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Hugues Jeannerat, Leila Yasmina Kebir

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ECONOMIC SYSTEMS OF KNOWLEDGE AND REGIONS: A TYPOLOGY BASED ON THE ANALYSIS OF PRODUCER-CONSUMER RELATIONS

Hugues Jeannerat

GRET-University of Neuchâtel
hugues.jeannerat@unine.ch

Leïla Kebir

UMR SADAPT INRA-AgroParisTech/FNS
leila.kebir@unine.ch

Abstract:

The attempt of the paper is to propose a coherent conceptual framework that enables to analyse today's knowledge dynamics in relation to regional development issues. Traditional approaches in territorial economy and economic geography have most often paid attention to production challenges and technological processes in order to analyse dynamics of innovation and knowledge creation. Recent critics have highlighted the importance of taking into consideration the consumer in knowledge creation (computer games issues for example). Our principal argument is that the role of consumers in territorial organisation of economic activities goes beyond specific activities such as video games or software production. The increasing importance of cultural industries, of cultural dimension of industrial products in value creation (not only design and marketing but aesthetics, image etc. which are integral part of the end product) give rise to very complex consumption systems (specialised media, event organisers, legitimizing third parties, experts, all sorts of labelling, associated services, etc.) that appear as structural hyphens between production systems and their consumers and, by this the knowledge resource. How do resource, production and consumption articulate, how do they articulate in space? What are the consequences for regional development?

Based on existing literature as well as on empirical observations made in the case studies undertaken within the FP6 European-funded project Eurodite, a comprehensive typology of four knowledge dynamics proposes to address issues related to organisation of knowledge creation and production-consumption systems.

Acknowledgement

We wish to thank the European Commission for the support it is giving to the 'EURODITE' project under its 6th Framework Program. This project enabled us to undertake the research presented here.

We also want to acknowledge all the EURODITE researchers who provided an important and high-quality empirical material from which we derived some illustrations in this paper. Any errors or incorrect interpretations of their work are, of course, ours. As their reports are part of the work presented here, we have decided to mention them separately at the end of the text.

Introduction

This paper intends to propose a coherent conceptual framework that enables the analysis of today's knowledge dynamics in relation to regional development issues. Whereas traditional approaches in regional studies and economic geography have mainly been paying attention to production challenges and technological processes in innovation and knowledge creation, particular work have highlighted the importance of taking into consideration the consumer in knowledge creation (Von Hippel 2006).

The principal argument presented here is that the place the 'consumption side' – the consumption system – in the territorial organisation should be more broadly taken into account in today's conceptual frameworks of economic geography or regional studies. The increasing importance of cultural industries, of cultural dimension of industrial products in value creation (not only design and marketing but also for example aesthetics and image which are integral part of the end product) give rise to highly complex consumption systems (e.g., specialised media, event organisers, legitimizing third parties, experts, all sorts of labelling and associated services) that mediate production-consumption processes and participate directly, or indirectly, in the creation of knowledge resources.

Based on the existing literature as well as on empirical observations made in the case studies undertaken within the FP6 European-funded project EURODITE, a comprehensive typology of four knowledge dynamics proposes to address issues related to the organisation of knowledge creation and production-consumption systems.

The first part presents conceptual framework mobilised to organise our analysis. The concept of *economic system of knowledge* is then proposed and defined. The second part develops a comprehensive typology based on four different knowledge processes: *knowledge viabilisation*, *knowledge improvement*, *knowledge adaptation* and *knowledge co-appropriation*.

1. General Background

1.1. Knowledge as a resource

In a knowledge-based economy, knowledge is considered the major resource in economic processes. On the one hand, knowledge can be considered as 'given' resource, that is, as a production factor (embrained in workers or embodied in technology) to be optimally allocated. That perspective is close to the neo-classical approaches of economics that consider knowledge as a 'finished' good. Its generation is dependent on exogenous technological progress that gives its users competitive productive advantages. The use of such a resource is limited by transaction costs that influence notably the way it is geographically allocated.

On the other hand, knowledge can be seen as 'constructed' resource, that is, as a *situated relation process* to be maintained and perpetuated (Crevoisier and Kebir, 2008) in time and space. Our contribution is built on that second perspective, as we are aiming to understand dynamics of knowledge creation that take place within different economic and socio-institutional contexts. Based on institutional economics approaches (Ayres, 1943, De Gregori, 1987, Hunker, 1964, Zimmermann, 1951) and on the seminal works of Raffestin (1980), Ollagnon, 1984, and De Mongolfier and Natali, 1987, this approach considers

resources as a process of relations between an *object*¹ (here knowledge: watchmaking know-how, carmaking know-how, traditions and historical knowledge, etc.) and a *production system* (watch industry, car industry, tourism, cultural industries, etc.). This relation starts – knowledge becomes a resource – when some actors identify a piece of knowledge as being useful to the production of a good or a service that can be valued in the market.

The knowledge realm encompasses all different kinds of knowledge (for instance, scientific, synthetic, symbolic, (Asheim, 2007), codified or not, embodied in books in artefacts, embrained in people, etc. Knowledge has its own life cycle marked by the creation process (learning) and the destruction process (forgetting). The logic prevailing here is the one of reproduction (maintaining over time, with or not qualitative enhancement/improvement) which is determined by the articulation of both processes of creation and destruction. As an *object* knowledge in itself has its own *raison d'être* beyond its economical use or resource status. It can also have other usages which are not economical such as being part of the identity and of the culture of a community (ex: language speaking, traditional know-how, popular singing, etc.).

The production system encompasses all the actors involved in the identification and the implementation of a resource in the perspective of the production of a good or a service (firms, research centres, public institutions, professional organisations, etc.) (Kebir, 2004). It also encompasses the relationships these actors developed both within and beyond the production system. The production system is the locus where the identification of resources and the implementation/production process occur. The identification process is fundamental and not obvious. First of all it is a collective process which can be long (think of the time needed for radical inventions or new ideas to be implemented) and harsh as it often implies taking distance and thinking over objects which can be connected with one self/regional identity or to a more or less happy collective past or history (see for example the resistance encountered by former actors trying to develop tourism from industrial or farming activities or trying to implement new technologies for example). Second identification is the driving force of innovation as it is the process by which objects, knowledge in particular here, are generated, used or recombined in different ways. The logic of the production system is to produce goods and services valued in a market. Competitiveness is of course a major purpose of market valuation within the production system. The rise of the financialisation of the economy, of alternative economic forms (social economy, fair trade) put into play in certain cases also criteria such as financial returns, fairness, etc.

As constructed resource, knowledge interrelates and co-evolves with the production system (Noorgard, 1994). The processes of learning/forgetting and of identification/production interplay: production can foster learning (learning by doing processes) or imply forgetting (the use of new machines can drive to forgetting old ways of doing).

The resource changes according to the evolution of the knowledge, the production system and their interrelations. It also evolves according to the context in which the resource develops: changes in the market, culture evolution, new trends, practices, socio-economic context etc. The resource is therefore not established once and for all. It is a constant recombination and readaptation; sometimes for the better (the relation strengthens) or the worse (the relation collapses) following different forms of dynamic: renewable growth, erosion/depletion, setting off and shortage (Crevoisier and Kebir, 2007).

¹ *Object* is not understood here as a 'thing' but rather as an entity (or system). The term presupposes that this entity (or system) has its own existence, independent from any economic use.

The knowledge-based resource construction has three fundamental dimensions:

1. a *technical* dimension: which relates to the way a resource becomes concrete (initial investments to create a route of industrial culture, brochures publication, guide training, historical research, setting off, etc.).
2. a *socio-institutional* dimension: that is the way actors organise and coordinate the process of resource creation (contracts, networks, hierarchy, conventions, codes, norms, certifications, legal context, etc.). In the case of knowledge issues related to the public/private character of knowledge (Antonelli, 2005) and the actor's strategies to cope with them (intellectual property rights, certifications, standards, etc.) are particularly structuring.
3. a *territorial* dimension: relates to the way a resource takes shape in space and time, that is the anchoring and mobility and simultaneity or successiveness of the processes. This dimension informs us of the contribution/constraints faced by region in which these processes are located as they may not all occur in the same place and at the same time (brain drain, migration, etc.).

Knowledge develops through actor's interaction and through processes of mobility and anchoring. These processes are situated; the socio-spatial configuration on which knowledge is generated (learning networks) and used is at the core of this paper. People, knowledge, competencies move and act together in more or less distant relation enhancing knowledge continuity or rupture and changes in its articulation to (regional) economic activities.

1.2. The need to understand complex market relations in territorial innovation models

Traditional approaches in regional studies and economic geography have most often paid attention to production challenges and technological processes in order to analyse the dynamics of innovation. Various conceptual models such as clusters (Porter, 1998), industrial district (Becattini, 1990), regional innovation systems (Braczyk et al., 1998) or innovative milieus (Aydalot 1986, Camagni et Maillat 2006) have established coherent frameworks to understand innovation processes and spatial shapes.

On the one hand, these approaches were able to explain how knowledge becomes a resource constructed within different time and spatial socio-economic contexts through the evolution of specific production systems. On the other, they showed how proximity enabled remarkable processes of creation/destruction of resources, in general, and of knowledge in a particular perspective. Later works on learning regions were especially illustrative of this idea (Lundvall, 1992, Florida, 1995, Morgan, 1997, Maillat and Kebir, 2001).

The central argument developed here is that those models have been able to explain particular learning processes within specific local production systems that are part of a global and quite 'undifferentiated' market. Those models participated in establishing the conceptual dichotomy between local and specialised production systems on the one hand and the global market on the other. Various critics and further conceptualisation have recently challenged that perspective.

Recent literature has pointed to the fact that the relations and the territorial configurations taking shape between a production system and its market – especially regarding the role of the end-consumer – have largely been 'neglected' in economic geography and regional studies (Grabher et al., 2008, Malmberg and Power, 2005). Conceptualising the role of the end-consumer in territorial economy and economic geography is challenging for two main reasons. The first is that important works have shown the increasing involvement of end-consumers in the *conceptualisation* of products and in innovation processes via new technological and organisational tools (von Hippel 2006). The second reason is that many

innovations today take place more frequently via socio-cultural dynamics than techno-scientific ones. Technological knowledge has thus simply become one of the types of knowledge that are combined within economic production. That debated shift to a culture-based economic geography (James et al., 2007) raises new research questions regarding the subjective involvement of the end-consumer in the process of value creation rather than in the process of conceptualisation.

Such issues are challenging traditional innovation models (Grabher et al., 2008, Malmberg and Power, 2005) as well as global production networks (Coe et al., 2008). If some traditional models have pointed out the role of the local 'sophisticated demand' as the innovation or learning factor (Porter, 1998), market relations are mostly distant, 'footloose' or 'aspatial' (Malmberg and Power, 2005). For Grabher et al. (2008), the analysis needs to go beyond the role of the specific 'smart neighbours', or proximate sophisticated customers, if we want to understand new spatialities in the global economy.

To understand the territorial forms taken today by knowledge dynamics requires that the analytical framework move beyond traditional industrial approaches, but also beyond the conception of user-driven innovation. As Malmberg and Power (2005, p. 281) explain: 'this does not imply that innovation always flows from a 'customer is always right' or 'customer participation' approach. Rather it implies that analytically in order to understand the initiation and life cycle of innovative actions we must first understand how the desire to innovate ultimately is most commonly related to understandings of the demand side. Current and perceived demand conditions most often drive firms to innovate in certain ways and pursue certain courses of action'.

In other words, we need to broaden, but not reject, traditional innovation models towards an understanding of multi-local and multi-scalar relations that take into account the diversity of production-consumption configuration.

1.3. Economic systems of knowledge and territorial knowledge dynamics

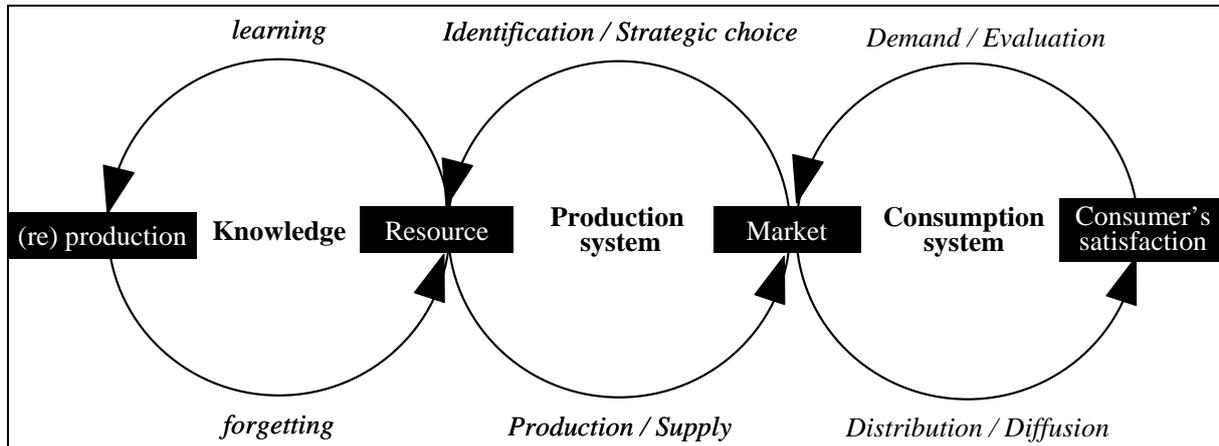
Integrating the end-consumer into the analysis of knowledge dynamics brings us to the debates on market creation. Market creation and the supply-demand relation have been addressed in different ways by literature. Again, we do not present here an exhaustive picture of that debate. However, it is worth mentioning an important conceptual distinction that has been discussed over the last decades. On the one hand, the neo-classical approach considers the market as an aggregation of exchanges between quantities of supply and of demand for various goods that converge naturally and mechanically toward a general equilibrium mediated by prices. On the other, various critics have been made towards that former conception of markets and have argued that market do not reveal a natural process of convergence towards and equilibrium but rather a constant process of differentiation between different actors that are embedded in particular networks (White 1981; 2002), coordinated around particular conventions (Favereau et al., 2002).

The general definition that we give of the market in this contribution is clearly in line with the second approach. For us, the market is *the interface where a resource mobilised through a production process, a supply, meets – or not – consumer's satisfaction expressed through a process of evaluation, a demand*. The construction of the market affects the identification process of a resource within the production system but also the way a product is delivered to the consumer. In other words, the market is a socio-institutional construct where the production system and the consumption system interplay. The economic system of knowledge as whole is organised in order to avoid 'unsatisfactory innovations' (Lundvall, 1988).

Similarly to the nature of the production system described above, the consumption system is the locus where the distribution/diffusion of a product and its evaluation occur. On the one

hand, 'delivering' a good or a service toward the end-consumer implies the establishment of adequate relays between the production system and the consumer's satisfaction. On the other, 'evaluation' is part of complex collective processes of quality certification, labelling, branding that implies technical and symbolic interpretations. The role of journalists and Medias is particularly illustrative of both processes: they provide relays between producers and end-consumers (diffusion channel) as well as provide an intermediate opinion that takes part to the evaluation process of a good or a service.

Figure 2: The economic system of knowledge



As for resources, the market can be described through three various dimensions. First, goods, services, brands, experiences, but also events, trainings, etc. are all *technical elements* that are at stake in the market. They orient the technical nature of the market and the kind of knowledge mobilised (high-tech market, arts market, service market, tourism market, etc.).

Second, the market is shaped by *socio-institutional* relations within both the production and the consumption systems. Within the production system, socio-institutional relations occur horizontally (between cooperating/competing firms) and vertically (between leading producers, subcontractors, product developers, etc.). In a similar way, within the consumption system, vertical (retailers, distributors, etc.) and horizontal relations (consumer communities, consumer's association/lobbies, etc.) take place. However, the analysis needs to get beyond an understanding of socio-institutional configurations and conventions (Eymard-Duvernay, 1989, Favereau et al., 2002) occurring within each system. It also needs to understand how they interact between each other and shape the creation process of knowledge. The relations within and between those two systems also structures the particular role of intermediaries (KIBS, Medias, Opinion Leaders, etc.) (Strambach 2008).

Third, those technical and socio-institutional relations occurring within and between the production and consumption systems take place in space and time, in various *territorial* configurations. If traditional TIMs have emphasised the role of the local dimension in particular learning processes, a broaden analysis should take into account complementary territorial relations within the consumption system such as specific retail territories (Coe and Wrigley, 2007, Wrigley and Lowe, 2007) as well as possible 'strategic coupling' (Yeung 2009) between both production and consumption systems (for instance, complementarities between urban and rural areas in the exploitation of tourism or agro-food market opportunities ; see for instance Zukin (2008).

The attempt of that paper is to propose a coherent conceptual framework that enables to analyse knowledge in various economic configurations.

2. Economic systems of knowledge: Toward a comprehensive typology

This section offers a comprehensive typology of *economic systems of knowledge* that seeks to present four configurations where knowledge use and generation are at stake. The typology proposes a particular lens for understanding challenges that firms, policy makers and regions face when economic changes involve the generation, use and combination of knowledge. It is based on an existing literature and on some empirical material produced within the EURODITE project².

This project was composed of twenty-eight partners across thirteen different countries and was founded by the European Commission under its 6th RTD Framework program for the period of 2005-2010. Several case studies were undertaken by 23 research teams in Europe between 2008 and 2009.

Those case studies explored *territorial knowledge dynamics* (TKDs) and *firm knowledge dynamics* (FKDs) by analysing *particular and significant knowledge change processes* for a region and a firm. This approach did not restrict the study of knowledge dynamics to bounded regions or firms. It rather addressed the role of proximate/distant relations in important learning processes and the regional capacity of 'knowledge anchoring' in the increased knowledge circulation (Crevoisier and Jeannerat, 2009).

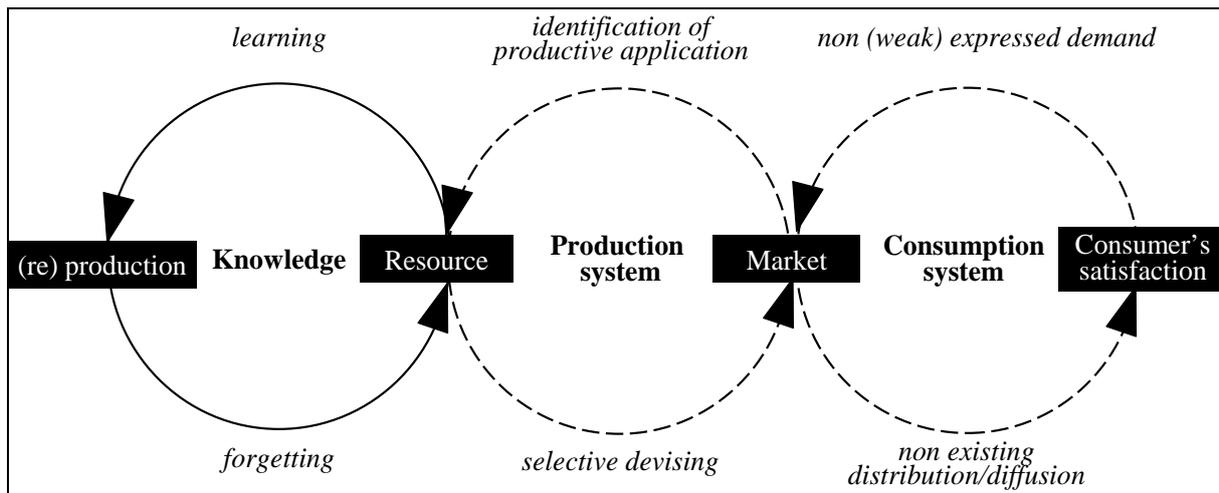
2.1. Knowledge viabilisation

Amendola and Gaffard (1994) distinguish two kinds of resource specification. The first takes place in an existing production system and involves specialised resource creation within a stabilised production process – this is close to what we call further 'knowledge improvement'. The second relates to the capacity to devise a particular product out of various potential 'productive options'; here, learning does not take place in a stabilised production system but rather involves the creation of a new production system. This type of learning can be defined as the ability to 'render viable' the process of radically new creation of knowledge resource (Amendola and Gaffard, 1994). We propose to use the original French word 'viabilisation' to characterise this specific process of making knowledge viable.

Knowledge 'viabilisation' involves the identification of new productive application within the production system, which leads to a *selective devising* of different potential knowledge use and to the shaping of a new supply. The emergence of a new technological paradigm can be seen as a 'viabilisation' process during which a production system determines 'the universe of possible modalities through which generic needs or productive requirement (which as such do not have any direct economic significance) are satisfied' (Dosi, 1982). This may also lead to a radical innovation when stabilised in the market (Nelson and Winter, 1982). However, knowledge viabilisation is considered here more broadly, as it encompasses all cases where an economic exploitation of knowledge involves the construction of production-consumption systems. Although the cases presented here are mostly science-based, this framework goes beyond traditional science-push knowledge dynamics (e.g. economic exploitation of an artistic creation). The emerging economic system of knowledge described here faces particular uncertainties that influence the way actor relations and institutions are shaped.

² <http://www.eurodite.bham.ac.uk>

Figure 4: Economic system of knowledge viabilisation



On the one hand, although a demand may potentially exist, it is not directly expressed; also, no distribution channels and no consumer-oriented services related to the potential new product are established. For instance, the development of new Global Navigation Satellite Systems (GNSS) (Balland and Vicente, 2009) faces a great uncertainty regarding its adoption in the market. Positive-feedbacks (Arthur, 1990) within the production system (e.g. adoption by related services and applications, compatibility with existing product) as well as within the consumer system (e.g. consumers buy a same technology in order to be able to exchange information) participate to the institutionalisation of new conventions and standards and to the success of the new technology (Foray, 1989). Specific intermediaries participate to this adoption (e.g. the research structure).

Uncertainty becomes even greater when there is a lack of public acceptance towards a technological change (negative-feedbacks), as it is the case regarding genetic modification (GM) of plants for food industry in Europe. Regulatory frameworks (e.g. a moratorium), public appreciations of new technology or unfavourable press coverage create poor conditions for commercial exploitation of GM food production. Such uncertainty 'discourages investments in GM and fosters seed breeding (and related) practices that do not rely on GM' (Vissers and Dankbaar, 2009: p. 5). Although GM appears to various firms in the production system as a future strategic knowledge resource, there is a lot of uncertainty regarding the emergence of the consumption system.

On the other hand, there is an 'essential temporal lag' between the creation of the new knowledge and its exploitation in the market. This knowledge creation process involves important sunk costs. Beyond uncertainty related to market failures, this affects the organisational design within the economic system of knowledge. Various kinds of cooperation between research institutes, firms, public and private investors, etc. establish over time in order to 'make the change process viable' (Amendola and Gaffard, 1994). Different actors and forms of coordination can be observed in that process.

First, *scientific communities* play an important role in the upstream knowledge creation process. Such communities are often led by universities that participate to research programs and networks. Some *pioneer entrepreneurs* participate to the emergence of the production system. Such entrepreneurs are aware of and understand the upstream creation process and are able to build a productive application toward a new market (technological transfer) (Colobrans 2009: 'university third mission'). Very often they are scientific entrepreneurs developing a particular economic supply from previous researches. Such actors often coordinate around the research centre (university or others) where they originate from (Vale et al. 2009). As their investment capacity is low they tend to group each other in order to share costs related to further researches, logistics, etc. In such a cases, the viabilisation process is often dependent of public policies that participate to knowledge

generation (educational and research structures) but also facilitate knowledge transfers from university, cooperation between start-ups or university spin-offs (e.g. through science parks, incubators, etc.) as well as to emergence of entrepreneurship (e.g. entrepreneurship awards and grants, provision of venture capital, etc.). Public and private venture capital is particularly important in such a context (Vale et al. 2009; Kaiser et al. 2009).

Second, the viabilisation process often involves the creation of a *consortium* bringing public/private research structures and firms together within a common learning process. On the one hand, such an institutionalised organisation enables to share sunk costs as well as combine fruitfully complementary knowledge. On the other it also makes cooperation possible between competitors. For instance, in the Wageningen region, while bilateral collaboration between two competing seed-breeding companies is hardly conceivable, in a consortium involving multilateral partnership collaboration becomes possible (Vissers and Dankbaar 2009). Also, public structures seem to mediate cooperation between large competitors (in technological standardisation processes for example).

Third, *firms already established in a mature market* participate in the viabilisation process. They provide a greater capacity to bear sunk costs and an opportunity to avoid the establishment of a radically new production system. As explained in the next part dedicated to knowledge improvement, such firms seek to improve their knowledge in order to maintain their market positioning and become strategic stakeholder in parallel explorative fields of knowledge (through shareholding, vertical absorption, etc.). In such a case, the knowledge viabilisation process might progressively shift to a process of knowledge improvement within stabilised production-consumption systems. For instance, large pharmaceutical or agro-chemistry companies often exploit fundamental biotech knowledge created in the Bavaria and Wageningen regions (Kaiser et al. 2009; Vissers and Dankbaar 2009).

Finally, institutions related to intellectual property right and especially licensing are crucial in the viabilisation process. Such institutions do not participate here to the protection of a market position but provide economic opportunities before the establishment of production-consumption systems. 'In-licensing' – that is, the process of buy and work with existing licences rather than developing a complete in-house R&D – makes it possible for small firms to avoid expensive in-house researches and to make profit quicker by selling an improved licence (Kaiser et al. 2009). That economic valorisation directly based on the knowledge creation process also makes emerging firms more profit-making and favours their absorption by larger companies (Vissers and Dankbaar 2009).

Such socio-institutional relations have various territorial implications. On the one hand, knowledge viabilisation involves actors and institutions that enable mobility and anchoring of knowledge (Crevoisier and Jeannerat 2009) within a quite globally dispersed scientific community. While national or European programs for research and circulation of researchers enable knowledge mobility, universities can play a great role in local anchoring of knowledge (Carrincazeaux et al. 2009; Colobrans 2009). Such an anchoring process is also related to a local knowledge viabilisation that involves local pioneer entrepreneurs, investors, larger firms and policy.

In early phases of knowledge viabilisation, local and national policies – partially European policies – are determinant because they enable the emergence of a new local production system (through non-economic interest spending, research and education funding, organisational support, entrepreneurship support, etc.).

While proximity seems to play an important role in 'nesting' (Balland and Vicente 2009) early starting up of the production system and while distance increases with establishment of market relation, proximity also seems to facilitate downstream applications of new techno-scientific development. Proximity may favour a specific context also relatable to the consumption system. Proximity to a particular demand can provide awareness of concrete market applications.

2.2. Knowledge improvement

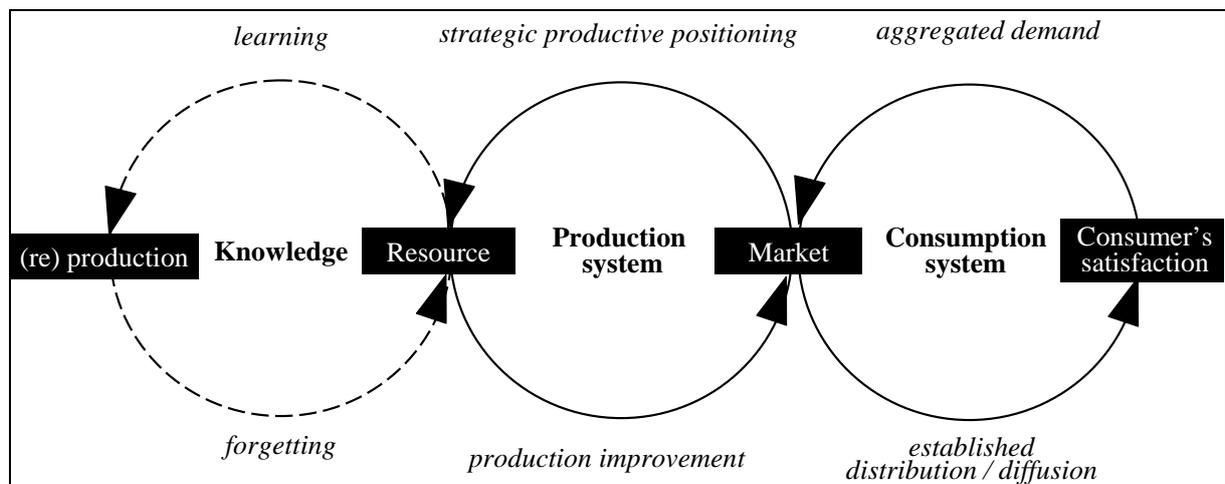
In many cases, innovations takes place within an existing market. This means that production and consumption systems are already established. Uncertainties and learning processes are of different kind to those related to knowledge viabilisation. Also, actor relations and institutional frames face different issues within the economic system of knowledge.

Actor relations occurring in the economic system of knowledge described here are very close to those analysed by White in production markets (White, 2002, White, 1981). *Production firms* face radical uncertainty regarding upstream supplying in the production system and downstream outlet in the consumption system. In order to reduce that uncertainty, they pay attention and interpret market signals given by upstream suppliers (upstream existing knowledge) from downstream buyers but also from structurally equivalent competitors. Embedding relations between those different actors shape networks and build an emerging 'quality order' that is reinforced by mutual commitments (Grossetti and Godart, 2007, White, 2000).

In a mature production market, upstream and downstream relations are quite stable (established distribution channels, identified demand trends, etc.) and structural equivalence between competitors is strong (e.g. similar technological basis). Institutions consolidate that stability (technological standards, quality conventions, market regulations, consumer organisation, etc.). In that situation, production firms become less dependant of a single pool of supplier (different suppliers can provide a same standardised element) and of differentiated end-consumers. A relational 'decoupling' occurs vertically between productions firms, *specialised pools of suppliers* and an *aggregated demand* (White and Godart, 2007). Uncertainty is thus reduced by reciprocal watching and *strategic productive positioning* between producers regarding price and quality of their product.

Innovation and learning processes are affected by such socio-institutional configurations. Construction of new knowledge resources relates to the need for a production firm to maintain, reinforce or change its position in relation to its market competitors. As resource specification takes place, we speak here of *knowledge improvement*. Despite possible punctual additions of radically new technology to the end-product, such improvement is strongly oriented by technological trajectories (Nelson and Winter, 1982, Nelson and Winter, 2002, Dosi, 1982) and reinforced by socio-institutional path-dependences in market (standards, regulations, etc.).

Figure 5: Economic system of knowledge improvement



The fundamental features of the economic system of knowledge can be considered as relatively stable. Automotive industry is certainly one of the most illustrative cases of knowledge improvement. For instance, the production system has progressively organised around major original equipment manufacturers (OEMs) and have established various technological standards diffused worldwide (airbag, fuel injection system, anti-lock braking system, electronic stability system, etc.). Also, the consumption system is well consolidated through efficient distribution channels, media coverage, driving regulations, consumers associations, etc. Although the demand is expressed in a rather aggregated way (expressed via media, organised consumer lobbying, etc.), this does not mean that it has no influence on innovation and learning processes. Most often, end-production firms are not involved in a personalised way with end-consumer but seek – often through specialised KIBS – to catch up with general emerging consumption trends (a growing sensitiveness to green technology, to safety, etc.) or with specific market segments (geographically-based, gender-based, age-based, class-based, etc.)(Strambach et al. 2009; Jürgens and Blöcker 2009). Here, knowledge processes relate to catching knowledge *about* the end-consumer rather than exploiting consumer's knowledge (as in the case of knowledge co-appropriation described further).

Furthermore, knowledge dynamics in the automotive mirrors strategic positioning between car manufacturers. For instance, the fact that Volkswagen was being challenged by direct competitors in electronics and software development drove the firm to adopt a strong strategy in electronic R&D (Jürgens and Blöcker 2009). Also, the strategic positioning of Volvo regarding safety has led the company to develop new crash-safety technologies (Larsson 2009).

As leading production firms in mature markets have an important investment capacity in private R&D and are relatively safe contractors, upstream actors within the production system (universities, suppliers, KIBS, etc.) have developed a specialised and dedicated knowledge profile related to knowledge improvement within the established system. This is reflecting the important cumulative knowledge dynamics occurring in such a system (Strambach et al. 2009). Furthermore, production firms also participate through external actors to knowledge creation at an early stage (front-loading) in order to secure concepts as comprehensive as possible (Jürgens and Blöcker 2009, p.32). Also, public policies provide specialised support. Even though policy may promote access to knowledge (complementary knowledge), they are mostly oriented by sectoral trajectory (Strambach et al. 2009).

Socio-institutional coordination is mostly led by large companies that seek to protect or reinforce their market share. Here, role of institutions such as IPR (patents, trade secrets, customer data, etc.) and standards do not relate to knowledge viabilisation (see previous section) but to knowledge appropriation, to hierarchical relations with suppliers and customers as well as to strategic positioning in relation to competitors. Also other global mature economic activities such as pharmaceuticals, agrochemicals (Vissers and Dankbaar 2009) or phone industry present important features of the ideal-type presented here (Chanaron and Scaringella 2009). When coordination becomes too much oriented about IPR and standards learning processes may weaken as competitiveness is related to preservation of hierarchy rather than to innovation (Jürgens and Blöcker 2009).

Knowledge improvement in mature activities is characterised by particular territorial dynamics. As large leading production firms (most often multi-national firms) are major actors, firm networks are determinant. They shape *global production networks* where different actors are 'anchored in different places and multiple scales' (Hess and Yeung, 2006) according to strategic productive and knowledge improvement needs.

Learning taking place within the *home region* (region where a production firm originally developed) is very much dependent of the evolution of the leading production firm and thus by the evolution of the sector it is involved in. Public actions (research, policy initiatives, etc.) which were also traditionally fostering local knowledge dynamics, tend to support access to

knowledge at the supra-regional level now (e.g. national or European cooperation and research programs).

At a supra-national scale (European and international), standards are negotiated between actors within the production system in order to facilitate mobility of knowledge and multi-local relations. For instance, automotive manufacturers, suppliers and tool developers negotiate open and standardised automotive software architecture via a common network called AUTOSAR. Such standardisation facilitated out-sourcing and pushes new multi-local relations (e.g. between the home region of automotive and eastern Europe and Indian regions) (Jürgens and Blöcker 2009).

Knowledge dynamics occur essentially within the production system that develops efficient channels and codes of information towards the end-consumer. When such codes are stable and standardised, distance between producer and consumer can be greater (Lundvall 1988). Distribution channels are conceived in order to reach physically and culturally the end-consumer. The local or national consumption context is related to local distribution of a standardised good or service. Local actors are intermediaries that are in charge of relaying communication from the production firms and to provide after sale services. Territorial configurations related to the consumption system are mostly shaped by national and international regulations about the use of the final product (eco-regulations, safety regulation, etc.). European or global standardised quality testing (e.g. safety testing)(Larsson 2009) and global communication strategies favours a *global aggregation of the demand* that is globally expressed and globally interpreted by the production system.

2.3. Knowledge adaptation

Knowledge adaptation corresponds to cases where the production system adapts its use of knowledge in order to react to an external change or exploit new market opportunities. This involves a new combination of resources and activities. In some situations the changes occurring are real 'external shocks' (quick changing demand, new regulations, financial crisis, etc.) and may affect strongly the production system leading to a *strategic transition* and, in some cases to a *resilience of the production system* (Pendall, 2009; Simmie and Martin forthcoming 2010).

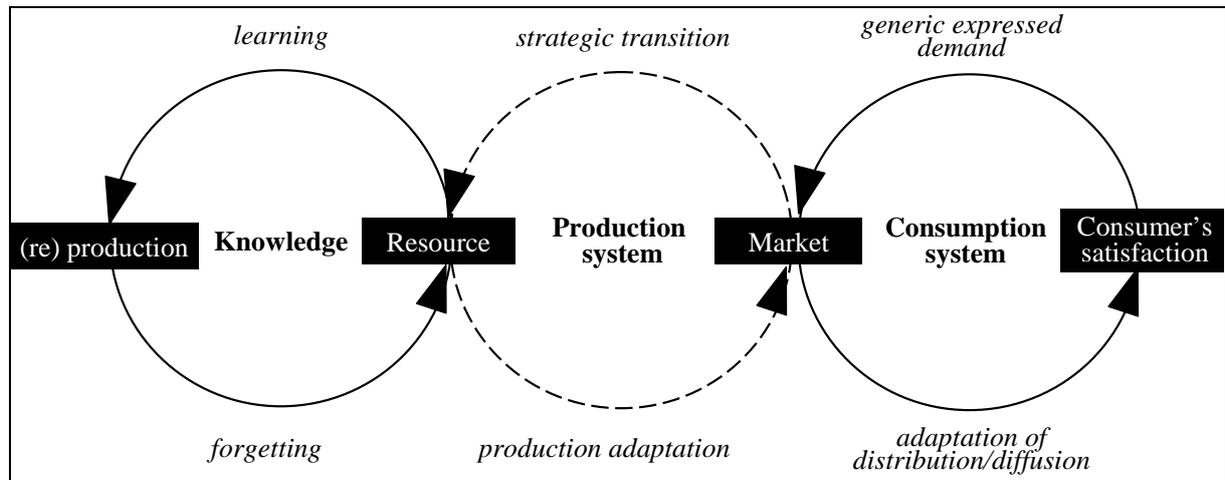
In other cases, the emergence of a new 'megatrend' (Harmaakorpi, 2006) shaping a new demand (e.g. demand for safe healthy and diet-friendly food) may provide opportunities of new cross-sectoral combination (e.g. strategic combination of the agro-food and biochemical industries). In both cases knowledge adaptation is about 'answering' a new demand which is neither addressed to a specific place nor to a specific industry. It can be considered as a *generic demand*.

As innovation is led by the identification of new market opportunities some similarities can be found with theories on demand pulled innovations. For that reason, we speak of a transition rather than of the creation of a new production system. However, the demand change does not directly determine the knowledge creation process. It rather influences the way existing knowledge becomes a resource. In other words, the process is not only oriented by the demand but also by already existing knowledge and resources (e.g. cross-sectoral combination). This means that knowledge adaptation is strongly oriented by path dependence (e.g. a farmer who wants to exploit new tourism opportunities will be more inclined to develop agro-tourism rather than a five stars hotel).

Knowledge adaptation as mentioned before should not be understood as a 'crisis' case. It relates more generally to a business and productive re-organisation related to new market opportunities market restriction. A crisis might appear when a production system fails to manage the transition by making a new use of existing knowledge resources. In other words,

crisis happens when the production system is not able to maintain/establish continuity between knowledge resources and the consumer system.

Figure 5: Economic system of knowledge adaptation



The process of knowledge adaptation described here differs from knowledge viabilisation because adaptive learning occurs according to a 'reactive adjustments to changes in the external environment' in the context of 'prevailing theories in use'. This means that general mental model of innovation in the economic system of knowledge does not change radically (Baker and Sinkula, 2002). It also differs from knowledge improvement because adaptation involves new market relations. Even if the consumption system may express a new demand (e.g. new consumption, lifestyle, socio-demographic trends, etc.) and provide new market opportunities, it is aggregated toward a specific kind of supply (e.g. as in the case of the automotive consumption system).

Uncertainty related to consumer's satisfaction is strong because concrete interdependences between production and consumption systems are not pre-existing and stabilised. Socio-institutional relations mirror that uncertainty. Adoption of established standards or best practices reduces uncertainty related to consumer's satisfaction. For instance in tourism, well-established business models are often used such as organisation of standardised event (meetings, incentives, conferences and exhibitions)(Halkier and Schmidt 2009), festivals (e.g. Love Parade)(Butzin and Widmaier 2009) or major standardised motifs (e.g. football route, sports training tourism)(Butzin and Widmaier 2009; Dulupçu et al. 2009). Knowledge related to does standards is accessed through international companies (e.g. hotel chains, large tour operators, large consulting companies, etc.) or KIBS. Also, such access can be supported by public programs for exchange of best practice.

Also, coordination of actors is important in recombination of activities and knowledge resources. Contrary to knowledge improvement where combinations of resources occur in an existing market, knowledge combination targets here a new market and economic uncertainty is greater. This means that production firms may not take on a leading position in the process. For that reason, public policies and research structures remain important incentives or supports for pre-competitive knowledge combinations (e.g. 'Prod Innov' cluster policy supporting cooperation between agro-industries and pharmacy health industries in Aquitaine)(Carrincazeaux and Gaschet 2009).

Finally, coordination issues are important regarding the development of a specific supply to the generic demand. For instance, Russian tourists can move from a destination to another, if a tourism production system fails to develop specific services (Russian speaking workers, transportation facilities, specific meals, etc.) (Dulupçu et al. 2009) they might leave to places more reactive. In such as visa regimes and working conditions for worker having demand-related knowledge about the demand can be determinant (e.g. Russian speaking workers).

Education structures may also facilitate the specific exploitation of knowledge toward a particular demand.

In the knowledge adaptation process, it is pre-eminently the production system that is at stake. Adapting its resources to produce goods or services required by the new demand trends, it needs to differentiate from other competitors in order to stay/reach the market. This differentiation can be made out of the valorisation of specific knowledge (specific to the region) or out of generic knowledge. In the former case, the production system builds its competitiveness on regional features and anchors in the territory. In the latter case, the advantage is more fragile as it relies to common undifferentiated knowledge (case of cost differentiation).

At a territorial level, such socio-institutional relations can take different shapes. Standards and best practices related to knowledge resources as well as emerging consumption trends occur at a global scale.

At a regional scale, the production system seeks to adapt in order to exploit new market opportunities. This is achieved of the valorisation of specific knowledge (specific to the region) or out of generic knowledge. In the former case, the production system builds its competitiveness on regional features and anchors in the territory. In the latter case, the advantage is more fragile as it relies to common undifferentiated knowledge (case of cost differentiation). Regional specification in knowledge adaptation can take three main forms.

The first one is the local specification of generic standard through a combination of existing productive resources. It is for instance the case of traditional industrial or agricultural areas that adopt existing business models of tourism and combine it with traditional knowledge (e.g. agro-tourism or industrial culture tourism)(Vaessen and Dankbaar 2009; Butzin and Widmaier 2009). Knowledge adaptation drives the regions to anchor external knowledge in the production system without paying a particular attention to the demand because adoption of standards and already established best practices is expected to reduce uncertainty related to consumer's satisfaction.

The second form of regional specification relates to particular knowledge adaptation related to a targeted demand. In such case, the potential demand is identified and specification results from an adapted supply to particular needs. The regional production system anchor external knowledge and combine it with a co-located demand (e.g. Russian tourists in Antalya or the new Slovenian sophisticated demand for ICT).

Finally, the third form of specification relates to a particular combination of existing activities regionally in order to exploit new emerging market trends. This case is a typical case of 'platform' (Asheim et al., 2007, Harmaakorpi, 2006). Access to external knowledge is not the key driver of specification. It is rather the identification of a new demand and of regional existing resources that shape the knowledge adaptation process. Figure 6 provide a particular picture of such a process.

3.4 Knowledge co-appropriation

In the case presented up to now, consumer's knowledge may be important for market entry (e.g. consumer's knowledge about how to drive a car) but it is not at the centre of the whole economic business model. Knowledge co-appropriation processes occur when a strong mutual learning is at stake between the production and the consumption systems.

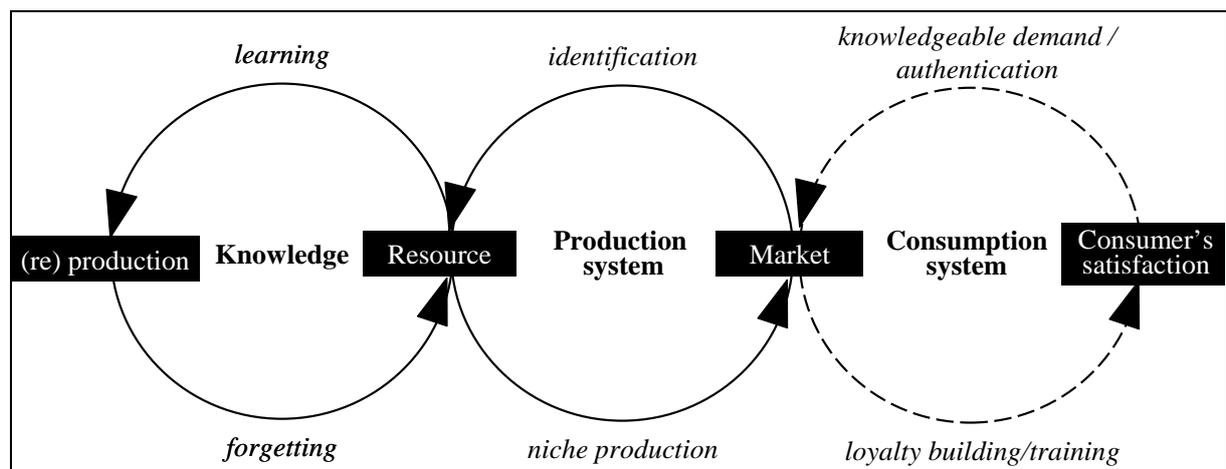
Whereas knowledge about the consumer participates to the identification of resources in the first three cases, knowledge *of* the consumer becomes here a resource for the production system. Knowledge dynamics are not only related to the production of a supply but also related to a knowledge valuation process in the consumption system. In other words, the value of a product depends of the consumer's knowledge and of the producer's ability to make use of that knowledge. The importance of knowledge co-appropriation between

producers and lead-users in today innovation have already been emphasised at a technical level (von Hippel, 1986).

In a knowledge co-appropriation process, socio-institutional relations differ significantly from a knowledge improvement process. In such situation, a firm seeks to escape relational interdependence with competitors by establishing a more particular and direct relation with the end-consumer. This means that the demand is less aggregated and more personalised. Coordination between actors is based on interrelations that occur across the production-consumption systems. Producer firms may provide a 'tool kit' that has to be personalised by end-consumers – as in the case of an open-source software – rather than a finished product (von Hippel, 2005). However, knowledge co-appropriation does not strictly refer to situations where the end-consumer makes a sophisticated use of a product or participates technically to its improvement. It occurs in a general process of economic valorisation that can be technical as well as socio-cultural.

We would like to stress here the *socio-cultural aspect of knowledge co-appropriation*, as this has been less studied by literature. For instance, in-depth consumer's knowledge about famous detective literature can become a resource for the production system through the development of a related tourism supply (Dahlström et al. 2009). Or, co-appropriation of knowledge may also be central in the authentication process of high-end product (Gilmore and Pine, 2007). For instance, end-consumers of fine watches are considered as 'connoisseurs' that are competent to value adequately the technical (mechanical complications) and cultural (historical know-how) components of a watch (Jeannerat et al. 2009).

Figure 5: Economic system of knowledge adaptation



In the case of knowledge co-appropriation, uncertainty relates strongly to maintaining consumer's loyalty between the production and the consumption systems. On the one hand, production firms seek to reinforce knowledge co-appropriation through specialised trainings (e.g. training to watchmaking) or through experiences (visit of firms, organisation of exclusive events) (Jeannerat et al. 2009). On the other, they innovate according to consumer's knowledge. For instance, the Morgan Motors company develops new cars but maintains certain authentic features such as flowing wings, flat windscreen and ash frame because those elements strongly relate to consumer's knowledge about the history of the company (MacNeill et al. 2009).

Particular *producer-consumer communities* develop and evolve around shared knowledge. Such communities can be established by the producers (e.g. car brands like Morgan Motors or Aston Martin have created exclusive 'clubs' for their customers) or by the consumers (e.g. specialised consumers create communities to exchange knowledge about fine watches) (Jeannerat et al. 2009; MacNeill et al. 2009). Different producers sharing same knowledge relations with the consumption system may also be partner within the community

(e.g. luxury watches often have partnerships with luxury cars because their value is related to the same knowledge co-appropriation with the consumer).

New Media play an important role within such communities by providing training opportunities to end-consumers and by facilitating more direct contacts between the producer and the consumer. Also, important intermediary actors are involved in such communities. On the one hand, they facilitate knowledge co-appropriation by the end-consumer (e.g. ambassadors, training entities, specialised retailers, event organisers etc.) (Manniche et al. 2009; MacNeill et al. 2009; Jeannerat et al. 2009). On the other, they provide through their own co-appropriation of knowledge an additional voice to the valuation process. For instance, specialised journalists, ambassadors, award organisers or retailers are 'legitimising third parties' (Jeannerat and Crevoisier 2009) who reinforce trust and loyalty between producers and end-consumers. Public bodies may also reinforce loyalty by providing a formal independent voice in the valuation process (e.g. public patronage of awards, public labelling, etc.).

Such relations have important territorial implications. Although in particular cases such as open-source software virtual communities develop almost globally, proximity, proximity between producer and consumer facilitates knowledge co-appropriation. Consumer's learning is often supported by different experiences staging the producer's environment (Pine and Gilmore, 1999).

In some cases, the production region can be the place where knowledge co-appropriation takes place. For instance, regional food and drink product are often valorised by tourism activities that facilitate proximity between producer and consumer in the region of production. Or, visits of original factories provide learning condition for the consumer (e.g. Swiss watchmaking manufactures or Morgan Motors factory) (Jeannerat et al. 2009; MacNeill et al. 2009). Particular co-localised relations can also be organised out of the region (e.g. fairs, awards, etc.).

When knowledge co-appropriation is not possible through co-localised relations between the producer and the consumer, specific training and diffusion channels are developed in order to provide an adequate learning context in the territorial consumption context. Mobility of knowledge is more often enabled by mobility of key actors than by standards. Those actors are responsible for providing adequate distant learning conditions.

The territorial organisation of knowledge co-appropriation is based in many cases (watch industry, etc.) on the mobilisation of specific resources which are embedded in the home region of the production system. These resources are combined with external resources in a multilocal specifying knowledge system. The consumption system (multi) locates close to the production system as well as close to the consumer; it acts as a sophisticated hyphen. The knowledge exchanges inside the system is about specific products, produced in specific areas, dedicated to specific consumers, the whole dynamic of the system is to preserve and develop this specificity which gives value to the product (economic and social value). The relation to the territory is defined by this specificity; the issue being connecting these specific features across space. We certainly face here forms of territorial organisation of economic activities that former models, based on the analysis of the supply side, capture with difficulty. Much work needs to be done to fully understand these multi-local forms and territorial relations across space.

3. Conclusion

The types of knowledge economic system presented here show how the consumption system intervenes in production organisation and on knowledge creation. The last two cases are particularly interesting in that respect. In knowledge adaptation, the demand constitutes an opportunity or a constraint to seize and/or deal with. In knowledge co-appropriation, there is a strong interdependence between production, consumption and knowledge (resource) creation.

As a production system mobilises and combines knowledge and know-how, it can face several forms of knowledge dynamics at the same time. In terms of regional policy, issues can mix and combine. Public actors, local institutions, and production actors, need to deal with questions such as how to capitalize on scientific or technological advance? How to prevent or correct market failures? How to make a particular knowledge change viable? How to anchor knowledge in an existing market context? How to make local competitors collaborate? But also how to identify new market trends and catch up new business opportunities? And less classical, how to reinforce loyalty, trust, legitimacy and experience development with particular and knowledgeable end-consumers?

The interpretation and importance given here to time, relations and institutions is in line with evolutionary economics literature that is able to explain the development and the creation of technological paradigms and trajectories (Nelson and Winter, 1982, Nelson and Winter, 2002, Bottazzi et al., 2007, Dosi, 1982). However, this paper sought to go beyond the traditional debate of science pushed and demand pulled innovation or of incremental and radical innovation. It offers to analyse knowledge production/reproduction as a complex non-linear process that takes place within and across complex production-consumption systems.

The four stylised economic systems of knowledge present different configurations where knowledge creation, production systems and consumption systems interplay and affect territorial knowledge dynamics. Those systems are *dynamic* in the sense that they evolve in time according to competitive and innovative challenges that involve new learning processes. Such evolution may also involve a shift from an economic system of knowledge to another. For instance, knowledge viabilisation may generate a new technological trajectory and a new mature market that would bring the economic system of knowledge to knowledge improvement. The decrease of a mature market where knowledge improvement has failed to maintain competitiveness may lead to a system of knowledge adaptation (e.g. transition from industrial knowledge resources to tourism knowledge resources) or to a system of knowledge co-appropriation (e.g. shift from industrial car production to niche vehicles where end-consumer's knowledge is critical in the valuation process).

We also showed that those economic systems are not only dynamic internally. They are interdependent. For instance, we highlighted the fact that large companies established in mature markets and involved in knowledge improvement may also participate technically and financially to knowledge viabilisation because they have a long term investment capacity. Large established multi-national can also provide access to knowledge standards to context of knowledge adaptation (e.g. large consulting firms providing new knowledge in the Bratislava region).

The argument stressed in this contribution is that knowledge viabilisation, improvement, adaptation or co-appropriation present different socio-institutional features. Those four types of knowledge processes propose an alternative to the traditional analyses based sectors. They also show that there is no single policy 'best practice' but rather 'tailor-made policies' (Asheim et al. 2007) within different economic systems of knowledge.

Finally, we also highlighted the different territorial configurations that those four types of knowledge processes may involve. While, for instance, regional proximity and multi-local knowledge pipelines may be pertinent organisations in knowledge viabilisation, global

production networks are stabilised important mediators of knowledge improvement. Also, while the capacity of a regional production system to absorb, of specify and be resilient in a changing environment are crucial for knowledge adaptation, organising co-location, even temporary, of producer, legitimising third parties and consumers often appear to be of crucial interest to facilitate loyalty and knowledge co-appropriation.

Keeping competitiveness based on knowledge seems today rather complex because production systems are more and more integrated and combined with complex consumption systems which promote and sell specificity. The need for economic geography and regional studies to explore and conceptualise the way consumption systems are created and organised with the production and knowledge creation has become central to understand today's specific driving forces to the regional systems, to resources creation and to sustainability.

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