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Considering adoption: Towards a consumption-oriented approach to innovation

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ABSTRACT

What are the forces that shape the adoption of innovations? This question has been sidelined in a largely production-centric literature on the economic geography of innovation. Inspired by Weber's dual concern with procurement and distribution activities in the location of industry, this paper examines the new nature of distances products must overcome en route to the market, and the resources that are necessary to do this successfully. Building on findings in sociology, this paper suggest a consumption-centric perspective and future research on innovation in the knowledge-based economy, which foregrounds the significance of actors that are able to validate new products.

Key words: innovation adoption and diffusion, consumption, sociology of scientific knowledge, Alfred Weber, knowledge economy

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Abstract

What are the forces that shape the adoption of innovations? This question has been sidelined in a largely production-centric literature on the economic geography of innovation. Inspired by Weber's dual concern with procurement and distribution activities in the location of industry, this paper examines the new nature of distances products must overcome en route to the market, and the resources that are necessary to do this successfully. Building on findings in sociology, this paper suggest a consumption-centric perspective and future research on innovation in the knowledge-based economy, which foregrounds the significance of actors that are able to validate new products.

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> "It is impossible to explain the sphere of production locationally without including in this explanation the distribution of material goods in all its aspects…Each part of production orients itself geographically with consumption in mind. The explanation of this orientation — locational theory — cannot neglect consideration of the place of consumption."
>
> (Weber, 1909/1929: 5)

> "An idea is not, by itself, of any importance for economic practice."
>
> (Schumpeter, 1947: 152)

> "both technical and market needs must be satisfied in a successful innovation… success demands not only selecting the right cost and performance combination, but also judging just when the timing is right for the product's introduction."
>
> (Kline and Rosenberg, 1986: 277)

I. Introduction

These statements, written over the span of eight decades, make a common point: innovations must be effectively communicated to others, and their diffusion, adoption and implementation is critical to innovative success. Notwithstanding contributions by Hägerstrand (1967) and colleagues in the 1960s on innovation diffusion, current research on the economic geography of innovation tends to focus primarily on knowledge creation processes. Although work in this field investigates the social and spatial conditions under which knowledge inputs are brought together in new and useful ways, a similar investigation on the distribution of these new products to the marketplace has remained largely undeveloped. In this paper, I argue there are good reasons to question this one-sided focus, and findings from other social sciences suggest that the process of bringing new knowledge-intensive products to markets is anything but straightforward. The point of departure for this paper is Alfred Weber's theory of industrial location, a classic from 1909 that still has much to say as we revisit it in the context of today's knowledge-based economy. The tradition of location theory has, however, fallen out of fashion over the last few decades as economic geography moved away from the models and assumptions rooted in neoclassical economics, and towards alternative approaches such as political economy. The nature of this evolution of the discipline, together with the interdisciplinary background of many scholars in economic geography today, gives reason to re-visit Alfred Weber's work in some detail as we cannot assume that these ideas are universally taught, known and understood in the field today. The greatest value of his work, I argue, lies in the general abstraction of the problem of location: whereas balancing procurement and distribution costs formed the basis for his theory a century ago, this dual concern has been somewhat forgotten in a largely production-centric literature on the economic geography of innovation. The question that drives this paper attempts to restore some of this balance: What are the social and geographic forces that shape the adoption of innovations?

Answers to this question reveal social mechanisms underlying the innovation process that are different from what we have learned from knowledge creation activities. These also identify a new set of economic actors that increase the likelihood of successful adoption of new knowledge-intensive products. This adoption-centric approach points to a fertile area of future research in the field of economic geography of innovation, but also has significant implications for firm strategies around market development, and public policy aimed at supporting innovation systems.

The paper is organized as follows. After a brief review of Alfred's Weber's theory of industrial location in section II, section III highlights some of the most important ways in which we have updated the 'procurement' process for the knowledge based economy. Section IV then suggests ways in which we can do something similar for the distribution process, building on literatures on communities as well as psychology and the sociology of scientific knowledge. These literatures help us to understand the reception side of knowledge transfer, and suggest that the uptake and implementation of innovations is fraught with potential challenges at the level of the individual as well as the social field. When compared to Weber's time period, producers need to overcome a different set of distances to bring innovations to the market in a knowledge-based economy (not only spatial but also significant cognitive and relational distances) and they require new types of resources to do this successfully. This will be discussed in section V. The concluding section considers the implications of these ideas for both firm strategy and policy initiatives aimed at supporting innovation systems.

II. Alfred Weber's theory of industrial location

How can we explain the distribution of economic activity in space? More importantly, why is it concentrated in some places and not in others? Does this spatial pattern change over time, and if yes, what are the forces that underlie these changes? These fundamental questions have occupied economic geographers for more than a century, with roots tracing back to the German economists Johan H. Von Thunen and Alfred Weber. Weber's work, published originally in 1909 as "Uber den Standort der Industrien" and in English translation in 1929, provided one of the first theories to explain the location of manufacturing industries and why they might move, based on factors such as the nature of material inputs, the factors of production, the market and transportation costs. For the purpose of the argument here, I will very briefly summarize the main idea of his theory in an admittedly simplified version. The point is not to teach the reader location theory, but rather to recall a piece of our intellectual ancestry that should, in abstract form, still resonate with our field today.

Manufacturers assemble a variety of inputs, process them, and distribute the output to markets. Both inputs and markets tend to be localized in space, meaning that they are only available at particular locations. Accessing material inputs and bringing produced outputs to the market therefore require movement across space in order to overcome the spatial distance between the material site, the manufacturing site and the market. There is a cost associated with this movement, in this case transportation costs. In Weber's time and model, this cost calculation depends on the nature of the material input and output (such as the product's material index, perishability and volume), and the ease and cheapness by which they can be transported. Procurement costs are the product of the weight of material inputs that are to be assembled together and the distance over

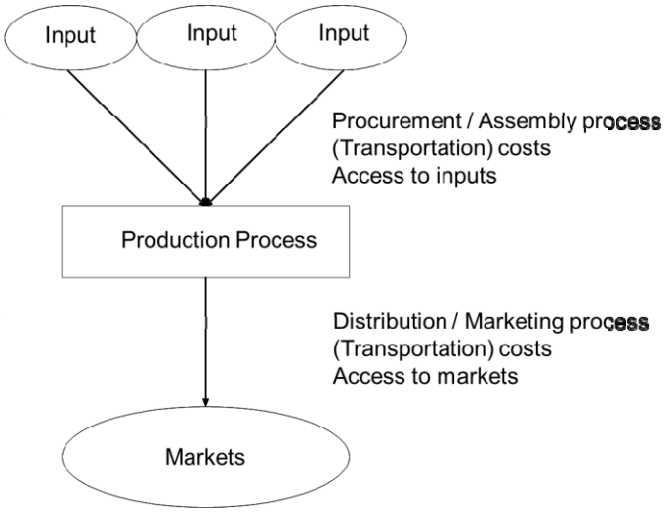
which they have to be moved to the manufacturing location. Likewise, distribution costs are a product of the weight of the final product and the distance over which this has to be moved to be sold at the market. When working within the constraints of the modeling tradition and the assumption that production costs are the same everywhere, then the locational problem is to find the point where the total transportation cost (or the "total freight bill" (Yeates and Garner, 1980: 131)) is minimized for the particular production-distribution process. In other words, the spatial distribution of economic activity is determined by balancing the costs associated with overcoming the distances between material site, production facility and the market[1].

Weber formulated his theory within the context of heavy manufacturing industry in Germany in the 19th century, where transportation costs played a fundamental role in determining location decisions. Since then, industrial composition and organization have changed dramatically due to new products and production processes, advances in communication and transportation technologies, and most recently the rise of a knowledge-based economy which places special emphasis on knowledge inputs and learning processes. Despite these changes however, I argue that Weber's theory is inspiration for a general framework for the study of spatial distributions of economic activity today, due to its dual and balanced concern with the nature of materials as well as markets: looking "both ways" (Dicken and Lloyd, 1990: 85). In the context of today's knowledge based, innovation or learning economy, we are acutely aware of the new types of 'distances' and 'costs' associated with procurement processes. Knowledge inputs, in the form of human capital, training and research organizations or capabilities, need to be brought together with other important factors of production (capital in particular) in order be combined and recombined in new and useful ways. Access to localized inputs is in this case not constrained by the friction of spatial distance that result in transportation costs, but by the friction of social and cognitive distance for example, that can be overcome through common affinities that facilitate knowledge transfer and learning. Organizational models ranging from communities of practice to triple helix arrangements aim to support these new processes of 'procurement'. We know much less about new costs associated with 'distribution' processes beyond those of advertising and branding, and often assume distribution happens more smoothly due to advances in transportation technologies, standardization of products and the globalization and integration of markets. Weber's industrial location theory reminds us that both procurement and distribution processes shape the spatial form of economic activity.

In the next section I will provide a brief overview of the ways in which we have already updated the 'procurement' side in the context of the knowledge based economy, before moving on to suggest ways in which we should be doing something similar on the 'distribution' side in section IV. In the process of revisiting Weber's location theory for the knowledge based economy, we identify new frictions and distances that need to be overcome, as well as the resources and capabilities that are necessary to do this successfully.

[1] Weber further advances his arguments, with respect to agglomeration economies and spatial variations in labour costs for example. Transportation costs remain at the root of the theory however: in these modifications, sites are able to generate cost savings associated economies of scale or factors of production that offset the increased transportation costs incurred at these site.

Figure 1: Stylized diagram of the procurement and distribution processes



III. Procurement processes in the knowledge based economy

1. The social foundations of innovation processes: interaction, learning and knowledge transfer

Whereas Weber's least cost model emphasized the importance of minimizing transportation costs, contemporary work on the geography of innovation focuses on factors that minimize the cost of interaction between economic actors (Scott, 1988). Our current view of innovation is that this is a social process, enhanced by exchange and feedback between different nodes along the value chain. This evolution in understanding is illustrated by the movement from a linear model of innovation to a chain-linked model (Kline and Rosenberg, 1986), and later to a systems model (Edquist, 1997). The nature of knowledge-inputs makes interaction between different economic actors not only beneficial, but a necessary condition for innovation and economic competitiveness. The relationships between firms, academic institutions, users and other partners are therefore of central importance to innovation dynamics, and much work in the economic geography of innovation examines the organizational form and intensity of such relationships (Boggs and Rantisi, 2003; Bathelt and Gluckler, 2003; Bathelt, 2006). Agglomerations function as "interactive learning sites" (Crevoisier, 1999: 63) where knowledge is generated, exchanged and combined in new and useful ways, because they facilitate frequent and low-cost communication between competitors, collaborators, suppliers, customers and supporting infrastructures (Harrison, 1992; Markusen, 1996; Porter, 2000 to name a few).

This relational perspective on the geography of the knowledge-based economy rests on three main ideas. The first is around the process of learning, which emphasizes a need for interaction between actors in networks of formal and informal relationships, with strong and weak ties. Secondly, there are benefits that are derived from the presence of relationships and the network at large, so-called 'relational assets' (Yeung, 2005), which include local buzz, spillovers and untraded interdependencies. The third idea concerns the characteristics of knowledge itself, where the tacit and know-how dimension in particular, has specific relational requirements for successful transfer, which include frequent and face-to-face interactions to support the development of stable

relationships based on trust (Winter, 1987; Storper and Venebles, 2004). This localized capability is especially important in the knowledge-based economy, as "...the more easily codifiable knowledge can be accessed, the more crucial does tacit knowledge become for sustaining or enhancing the competitive position of the firm" (Maskell and Malmberg, 1999: 172). In sum, the question of why economic activity is concentrated in particular locations remains at the core of a large body of work in economic geography and innovation studies, but the forces that underpin this spatial pattern have changed over time. "There is a lot to learn about the role of proximity and place in economic processes by trying to pinpoint the driving forces that make for the agglomeration in space of similar and related economic activities" (Malmberg and Maskell, 2002, 430).

2. The role of users in the economic geography of innovation

Although markets, users and customers are not ignored in the body of work on the economic geography of innovation, they tend to be portrayed as co-developers of innovations, rather than as recipients. Professional and lead users provide a valuable source of feedback and input to the innovation process (Von Hippel, 1988), and the user-producer interaction perspective argues that the innovating unit needs access not only to information about technical opportunities, but also about user needs (Lundvall, 1985; 1988; 1992). This interaction is especially important for specialized goods such a machine tool or software package, which "often can only be adopted in a process of cooperation between the user and the producer" (Lundvall, 1985: 10; also Gertler, 1993). Cooperation may take several forms and occur at different stages of the innovation process, which Grabher and colleagues attempt to synthesize in a typology of different modes of 'co-development' based on the degree of user involvement and the prevailing locus of knowledge production (Grabher et al., 2008). Although these and other studies argue that some users play an important role in the innovation-adoption process, they tend to focus on how the firm utilizes these users for product development, and not on the adoption process itself. Typically users are engaged in partnership-based interaction with producers, and are seen as drivers, not receivers, of innovation.

In contrast to the rich body of research that seeks to understand the complexities of knowledge creation, relatively little work focuses on the reception-side of knowledge transfer. Although "one of the hallmarks of the knowledge economy is the recognition that the diffusion of knowledge is just as significant as its creation" (OECD, 1996: 24), this production-centered approach tends to assume that new knowledge and knowledge-intensive products are readily accepted, absorbed and adopted.

3. Economic geography and the diffusion of innovations

This one-sided perspective has not always been so dominant. Forty years ago, the distribution process played a much more prominent role in the work Hägerstrand (1967), Brown (1975) and their colleagues (Brown et al., 1974; Spector et al., 1976; Brown and Cox, 1971; also see Rogers, 1995) on the diffusion of innovations. "Innovations do not immediately appear over the entire earth's surface" (Brown, 1981: 1), and moreover, these authors argue there are distinct spatial patterns to diffusion. Hägerstrand's focuses on diffusion as the outcome of a communication process, where populations can be transformed from a low to a high proportion of adopters by means of information

dissemination through media and interpersonal contact (Hägerstrand, 1967). A few years later, Brown (1975) shifts the focus from such consumer-behaviour (the demand aspect) to the opportunity to adopt (the supply aspect). Diffusion agencies make innovations available and they are the vehicle for marketing the innovation in the geographic area. Their success relies on information factors such as media and interpersonal communications, but also on market factors which include the location of 'agencies', and shopping trip behaviour. In this body of literature, 'diffusion agencies', such as retail outlets and warehouses, are therefore of primary importance in shaping the spatial pattern of diffusion.

However, this work was based on consumer innovations of its time, such as cable television, electric toothbrushes and energy efficient appliances. New knowledge-intensive innovations that characterize today's economy, such as biopharmaceuticals and cultural products, face additional challenges in their distribution to the marketplace. Aside from spatial distance, these products need to overcome more significant cognitive distance to consumers, which is associated with their novelty and unfamiliarity. Adoption in this case is neither solely driven by inherent qualities of the innovation, nor by individual attributes of potential adopters. Instead, 'value' must be interpreted and validated by intermediaries in order to increase likelihood of adoption in the marketplace. Users are active recipients that search for information when they face the decision whether or not to adopt new and unfamiliar knowledge-intensive products whose value is uncertain. In other words, the knowledge-based characteristics of new and innovative products are likely to make the distribution process more complex, more social and more prone to failure in the knowledge-based economy than before.

IV. Distribution processes in the knowledge-based economy: Reception of knowledge

The nature of the distribution process, which is of fundamental importance in Weber's least cost location model, is not sufficiently updated in our discussion of the knowledge economy (or, in the words of participants in the Economic Geography 2010 Workshop, "how markets are produced, stabilized, and dissolved" (Aoyama et al., 2010; 114)). On the procurement side, we have broadened the idea of overcoming physical distances to also refer to relational and cognitive distances. Localized knowledge inputs are more easily combined when economic actors are able to interact frequently and when they share a certain set of affinities. Research in economic geography on agglomeration economies, learning processes and relational perspectives implies that co-location (or geographic proximity) is a stimulus for innovation as this facilitates or smoothes interaction (Coenen et al., 2004). The social foundations of innovation are key to explaining the geographic distribution of innovative activities.

We assume that similar new forms of 'distance' replace the central importance 'physical distance to the market' on the distribution side of the model. In addition to transportation costs, producers must overcome a different set of barriers to market access. The most critical barrier en route to innovative success, is the process by which new products are evaluated as useful and 'worthy', as is implied by Schumpeter's distinction between the inventor and the entrepreneur, and the processes of invention and innovation:

> "The inventor produces ideas, the entrepreneur "gets things done"…Moreover, an idea or scientific principle is not, by itself, of any importance for economic practice….It is in most cases only one man or a few men who see the new possibility and are able to cope with the resistances and difficulties which action always meets with outside of the ruts of established practice."
>
> (Schumpeter, 1947: 152)

New products are often characterized by a substantial amount of uncertainty when introduced to the market (Nelson and Winter, 1977), which potentially impedes adoption. The evaluation and validation of meaning, usefulness and value are therefore important steps in the innovation process. These activities are also social and rely on a variety of economic actors. However, our conceptual frameworks for understanding the social foundations of innovation are predominantly based on procurement, development and production activities. The geographic and social conditions that fruitfully bring inputs together are framed as sources of competitiveness. Does this production-based conceptual framework also inform our understanding of the forces that shape the introduction and implementation processes? Are the barriers, forms of distance and strategies to overcome distance the same in procurement and distribution processes? Findings in other social sciences suggest there is good reason to question this assumption.

In order to more fully understand the factors that separate actors and the forces that can bring them together, scholars in economic geography already draw on a number of ideas from related disciplines. In particular, some ideas that originated in sociology are becoming mainstream in the economic geography of innovation and are cited with increasing frequency (see Grabher, 2006 for a review of such 'trading routes'), including communities of practice (Lave and Wenger, 1991; Brown and Duguid, 2000; Amin and Cohendet, 2004), epistemic cultures (Knorr-Cetina, 1999) and social networks (Owen-Smith and Powell, 2004). In addition to these 'community' level ideas, we are able to identify mechanisms that facilitate knowledge reception at the scale of individuals as well as the scale of the 'field'. Although the latter two are perhaps less familiar in economic geography, they provide useful clues to begin to update our understanding of distribution processes for a knowledge-based economy.

1. Communities

The literature that has influenced economic geography the most, is Lave and Wenger's (1991) work on communities of practice, which focuses on the mechanisms that 'unify' members, such as shared learning, identity formation, and the negotiation of meaning through participation (Wenger, 1998). Brown and Duguid's (2001; 2000) application of these ideas to organizations illustrates the ways in which communities provide a setting for interaction, knowledge transfer and learning as they bring together actors with different perspectives, experiences and skills. This 'unifying' power of communities of practice makes this a promising organizational form in economic geography sites of learning and knowledge generation. However, this approach has not yet articulated a convincing analysis of the relative importance of geographic, social and institutional proximity between community members (Gertler, 2008). Whereas 'communities' of practice are organized around a common task (such as fixing Xerox machines, so-called 'networks' of practice are defined by their common identity (the law profession for example) where one member may or may not know the

other members on a personal basis (Amin and Cohendet, 2004). In epistemic cultures (Knorr-Cetina, 1999) on the other hand, members have a shared way of doing things based on professional codes of practice and common background knowledge that result in 'cultures of knowing' and social machineries of knowledge production.

What can we learn from this 'procurement'-based understanding of the social nature of innovation? The literatures on knowledge communities suggest that practices such as socializing, conforming and consensus building are important to learning processes and knowledge production. Communities, as an organizational form, are thereby able to overcome potential obstacles associated with the social nature of innovation by bringing diverse sets of actors together in a unified context – minimizing relational and institutional distances. The distribution, acceptance and adoption of innovations are also processes that involve a diverse group of economic actors that are linked through formal and informal communication channels. However, intermediaries such as marketing partners, media, industry organizations and user-networks do not share a common identity, do not cooperate on a task, and their practices are governed by their respective community's formal and informal institutions. Seen through this lens, knowledge about new products is not simply transferred between producers and consumers, but must be communicated across multiple communities. We have learned a lot about the ways in which single communities help minimize frictions associated with (geographic, social, cognitive) distances between economic actors and partners in product development. Unfortunately, we know fairly little about communication between different communities: the reception of knowledge by actors in external communities and the consequences for knowledge transfer.

2. Individuals

Research in psychology and sociology suggests that the knowledge-reception process is anything but straight-forward. In psychology, Piaget's cognitive theory of development (1928) argues that assimilation of new knowledge is relatively easy when this fits within existing views of the world, but is more difficult when accommodation requires the modification of mental schemas. This 'activity theory of knowledge' illustrates that mental categories develop from experience and interaction with the social and physical world. Research on organizational learning reflects Piaget's theory in a contemporary context (Blackler, 1995; Kolb, 1984; 1976; Levitt and March, 1988), and elements of this work are also incorporated in the innovation literature as an organization's 'absorptive capacity' (Cohen and Levinthal, 1990), where investments in basic research play an important role in shaping the firm's ability to respond quickly to emerging trends and technologies. These ideas suggest that the process of adopting new knowledge depends in large part on how different new knowledge is from previously acquired knowledge – the lower this 'cognitive distance' is, the easier it is to understand and accept new knowledge (Nooteboom, 2000a; 2000b).

More distant knowledge however, is more likely to be associated with novel and innovative value. Relationships with other economic actors that have a knowledge profile that is considerably different from one's own (perhaps a 'weak tie' in Granovetter's terms (1973), or perhaps due to their relative structural position in a network as in Burt's work (2004)), can be an important source of innovative ideas and entrepreneurial insight, as standard practice in one sector may be revolutionary in another (Valente, 1995). However, truly novel knowledge is not only more difficult to access and assimilate

(as work on 'optimal' cognitive distance and creativity suggests (Nooteboom et al., 2007)), it is also much more difficult to evaluate. Without prior knowledge and experience, and in the absence of existing nuanced mental schemas, it is difficult to develop an informed attitude towards new and unfamiliar information. Lundvall (1992) makes a similar argument about technological trajectories, where established producers will have difficulties in evaluating the potentials of a new paradigm.

Taken together, these findings in psychology and sociology suggest that the criteria for evaluating and validating new knowledge are not limited to the internal validity of the individual claim. That is to say, novel knowledge, or a knowledge intensive product, is not inherently right or wrong, or inherently valuable and meaningful. Instead, research on small group dynamics and media studies suggests that we rely on shortcuts when dealing with uncertainty and unfamiliarity, and turn to sources that are able to provide a recognized indication of quality, such as reputable publications or respected opinion leaders (Katz and Lazarsfeld, 1955; Hagstrom, 1965; Frenzen and Davis, 1990; Chaiken and Maheswaran, 1994). In order to identify the mechanisms that underlie such shortcuts, we can draw on work in the sociology of scientific knowledge (SSK), which offers illustrative insights with respect to the advancement of science.

3. The field

> "For science to be advanced, it is not enough that fruitful ideas be originated or new experiments developed or new problems formulated or new methods instituted. The innovations must be effectively communicated to others. In the end, science is a socially shared and socially validated body of knowledge. For the development of science, only work that is effectively perceived and utilized by other scientists, then and there, matters" (Merton, 1968: 452)

The fundamental starting point of this body of work is that the scientific 'field' is a social field like any other, with its distribution of power, struggles, interest and profits (Bourdieu 1975). A sociological study of science therefore rests on the hypothesis that "'scientific truth' lies in a particular type of social conditions of production, in a determinate state of the structure and functioning of the field" (Bourdieu, 1975: 19). Arguing against the prevailing image of science as neutral and free of social factors, Robert Merton worked from the 1930s to the 1960s to constitute the study of science as a legitimate branch of sociology. In order to understand science as a (social) process, scholars in this field have primarily focused on "the relations between knowledge and other existential factors in the society or culture" (Merton, 1945: 7). Up until Merton's project, sociology was limited to studying scientific errors, because 'good' science was discovered by objective scientists and based on universal norms of reason, free from social noise. Merton argued that 'truths', just like errors, are socially and historically conditioned, and that social factors should be seen as constitutive of the very idea of scientific knowledge, and not as contaminants. 'Truths' in science are thereby not merely discovered facts, but certified, confirmed and accepted by a scientific community.

Scientific knowledge, according to this view, is not only a product of the work of individual objective scientists or laboratory teams. Instead, findings must be effectively 'communicated' to, and 'perceived and utilized' by others in order to become part of a body of knowledge that is developed, accumulated and advanced over time. The resemblance of his project on science to that of

innovation is clear in the OECD's definition of 'innovation' as "the *implementation* of a new or significantly improved product or process" (OECD, 2005, emphasis added). SSK uses science to study the social foundations of knowledge, and physics (traditionally perceived as non-social) was considered the 'hardest case': "The term 'knowledge' must be interpreted very broadly...studies [in the sociology of knowledge] have dealt with virtually the entire gamut of cultural products, ideas, ideologies, juristic and ethical beliefs, philosophy, science, technology" (Merton, 1945: 7). Although SSK focuses on scientific communities, the following pages will highlight relevant findings of this body of work to help us understand the mechanisms that underlie knowledge reception. A sociological perspective on science prioritizes these final steps of knowledge transfer, and incorporates the readers or 'consumers' of new knowledge fully into the (innovation) process. Key consumers such as opinion leaders have acquired the authority necessary to turn discoveries into 'certified and confirmed' knowledge (Merton, 1942). The core arguments underlying this research area suggest it is able to offer useful insights into the process of introducing innovations.

Two mechanisms that shape the social field of science are discussed below. The first, the acquisition of recognition and reputation as a driver of knowledge circulation (which also plays a role in literature on industrial ecology (for example Hannan and Freeman, 1977; Hannan et al., 2007; Cattani et al., 2008; Suchman, 1995 on legitimacy and credibility). The second is the use of different audiences in this process of knowledge circulation in order to establish credibility. These ideas have the ability to inform a knowledge-based understanding of the distribution and diffusion process by pointing to new forms of distances that need to be overcome, and strategies to pay the 'price' associated with doing so. As this area of research is relatively unfamiliar to scholars in economic geography, I will provide a bit more context and include details of the empirical work that gave rise to these ideas. This not only serves as an illustration, but it is also an effort to lessen the risk of blindly importing new concepts into geography divorced from their original context.

a. Recognition and reputation

Scientific contributions must be communicated and subsequently recognized and accepted by members of the scientific community. The effectiveness of this process is not only dependent on the socialized (through education) and self-controlled scientist who is strongly committed to central values of science, but also by the scientific community's institutions. The 'exchange system', where knowledge is shared in exchange for recognition from colleagues (Hagstrom, 1965), serves as a social control to maintain these values. Recognition is given to scientists primarily through formal channels of communication such as publication in reputable journals, citations and awards, and depends on "the distinctive value of his products and the collectively recognized originality of his contribution to the scientific resources already accumulated" (Bourdieu, 1975: 25). Value or 'meaning' is not inherent to the knowledge itself, but in its interpretation. This illustrates that knowledge circulation is shaped by the institutionalized practices of the community, and not merely a result of the (codifiable) nature of knowledge. Intellectual priority for example, is one of the mechanisms that encourages quick and open communication within scientific communities, and deters secrecy (Dasgupta and David, 1994). "The scientist's claim to 'his' intellectual property is limited to that of recognition and esteem which...is roughly commensurate with the significance of the increments brought to the common fund of knowledge" (Merton, 1942: 273).

Related to Hagstrom's ideas on institutionalized practices and the acquisition of 'recognition,' is Merton's (1968) theory in which structural attributes (such as reputation) affect the allocation of rewards to scientists for their contributions. "The Matthew effect consists of the accruing of greater increments of recognition for particular scientific contributions to scientists of considerable repute, and the withholding of such recognition from scientists who have not yet made their mark" (Merton, 1968: 446). Such recognition subsequently provides access to larger facilities and resources. When introduced by a scientist of high standing, a contribution to science is more likely to be accepted and will experience greater visibility in the scientific community. These mechanisms ensure a certain degree of continuity as well as inertia in science. This Matthew effect also finds parallels in the principle of cumulative advantage; centres of demonstrated scientific excellence are allocated greater resources for investigation, which leads to the concentration of scientific resources and talent.

These works illustrate that the criteria for evaluating and validating new knowledge are not limited to the internal validity of the individual claim. New knowledge is considered valuable by the adopting community if it significantly advances existing theories, which ensures accumulation, advancement, and continuity. By the same token, new knowledge that is controversial and disruptive to this process faces greater difficulty receiving recognition and visibility from the scientific community. Overcoming this type of 'distance' requires recognition and reputational capital. Similarly, during the innovation process new products must offer significant and visible advances over existing options, but not be too radical and disruptive. Unfamiliarity and uncertainty impede adoption, and preparing the market by using marketing and validation channels is therefore a crucial step in the innovation process. Producers require access to recognition and reputation in order to overcome distances or gaps in terms of user experience and cognition.

b. Audiences and interests

The process of building such reputation capital therefore appears critical in the distribution of knowledge intensive innovations. Who can offer this? Or, in other words, who does the 'recognizing' that matters, whose interpretation and evaluation of new knowledge provide that shortcut and eases knowledge acceptance at-large? In the field of SSK, scientific controversies provide a unique window on the structures of scientific communities, and the impact of social organizations on knowledge adoption. During his study of the high-energy physics community, Pickering (1982) examined the period during which one theory about newly discovered particles became accepted truth while another was abandoned. The first theory built on existing bodies of scientific practice that cut across sub-disciplines; the second relied on work in a single small sub-field. Based on this study, Pickering developed the 'interest' model of cognitive organization and cognitive change: "when a concept becomes thoroughly entrenched in the practice of several diverse research groups it acquires impersonal qualities...this allows the concept more easily to be perceived in isolation from its social origins and hence more easily to be represented as in correspondence with an asocial natural world" (Pickering, 1982: 127). This model suggests that new knowledge that is able to intersect with the interests of a range of sub-groups is more likely to circulate among the scientific community and become widely adopted than isolated and disruptive new knowledge that is

'invented' from scratch or a single sub-community. Again, 'new' must be ably integrated with 'old' knowledge, schemas and theories in order to be considered valid and valuable.

Pickering's model illustrates that these networks of diverse interests are important not only at the formation stage of knowledge production, but also in the process by which the value of this new knowledge is recognized and established. The value of new knowledge is negotiated through these networks to capture the support of subfields whose intersecting interests allow them to recognize value. Furthermore, some audiences such as funding agencies, highly reputable subgroups and bodies of authority play an especially important role in the validation process. This segmented social structure shapes knowledge circulation, as different audiences (or 'interpretive communities' (Fish, 1980)) play roles in the process of introducing novelties: "It is through anticipation of these demands and expectations of particular audiences which can be effectively located in the social structure, that the men of knowledge organize their own work, define their data, seize upon problems" (Merton, 1945: 34). This work suggests that new knowledge must be actively negotiated through the social structure of the scientific community, collecting support, endorsement and approval from different audiences.

V. Discussion

> "The acceptance or rejection of concepts is not determined merely by their objective validity, but also by their consistency with other prevailing beliefs"
> (Merton, 1945: 24)

The above findings in the field of SSK suggest three main ideas concerning the reception side of knowledge transfer that have potential to significantly contribute to our understanding of the distribution process in a knowledge-based economy. First, 'meaning' or 'value' is not inherent to knowledge itself, but is a process of interpretation. New knowledge that builds closely on existing knowledge is communicated to others more easily than knowledge that requires the reorganization of previously accepted 'truths'. Although "originality" (Bourdieu, 1975) and the "significance of the increments brought to the common fund of knowledge" (Merton, 1942) result in greater degree of recognition, this new(er) knowledge is also characterized by greater uncertainty, which impedes adoption. Second, in order to mitigate this uncertainty, receivers often rely on external sources of validation to assess the value of this new knowledge. Publication in reputable journals, citation by highly ranked scientists and endorsement by bodies of authority serve to 'validate' new knowledge, which eases adoption. Third, these processes suggest that new knowledge must be purposefully navigated through the community's sub-groups to find acceptance, endorsement and validation. Although these studies are based on the process of science, their contributions inform our understanding of innovation, as both are characterized by novelty and uncertainty. The ideas discussed above suggest innovations are not readily adopted, and that producers must pay attention to both product development and market development.

These findings demonstrate that compared to Weber's time period, products in the knowledge-based economy need to overcome additional critical distances to reach the market. Distribution costs are not only determined by the weight of output and the distances over which this needs to be moved to be sold in the marketplace. In addition to spatial distances, knowledge-intensive products

must overcome significant cognitive distances that have the potential to impede adoption by consumers. This is not to say that these distances did not matter a hundred years ago, but they are more critical to economic success in the knowledge economy. By examining these cognitive and relational distances we reveal a new set of economic challenges and resources. In order to distribute innovations to the market successfully, producers need to establish product value and visibility. This requires access to those economic actors that have the reputational capital to valuate and validate innovations in the eyes of consumers. Instead of transportation costs, producers face costs associated with translating novelty into value.

Furthermore, these findings suggest that an examination of distribution activities in the knowledge-based economy yields new insights when compared to the research on procurement activities. The innovation challenge is different for these two sets of activities: In procurement, producers must overcome the problem of socially and spatially distributed sources of innovation, by bringing together and uniting distant partners engaged in new knowledge creation and facilitate knowledge transfer. In distribution, producers must overcome the problem of novelty, uncertainty and unfamiliarity associated with innovations, by accessing socially (and perhaps spatially) distributed sources of validation. Navigating this path to the market is therefore likely to involve multiple audiences (or validating intermediaries) whose acceptance helps to build reputational capital.

VI. Conclusion

This paper set out to explore an important question that is left unresolved by a relatively production-centric literature in economic geography: what are the forces that shape the adoption of innovations? Research on firm competitiveness and regional economic development suggests that innovation is a social process, enhanced by interaction and feedback between different nodes along the value chain. Much of the research on the social foundations of innovation focuses on production processes and how these are being shaped by, and shaping, geography. Economic activity continues to be concentrated in space, this body of work argues, due to both the characteristics of knowledge inputs (especially the importance of tacit knowledge (Maskell and Malmberg, 1999; Gertler, 1993)) as well as the interactive and social nature of the procurement process (including face-to-face interaction and learning (Storper, 1995; Storper and Venables, 2004; Morgan, 1997). These ideas have informed a number of economic development initiatives at the level of the region, ranging from industrial clusters to regional innovation systems to creative city strategies, that aim to promote the generation and attraction of knowledge inputs (whether this is university research, new firms or human capital) and their combination into new products and processes.

However, in addition to the wealth of work that seeks to understand the complexities of knowledge creation and new forms of 'procurement costs', there are ways to operationalize a similar make-over on the reception-side of knowledge transfer. Research in other social sciences, including psychology and sociology, suggests the reception of new knowledge is not straightforward. New knowledge is often difficult to evaluate, and access to sources of recognition and validation are therefore likely to play an important role in the successful introduction of new knowledge-intensive products.

What does this mean for future lines of research on the economic geography of innovation? Most importantly, this perspective highlights a new set of economic actors in innovation systems:

individuals and organizations that support the diffusion and adoption of innovations. Quality control organizations and industry consortia engaged in standard-setting for example, play important roles in establishing norms by which to evaluate new products and processes. User-groups and the media are other types of 'intermediaries' that provide sources of objective and credible third-party information used to validate uncertain and unfamiliar new products. Who are these intermediaries, what are the factors that influence their location, and what is their relationship with other economic actors? What is the basis for their expertise, and what is the source of their credibility? How do firms gain access to such 'distribution channels', and how could public policy aimed at supporting innovation systems help firms of different sizes in doing so?

Secondly, a greater understanding of the diffusion of innovations shines new light on the integration, convergence and globalization of markets. Why do some industries globalize this activity more easily than others, or why do firms in some locations export their products with much greater ease than firms in other locations. Furthermore, the importance of accessing and accumulating reputational capital in order to overcome the distance between producers and consumers, means we need to seriously reconsider the trickle-down and neighbourhood models of diffusion, and investigate the ways in which different users and marketplaces lend 'credibility' to innovations.

Thirdly, this perspective could help us to reconsider the role of public policy in supporting innovation systems. In addition to R&D credits and grants that stimulate collaboration between firms and university partners for example, policy instruments could include demand-side supports for 'market development' and facilitate attendance at trade fairs to connect to new local and non-local customers. The survival and growth of small and medium sized firms depends in large part on their ability to reach a market. Public sector (pre-) procurement practices also fall in this category of support, and they need to adapt to the particular characteristics of the knowledge based economy.

These are just three lines of future work that stem from a greater consideration of the 'distribution' process for knowledge-based industries. Our primary concern may no longer be transportation costs, but there are new frictions and distances that need to be overcome, and new resources and capabilities to do this successfully. Weber's theory of industrial location helps to remind us that both procurement and distribution processes shape the spatial form of economic activity. Even now, "perhaps, therefore, Weber still has much to say to modern geographers" (Gregory, 1982; 118).

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