of opportunities. However, Teece *et al.* (1997) also stress that opportunity recognition is limited by the firm's historical development, in terms of the path that it has followed over time, and the organizational and managerial processes that are used to leverage existing resources and create new ones. We also note that productive opportunities may refer to opportunities outside the realm of innovations, for example, in terms of improved utilization of existing resources. Minor productivity improvements of existing processes would hardly qualify as innovations according to the definition used here, but would nevertheless be the result of a realized productive opportunity. While innovations may certainly be a part of productive opportunities, this literature does not put much explicit focus on it.[5]

Summarizing the implications of the knowledge- and resource-based theory for opportunities, we note significant overlaps with the ideas proposed concerning both technological and entrepreneurial opportunities. The literature review of ''technological opportunities'', ''entrepreneurial opportunities'' and ''productive opportunities'' indicates that each provides parts of a unique perspective on the role and function of opportunities with respect to innovation activities and industrial dynamics. However, while the three different opportunity concepts to some extent are overlapping and complementing, they also miss out aspects of significant importance for understanding innovation, individually as well as jointly. Altogether, the exposition of the types of opportunities already established in different fields of studies reveals that these concepts only have limited potential to capture and explain innovation, and economic transformation.

The literature on technological opportunities exclusively addresses the supply side of innovation in terms of a developing knowledge base, while neglecting the market side. Moreover, theory on technological opportunities does not attend to actors' idiosyncratic

[5] We are grateful to an anonymous reviewer for pointing this out.

perceptions and actions and the resulting complexity, but rather regards opportunities as objectively existing.

The literature on entrepreneurial opportunities also displays a number of limitations in relation to innovation. First of all, innovation is involved only in a subset of entrepreneurial ventures, namely, the ones in which there is a higher level of uncertainty. Focusing primarily on arbitrage profits resulting from market imperfections, this theoretical stream also does not attend sufficiently either to the resources needed in order to realize an opportunity or the intricate issue of appropriating the created value during this process.

The notion of productive opportunities appears to be internally biased, largely neglecting the demand side of innovation. Moreover, it also does not make a clear distinction between opportunities that result from innovation and other changes of a more incremental nature.

Arguably, none of the existing concepts on their own, or in combination, allow for a thorough understanding of the role opportunities play in innovation activities and economic transformation. In particular, we note three aspects that are warranted for the present purposes. First, it is clear that the conceptualization needs to be specifically aimed at innovation, including some economic dimension. Second, the conceptualization needs to take into consideration how resources are identified and acted upon. Third, the role played by appropriation is essential. Based upon these aspects, we therefore propose the introduction of the more comprehensive concept of innovative opportunities, which we will define and develop further in the coming section.

4. Innovative Opportunities

This section proposes the new concept of ''innovative opportunities'', which has been developed through the review and critique of existing concepts, found in the previous two sections. The definition of ''innovative opportunities'' is here aimed at being more useful for characterizing innovation and innovative processes than other conceptualizations. The reason is that such an expansion is needed to be more able to identify those aspects of ''opportunity'' identification and exploration which are most relevant for innovations, for example, how and why actors identify, act upon and realize opportunities. Based on the literature review in Section 3, we have found that opportunities at least need to comprise an element of economic value. Moreover, this value can be generated through a new matching of resources and market needs. Furthermore, the importance of idiosyncratic views of opportunities needs to be taken into account and thus calls for a further elaboration on the role of perception for all the conceptual elements.

4.1. Defining Innovative Opportunities

An innovative opportunity is here defined as ''*the possibility to realize a potential economic value inherent in a new combination of resources and market needs, emerging from changes in the scientific or technological knowledge base, customer preferences, or the interrelationships between economic actors*''.

The concept of ''innovative opportunities'' comprises both aspects related to a potential market as well as aspects related to the scientific and technological knowledge needed to serve this specific market. We would argue that this concept is useful to broadly grasp the

type of actions and decision-making which diverse actors must engage in to identify and exploit such an opportunity—and thereby drive forward an innovation process. Because it is a more comprehensive concept, ''innovative opportunities'' is somewhat more complex than the other concepts that exist in the literature. In other words, in our view, the conceptualization of innovative opportunities has to be more complex than the existing literature would suggest, because innovation is more than a known technology or an individual perception or an internal bundle of resources in the firm.

Still, definitions of concepts are often only the beginning of the research process. It is necessary to go further than just defining concepts, breaking them down into conceptual elements which are more directly and practically useful for research and for analysis for decision-making. Consequently, an innovative opportunity must consist of at least the following three conceptual elements in order for actors to have the possibility to identify, act upon and realize the potential inherent in an idea:

(1) an economic value for someone;
(2) a possibility that the resources needed to realize the opportunity can be mobilized;
(3) a possibility that at least some part of the generated economic value can be appropriated by the actor pursuing the opportunity.

Our proposed concept of ''innovative opportunities'' thus consists of three conceptual elements, that is, economic value, mobilization of resources and appropriability.

4.2. The Role of Perception in Identifying, Acting Upon and Realizing Opportunities

All three conceptual elements stress the importance of perception during conditions of uncertainty—that is, that the actors involved in choice situations have neither complete information nor reliable predictions about the future course of events. In somewhat different ways, the evolutionary economics literature on knowledge and search as well as the firm-related literature on entrepreneurial and productive opportunities stresses the importance of search and perception. In especially the latter two streams, individual and idiosyncratic perception is considered to be a key aspect of opportunity identification.

Because of the unfolding of historical processes of identifying, acting upon and realizing opportunities, perception and uncertainty, one could say, are intimately part of our conceptualization of ''innovative opportunities''. Following the reasoning above, a discussion first focuses here on the role of ''perception'' in these processes, because it is related to the three conceptual elements. Perception is related to our understanding of the need to address true uncertainty (Knight, 1921), as opposed to risk.[6] If the outcome and even the occurrence of a process are unknown (as during conditions of uncertainty), then we take this to mean that actors cannot fully rationally calculate alternatives. Through their perceptions, they have to ''conceptualize'' the future and these conceptualizations will differ among actors (Loasby, 1999, 2001a). Indeed, such differences in perception are related to what Lane and Maxfield (2005) refer to as semantic uncertainty, while the unknowability of future interrelationships between actors is referred to as ontological uncertainty.

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[6] In a modern economics textbook, Sloman (2001: 75) differentiates the two definitions as follows. ''Risk: When an outcome may or may not occur, but its probability of occurring is known. It is a measure of the variability of that outcome. Uncertainty: When an outcome may or may not occur and its probability of occurring is not known.''

Our emphasis on technological change as an unfolding process within economic activities differs from what economists have traditionally tended to think of technology as a known, transferred easily and without cost to firms, while developed outside the market (and hence economy) per se. In contrast to these characteristics of knowledge, our proposed conceptualization of innovative opportunities stresses aspects like true uncertainty at the present, reduction of uncertainty over time as actors explore (or experiment with) different alternatives. However, over time, actors learn and new ''solutions'' emerge, both of which may open up previously difficult paths of development or previously unconceived ideas. This implies that new opportunities also arise as a result of the search, and hence new types of uncertainty also arise over time. This is similar to the modern literature on science, technology and innovation (see Fagerberg *et al.*, 2004).

Another implication of our emphasis on ''perception'' is that firms and other actors are actively shaping the process of economic transformation. Their views are affected by the system and vice versa. At any given point in time, actors identify problems or opportunities by observing differences between their expectations and their perception of something factual, known as ''Pounds' principle'' (Pounds, 1969, as elaborated by Loasby, 1976). This observation is dependent upon their previous knowledge and the information that they are able to discern in accessible data. As a consequence, the firm undertakes some decision and action, and these actions (the search for new knowledge or the reuse of their own or someone else's knowledge) are largely shaped by institutions as well as the broader, related technological regimes. While undertaking these activities, the actors affect ''the system'' in that signals may be observed, possibly creating an identification of new opportunities (''problems'') because other actors discern differences and act upon them. This suggests that the process of economic transformation is inherently one of interactions between the firm and a larger socio-economic–political system.

Moreover in our concept, actions carried out in order to benefit from opportunities are based on idiosyncratic perceptions.

Finally, ''perception'' implies that time matters, in the meaning of making economic activities and choices irreversible. This point has been argued much better by others such as Foster and Metcalfe (2001) and Loasby (2001b), leaving us to concur with the more fundamental implications about the need to understand the economy as an historical process and not as a reversible model. Here, we simply wish to point out that this also implies that innovative opportunities differ over time, but more importantly, that they unfold in such a way that they may not be perceived—much less calculated upon fully rationally—by firms and others. Actors do not simply perceive well-defined opportunities in advance. Rather, they often perceive rather vague contours of possible opportunities, and then their actions (and those of others) add to the experimentation which in its turn opens up sets of opportunities. Which alternatives were relatively more or less successful as innovations will however only show *ex post*.

4.3. How Innovative Opportunities Inform our Understanding of Innovation Activities and Industrial Dynamics

Let us now turn to how our proposed concept, and conceptual elements, of innovative opportunities modify the existing understanding of innovation activities and industrial dynamics. The first part of the innovative opportunity concept is *economic value*. Economic

textbooks assume that the value (and prices) of goods and services can be calculated, based on assumptions about how markets work. If factor prices, final markets, technology and so forth are given (that is, known variables), then the economic value of a new technology may also be calculable. However, if the scientific and engineering knowledge is currently *being developed* for use in a business context, then uncertainty exists which affects future search. There may be uncertainty regarding *how* the new technique will be used, and not only *to what extent* it improves existing ways of performing a task or process, and therefore the future economic value can only be perceived, not calculated.[7]

Our statement that innovative opportunities stem from a perceived possibility to create economic value (for someone) has implications for understanding economic transformation. First of all, entrepreneurial activities—that in the end result in economic change—derive from the actors' idiosyncratic views of opportunities. These idiosyncratic perceptions may stem from the entrepreneurs' differing access to information, but they may also stem from other important factors, such as the knowledge at hand within a firm and the mental frameworks that are used to interpret what is taking place in the environment. This view affects the conceptualization of the use of new scientific and technological knowledge for a business context, as the market uses of this knowledge may be very difficult to identify *ex ante*. In situations characterized by high uncertainty, there ought to be more pronounced differences in firm perceptions about the potential economic value of an innovation. Consequently, the variety of firm actions in order to pursue opportunities in this situation will accordingly be higher.[8]

Another point is that the perception of opportunities is not only the result of the single firm's interpretative framework and knowledge—but also of other firms' actions, in both market and resource domains. This may be related to swarming effects around one idea and to clustering of innovations. As firms observe other firms' actions, they may identify the same opportunities and thereby lead to swarming, or they may perceive other opportunities, complementary or otherwise related to the other firms' actions and thereby lead to clustering of innovations and problem-solving of bottlenecks among related technologies.[9]

The second conceptual element to inform our understanding of entrepreneurship and industrial dynamics is the possibility to *mobilize resources*. As discussed in the literature about entrepreneurship and theory of the firm, firms usually need to mobilize different types of resources in order to achieve their goals. In this case, the mobilization of resources is needed, in order to attempt to realize the potential economic value of an innovation. Perceiving the potential of mobilizing resources needed to realize an opportunity highlights that there are barriers to actually pursuing opportunities, even though those opportunities have been identified (perceived) to have economic value. Such barriers can affect the rate,

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[7] For example, pharmaceutical companies have used combinatorial chemistry and other techniques to synthesize many more molecules at a radically lower cost per unit, but now they are questioning the value of having many chemicals synthesized, if they still cannot assess which will become a best-selling pharmaceutical (Malo, 2004).

[8] See Rosenberg (1969), Sahal (1985) and Dosi *et al.* (1988). Nelson (1996) has argued that fundamental differences in companies' strategy, structure and core competencies are fundamental to the experimental, or unfolding nature, of capitalism.

[9] An interesting research question, beyond the scope here, is to analyse the process from hype to standardized good or service in terms of how and why the reduction of uncertainty occurs (or not), in which dimensions, whether new uncertainties are introduced over time, etc. Such questions could be related to behaviour of firms and industrial dynamics.

and direction, of further economic change. The first problem is that many (potential) entrepreneurs who perceive an opportunity need to convince others that this opportunity actually exists, in order to gather the necessary resource constellation. So, other individuals in the same organization need to be convinced, in order to focus joint efforts on a shared target (Witt, 1998). Gradually, this individual perception of a desired future state becomes institutionalized as the shared vision of a large number of employees. Another necessary step is to convince also external stakeholders, such as investors, customers and suppliers, about the realizability of the imagined business vision, both in terms of its general viability and the specific benefits for the partner in question. The specific individual or firm entrepreneur may be more or less successful at this, partly dependent upon whether others are also perceiving the same potential economic value to be appropriated. A second problem is that firms may want to stop a certain development trajectory under certain circumstances, such as a defensive measure, if there is a risk that their existing resources will become obsolete. Their ability to acquire a competing technology and make sure that it is not used would contribute to the inertia of the economic system, but their ability to do so is likely balanced by other actors' attempts to innovate "around" such defensive blocking strategies.

Indeed, if more firms (or individuals wishing to start firms) have access to resources, the economy as a whole will likely have more experimentation. Without knowing the opportunities available and identified in a specific case, it is hard to predict, however, whether this experimentation will lead to better systemic returns to flexibility (that is, more alternatives tried out, thereby more likely to find a winner for the environment) or if this is just turbulence (that is, a lot of noise but not any more likely to find a winner).

The third conceptual element is the possibility to *appropriate the economic returns*. Much of mainstream literature focuses on patents, as the main mechanism to secure the firm's ability to appropriate the returns to R&D (innovation). The neo-Schumpeterian and evolutionary economic literature review discussed that firms could have other strategies to appropriate, partly because new scientific and technological knowledge for a business context can be used in many different ways and partly because innovation can involve a high degree of uncertainty. This underlines that the perception of the possibility to appropriate—whether through intellectual property rights (IPR) or other mechanisms—plays an important role in economic transformation, given the presupposition that it can modify the actors' willingness to act in order to realize a certain economic value. In other words, the perceived potential benefit as well as the possibility to appropriate parts of it may well affect the entrepreneur's behaviour in regards to innovative opportunities.

The ability to appropriate parts of the created value may promote experimentation but it may also promote the diffusion of information for alternative types of technology. As such, a strong focus on IPR will most likely have both positive and negative effects on the number of opportunities that are realized. While IPR limits the possibilities to exploit a certain set of scientific and technological knowledge for others than the owner of the IPR, it also works as an effective information source for other firms. They may perceive new opportunities that are not dependent on the use of the specific piece of IPR—or be stimulated to develop alternative types of technology.

Another factor to consider is that appropriation is not only a matter of IPR, but to a significant extent to market factors. One such example is the existence of bandwagon effects, when a dominant solution makes all other alternatives redundant as it becomes the

de facto standard. This, in turn, is influenced by, for example, network externalities. Briefly put, when the possibility to appropriate the generated economic value is unclear, firms may well be more reluctant to attempt to realize the perceived opportunities. However, we still see that firms are involved in areas where it is difficult to appropriate—or even to define innovation in an economic sense—as in open source software.[10] The firms seem willing to continue to innovate and introduce new products, as long as they at least partially benefit from it.

Taking these points together, we would like to argue that the development of innovative opportunities, as related to the degree of uncertainty regarding market and resource factors, as well as different interpretations by different actors, including competitors, strongly impacts the pattern of economic transformation, as it emerges in terms of innovation activities and industrial dynamics.

5. Conclusions

In conclusion, we can distinguish a number of important features of innovative opportunities that call for new models and frameworks to understand innovation. These features suggest many areas for future research. The first point is the role of different perceptions held by different actors, which leads to a differentiation in experienced entrepreneurial opportunities. At the root of these idiosyncrasies we find imperfect access to information or knowledge, or more fundamental differences in the interpretation of the environmental state of being. The higher the uncertainty in a specific area, the more diversity in the perceived opportunities is likely. The economy is thus by necessity a distributed knowledge system (Tsoukas, 1996), which reveals some typical characteristics of complex systems, for example, local instability and at the same time comparably high global stability. Also, the possible system effects of a change at one place in the system can be seen as a typical feature of a large, non-linear, interconnected system.

With regards the mobilization of resources, we can here see a factor of inertia in economic systems, which so far has been more or less neglected in models of economic transformation. The inertia can reveal itself as a lack of access to capital needed to acquire other resources, a lack of critical knowledge, as this due to being tacit or organizationally embedded is not transferable or imitable (Spender, 1996). Yet another source of inertia for knowledge transfer may be a lack of absorptive capacity (Cohen and Levinthal, 1990), which puts a limit to the search space available for each single individual and firm. Moreover, access to customers, who can be regarded as a key resource, may be a source of inertia. Not only do firms have to identify potential customers, in many cases they also need to convince the customer in question that what will be offered to them in the future is valuable, by transferring the vision of a desired future state of the business and the industry. As is easily realized, this process is radically different from the examples of arbitrage prevalent in the literature on entrepreneurial opportunities, where an identified source of profits can almost immediately be realized.

We also need to consider the systemic nature of economic systems, and then in particular in relation to appropriability. Apparently, innovation never involves a single

[10] Franke and von Hippel (2003).

partner, but there needs to be at least one provider of the new goods or services as well as one customer. In complex and ambiguous situations, the question is how to split the generated value between all involved parties, and this constitutes a key issue in getting new products and services into the marketplace. To overcome this complexity, long-term relationships and high levels of trust may be important elements, as these factors can limit the use of opportunistic behaviour. Another solution to this potential problem is the generation of new business models that allow for more sophisticated value division, and not only the straightforward sales of products and services. Altogether, using the notion of innovative opportunities in order to view economic transformation reveals a far more emergent, distributed and interrelated process than what has normally been proposed in relevant literature, calling for both revised theoretical models and new management practice.

Finally, it is worthwhile to point out that the conceptualization of innovative opportunities may be useful in contexts outside the domain of innovation.[11] However, such an argument is beyond the scope of the present paper.

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[11] We are grateful to an anonymous reviewer for pointing this out.

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