

Knowledge Spillovers in High-tech Clusters in Developing Countries

Effie Kesidou

(Ecis) Eindhoven Centre for Innovation Studies, (TU/e) Technological University of Eindhoven,
The Netherlands, e.kesidou@tm.tue.nl

1. Research problem

Do local knowledge spillovers foster innovation in clusters in developing countries? If so, what is the extent of local knowledge spillovers? How do they take place under different conditions? How important are in comparison to other geographic advantages? Local knowledge spillovers are positive technological externalities, which derive from the inability of firm A to retain the economic returns of its innovative activity. As a consequence, firm B can take advantage of the new product or the new knowledge directly and without compensating firm A. The literature¹ on local knowledge spillovers (LKS) claims that local technological externalities are the main reason for the clustering of innovative activity. Modern economic theory emphasises that innovation and technological change boost economic growth. This happens due to the fact that innovation creates conditions of increasing returns in production (Romer 1986). Such conditions accelerate economic growth over the long run. Local knowledge spillovers are one of the key mechanisms through which this occurs. This project aims at achieving a deeper understanding in the phenomenon of LKS.

The theoretical argument that has been put forward to support idea that KS are spatially bounded emanates from the tacit nature of knowledge. Knowledge constitutes an important component of any type of innovation. Various aspects of knowledge (information) can be codified and thus be diffused, be imitated and be sold. Yet, the tacit part of knowledge cannot be traded but can only be learned. This learning process has two major characteristics: it is cumulative (Dosi 1988) and is achieved through interaction (Lundvall 1992).

Firstly, learning is cumulative. This indicates that learning is not a rapid jump to wisdom or what the innovation literature refers as radical innovation (Nelson and Winter 1982). Rather, learning is a gradual process whereby new knowledge is build upon previous understandings and incremental changes on the known parts unravel the unknown aspects of the matter. This is why knowledge spillovers and consequently innovation have a *local* dimension; regions

¹ Economic geography (Jaffe 1993, Audretsch and Feldman 1996).

that have accumulated knowledge can easier produce new knowledge than other areas that are in the beginning of the learning process.

A second characteristic of learning is that it is an interactive process. It is acknowledged now that innovation is the result of the interaction between firms, between functions within the firm, between producers and users and between firms and the research institutes as well as the wider institutional infrastructure (Lundvall, 1992). *But how this relates to geographic distance? Do firms in a cluster² interact more than firms outside a cluster?* Directly or indirectly most of the territorial theories³ claim that firms interact more when they are close to each other. This happens because face-to-face interaction is necessary for the exchange of knowledge that is tacit. Face-to-face interaction facilitates the sharing of knowledge. During this process tacit knowledge becomes explicit and it is converted to another new knowledge (Nonaka 1994).

The attributes of tacit knowledge, which is an important ingredient of innovation, are the foundation of the current conceptualisation of local knowledge spillovers. Empirical studies have been undertaken in advanced countries, which confirm that knowledge spillovers are geographically bounded. This trend is especially stronger in high-tech sectors because they involve relatively more tacit knowledge than the traditional sectors. Yet, an important gap in the literature remains, in that research primarily has been limited to high-tech clusters in the advanced economies. There is not any indication that this argument holds in less developed countries too. Although, clustering is a phenomenon that has been identified and researched in developing countries, mostly in traditional sectors, less is known about the nature and the function of knowledge spillovers in less developed countries. Income poverty, financial crisis, environmental and health problems are an every day problem faced by more than 3 billion⁴ people living in developing countries. The purpose of this research, thus, is to find out whether local knowledge spillovers are important drivers of innovation and learning in a less

² Clustering refers to firms that are located in close distance. An important consideration that is relevant to LKS is that a cluster may be comprised of firms of the same industry or of firms of different industries. In the first case, knowledge spills over only between firms that belong to the same industry. The second case is about inter-industry knowledge spillovers. Much research has been done in trying to assess the significance of intra-industry KS versus inter-industry KS.

³ Regional Systems of Innovation and Learning Region (Cooke 2001, Morgan 1997), Innovative Milieux (Aydalot 1986, Camagni 1992), New Industrial Spaces (Porter 1990, Storper & Scott 1988, Saxenian 1994), Industrial District (Piore & Sabel 1984, Becattini G. 1990, Schmitz 1999).

⁴ This includes estimates for people leaving with less than 1\$ a day as well as people leaving with less than 2\$ a day (Global Economic Prospects and the Developing Countries 2003, World Bank).

developing country context. This will contribute to a better understanding of the current mechanisms of LKS in developing countries and will indicate whether this could be a potential path of development and growth.

2. The identification of the problem in the literature⁵

The first author raised the claim, that clusters facilitate the diffusion of knowledge through the concentration and the mobility of specialised labour was Alfred Marshall (1920). Inspired by Manchester's cotton mills in the 19th century, he noticed the existence of production systems that are geographically concentrated. One of the ingredients of Marshall's district theory can be interpreted to refer to knowledge spillovers '*The mysteries of the trade become no mysteries, but are as it were in the air*⁶' (Marshall 1920, p. 225). The concept of knowledge spillovers reappeared in the literature in the work of Scitovsky (1954). The so-called real or technological externalities look similar to what Marshall was referring to be 'something in the air' even though, Scitovsky did not consider explicitly the spatial attributes of knowledge spillovers. According to Scitovsky, real external economies are the result of the interdependence between the decisions and actions of various firms. In the presence of interdependence between firms, the production of a firm can be modified by the behaviour and outcomes of another enterprise directly and not through the market. A major contribution of Scitovsky was the idea that the concept of real externalities and generally of external economies should be studied in two distinct contexts: The static theory of equilibrium and the theory of industrialisation of underdeveloped countries. His analysis together with the theory of balanced growth (Rosenstein-Rodan 1943) provided theoretical support to the so-called import substitution policy of industrialisation (ISI) that has been applied in many developing countries during the 1960s.

However, the failure of several countries to 'catch up' following the ISI model of industrialisation in contrast to many other countries that pursued the so-called export-led strategy of industrialisation led several academic scholars as well as policy makers in the 1970s to believe that trade liberalisation is the policy which will enable less developed countries to grow fast. Twenty years later the difficulty of various countries to respond to the expectations of the trade liberalisation model of development made many of its initial

⁵ For an extensive discussion of the issue see 'Regional Agglomeration and Technological Learning: A Review of the Literature' Kesidou E. (2003).

⁶ This refers to the informal exchange of knowledge or *cafeteria effects*.

supporters rethink this policy. Currently is claimed that the export-led model of growth entails a degree of intervention and it has been mistakenly argued that trade liberalisation was the only policy which reflected the content of the export-led model (Westphal 1990).

Under these conditions of uncertainty and hesitation to follow any of the two dominant models of development, much emphasis has been given again to external economies. Real external economies in the context of industrial district or cluster occupy a prominent role in the debates of growth the last decade. At the same time, this theoretical consideration yields a challenge for many developing countries: Do local knowledge spillovers (or technological externalities) foster innovation in clusters in developing countries? It is worth knowing this, because if high-tech clusters drive innovation and learning in developing countries, this could attract the attention of government policies and stimulate economic development by identifying and encouraging high-tech clusters.

Currently, a number of economic geographers, economists' of innovation and geographers incorporate knowledge spillovers in their analysis of clusters. Jaffe, Trajtenberg and Hesterson (1993) analysed the geographic distribution of patents and the citations of these patents and concluded that patent citations are highly localised, indicating that knowledge spillovers are spatially bounded. In addition, Audretsch and Feldman (1996) examined the spatial distribution of innovation using as a proxy new products introduced to the U.S. market. Their findings support the idea that innovation is spatially concentrated. This is due to the tacit nature of technological knowledge, which indicates that in-person interaction is necessary for the knowledge to spill over (Verspagen and Schoenmakers 2000, Caniels 1999).

Recently, however, this line of argumentations received criticisms. In particular, Breschi and Lissoni (2001) argued that the association of patents' distribution with LKS constitutes only an indirect evidence of the presence of local knowledge spillovers. The fact that patents and patents' citations are locally distributed advocates that knowledge flows more frequently among local firms than among firms situated in long distance. There is not any indication that knowledge circulates freely and without compensation between the firms. Zucker et al (1998) provide empirical evidence, which shows that the knowledge, which is exchanged between local firms and Universities, is pecuniary.

In addition, the notion of tacit knowledge and the way that it has been often used to justify the presence of LKS is challenged. According to economics of knowledge the strict division between tacit and codified knowledge is an oversimplification of a more complex problem that derives not only from the features of knowledge but also from the characteristics of the recipients of this knowledge (Cowan, David and Foray, 2000). In particular, technical knowledge is not tacit only because it cannot be articulated. Rather technical knowledge is highly contextual and specific and thus not everybody is aware of the way that this knowledge is translated into simple meanings. For example, to understand how a software program is built in order to imitate it or to change it, it is necessary to know the particular programming language that the code is written in. For an economist the produced code might be tacit knowledge. However, for a software engineer who is aware of the particular vocabulary, each code represents a well-defined meaning that he can manipulate, reproduce or improve it. On the same ground, Cowan et al (2000) argue, that knowledge is highly contextual and that specific institutional incentives determine its public or private character. Whether knowledge is a public or a private good does not depend on the intrinsic characteristics of knowledge; rather, ‘...the economically relevant characteristics of a good or service derive from the structure of incentives provided for its production and/or consumption’ (Cornes and Sandler, 1996; cited in Breschi and Lissoni, 2001, p. 13).

Another stream of research, which has implicitly incorporated LKS, is qualitative case studies in clusters as well as comparison of clusters in different countries. One of the most influential works has been carried out in the high-tech cluster of Silicon Valley (Saxenian 1994). This study supported empirically the idea that the particular cluster draws its advantages from the strong interdependence of firms, which allows the exchange of ideas and knowledge, which in turn facilitates learning and consequently increases the innovative activity of these firms. However, an important gap in the existing literature is that research has been restricted to high-tech clusters in advanced economies. No much is known whether this argument holds in less developed countries as well.

The most influential work on clusters in developing countries has been undertaken by Schmitz (1999). He analysed the impact of external economies and of joint action upon the competitiveness of clustered firms. He concluded that firms, which act jointly, are more dynamic and competitive than those that receive passively the advantage of external economies within a cluster. However, Schmitz when he refers to external economies does not

separate technological externalities from pecuniary externalities rather external economies are conceived as one thing. Therefore, by treating external economies as a ‘black box’ many aspects of the issue remain in the shadow. This is crucial because technological externalities are different from pecuniary externalities and subsequently they lead to distinct policies. In addition, Schmitz added the notion of “collective efficiency” which is defined as ‘...the competitive advantage derived from local external economies and joint action’. According to Schmitz the existence of external economies the so-called ‘passive collective efficiency’ is not sufficient to sustain the competitiveness of the clustered firms. It is the cooperation of firms that gives rise to the ‘active collective efficiency’, which is crucial for the long-term competitiveness of firms. However, at this point it is important to understand what Schmitz means by joint action, which is so significant for firms’ competitiveness. Joint action or active CE is not other thing but the utilisation or internalisation of external economies. Firms take into account external economies and thus pursue investments in a coordinated way. In sum, what Schmitz suggests is that there are external economies within clusters without specifying the various types of external economies and that firms which take them into account and coordinate their investment (joint action) receive additional advantages (active CE) than others that do not cooperate (passive CE). It becomes apparent now that the literature on developing countries has made considerable efforts to comprehend external economies within clusters. Yet, it is not clear which type of external economies is the most important since they have not been separately examined.

In sum, the review of the literature indicates that LKS are claimed to be crucial for increasing firms’ competitiveness and innovativeness. Yet, the evidence that has been put forward to support these claims is indirect and not convincing. Things do not look better in the literature in developing countries where LKS have not been distinctively examined. In order to assess the importance of LKS for firms’ competitiveness it is first crucial to see if LKS do exist. Thus, the mechanisms of knowledge flows should be examined and analysed.

3. A Theoretical Framework

This study focuses on knowledge flows. In particular, I will investigate the mechanisms of knowledge flows within clusters. Knowledge flows can be classified under the following four types (see Table 1):

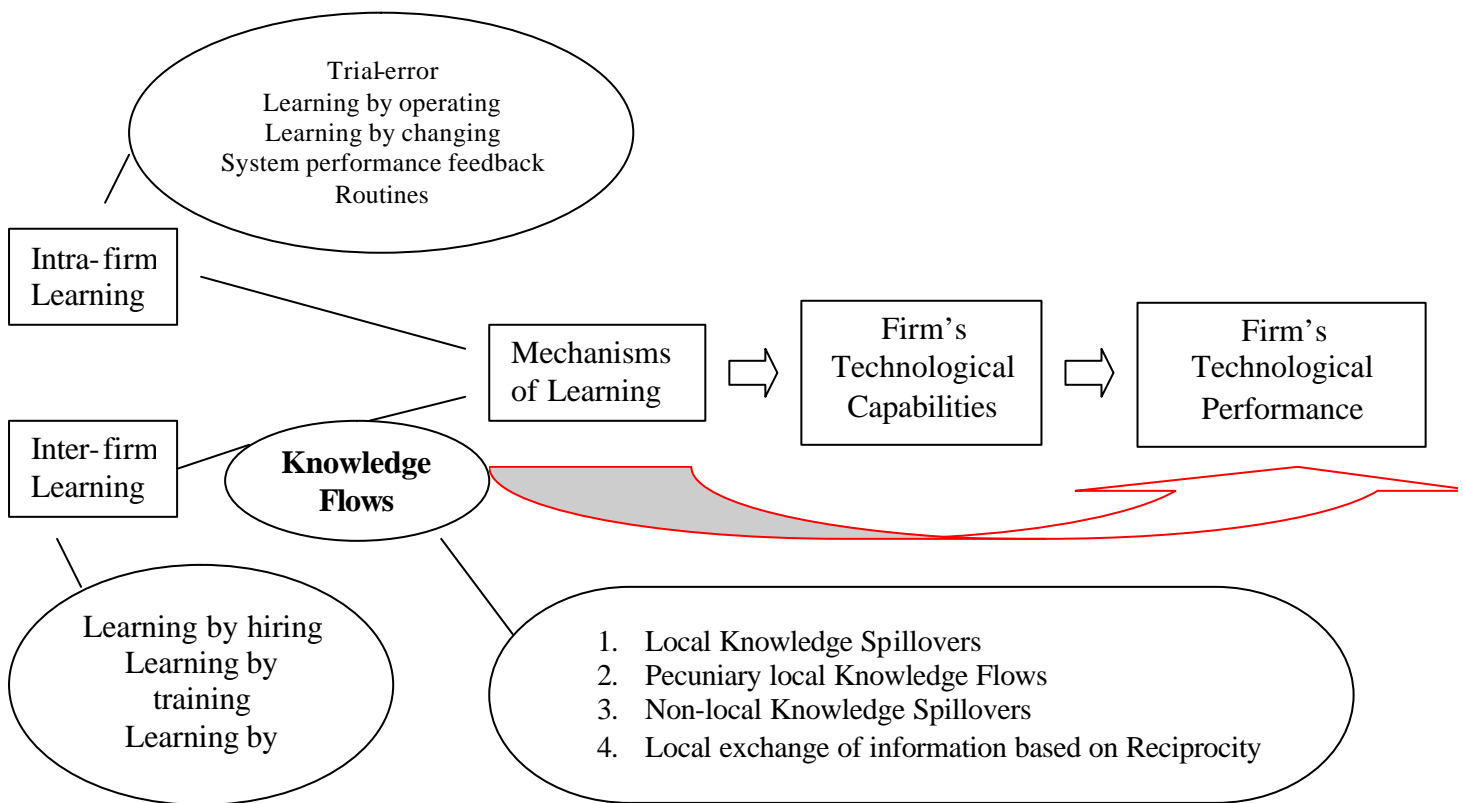
- a. **Local knowledge spillovers** (Audretsch and Feldman 1996, Allen 1983, Lundvall 1992): Local knowledge spillovers denote knowledge that flows freely (anyone can take advantage of it) within the cluster, in a direct (not through the market) and informal way between firms.
- b. **Pecuniary local knowledge flows** (Zucker et al 1998): Pecuniary local knowledge flows indicate knowledge that circulates in the cluster as a result of firms' formal and indirect (through the market) interdependence. Knowledge does not flow freely; only the firms that actually cooperate or are involved in a type of transaction may take advantage of the knowledge flow. In addition, firms interact through the market. For example, the cooperation of firms in sharing the cost or risk of an investment may result in the exchange of valuable knowledge. However, this cannot be considered as a knowledge spill over since it is a deliberate exchange of information mediated by a market transaction.
- c. **Non-local knowledge spillovers:** Non-local knowledge spillovers point out to a free exchange of information over a long distance. Firms imitate each other through reverse engineering, attending trade fairs, following scientific or technical journals and, of course, through patent disclosures.
- d. **Local exchange of information based on reciprocity** (Von Hippel 1987 and 1994): Local exchange of information based on reciprocity signifies that knowledge does not flow freely, but that it is mutually exchanged. Before the exchange takes place, the provider of the knowledge evaluates the knowledge capabilities of the recipient. Subsequently, he provides information according to what he expects to receive.

Table 1: Classification of knowledge flows

Knowledge Flows				
	Local Knowledge Spillovers (Audretsch and Feldman 1996, Allen 1983, Lundvall 1992)	Pecuniary Local Knowledge Flows (Zucker et al 1998)	Non-local Knowledge Spillovers	Local exchange of knowledge based on reciprocity (Von Hippel 1987 and 1994).
Type of knowledge exchange	Free exchange of knowledge	Non-free exchange of knowledge	Free exchange of knowledge	Reciprocal exchange of knowledge
Place of knowledge exchange	Local exchange of knowledge	Local exchange of knowledge	Non-local exchange of knowledge	Local exchange of knowledge
Actors	Firms- Universities/Research Institutes & Between Competitors (horizontal relation) & User-producer (Vertical relation)	Firms- Universities/Research Institutes & Between Competitors (horizontal relation) & User-producer (Vertical relation)	Firms- Universities/Research Institutes & Between Competitors (horizontal relation) & User-producer (Vertical relation)	Between Competitors (horizontal relation)
Mechanisms of acquisition of external knowledge	<ul style="list-style-type: none"> a. Informal exchange of knowledge between university's employees and local firm's employees b. Informal exchange of knowledge among employees of local firms c. Informal exchange of knowledge between suppliers' and users firms' employees. 	<ul style="list-style-type: none"> a. Contract agreements b. Consultancy c. R&D co-operation d. License or selling of proprietary technological knowledge e. Joint investments in training f. Exchange of knowledge with supplier as a by-product of formal co-operation. 	<ul style="list-style-type: none"> a. Reverse engineering b. Journals c. Trade fairs d. Patent disclosures 	Informal exchange of knowledge through communication/meetings of employees

This analysis will produce some valuable results concerning the mechanisms of knowledge flow within clusters and the actors involved. LKS is one of the mechanisms by which knowledge flows within a cluster. Knowledge may also be transferred through partners that are involved in a formal cooperative relation. Additionally, it could be an intermediate situation where a clear pecuniary transaction does not take place. Rather, knowledge is transferred *quasi-free* based on reciprocity. In other words, the provider of the information expects to receive the same quality of information in the future. For example, investing in training and augmenting the human capital of the firm is undoubtedly beneficial for firm's competitiveness. This paper argues that the magnitude of this benefit will depend on the type of knowledge flow through which firms acquire the training (see figure 1). If training is acquired through LKS this means that, possibly, a local supplier (or a local university) might train the employees of the firm for free. In the case of a pecuniary local knowledge flow the training is a distinctive investment made by the firm. Non-local knowledge spillovers imply that the firm prefers to send their employees away to acquire a national or international training. Finally, local exchange of information based on reciprocity shows that firms invest in local social relations as a way to acquire training.

Figure 1: Mechanisms of Learning, Knowledge Flows & Firm's Competitiveness



Inferences can be drawn by examining the mechanisms used by the majority of the firms. When a successful cluster of firms uses a specific type of mechanism, this could mean that in comparison to the other existing potential mechanisms, this one in particular is the best. It could also be the case that firms within the cluster use diverse mechanisms of knowledge transfer. Understanding why different groups of firms use different mechanisms will shed light upon the ways in which knowledge flows operate. It might be the case that large dynamic firms use pecuniary ways of acquiring knowledge, whereas small firms attempt to obtain knowledge through LKS, or by developing relations based on mutual exchange of information. To answer *why some firms choose a particular knowledge flow* we shall look inside the firm and understand their internal mechanisms of learning.

4. Research questions

A first prerequisite towards operationalising this approach, it is the appropriate comprehension of the firms' mechanisms of learning in less developed countries. In other words, it is important to understand how firms acquire knowledge from external sources (inter-firm learning) and how they process this knowledge internally (intra-firm learning). LKS is a type of knowledge, which flows when a firm attempts to learn from external sources. However, as I have already mentioned in section 3, LKS are not the only mechanisms of knowledge flow identified in the literature. It is worthy knowing which are the mechanisms of knowledge flow within a cluster for two main reasons; firstly, the empirical identification and analysis of the different types of knowledge flow within a cluster will help us understand the functioning of the mechanisms of LKS. As Audretsch et al (2003, p.13) admit '*...there is no understanding of the way in which spillovers occur and are realised at the geographic level*'. A micro study may be useful in distinguishing LKS from other mechanisms of knowledge flow. Secondly, thanks to this analysis, we will be in a favourable position to verify the presence of LKS, and also to assess their strengths in comparison to other types of knowledge flow. Therefore, the most important research question I will address throughout this study is:

RQ 1: Which are the various mechanisms of knowledge flow within a cluster?

Furthermore, it is relevant to comprehend whether there is any association between the type of knowledge flow that a firm mainly uses, and its technological performance and economic competitiveness. This issue will be addressed by the following two questions:

RQ 2: How important are LKS versus the other mechanisms of knowledge flow for firm's technological performance and economic competitiveness?

RQ 3: How important are intra-cluster versus extra-cluster mechanisms of knowledge flow for firm's technological performance and economic competitiveness?

Last but not least, this project suggests that the choice of a particular mechanism of flow might be influenced by the firms' internal mechanisms of learning. The latter determines the absorptive capacity of a firm, which in turn influences the quantity and quality of information that a firm may absorb (Cohen and Levinthal 1990). For example, a firm that has a well-organised system of performance feedback will have a higher absorptive capacity than a firm that does not keep a record of the problems that has confronted, and the ways in which those problems were surmounted. Consequently, firms with a high absorptive capacity may be able of grasp the knowledge that flows freely in the cluster. On the other hand, firms with a low absorptive capacity may invest in social relations, which would provide them with reciprocal exchange of information. Thus, the last two research questions are:

RQ 4: Which is the quantitative distribution of the different mechanisms of knowledge flow over firms within a cluster?

RQ 5: Is there any correlation between the internal (to the firm) mechanisms of learning and their choice of a particular type of knowledge flow? Do firms with different absorptive capacities use different types of knowledge flow?

Inferences can be drawn, thus, about the attributes of LKS and the basic claim that their circulation is free within a cluster and available to all the firms. If the intra-firm learning mechanisms represent the firm's absorptive capacity, what is important to see is whether firms with heterogeneous absorptive capacities utilise in a different way their external environment. This analysis will reveal which type of firms use a specific mechanism of flow and why.

5. Methodology

If we want to find out whether local knowledge spillovers are important drivers of technological advance and competitiveness in a less developed country setting, we should explore new methodological avenues. A common approach to study knowledge spillovers is the use of secondary data in a high level of aggregation and the analysis of this data with the use of statistical methods. Innovative output (patents or new products) and innovative effort

(R&D) are used as proxies of innovative activity and their spatial distribution is analysed. We argue that an alternative approach should be used for the following reasons:

Firstly, aggregate data related to innovation is scarce in most developing countries. Secondly, many problems derive from the method of aggregation itself. For example patents, which usually are considered as a proxy for innovation, are mainly the outcome of formal research activity. However, patents do not cover all the outcomes of innovative activity. Even in the case of considering R&D activity as a proxy of the innovative effort, this ignores the complex activities and efforts, which contribute to technological accumulation. These efforts many times do not entail formal R&D which is an activity mainly undertaken by large firms usually in developed countries. Technological upgrading in firms in less developed countries and in particular in small and medium enterprises, is rather demonstrated by the ability to adapt, improve and develop technologies as well as by the ability of problem solving (Bell M. 1984).

Another methodology, which has been used more in the analysis of clusters and in the analysis of knowledge spillovers, is the qualitative approach (Nadvi 1996, Saxenian 1994). However, a qualitative case study will not serve the purpose of this research; that is to assess and measure the importance of LKS. This is not to say that qualitative research is not essential. On the contrary, qualitative research will complement this project by providing more in-depth information and consequently get a complete picture of the problem. It is argued that the trustworthiness⁷ of the information acquired by research would be greater if the two methodologies will be combined (Marsland et al 1998).

Finally, innovative surveys have been undertaken in many developed countries and less in developing countries. This methodology considers more indicators of innovative activity than the macro-quantitative approach. However, it is more general since it covers the whole economy whereas this project aims to understand in depth the function of local knowledge spillovers in an industrial area.

Therefore, it is necessary to develop a methodological approach in which the importance of LKS (in relation to other mechanisms of knowledge flow) will be measured and statistically analysed on the basis of new firm level data collected through fieldwork. A micro quantitative

⁷ The value of information can be tested in the following four ways: a. Internal validity; b. External validity; c. Reliability; d. Objectivity (Marsland et al 1998).

study will explore the phenomenon of knowledge spillovers in a high-tech cluster in a developing country by overcoming two important problems that derive from existing studies: first, the lack of data in less developed countries and second, the risk of misrepresenting innovative activity by considering indicators related to patents or R&D in a developing country setting. New firm level data will be collected through structured questionnaires and will be enriched by selected interviews. Indicators of innovative activity will be considered to articulate thoroughly the technological advancement of firms in less developed countries.

6. Project outcome

The aim of this project is to investigate whether LKS stimulate technological upgrading and increases the economic competitiveness of firms in high-tech clusters in developing countries. The main research procedure to tackle this problem is to assess the importance of LKS versus other types of knowledge flow through which firms acquire external learning. If LKS occupy a prominent role in high-tech clusters in developing countries this would suggest that a scenario similar to that of developed countries takes place in a developing country setting. Policies similar to those that are implemented in developed areas could be used and slightly adjust to the different environment of a less developed country. On the contrary, if it will be shown that LKS play a minor role in increasing the technological competitiveness of firms in high-tech clusters in developing countries, this would indicate that something entirely different and unknown is taking place in less developed countries. It could be the case that other advantages related to geographical distance and not LKS stir technological advance in developing countries. This outcome would propose that distinct policies other than the ones implemented in developed countries should be applied in less developed countries.

By undertaking a micro quantitative investigation many problems related to aggregate studies, to qualitative research as well as to the peculiarities of developing countries will be surmounted. The limitations of this research would derive from the consideration of a case study and the danger of subjectivity. For that reason a list of criteria will be set beforehand in order to facilitate the objective selection of the case which would serve best the aim of this research.

7. Criteria for selecting the case study

▪ Developing country setting

The relevance of local knowledge spillovers for developing countries is high. Technological externalities or LKS have a significant impact on economic growth. Less developed countries that try to catch-up technologically may take advantage of LKS and accelerate their economies. An obstacle to this type of development is that technological spillovers are weak in developing countries. An explanation for this could be the low levels of absorptive capacity that characterise many firms in developing countries. In other words, LKS can have an impact on the technological performance of firms, only when the latter are able to make use of the received knowledge. The aim of this project is to clarify the mechanisms of knowledge flow and through light on the way that technological spillovers operate. This research can be useful for developing countries in suggesting ways to strengthen their technological spillovers and thus achieve high rates of growth.

▪ High-tech cluster

It has been claimed that knowledge spillovers are important, especially for knowledge intensive sectors since they involve a great degree of tacit knowledge (Audretsch and Feldman, 1996). Therefore, to be able to assess empirically the significance of LKS and to explore in detail their functions, a knowledge intensive sector needs to be selected. A high-tech sector can be identified by using Pavitt (1984) classification or the Industrial Classification based on the R&D intensity of the sector. An adequate criterion for selecting the sector may be its high percentage of human capital (education level, years of experience).

Currently a few high-tech clusters exist in developing countries. However, many developing countries attempt to shift towards high-tech sectors and profit from LKS. Technological spillovers can play a key role in the development of high tech clusters in LDC and contribute significantly to economic growth.

▪ Economic & technological dynamic sector

In terms of development strategy the chosen sector should be large and economically dynamic. In other words, it should have or expected to have a significant contribution to the country's growth, productivity and employment. Another consideration when choosing the sector will be whether it is included in the national plans of industrial or technological development.

REFERENCES

- Audretsch D. and Feldman M. (1996) R&D Spillovers and the Geography of Innovation and Production, *The American Economic Review*, Vol. 86, No. 3.
- Audretsch D. and Feldman M. (2003) Knowledge Spillovers and the Geography of Innovation, Prepared for the Handbook of Urban and Regional Economics, Volume 4.
- Aydalot P. (1986) Presentation in Aydalot P. (ed) *Milieux innovateurs in Europe* Paris, Gremi (pp. 9-14).
- Becattini G. (1990) The Marshallian industrial district as a socio-economic notion in Pyke F., Becattini G., Sengenberger W. (eds.), *Industrial Districts and Inter-Firm Co-operation in Italy*, Geneva. ILO (pp.37-51).
- Bell M. (1984), Learning and the Accumulation of Industrial Technological Capacity in Developing Countries, in Fransman M. and King K. (eds.) *Technological Capability in the Third World*, Macmillan Press, Hong Kong.
- Breschi S. and Lissoni F. (2001) Knowledge Spillovers and Local Innovation Systems: A Critical Survey, *Liuc Papers*, N. 84, *Serie Economia e Impresa*.
- Camagni R. (1991) *Innovation Networks: Spatial Perspectives* (Ed), Belhaven Press, London/New York.
- Caniels M. (1999) Regional Growth Differentials: The Impact of Locally Bounded Knowledge Spillovers, PhD thesis, Maastricht.
- Cohen W.M. and Levinthal D.A. (1990), Absorptive capacity: a new perspective on learning and innovation, *Administrative Science Quarterly*, 35.
- Cooke P. (2001) Regional Innovation Systems, Clusters, and the Knowledge Economy, *Industrial and Corporate Change*, vol. 10, N. 4, pp. 945-974.
- Cowan R., David P.A. and Foray D. (2000) The Explicit Economics of Knowledge Codification and Tacitness, *Industrial and Corporate Change*, Vol. 9, N. 2.
- Dosi G. (1988) Sources, procedures and microeconomic effects of innovation, *Journal of Economic Literature*, 26, 1120-1171.
- Hirschman A. O. (1958) *The Strategy of Economic Development*, Yale University, New Haven
- Jaffe A. B., Trajtenberg M. and Henderson R. (1993), Geographic Localization of Knowledge Spillovers as Evidence by Patent Citations, *Quarterly Journal of Economics*, August 1993, 63 (3), pp. 577-98.
- Lundvall B. A. (1992) *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*. Pinter, London.
- Marshall A. (1920) *Principles of Economics*, MacMillan.

- Marsland N., Wilson I., Abeyasekera S., Kleih U. (1998) *A Methodological Framework for Combining Quantitative and Qualitative Survey Methods*, Report written for DFID Research project R7033.
- Morgan Kevin (1997) *The Learning Region: Institutions, Innovation and Regional Renewal* *Regional Studies* Vol. 31, No. 5, pp. 491-503.
- Nelson, R. and S. Winter (1982) *An Evolutionary Theory of Economic Change*, Harvard University Press, Cambridge, MA.
- Nonaka I. 1994 A Dynamic Theory of Organizational Knowledge Creation *Organizationa Science*, Vo. 5, No. 1.
- Piore M. and Sabel C. (1984) *The Second Industrial Divide: Possibilities for Prosperity*, New York, Basic Books.
- Porter M. (1990) *The competitive Advantage of Nations*. Macmillan, London.
- Ray D. (1998) *Development Economics*, Princeton University Press, Princeton New Jersey.
- Rosenstein-Rodan P. (1943), Problems of Industrialization of Eastern and Southeastern Europe, *Economic Journal* 43, (June-September 202-211).
- Saxenian A. (1994) *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*, Harvard University Press, Cambridge, MA.
- Schmitz Hubert (1999) Collective Efficiency and Increasing Returns *Cambridge Journal of Economics*, Vol. 23, pp. 465-483.
- Scitovsky T. (1954) Two concepts of external economies, in Arrow K. and Scitovsky T. (Eds) *Readings in Welfare Economics* (1969) Allen and Unwin LTD, London.
- Stewart F. and Ghani E. (1991) How Significant Are Externalities for Development? *World Development*, Vol. 19, No. 6, pp. 569-594.
- Storper M. and Scott A. J. (1998) The Geographical Foundations and Social Regulation of Flexible Production Complexes, in Wolch J. and Dear M. (Eds) *The Power of Geography* Allen and Unwin, London.
- Verspagen B. and Schoenmakers W. (2000) The spatial dimension of knowledge spillovers in Europe: Evidence from patenting data, Paper presented at the *AEA Conference on Intellectual Property Econometrics*, Alicante, 19-20 April.
- Westphal Larry E. (1990) Industrial Policy in an Export-Propelled Economy: Lessons from South Korea's Experience, *Journal of Economic Perspectives*, Vol 4, No. 3, 41-59.
- World Bank (2003) *Global Economic Prospects and the Developing Countries*.