WORKING PAPER 4 - 2013/E

MAPS MAISON D'ANALYSE DES PROCESSUS SOCIAUX

MOBILITY OF KNOWLEDGE

THE PHOTOVOLTAIC INDUSTRY IN WESTERN SWITZERLAND : THE EMERGENCE OF A MULTI-LOCAL VALUATION MILIEU

Christian Livi, Hugues Jeannerat and Olivier Crevoisier

unine
UNIVERSITÉ DE NEUCHÂTEL

Authors
Christian Livi, Hugues Jeannerat and Olivier Crevoisier

Christian Livi is a PhD Student at the University of Neuchâtel, in the Research Group on Territorial Economy (GRET). His main research interests are on innovation, market construction and value creation considering territorial and social contexts. Actually, his main investigations fields relate to Cleantech and Medtech activities in Western Switzerland.
Christian.livi@unine.ch

Hugues Jeannerat is a postdoctoral research fellow at the University of Neuchâtel, in the Research Group on Territorial Economy (GRET). Among his main research interests are economic geography and economic sociology of knowledge, innovation and market construction. His main investigation fields relate to the watchmaking industry, to Medias, and to tourism.
Hugues.jeannerat@unine.ch

Olivier Crevoisier is professor in territorial economy at the institute of sociology, University of Neuchâtel. His main research interests are on the one hand the causes and consequences of the financialisation on the economy and society of regions and nations, and on the other hand the innovation and knowledge economy considering their territorial and social contexts.
Olivier.crevoisier@unine.ch

ISSN : 1662-744X

MAPS MAISON D'ANALYSE DES PROCESSUS SOCIAUX

Contact:
MAPS - Maison d'analyse des processus sociaux
Faubourg de l'Hôpital 27
CH - 2000 Neuchâtel
Tél. +41 32 718 39 34
www2.unine.ch/maps
maps.info@unine.ch

ABSTRACT

Various territorial innovation models have been developed since the 1980s, offering a new perspective on how certain regional production systems have grown out of the innovation and training processes specific to certain local milieus. These models reflect a process of economic globalisation characterised by the increased mobility of goods and services but limited by those production factors which underpin innovation such as knowledge and innovation capital. This article reconsiders this approach, taking into account the new equally increased mobility of those cognitive and financial resources. It also seeks to understand how innovation embeds in a broader valuation system. Taking as its case study western Switzerland's photovoltaic industry, the concept of the 'innovative milieu' is re-examined in the context of ever-increasing economic, political and social interest in sustainable development. Finally, in this revisited approach to territorial innovations, the use of the term 'multi-local valuation milieu' is proposed.

KEYWORDS

Territorial innovation models, Innovative milieu, Photovoltaic industry, Regional economy, Valuation, Multi-local valuation milieu.

INTRODUCTION

The issue of the concentration and the location of economic activities has been the subject of numerous regional studies. Various territorial innovation models (TIMs) (Moulaert & Sekia 2003; Lagendijk 2006) show how certain socio-economic processes shape particular spaces and how they are, in turn, shaped by them. These models principally reflect a process of economic globalisation characterised by the increased mobility of goods and services but limited by those production factors which underpin innovation such as knowledge and innovation capital. Of these various models, the concept of innovative milieu provides an explanation as to how certain local players end up developing informal production and innovation networks, independently of an increasingly integrated global economy (Camagni & Maillat 2006). To what extent should this approach be updated to take into account current thinking and include new territorial, economic and social dynamics?

In this article, we propose that, although it still allows us to understand certain important local innovation processes, the definition of the 'innovative milieu' should be opened up to renewed questioning. On the one hand, we support the idea that we need to take into account the increasing mobility of knowledge (Crevoisier & Jeannerat 2009) and capital (Theurillat 2011) when evaluating current territorial development and innovation. On the other hand, we wish to demonstrate that TIMs have not, generally speaking, satisfactorily covered the way in which the economic value of innovation is socially and territorially constructed; this applies both to the way that it mobilises the requisite financial resources for their development and to the way it is transformed into market value through complex production–consumption relations.

To take this argument further, this article examines the social and territorial forces which characterise the photovoltaic industry in western Switzerland and identifies the relations forged within the region. It indicates the various territories in which different innovations are developing in conjunction with photovoltaic technology and shows the new territorial forms which these innovations in turn then create. More specifically, we identify how sustainable development becomes marketable through the socio-economic value placed on innovations which are seen as 'responsible'. We examine how these innovations are developed and valued around local and multi-local investment, manufacturing, consumption and mediation processes.

On the basis of this case study, we ultimately argue that the definition of the 'local innovative milieu' should be expanded to avoid being limited to a merely regional and manufacturing analysis of innovation. We propose the term 'multi-local valuation milieu' as a way of instigating more systematic investigation not only of the way in which innovation is locally territorialised within specific production systems but also of how it is valued in different places and at different geographical scales.

1. Territorial Innovation Models: the Emergence of New Thinking

Since the 1980s, there has been an increasingly territorial approach to economic development in relation to the issue of innovation and competitiveness. Various different conceptual models such as Innovative Milieus (Camagni & Maillat 2006), Regional Innovation Systems (Lundvall 1992), Learning Regions (Maillat & Kebir 1999) and even Clusters (Porter 1998) have shown how geographical proximity can enhance innovation and competition in certain regions. In particular, these models show how regional innovation is based on market and non-market relationships between local players, relying on prior socialisation (confidence, shared competition/cooperation rules, social capital, common language, etc.) (Grossetti & Godart 2007).

These 'territorial innovation models' (TIMs) have over the last few years led to various reviews (Lagendijk 2006; Moulaert & Sekia 2003; Simmie 2005; Doloreux 2002, Benko 2007; Cooke 2008) and are currently the subject of renewed examination. This contribution is not intended to provide a new assessment of these models but to use certain aspects of TIMs, and in particular the 'innovative milieu' as a means of understanding territorial development and innovation. This framework of reference will then allow us to introduce certain debates and new perspectives on research in economic geography.

1.1 Territorial Innovation Models and Innovative Milieus

Whilst TIMs are based on different research traditions and different schools of thought (Moulaert & Sekia 2003), we can see that they share certain common conceptual approaches to the phenomena of economic development and innovation.

Firstly, technological evolution is seen as the basis of competitive innovation. Regional innovation is largely characterised by the ability of local manufacturing systems to either flexibly adapt to constant changes in demand (flexible specialisation) (Simmie 2005), or to

develop and incorporate new technology into goods or manufacturing tools which outperform those of their market competitors. Innovation is seen as the main factor in competitive differentiation and represents a company's evolution in its natural and market environment (Crevoisier 2010).

Innovation is also seen as the main driving force behind economic change and as a process which reflects the ability of local players to respond independently to challenges presented by the wider socio-economic environment (Moulaert & Sekia 2003). However, regions are not completely independent productions systems but systems capable of developing specifically and endogenously in response to the global environment which itself remains relatively poorly defined (Crevoisier 2010). This endogenous growth does not only occur in response to changes in the global environment but is also determined by the territorial context in which the innovation is rooted (institutions, culture, traditional skills, investment channels, networks of players, etc.).

Regional innovation is therefore seen as a process of generating and utilising financial and intellectual resources, representing local cumulative and distributive practices specific to a particular territory. It is typified by relatively long life cycles characterised by different spatially and historically based path dependencies (technological, industrial, institutional, social etc. (Boschma & Frenken 2009). Innovative capacity (i.e. entrepreneurship) is seen regionally. At a more general level, economic development is consequently based on various competing territories' capacity for innovation (Crevoisier 2010).

Ultimately, TIM models are based on a production-based vision of economic development (Grabher et al. 2008). Indeed, the region is effectively principally seen as a specific production system which is in competition with other production systems. The existence of sophisticated local demand is seen as an opportunity for innovative technological developments. However a region's competitiveness is based principally on its capacity to export to a market which is international, rarely differentiated and footloose (Malmberg & Power 2005). From this point of view, the response to the socio-economic challenges presented by globalisation has been the mobility of goods and services: produce locally, export globally (Jeannerat 2013).

The innovative milieu model widely taken up, developed and consolidated following the pioneering work of Philippe Aydalot (1986) in many ways reflects this innovative and territorially competitive approach. Set against a backdrop of regional industrial decline, this theory took into account a process of economic development increasingly influenced by the need for manufacturing flexibility and networked innovation in the face of varied and changing market demand. Emphasising territorial and social issues, the innovative milieu

approach posits territory as a constitutive element of innovation and economic change. It encompasses the idea that technological, organisational and territorial factors all go to determine the regional milieus that generate innovation for new products, technologies and organisations (Camagni & Maillat 2006).

This being the case, the innovative milieu represents the territorial set-up in which the processes of innovation emerge. It posits the entrepreneurial activity of economic players and their privileged local relationships as the endogenous force behind the creation of specific resources (Coppin 2002). Territory is thus seen as part of the processes of innovation and a fundamental framework for understanding economic change. It reflects the spatial nature of the socio-economic transformations studied and vice versa (Crevoisier 2001). The innovative environment model commonly emphasises the importance of what local players do and their ability to generate the resources required for innovation. Based above all on an industrial and technological approach to economic development, it emphasises how local training and apprenticeship can help encourage the economic competitiveness of specific production systems.

Here, there are two lines of thought which allow us to expand and examine the innovative environment model in greater depth; on the one hand demonstrating the mobility of resources and on the other, the emergence of theories about market construction and the socio-economic value of goods and services.

1.2 Contemporary Reflections: the Mobility of Production Factors and Socio-economic Market Value

The approach to economic change and innovation taken by TIMs, particularly innovative milieus, is now subject to theoretical and empirical re-evaluation. There are increasing calls to take into account new socio-economic issues in order to gain a wider understanding of territorial and economic development. Two avenues of research strike us as particularly noteworthy in this regard.

The first deals with the mobility of production factors. So whilst the TIMs' approach focused primarily on the mobility of goods and services, these days we also have to consider the increased mobility of production factors (Sheller & Urry 2006, Urry 2007, Cresswell & Merryman 2008), particularly knowledge and capital.

In fact, various works demonstrate the trans-regional (Saxenian 2005, Henderson et al. 2002; Coe et al. 2004), multi-local (Crevoisier & Jeannerat 2009) and meta-national networks

(Doz et al. 2001) shaping the generation, usage and (re)combining of knowledge which characterise innovation today. Innovation is therefore no longer considered simply as an endogenous development process within a region but as a process of integration and participation in global knowledge and innovation networks (Chen 2007).

Moreover, various studies indicate an increased mobility of capital within the global financial channels, enabling investments to be made anytime, anywhere (Sassen 1991; Dow 1999; Corpataux et al. 2009; Morin 2008). This mobility challenges traditional regional investment channels and makes it possible to instantly invest or withdraw capital in a business sector or in a business from one region to another (Corpataux & Crevoisier 2005; Theurillat et al. 2008; Crevoisier et al. 2011). Financing local innovation is no longer linked just to the regional environment's ability to raise local investment (e.g. bank loans, business angels, etc.), but also to capture the interest and secure the involvement of financial investors organised at global level.

A second avenue of research concerns the way in which the economic value of economic change is constructed. Working mainly on the basis of an industrial and technical/scientific view of innovation, TIMs connect economic value with the idea of competitiveness. The value of innovation resides in the ability of a company or production system to compete in a market. This competitiveness is observed but rarely deconstructed within the market. Various authors take the view that it is not enough to simply understand how innovation works as a production process but we also need to understand how this innovation is given socio-economic value in the marketplace (Peck 2005, Lagendijk 2006, Grabher et al. 2008). This involves seeing the market not as an exogenous mechanism for selection or information but as a social construct involving various different parties co-ordinating their activities around the qualification (Callon 2007) and valuation (Beckert & Aspers 2011) of different goods and services.

From this point of view, the construction of value in the marketplace becomes an essential issue when considering the evaluation of goods and services. This involves not only analysing how value is constructed between the production and consumption of goods and services, but also the role that territory plays in this construction. According to Stark (2011), the market value of a good or service is determined by the social performance of players to give not only its exchange value (price), but also the social conditions of its evaluation (prize) and its experimentation (praise). Therefore, the study of territorial development consists not only of understanding where and how competitive innovations are produced but also where and how these innovations are given socio-economic value, i.e. collectively mobilised, co-produced, diffused, negotiated and legitimised (Jeannerat 2013).

In what way should the innovative environment approach be adapted to take on board these new issues? Here we are using western Switzerland's photovoltaic industry as a case study to demonstrate how certain local and extra-local innovations develop. These innovations are linked to social and economic concerns about so-called "sustainable" development.

2. 'Sustainable' Values as 'Responsible' Innovations in Western Switzerland's Photovoltaic Industry

The notion of 'sustainable development' is now central to social and economic projects and key policies (Strange & Bayley 2008; OCDE 2011). Considering territorial and economic development from this point of view raises various questions as to the development of territorial innovation models, the socio-economic value of goods and services, as well as the business models to which they relate. For some scholars, this involves a shift in perspective, from an isolated view of the economy to seeing it rather in terms of its relationship to the environment and to society (Laperche et al. 2009: 11). Similarly, this leads to a re-examination of how we currently view territorial innovation as well as the role of innovative milieu (Kebir et al. 2012). In this second section, we will examine the issue of sustainable development from the point of view of current innovations in western Switzerland's photovoltaic industry. Empirical observations included in this study are taken from the wider 'GREMI-T ASSLIn' research project, financed by the French Ministry of Infrastructure's (Plan Urbanisme, Construction, Architecture - PUCA)1 (Kebir et al. 2012). This project involved eleven research teams from Europe, Canada and Japan. Its brief was to analyse the new territorial innovation processes which typify sustainable development today.

[1] Research entitled "*Ancrage, Durabilité, Localisation de l'innovation: vers des nouvelles formes de territorialisation des activités?*", October 2012.

2.1 The International Photovoltaic Industry: from Oil Market Dependency to the Value of Sustainable Technologies

First solar cell was created at the end of the 19th century by American researcher and inventor Charles Fritts. However, it was not until the 1950s that serious study into photovoltaic technology began, and its first market application was in the aerospace industry. Finally in the 1970s-1980s it started to undergo considerable development. In the wake of various oil crises, solar power was seen as an alternative to fossil fuels. Research into first-generation silicon cells then began to receive more funding. Although the cost of photovoltaic cells remains prohibitive in relation to other energy sources, the first photovoltaic industries are beginning to see a reduction in some of their production costs and are developing an initial niche market.

In the 1980s, and in the decades which followed, technological innovation in photovoltaic industry then began to diversify along two broad lines. On the one hand, basic research led to significant improvements in the capacity of first-generation photovoltaic cells. Mono-crystalline and multi-crystalline silicon cells still remain the most profitable on the market, representing almost 80% of the global market. On the other hand, new research enabling the development of second-generation photovoltaic cells, which do not necessarily have greater capacity but with the potential for new applications (e.g. flexible manufacturing cells) (Ballif 2011).

The 2000s were a critical period in the global photovoltaic industry's development. This period was the third generation era of very high-powered photovoltaic cells (Ballif 2011). Moreover, frequent energy crises (e.g. rising oil prices, the anti-nuclear debate, etc.) and a considerable reduction in the cost of producing first-generation cells enabled the photovoltaic industry to develop independently of the oil market and to make inroads into the consumer market (Ballif 2011). This phase of industrial and technological maturity led to the standardisation and territorial specialisation of production and to the globalisation of the international market. Today China and Germany are the main international producers of solar panels. The German industry mainly serves national consumption whilst the Chinese industry focuses mainly on export (Dunfort et al. 2012).

2.2. Western Switzerland's Photovoltaic Industry and Its Case Studies

Over the last thirty years, western Switzerland has played a key role in the development and evolution of the international photovoltaic industry in three ways.

- Firstly, numerous key studies have contributed to the development of different photovoltaic technologies. From the 1980s onwards, research by the photovoltaic laboratory (PVLab) at the University of Neuchâtel's Institute for Microtechnology (IMT), now affiliated with the Ecole polytechnique fédérale de Lausanne (EPFL), has contributed to improving the profitability of photovoltaic cells and the development of new generation photovoltaic technologies (Ballif 2011).
- Secondly, these key studies have led to the creation and development of numerous local start-ups and businesses. Often founded by former researchers, these businesses have pioneered the development of specific applications and products using photovoltaic technology.
- Thirdly, local research has led to the development of the sophisticated manufacturing equipment still required by major international photovoltaic companies.

How are we to understand the innovations now being used in western Switzerland's photovoltaic milieu in this industry's global economic context? How do these innovations develop and are they valued in relation to sustainable development? What new forms of spatial development do they represent?

These issues have been examined in an empirical survey conducted between May and September 2011. This survey involved a qualitative study based on an in-depth documentary analysis of press articles, expert reports and professional journals. 18 semi-directive interviews were conducted with business people, research institutes, public figures and representatives of associations in the west of Switzerland. The aim of these interviews was to understand in greater depth various individual business projects so as to discern the social and economic values that players in this milieu give to these activities. In particular, seven business projects were studied. These can be divided into three categories.

The first project type aims to raise public awareness on an international scale by demonstrating the efficiency of photovoltaic energy: the *PlanetSolar* project, (devised in French-speaking Switzerland and carried out in Germany) which enabled the first completely solar-powered boat to make a tour of the world between September 2010 and May 2012; *SolarImpulse* is a project which plans to make a tour of the world with a solar-powered

aeroplane; the *ICARE* project, which received less media attention, is a project to take a solar and wind powered vehicle around the world between 2010 and 2011.

A second project type contributes to the value of public and tourist destinations: the *Magic Turtle* solar-powered tricycle offers an alternative form of transport and is supported by community groups to raise public awareness of 'sustainable' transport. On a more industrial scale, the *Grove Boats* company manufactures solar-powered boats largely for state-sector customers for tourist and environmental use.

A third, more traditional type of project involves developing and exploiting on the private market a final product or specific application which uses photovoltaic technology. This case was studied through two complementary businesses: the start-up *Iland Green Technologies* which created a portable solar-powered generator using flexible manufacturing cells developed by a company called *Flexcell*.

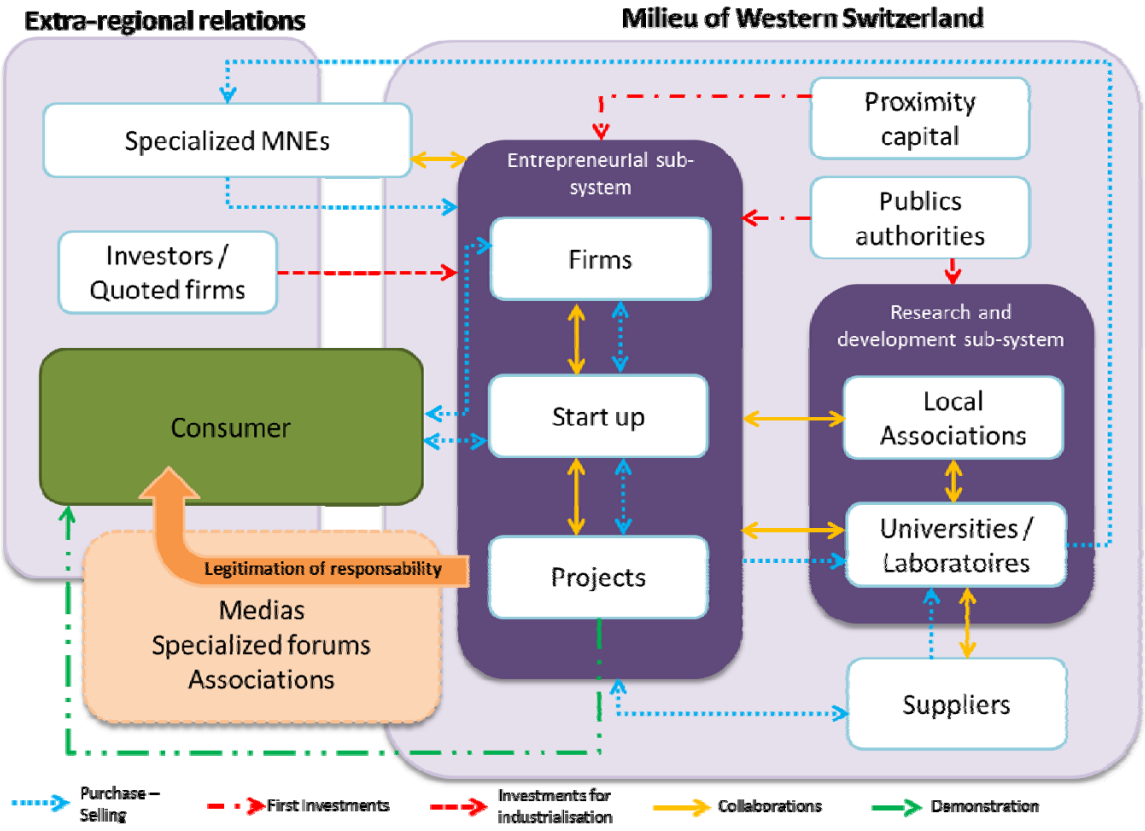
These case studies allow us to identify different paths that innovations may take and the way that they are integrated -or not- into public, local and/or extra local processes. In particular they have enabled us to show the innovation networks and financial and market valuation mechanisms at play in the area of photovoltaic innovation. Alongside the collection and analysis of data, direct observations have also been collected at public events such as trade fairs, specialist exhibitions, forums, etc).

Taken as a social construction, this analytical and methodological approach focused on the idea of 'actually existing sustainabilities' (Krueger & Agyeman 2005; Evans & Jones 2008; Krueger & Gibbs 2008). This empirical approach did not involve defining a priori what sustainable development is (e.g. using an analytical model or pre-determined sustainability criteria), but rather observing the actions and discourses of those studied. The operationalization of sustainable development thus takes different forms according to the institutions and territories in which the networks of players and systems of socio-economic valuation operate.

3. Multi-local Relations and the Socio-Economic Valuation of Responsibility

On the basis of our case study of western Switzerland's photovoltaic milieu, we can identify three kinds of interdependent system (see Figure 1): the productive innovation system, the financial valuation system and the market valuation system.

FIGURE 1: MULTI-LOCAL RELATIONSHIPS IN THE MILIEU OF WESTERN SWITZERLAND.



Source: Own Elaboration.

3.1 Productive Processes in the Innovative Photovoltaic Milieu of Western Switzerland

Productive processes in the innovative photovoltaic milieu of western Switzerland can be seen as two interacting, interdependent sub-systems: the entrepreneurial sub-system and the research and development sub-system.

The local entrepreneurial sub-system represents the area in which innovative entrepreneurial projects are developed. These projects mainly include three types of players. Firstly, certain 'mature businesses' develop innovative and specialist photovoltaic products for the domestic and international markets. *Flexcell* is a good example of this, with its production of flexible photovoltaic panels aimed at the consumer market. Then there are the various 'pre-competitive start-ups' which develop, in the form of prototypes, various applications and actual products using technologies developed in the region (second and third generation technologies) with a view to selling them on the market. *Iland Green Technologies*' portable solar generator made use of skills from both local research laboratories and components produced by local businesses. Finally, there are 'demonstration project developers', whose aim is not to create goods for the market but to promote the social and technical potential of photovoltaic energy. For instance, the solar aircraft, *SolarImpulse* was designed primarily to contribute to photovoltaic technologies whilst also demonstrating their credibility and potential for other market applications. Technological skills combine and circulate continuously between the various parties within this system. On the one hand, businesses provide start-ups with second and third generation photovoltaic cells. On the other hand, demonstration projects can promote certain technologies produced by these businesses and start-ups.

The research and development sub-system brings together players behind the development of new technologies whilst local associations look to connect them. Generally speaking, public laboratories are involved in third generation photovoltaic technology research, improvement and development. Local associations look to create networks for these players, enabling them to generate mutually-beneficial industrial synergies.

By analogy with the theory of innovative milieus (Camagni & Maillat 2006), these two sub-systems represent the heart of the innovative milieu and constantly co-operate within innovative local networks. Local technological relationships between the players in this environment often take the form of local learning and training relations (Lundvall & Johnson 1994), i.e. the collective organisation and use of resources by players in the environment. Therefore these collective training and learning initiatives enable the environment to adapt and respond to its changing environment (Uzunidis 2010: 96). Local innovation networks encourage the creation, use and (re)combining of the knowledge necessary to this evolution. This productive organisation usually takes the form of a technological transfer: regional research laboratories very often supply local businesses with technological knowledge.

However, beyond the traditional innovative environment organised principally on a regional basis, important multi-local relationships can also be seen (Crevoisier & Jeannerat 2009). For instance, a number of German and Asian companies have set up laboratories in the

region, in order to get involved in and have access to local technological innovations which enable them to develop increasingly profitable photovoltaic cells. A leading German business on the international industrial photovoltaic technology and equipment market has set up a private laboratory next to a public regional research centre in order to be able to exploit the new technologies being developed in western Switzerland. Major international companies are therefore equally players in the local innovative milieu and integrate this environment into global production networks, considerably exceeding the bounds of the region (Henderson et al. 2002; Coe et al. 2008).

3.2 Financial Valuation in the Photovoltaic Milieu: Building a Reputation within Multi-local Relations

Alongside the multiple, more globalized relationships of its technological and manufacturing innovations, western Switzerland's photovoltaic milieu is also developing within regional and extra-regional investment channels. The financial resources of those entrepreneurial projects studied vary considerably depending on the project type and development phase. In the earliest stages of a start-up's life, it is often necessary to have entrepreneurs and investors in close geographic proximity, as there needs to be a relation of trust between these parties (Crevoisier 1997). The initial investment in entrepreneurial projects generally comes from public funds through the entrepreneur's interpersonal relations. For example, certain forms of public finance give businesses the opportunity to initiate and incubate so called 'precompetitive' projects, i.e. those which are not yet at the manufacturing and marketing stage. Similarly, the first investors in a project may be family, work colleagues or friends. *Iland Green Technologies* is such a case in point, with company start-up capital coming mostly from the owner's social network.

However, these initial investments are not sufficient to cover the large-scale manufacturing and marketing of newly-developed products. The cost of this second phase is generally too high to be met by those in the entrepreneur's personal network or too risky to be of interest to regional lenders. The local milieu is therefore often unable to support the industrial development of innovative entrepreneurial projects through the instigation and use of local financial resources. Generally speaking, it is multinational, listed companies with the ability to invest large sums of money quickly which then provide the requisite support at this stage. Such was the case for *Flexcell*, a company producing flexible solar panels: once it reached the industrialisation phase, it was bought up by *Q.Cells*, a German manufacturer of photovoltaic cells and production lines.

Very often, innovative companies which have benefited from the investment capital of major listed groups are then bought up once they reach the industrialisation phase (Garel & Jumel 2005). These big companies have considerable liquid assets to invest and are generally more interested in making profitable investments (Crevoisier 1997). These investments are part of the major groups' innovation strategy, based more on corporate venture capital, i.e. high-risk buying and selling of innovative entrepreneurial projects (Chesbrough 2002; Ben Hadj Youssef 2006). Big companies investing in photovoltaic projects in western Switzerland may be motivated either by the prospect of a return on the future sale of a business or the international exploitation of a company's product.

Moreover, the socio-economic value of these investments may be more than just monetary. They may also be of symbolic and PR value. This is particularly evident in the case of demonstration projects. Investors in projects such as *PlanetSolar* or *SolarImpulse* wish primarily to be associated with the sustainable and eco-friendly values that they embody. Investment may therefore be done as a form of sponsorship rather than as a straightforward industrial investment. These sponsorship-style investments are not just about money but also reputation. Financing such projects is complicated and involves both public and private as well as regional and international investment.

Therefore the financial value of innovative local projects may lie in improved visibility, credibility and legitimacy with multi-local investors. In this situation, marketplace initiatives play a crucial role. Trade shows are ideal environments for the creation of markets and industries (Lampel & Meyer 2008; Aspers & Darr 2011). They not only bring together entrepreneurs and investors but also enable worthwhile projects to be presented and selected.

3.3 Market Valuation of Photovoltaic Innovations: the Socio-Economic Construction of Responsibility

The economic value of innovations developed in western Switzerland's photovoltaic milieu cannot be seen merely in terms of a competitive technology in the marketplace, e.g. in terms of price or energy efficiency. It is built through a complex process of socio-economic valuation. In common with other studies on sustainable development (Gabriel & Gabriel 2004/5; Ingham 2011), our case study shows that the market value of the innovations studied is in large part built around the idea of 'responsibility'. Ingham (2011: 32) defines responsibility as being open to environmental and social concerns when developing and deploying innovations shared by various players in society. The market valuation of

photovoltaic innovations is therefore made through production and consumption activities which are socially validated (Boltanski & Thévenot 1991) as either ‘responsible’, ‘not responsible’ or ‘irresponsible’. Gabriel and Gabriel (2004/5: 206) see this validation process as bestowing a legitimacy which gives value to the product and its message.

In this case, the relationship between production and consumption relates to two pivotal groups: responsible entrepreneurs and committed consumers. On the one hand, the entrepreneur is often seen in an emblematic role, embodying the planet’s salvation through their chosen innovation. They are seen as ‘responsible’ when they follow a ‘defensive and curative purpose’ with regard to reducing the environmental pollution created by industrial civilisation (Djellal & Gallouj 2009: 61). On the other hand, consumers are exhorted not only to buy ‘useful’ products but also to adopt environmentally-friendly behaviour to help save the planet. By buying photovoltaic products, they also become ‘responsible’. They thus evaluate technical quality as well as producers’ behaviour. They identify themselves with the discourse and ideology which go with the product itself. A product’s given value is not just down to strictly technical factors but also the discourse which the product symbolises and communicates. This process of market valuation involves various technical players and devices enabling the evaluation and stigmatisation of the players’ social behaviour and the quality of the innovations.

Demonstration projects such as the solar boat and plane are good examples of this issue. Their aim is to promote the performance of photovoltaic technologies, but also to raise public awareness and understanding of renewable energy. The social dimension of these projects is transmitted, legitimated and co-created by media-driven and symbolic forces for an audience of the general public and potential consumers. Once the media get hold of this, it is then easier to involve investors wishing to promote a responsible image.

In the specific case of the photovoltaic industry, legitimating third parties (particularly the media and public bodies) automatically give visibility and perhaps even support to innovations that respond to genuine social desirability and put entrepreneurs’ responsible practice in the spotlight (Pratt 2000; Jeannerat 2012; Tremblay 2011). These players also transmit image, social control and credibility to a national and international audience (Rekers 2010). Thus the dissemination and legitimisation of responsible innovations occur in specific locations such as promotional marketplaces, e.g. trade fairs, specialist shows, events etc.

Consequently, the process of social evaluation is based on media debate and confers symbolic value on photovoltaic innovations. This symbolic value is a key element of the economic value of photovoltaic innovations, beyond the efficiency of the products or technologies involved. It helps justify both investment processes upstream and consumption

behaviours downstream of the innovation. From this point of view, local innovation within complex business and revenue models can be seen as based not only on the buying and selling of goods and services but also on the reciprocal action of market players (Chesbrough & Rosenbloom 2002; Ng 2010; Storbacka et al. 2012).

In contrast to the traditional industrial business model, photovoltaic innovations developed in western Switzerland are not necessarily economically valued simply as final goods and services for sale on the market. Each entrepreneurial project has, to varying degrees and levels, a value in terms of demonstration, social desirability and its contribution to a better world. Their economic value involves various public and private, local and global, manufacturing, media and consumer bodies within the marketplace. Certain services are given value through direct monetary exchange (e.g. a purchase), others are given value indirectly through an enhanced image (e.g. deferred purchase) and others are ultimately given value through the development of products and technologies derived from an original project (e.g. the transfer of knowledge from a demonstration project).

4. From 'Local Innovative Milieu' to 'Multi-local Valuation Milieu'

In line with other territorial innovation models (Moulaert & Sekia 2003), the 'innovative milieu' developed since the 1980s has led to an understanding of the territorial dimension of local innovations (Camagni & Maillat 2006). Aside of the theoretical contributions of this model, the study of western Switzerland's photovoltaic milieu opens up new avenues of thought and research.

Our aim here is not to propose an alternative and definitive model to that of the innovative milieu. However, based on our own observations and echoing certain ongoing debates in economic geography, we believe that by proposing the term 'multi-local valuation milieu' we can open the door to some new ways of thinking. It offers a new conceptual framework based on three principal observations (Table 1).

Our first observation concerns the kind of players involved in the milieu. The multi-local valuation milieu is characterised by players' relations extending beyond a manufacturing and regional view of innovation. These relationships contribute to construct and legitimise the socio-economic value of innovation beyond the production systems which operate in the traditional innovative milieu. Whilst businesses and research and development laboratories continue to play a dominant role in innovation processes, the economic value of their activities must be understood within the framework of wider public constructions. 'Committed'

consumers, local and global interest groups, media and investors play an active role in the creation and development of the milieu, not just at production level but also in communicating and financing entrepreneurial projects.

TABLE 1: COMPARING A CLASSIC INNOVATIVE MILIEU WITH THE MULTI-LOCAL VALUATION MILIEU.

	Local innovative milieu	**Multi-local valuation milieu**
Players	Players involved in the production system *(research laboratories, businesses, etc.)*	Players involved in the market *(manufacturers, investors, consumers and media and consumer groups)*
Innovation	Result of endogenous technological and production processes	Result of socio-economic processes based on production, exemplarity and demonstration of discourse
Socio-economic legitimisation and valuation of innovation	Technical device	Link between discourse and technical device subject to critical attention
Type of territorial relationship	Productive local combination	Multi-site and with media involvement
Intermediary issues	Networking in production milieu	Networking, co-creation of media-led discourse and social control

Source: Own Elaboration.

A second observation concerns the socio-economic value of innovation. Whilst innovations remain focused mainly on production, their value is constructed through media's representation of them to the public. On the one hand, they are represented by new products and new actions legitimised through discourse about 'sustainability' (Gabriel & Gabriel 2004/5). On the other hand, innovation can also be used for teaching and demonstration purposes, thus constructing a legitimate discourse, legitimised by market players. In the case of the photovoltaic projects studied, the idea of responsibility is subject to commonly-agreed notions of quality which are technically and symbolically constructed. In this situation, the social process leading to the valuation of innovation on the market works through complex processes of production, consumption and media representation.

The third observation concerns the territorial nature of the innovation processes studied. Our case study shows that local players' interactions are based on local relationships of trust similar to those described by the innovative milieu (Camagni & Maillat 2006). These players develop regional networks which allow them to combine innovative skills and productive synergies. However, these local relationships play an active part in even wider production and consumption networks, at medium and long distance. Over the last few years, the increasing power of China's photovoltaic industry has for instance led to the division of labour at intercontinental level (Dunford et al. 2012). Players in western Switzerland's photovoltaic milieu must therefore get involved in global production and consumption networks enabling the socio-economic valuation of their specific projects.

According to Grabher et al. (2008), the construction of the market introduces production and consumption processes with a view to 'co-development', involving multiple relationships between players. Territorially speaking, these relationships fall under regional and extra regional processes. 'Responsible innovations' which are developed and valued within western Switzerland's photovoltaic milieu clearly extend beyond regional and national boundaries and involve different production, consumption and mediation locations. Projects such as *PlanetSolar* and *Solar Impulse* are good examples of a multi-local combination of intellectual and financial resources. They illustrate innovations that far exceed the bounds of regional technology and production. They are innovative vectors of socially co-constructed values, reflecting a quality that economic and noneconomic players seek to attain in future. These values include social responsibility represented globally and initiated locally, between different places of action.

REFERENCES

ASPERS, P. & DARR, A. (2011). "Trade shows and the creation of market and industry." *The Sociological Review*, 59(4): 758-778.

AYDALOT, P. (1986). *Milieux innovateurs en Europe*. Paris: GREMI.

BALLIF, C. (2011). "Cellules solaires en silicium à haut rendement." *Electrosuisse*, 3: 12-14.

BECKERT, J. & ASPERS, P., éd. (2011). *The Worth of Goods. Valuation & Pricing in the Economy*. New York: Oxford University Press.

BEN HADJ YOUSSEF, A. (2006). "Le capital risque: que vont faire les grands groupes dans les start-ups?" *Gérer et comprendre*, Juin(84): 34-43.

BENKO, G. (2007). "Économie urbaine et régionale au tournant du siècle." *Métropoles*, (1).

BOLTANSKI, L. & THÉVENOT, L. (1991). *De la Justification, les économies de la grandeur*. Paris: Gallimard.

BOSCHMA, R. & FRENKEN, K. (2009). "Some Notes on Institutions in Evolutionary Economic Geography." *Economic Geography*, 85(2): 151-158.

CALLON, M. (2007). "What does it mean to say that economics is performative?", in MACKENSIZE, D., MUNIESA, F. et SIU, L. (éd.), *Do Economics Make Markets?On the Performativity of Economics*. Princeton.

CAMAGNI, R. & MAILLAT, D. (2006). *Milieux innovateurs: Théorie et politiques*. Paris.

CHEN, Y.-C. (2007). "The Upgrading of Multinational Regional Innovation Networks in China." *Asia Pacific Business Review*, 13(3): 373-403.

CHESBROUGH, H. (2002). "Making sense of corporate venture capital." *Harvard Business Review*, (March): 4-11.

CHESBROUGH, H. & ROSENBLOOM, R.S. (2002). "The role of the business model in capturing value from innovation: evidence from Xerox Corporation's technology spin-off companies." *Ind Corp Change*, 11(3): 529-555.

COE, N.M., DICKEN, P. & HESS, M. (2008). "Global production networks: realizing the potential." *Journal of Economic Geography*, 8(3): 271-295.

COE, N.M., DICKEN, P., HESS, M. & YEUNG, H.W.C. (2004). "Making connections: Global Production Networks and World City Networks." *Global Networks*, 10(1): 138-149.

COOKE, P. (2008). "Regional innovation systems: origin of the species." *International Journal of Technological Learning, Innovation and Development*, 1(3): 393-409.

COPPIN, O. (2002). "Le milieu innovateur: une approche par le système." *Innovations*, 2(16): 29-50.

CORPATAUX, J. & CREVOISIER, O. (2005). "Increased capital mobility/liquidity and ilts repercussions at the regional level: some lessons from the experiences of Switzerland and Great Britain (1975-2000)." *European Urban and Regional Studies*, 12(4): 315.

CORPATAUX, J., CREVOISIER, O. et THEURILLAT, T. (2009). "The Expansion of the Finance Industry and Its Impact on the Economy: A Territorial Approach Based on Swiss Pension Funds." *Economic Geography*, 85(3): 313-334.

CRESSWELL, T. & MERRIMAN, P. (2008). *Geographies of Mobility: Practices, Spaces, Subjects*. London: Ashgate.

CREVOISIER, O. (1997). "Financing regional endogenous development: the role of proximity capital at the age of globalization." *European planning studies*, 5(3): 407-415.

CREVOISIER, O. (2001). "L'approche par les milieux innovateurs: états des lieux et perspectives." *Revue d'économie régionale et urbaine*, 1: 153-166.

CREVOISIER, O. (2010). "La pertinence de l'approche territoriale." *Revue d'économie régionale et urbaine*, 5: 969-985.

CREVOISIER, O. & JEANNERAT, H. (2009). "Les dynamiques territoriales de connaissance: relations multilocales et ancrage régional." *Revue d'économie industrielle*, (128): 1-23.

CREVOISIER, O., THEURILLAT, T. & ARAUJO, P. (2011). "Les territoires de l'industrie financière: quelles suites à la crise de 2008-2009?" *Revue d'économie industrielle*, 134(2): 133-158.

DJELLAL, F. & GALLOUJ, F. (2009). "Innovation dans les services et entrepreneuriat: au-delà des conceptions industrialistes et technologistes du développement durable." *Innovations*, 1(29): 59-86.

DOLOREUX, D. (2002). "What we should know about regional systems of innovation." *Technology in Society*, 24(3): 243-263.

DOW, S.C. (1999). "The Stages of Banking Development and the Spatial Evolution of Financial Systems", in MARTIN, R.E. (éd.), *Money and the Space Economy*. New York: John Wiley & Sons.

DOZ, Y.L., SANTOS, J. & WILLIAMSON, P. (2001). *From global to metanational: How companies win in the knowledge economy*. Boston: Harvard Business School Press.

DUNFORD, M., LEE, K.H., LIU, W. & YEUNG, G. (2012). "Geographical interdependence, international trade and economic dynamics: The Chinese and German solar energy industries." *European and Urban Regional Studies*, 20(1): 14-36.

EVANS, J. & JONES, P. (2008). "Rethinking sustainable urban regeneration: ambiguity, creativity and the shared territory." *Environment & Planning A*, 40: 1416-1434.

GABRIEL, P. & GABRIEL, P. (2004/5). "Diffusion du développement durable dans le monde des affaires: un schéma conventionnel." *Revue française de Gestion*, 152: 199-213.

GAREL, G. & JUMEL, S. (2005). "Les grands groupes et l'innovation: définitions et enjeux du corporate venture." *Finance, Contrôle, Stratégie*, 8(4): 33-61.

GRABHER, G., IBERT, O. & FLOHR, S. (2008). "The Neglected King: The Customer in the New Knowledge Ecology of Innovation." *Economic Geography*, 84(3): 253-280.

GROSSETTI, M. & GODART, F. (2007). "Harrison White: des réseaux sociaux à une structure de l'action." *SociologieS [En ligne], Découvertes / Redécouvertes, Harrison White, mis en ligne le 17 octobre 2007, Consulté le 06 janvier 2010. URL : http://sociologies.revues.org/index233.html*.

HENDERSON, J., DICKEN, P., HESS, M., COE, N.M. & YEUNG, H.W.C. (2002). "Global Production networks and the analysis of economic development." *Review of International Political Economy*, 9(3): 436-464.

INGHAM, M. (2011). *Vers l'innovation responsable: pour une vraie responsabilité sociale*. Bruxelles: De Boeck.

JEANNERAT, H. (2012). *Production, consommation et valeur économique: vers une approche territoriale du marché*. Neuchâtel: Faculté des Lettres et sciences humaines, Université de Neuchâtel.

JEANNERAT, H. (forthcoming 2013): Staging experience, valuing authenticity: Towards a market perspective on territorial development. In: European urban and regional studies.

KEBIR, L., COSTA, P., CREVOISIER, O. et PEYRACHE-GADEAU, V. (2012). Ancrage, durabilité, localisation de l'innnovation: vers des nouvelles formes de territorialisation des activités? Paris, PUCA.

KRUEGER, R. & AGYEMAN, J. (2005). "Sustainability schizophrenia or "actually existing sustainabilities?" toward a broader understanding of the politics and promise of local sustainability in the US." *Geoforum*, 36(4): 410-417.

KRUEGER, R. & GIBBS, D. (2008). "Third wave sustainability? Smart Growth and Regional Development in the USA." *Regional Studies*, 42(9): 1263-1274.

LAGENDIJK, A. (2006). "Learning from conceptual flow in regional studies: Framing present debates, unbracketing past debates." *Regional Studies*, 40(4): 385 - 399.

LAMPEL, J. & MEYER, A.-D. (2008). "Field-configuring events as structuring mechanisms: how conferences, ceremonies and trade shows constitute new technologies, industries, and markets." *Journal of Management Studies*, 45(6): 1025-1035.

LAPERCHE, B., CRÉTIÉNEAU, A.-M. & UZUNIDIS, D., éd. (2009). *Développement durable: pour une nouvelle économie*. Bruxelles.

LUNDVALL, B.A., éd. (1992). *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*. London: Frances Pinter.

LUNDVALL, B.A., & JOHNSON, B. (1994). "The learning economy." *Journal of Industry Studies*, I(2): 23-42.

MAILLAT, D. & KEBIR, L. (1999). "Learning region et systèmes territoriaux de production." *Revue d'économie régionale et urbaine*, 3: 429-448.

MALMBERG, A. & POWER, D. (2005). "On the role of global demand in local innovation processes", in FUCHS, G. et SHAPIRA, P. (éd.), *Rethinking Regional Innovation And Change: Path Dependency Of Regional Breakthrough?* New York: Springer. 30, 273-290.

MORIN, F. (2008). "Le capitalisme de marché financier et l'asservissement du cognitif", in COLLETIS, G. et PAULRÉ, B. (éd.), *Les nouveaux horizons du capitalisme - Pouvoir, Valeurs, Temps*. Paris: Economica, 211-233.

MOULAERT, F. & SEKIA, F. (2003). "Territorial Innovation Models: A Critical Survey." *Regional Studies*, 37(3): 289-302.

NG, I.C.L. (2010). "The future of pricing and revenue models." *Journal of Revenue and Pricing Management*, 9(3): 276-281.

ODCE (2011). “Travaux de l’OCDE sur le développement durable”. Juin 2011.

PECK, J. (2005). "ECONOMIC SOCIOLOGIES IN SPACE." *ECONOMIC GEOGRAPHY*, 81(2): 129-175.

PORTER, M.E. (1998). "Clusters and the new economics of competition." *Harvard Business Review*, 76(6): 77-90.

PRATT, A.-C. (2000). "New media, the new economy and new spaces." *Geoforum*, 31: 425-436.

REKERS, J.-V. (2010). Introducing innovations: the role of market intermediaires and institutions in culture and science-based industries. Paper presented at the Summer conference of June 2010 "Opening up innovation: strategy, organisations and technology", Imperial College London Business School.

SASSEN, S. (1991). *The Global City : New-York, London, Tokyo*. Princeton, New-Jersey: Princeton University Press.

SAXENIAN, A. (2005). "From Brain Drain to Brain Circulation: Transnational Communities and Regional Upgrading in India and China." *Studies in Comparative International Development*, 40(2): 35-61.

SHELLER, M. & URRY, J. (2006). "The new mobilities paradigm." *Environment and Planning A*, 38: 207-226.

SIMMIE, J. (2005). "Innovation and Space: a critical review of the Literature." *Regional Studies*, 39(6): 789-804.

STARK, D. (2011). "What's Valuable?", in BECKERT, J. et ASPERS, P. (éd.), *The Worth of Goods: Valuation & Pricing in the Economy*. Oxford: Oxford University Press, 319-338.

STORBACKA, K., FROW, P., NENONEN, S. & PAYNE, A. (2012). "Designing business model for value creation", in STEPHEN, L.V. et ROBERT, F.L. (éd.), *Toward a better understanding of the role of value in markets and marketing (Review of marketing research)*. Emerald Group Publishing Limited. 9, 51-78.

STRANGE, T. & BAYLEY, A. (2008). "Le développement durable à la croisée de l'économie, de la société et de l'environnement." OCDE, Les essentiels de l'OCDE.

THEURILLAT, T., CORPATAUX, J. et CREVOISIER, O. (2008). "The Impact of Institutional Investors on Corporate Governance: A View of Swiss Pension Funds in a Changing Financial Environment". *Competition & Change*, 12(4): 307-327.

THEURILLAT, T. (2011). Une approche territoriale de la financiarisation des régions, des villes et de la durabilité urbaine. Institut de Sociologie, Université de Neuchâtel. Thèse de doctorat en sciences humaines.

TREMBLAY, S. (2011). "Développement durable et communication: vers un espace ouvert fondé sur la participation citoyenne, l'éthique du dialogue et l'interinfluence." *Télescope*, 17(2): 239-255.

URRY, J. (2007). Governance, flows, and the end of the car system? New York, NY, Elsevier Sci Ltd: 343-349.

UZUNIDIS, D. (2010). "Milieu innovateur, relations de proximité et entrepreneuriat. Analyse d'une alchimie féconde." *Revue Canadienne de Science Regionale*, 33(Special Issue): 91-106.