SMEs' Absorptive Capacities and Large Firms' Knowledge Spillovers: Micro Evidence from the Machining Industry in Mexico

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***Abstract*:** The aim of this paper is to analyse the relationship between large firms' knowledge spillovers and small and medium enterprises' absorptive capacities. We build *ad hoc* indicators for these two concepts following a factor analysis methodology, and carry out a structural equations analysis to determine the relationship between them. Based on firm level data from a survey that focuses on SMEs of the machining industry in a Mexican locality, this paper argues that in a low-tech and mature sector, which operates in a loosely articulated local system, two knowledge spillover mechanisms are relevant – the backward linkages and the employees' mobility. SMEs' absorptive capacities are strongly influenced by organisational capabilities and innovation and learning activities. We also argue that large firms' knowledge spillovers are strongly correlated with SMEs' absorptive capacities within the sector and locality analysed.

Keywords: diffusion processes, economic development, entrepreneurship, knowledge, Latin America, machinery, models, regional economic activity, SME, technological change

JEL classifications: D83, L11, L26, L64, O10, O30, O33, O54, R11, R15

1. Introduction

There has been a growing interest regarding the analysis of knowledge spillovers within localities. Several studies from different bodies of literature have identified a set of factors that affect the scope of knowledge spillovers, reaching consensus that one of the most important factors is firms' absorptive capacities. Even though there is a common agreement with regard to the positive and direct relationship between knowledge spillovers and absorptive capacities, there are still gaps in identifying the nature of this relationship, the specific knowledge spillovers' mechanisms and the determinants of absorptive capacities.

There are important contributions from the organisational and cognitive literature about the identification of different spillover mechanisms, such as demonstration-imitation effects, backward linkages, direct technology transfer, training, human capital mobility, competence, and foreign linkages (Albaladejo, 2001; Chudnovsky *et al*., 2003; Vera-Cruz and Dutrénit, 2005; Jordaan, 2005; Marin and Bell, 2006; Chudnovsky *et al*., 2008; Nelson, 2009). Other studies that focus on localised knowledge flows and the effects of foreign direct investment (FDI) have analysed the importance of firms' absorptive capacities to appropriate knowledge spillovers. They emphasise the role of investment in R&D, knowledge, technological capabilities, embedded technology, and firms' innovation strategies as the main determinants

of absorptive capacities (Alcácer and Chung, 2003; Chudnovsky *et al*., 2003; Giuliani, 2003; Escribano *et al*., 2005; Ivarsson and Göran, 2005; Vera-Cruz and Dutrénit, 2005; Marin and Bell, 2006; Chudnovsky *et al*., 2008; Rasiah, 2008; Escribano *et al*., 2009).

However, most of the works that have analysed the relationship between knowledge spillovers from FDI and local firms' absorptive capacities use proxy indicators either for knowledge spillovers or absorptive capacities. The use of such indicators is problematic, as they might not grasp the main characteristics of absorptive capacities, reaching contradictory results regarding the relationship between absorptive capacities and knowledge spillovers. Some of those studies conclude that technology sectors (Girma and Wakelin, 2000; Kinoshita, 2000; Girma, 2003; Marin and Bell, 2006), or the level of aggregation and geographic distance (Blomström and Kokko, 2003; Girma, 2003; Jordaan, 2005; Rasiah, 2008) play an important role in the scale and nature of knowledge spillovers and the associated benefits derived.

Most of those studies have analysed the effect of FDI in host countries, focusing on knowledge spillovers from MNCs to local firms. However, based on the empirical evidence from this paper, we observe knowledge spillovers from MNCs and large domestic companies to SMEs, and we did not find significant differences between MNCs' and large domestic companies' spillovers in the context analysed. Therefore we analyse large firms' knowledge spillover mechanisms without differentiating by property type.

Focusing on SMEs from the machining industry located in Querétaro, Mexico, the aim of this paper is twofold, first to discuss whether there is a positive and strong relationship between large firms' knowledge spillovers and SMEs' absorptive capacities. We also seek to disentangle the specificities of the relationship between large firms' knowledge spillovers and SMEs' absorptive capacities, and contribute to the analysis of the determinants of these two concepts. We argue that identifying accurate determinants of knowledge spillovers and absorptive capacities would be useful for policy-makers seeking to design policy for stimulating the benefiting by firms from the large firms' knowledge spillovers.

This paper is based on micro data from a survey applied during 2005 to SMEs that belong to the machining industry in Querétaro. This is a traditional and low-tech industry dominated mostly by SMEs. These firms present a *hub-and-spoke*[1] type of arrangement with their clients, which are mostly medium-large domestic firms and MNCs, half of them from the automotive and home appliances sectors. Querétaro is geographically located in the centre of Mexico and is one of the most dynamic cities with important industrial activity. Its main industrial activities are metal mechanic, automotive, textile, chemistry, electric-electronic and

food processing These comprise 1.8 per cent of the Mexican GDP. Local infrastructure such as electric services, industrial parks and road systems has fostered the growing of different industries.

The machining industry in Querétaro reported sales of US$49 million dollars and employed more than 3,000 people in 2005. The SMEs supply around 10 per cent of the total demand for machining products in the locality, most of them low-tech products. Their principal products are gears, arrows and dies (production and repairing).

This paper is divided into five sections, the next one presenting an analytical framework that refers to knowledge spillovers, absorptive capacities and the relationship between these two concepts. Section three describes the methodology for data gathering and information analysis. Section four presents and discusses the empirical evidence and the main analytical results. Section five contains the concluding remarks.

2. Conceptual Framework: The Importance of Absorptive Capacities

Several studies from organisational theory that have analysed the impact of FDI on host countries focus on spillovers from MNCs to local firms. These studies follow different methodologies using *proxy* indicators that relate FDI with local firms' productivity, arguing that productivity increases are directly related to MNCs' spillovers (Sjöholm, 1999; Chung, 2001; Blomström and Kokko, 2003). Nevertheless, the use of this type of indicator does not allow us to observe whether local firms' productivity increases are in fact due to MNCs spillovers or to other factors. Some other bodies of literature that focus on knowledge flows among agents within the same locality (Dutrénit and Vera-Cruz, 2003; Giuliani, 2003; Giuliani, 2005) usually emphasise the heterogeneity of firms, some using *ad hoc* indicators. These works stress the fact that knowledge flows cannot be diffused homogenously to different firms in a locality, as local firms need a certain level of absorptive capacities to reap their benefits. We build on this second stream of literature and contribute to the identification of specific determinants for knowledge spillovers and absorptive capabilities and the relationship between these two concepts.

Escribano *et al*. (2005) define knowledge spillovers as involuntary knowledge flows that arise when part of the knowledge generated by an organisation spills over its boundaries and becomes available to other organisations. We adapt their concept to analyse large firms' knowledge spillovers – that can be either from national large firms or MNCs and different types of firms' performance – including productivity and other dimensions. Thus we define

knowledge spillovers as "the organisational and technological benefits that local SMEs get from large firms' knowledge flows, which can be either intentional or unintentional, and increase SMEs' performance".

Knowledge spillovers can be horizontal (across sectors), or vertical (within the same sector). The amount and nature of vertical and horizontal spillover varies within sectors and regions, as found by Kinoshita, (2000); Girma *et al*. (2001); Girma, (2003); Jordaan, (2005); Kugler, (2006); Motohashi and Yuan, (2010).

There are several diffusion mechanisms of knowledge spillover. One major mechanism is *backward linkages* – this requires upgrading from local firms to use their resources more efficiently to remain competitive (Blalock and Gertler, 2004; Javorcik, 2004; Kugler, 2006). A second is *human capital mobility* – this means that MNCs have the ability to increase the human capital pool. Imbued with the technology, knowledge and organisational techniques, their employees become direct agents of technology transfer. This spillover mechanism can be observed through employees' mobility (Chudnovsky *et al*., 2003; Girma and Görg, 2005; Jordaan, 2005; Rasiah, 2007; Chudnovsky *et al*., 2008) and entrepreneurship by the creation of new firms (Görg and Greenaway, 2001; Vera-Cruz and Dutrénit, 2005). A third mechanism is *training* – MNCs sometimes promote the training of key employees of their suppliers, which increases local firms' technological and organisational capabilities (Kinoshita, 2000). Other forms of diffusion mechanisms are: demonstration-imitation (Kim, 1997; Liu and Buck, 2007); increased competence (Chung *et al*., 2003); foreign linkages (Gorg and Hijzen, 2004; Liu and Buck, 2007); and patents and R&D (Cabrer-Borrás and Serrano-Domingo, 2007; Liu and Buck, 2007; Kafouros and Buckley, 2008; Coe *et al*., 2009; O'Mahony and Vecchi, 2009; Motohashi and Yuan, 2010). Only some of these mechanisms have been measured empirically, providing important insights about the nature of knowledge spillovers in certain regions and sectors. The current study draws on these studies and focuses on an analysis of the first three mechanisms.

There are different factors that may affect the level of knowledge spillovers by local firms, such as technology level and geographical distance, but as we mentioned above, there is a strong consensus regarding the importance of firms' absorptive capacities for gaining the benefits from knowledge spillovers. Knowledge does not automatically spill over and result in increased innovativeness, competitiveness and growth. In fact it has been confirmed by several studies that the scope of spillovers may depend on the absolute level of local firms' absorptive capacities (Borensztein *et al*., 1998; Durham, 2004; Liu and Buck, 2007). In this direction, several studies from different perspectives have contributed to an analysis of the

relationship between knowledge spillovers and absorptive capacities (Albaladejo, 2001; Chudnovsky *et al*., 2003; Jordaan, 2005; Chudnovsky *et al*., 2008; Escribano *et al*., 2009), stressing the fact that local firms need a certain level of absorptive capacities to benefit from spillovers.

Absorptive capacities reflect firms' knowledge bases and are related to the individual performance of firms (Albaladejo, 2001; Giuliani, 2003; Giuliani, 2005). According to Cohen and Levinthal (1999: 128), absorptive capacities are the ability of firms to recognise the value of new information, assimilate it and apply it to commercial ends. Thus the identification of external knowledge sources and the assimilation and exploitation of knowledge is vital to increasing firms' competitive advantage. Firms with higher levels of absorptive capacity can identify and manage external knowledge flows and stimulate innovative outcomes more efficiently than otherwise. The current paper uses this definition of absorptive capacities.

One set of empirical works that analyses the importance of absorptive capacities to appropriating the benefits from spillovers correlates the technology gap between MNCs and local firms with the latter's absorptive capacities (Girma, 2003; Girma and Görg, 2005). In some cases, the results are vague, as some studies have shown that the larger the technology gap is, the higher the level of knowledge spillovers (Driffield, 2001; Castellani and Zanfei, 2003), while on the other hand, some studies have shown that firms are able to reap the benefit from spillovers only when the technological gap is moderate (Kokko, *et al*., 1996). Girma (2003) stresses that there must be a certain range of technology gap or cognitive distance between firms. Below the minimum level there are no technology spillovers as firms share about the same level of knowledge. In contrast, above the maximum level, the cognitive distance is far too large for firms to absorb higher levels of knowledge and again there are no spillovers. These results suggest that the use of the technology gap as an indicator of absorptive capacities is sometimes problematic, as it does not capture the main determinants that explain absorptive capacities at firm level. Thus, the analysis of the importance of absorptive capacities to appropriate the benefits of knowledge spillovers remains unclear in such studies.

Another set of empirical studies (Chudnovsky *et al*., 2003; Escribano *et al*., 2005; Marin and Bell, 2006; Chudnovsky *et al*., 2008) has used other types of indicators that reflect more directly absorptive capacities, such as R&D expenditure, patents, human capital, scientific and technical training, and investment in equipment. These studies have usually found a positive and strong relationship between knowledge spillovers and absorptive capacities. However, most of them measure knowledge spillovers by the impact of FDI on firms'

productivity, which is a *proxy* indicator for knowledge spillovers and does not really represent the exact mechanisms of knowledge spillover.

To analyse absorptive capacities, this study uses indicators proposed by other studies: human capital – measured by entrepreneurs and employees' background; technology embedded in equipment; and learning and innovation activities. It also incorporates other indicators – organisational capabilities and linkages with other local agents.

We aim to contribute to the empirical approach by building *ad hoc* indicators to analyse the main determinants of knowledge spillovers and absorptive capacities, and by analysing the relationship between these two concepts in a particular sector and region.

Regarding the specificities of the relationship between knowledge spillovers and absorptive capacities, we have conceptualised two sets of indicators (second order factors), one to analyse knowledge spillovers of large firms, and the other to analyse absorptive capacities of traditional and low-tech SMEs, where R&D activities are not common, and human capital is not specialised. To conceptualise spillover indicators, we focus on three spillover mechanisms – backward linkages, human capital mobility (employees' mobility and entrepreneurship), and training. With absorptive capacities we build an indicator that includes owner and employees' background and experience, technology embedded in equipment, organisational and innovative capabilities, and linkages with other local agents. This analysis aims to close the gap related to the most important mechanisms of knowledge spillovers and the most important determinants for absorptive capacities. These indicators provide the basis for analysing the relationship between knowledge spillovers and absorptive capacities in the low-tech and mature sector of machine tools in the dynamic industrial locality of Querétaro, Mexico.

3. Methodology

This paper draws on primary data gathered from a survey applied during 2005 to the machining industry in Querétaro, Mexico. Of the 225 firms we identified, 179 responded to our questionnaire, representing 80 per cent of the machining industry in the locality. However, we only collected complete information for analysing 110 firms according to the aims of this paper.

The survey sought each firm's general information, characteristics of the entrepreneur, characteristics of the employees, machinery and equipment, innovative behaviour,

organisational characteristics, linkages with clients, and linkages with other agents in the locality.

A previous version of this survey was applied to SMEs of the same industry in Ciudad Juarez, Mexico, a border city with the United States (Vera-Cruz and Dutrénit, 2005). Even though both localities can be compared using the surveys, this new version was modified in order to capture better the main characteristics of SMEs, and to build indicators of absorptive capacities and knowledge spillovers. Table 1~~Table 1~~ presents statistics that describe the main characteristics of the machining industry.

[INSERT TABLE 1 ABOUT HERE]

It can be seen that the machining industry in Querétaro is characterised by low-tech, where most firms enjoy basic capabilities to supply low-tech products to their clients. This industry requires technicians and engineers with production, design and computational skills, but much of the expertise has been developed through learning by doing rather than through formal education. This type of knowledge acquisition can be represented mainly as a form of tacit knowledge acquisition by learning-by-doing (Nonaka and Takeuchi, 1996). However, their schemes for knowledge acquisition have not provided the basis to keep building on that knowledge to reach higher levels necessary to produce more complex products and increase market shares.

To analyse the relationship between large firms' knowledge spillovers and SMEs' absorptive capabilities we perform a multivariate analysis by principal factors to build two indicators, one for SMEs' absorptive capacities and the other for large firms' knowledge spillovers. Then we build a structural equation model to identify the relationship between these two variables.

Multivariate Analysis to Obtain Indicators of Absorptive Capacities

We suggest that SMEs' absorptive capacities can be analysed using a set of indicators related to the entrepreneur and employees' background, technology embedded in equipment, organisational capabilities, learning and innovation activities, and linkages with other local agents. To build the indicator of absorptive capacities (second order factor), first we need to build the indicators associated with each one of its components (first order factors).

(i) *Entrepreneur and employees' background*: Most of the studies that have analysed absorptive capacities emphasise the importance of human resources, and analyse education and experience as one of the most important indicators for absorptive capacities (Marin and Bell, 2006; Escribano *et al*., 2009). To build this indicator we analysed variables related to formal education and previous experience of owners and employees. Most employees in the sector have a technician's degree (35 per cent) or have gained their experience empirically (13 per cent). Only 4 per cent of them have an engineer's degree.

(ii) *Technology embedded in equipment*: Marin and Bell (2006) analysed this variable as an important indicator of absorptive capacities, arguing that machinery and equipment is highly correlated with the production of complex products, requiring employees to develop higher levels of expertise, which represent higher levels of absorptive capacity. To build this indicator we analysed variables related to the type of equipment and the years that firms have been using that particular equipment. As we can see from Table 1~~Table 1~~, most of the firms have conventional equipment, while a small number of firms have numerical control (NC) or computer numerical control (CNC), which is necessary to produce more complex products.

(iii) *Organisational capabilities*: Within the sector and locality analysed, we observed that organisational capabilities represent a key element for SMEs' competitiveness, thus we incorporate some variables to analyse organisational capabilities such as quality control management, and management and decision making techniques. However, only 4 per cent of the owners in the sector have previous experience in management, and 21 per cent of them have experience in quality control.

(iv) *Learning and innovation activities*: R&D and innovation activities are one of the preferred indicators for absorptive capacities (Cohen and Levinthal, 1999). However, within a mature and low-tech sector, where R&D is not very common, we decided to consider other variables related to learning mechanisms and innovative activities, such as projects with clients and suppliers, process documentation, training programs, and product and process innovation that the firm has conveyed within a three year period.

(v) *Linkages with other local agents*: These linkages represent an important source for raising SMEs' absorptive capacities. We included in our analysis linkages with firms, technical institutions and industrial associations.

The following set of equations expresses the indicators for SMEs' absorptive capacities.

$$F_{1EEE} = \gamma_{11} X_{AC1} + \varepsilon_1$$

$$F_{2TEE} = \gamma_{12} X_{AC2} + \varepsilon_2$$

$$F_{3OC} = \gamma_{13} X_{AC3} + \varepsilon_3$$

$$F_{4LIA} = \gamma_{14} X_{AC4} + \varepsilon_4$$

$$F_{5L} = \gamma_{15} X_{AC5} + \varepsilon_5$$

where:

F_{1EEE} is the indicator for entrepreneur and employees' experience;

F_{2TEE} is the indicator for technology embedded in equipment;

F_{3OC} is the indicator for organisational capabilities;

F_{4LIA} is the indicator for learning and innovation activities;

F_{5L} is the indicator for linkages with other local agents;

$X_{AC1...5}$ is a vector of explanatory variables for each one of indicators of absorptive capacities.

Table 2~~Table 2~~ lists each one of the variables that we used to build the five indicators of SMEs' absorptive capacities.

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[INSERT TABLE 2 ABOUT HERE]

Multivariate Analysis to Obtain Indicators of Knowledge Spillovers

We analyse large firms' knowledge spillovers in a broad sense. Included are those from subsidiaries of MNCs and from medium and large firms owned by domestic capital. We consider that knowledge spillovers (second order factor) can be analysed by three main sets of indicators related to specific mechanisms (first order factors), which are derived from different variables in the survey. Thus, first we built indicators associated with the types of knowledge spillover mechanisms and then built the indicator of knowledge spillovers. We focus on knowledge spillovers that are diffused by three main spillover mechanisms:

(i) *Backward linkages*: This type of spillover is mainly observed by direct technology support and by the need of local firms to use their resources more efficiently to meet their clients' requirements (Lall, 1980; Jordaan, 2005). We suggest that in the sector and locality analysed this type of knowledge spillover is particularly important for the type of vertical integration between SMEs and their clients. We analyse variables such as the type of knowledge and information that firms get from their clients and if those linkages are formal or informal. In general terms, SMEs have an average relationship of 6 years with their clients. They usually do not establish formal contracts, which can represent a barrier for their investment projects. The most common types of interaction are access to clients' installations, joint projects to increase product quality, and transfer of design and production capabilities.

(ii) *Human capital accumulation and mobility*: According to Blomström and Kokko (2003) and Görg and Greenaway (2001), this is one of the most important knowledge spillover mechanisms. Rasiah (1994, 2002) provides empirical evidence about the importance of human accumulation and mobility as a mechanism of knowledge spillover. We analyse the mobility of employees to SMEs and also the role of entrepreneurship (i.e. the creation of new firms by large firms' former employees). We expect that entrepreneurship plays an important role as a mechanism of knowledge spillover in the sector analysed, as 91 per cent of entrepreneurs have had experience in other organisations (mainly large firms) for 18 years on average. Regarding employees' mobility, almost 39 per cent of the employees have had experience in large firms. Their experience has been mainly in production, quality control and maintenance. Only 16 per cent of them have engineering experience and 4 per cent managerial experience.

(iii) *Training*: Kinoshita (2000) has emphasised the role of backward linkages to promote the training of key employees of supplier firms. The main purpose of training is to increase their abilities to meet clients' demands. We analysed the number of employees that have been trained by their clients, the importance of training, and previous experience of employees in other firms. We argue that this is an important spillover mechanism, as employees get more involved with the techniques and requirements from their clients and several MNCs have either formal or informal training programmes for their clients. We observed that large firms have trained 4 per cent of SMEs' employees.

To build the indicator of knowledge spillovers, first we construct four indicators (first order factors) associated with three mechanisms of knowledge spillover: i) for backward linkages we built two indicators, one for formalisation of linkages with clients and the other for type of linkages established with clients); ii) human capital accumulation and mobility (for owners); and iii) human capital accumulation and mobility and training (for employees). The following set of equations expresses the indicators for large firms' knowledge spillovers.

$$F_{1FL} = \beta_{13} X_{KS3} + \varepsilon_3$$

$$F_{2TL} = \beta_{14} X_{KS4} + \varepsilon_4$$

$$F_{3OM} = \beta_{11} X_{KS1} + \varepsilon_1$$

$$F_{4EM} = \beta_{12} X_{KS2} + \varepsilon_2$$

where:

F_{1FL} is the indicator of formalisation of linkages with clients;

F_{2TL} is the indicator of the type of linkages with clients;

F_{3OM} is the indicator of human capital accumulation and mobility (owners);

F_{4EM} is the indicator of human capital accumulation and mobility and training (employees);

$X_{KS1...4}$ is a vector of explanatory variables for each one of the indicators of knowledge spillovers.

Table 3~~Table 3~~ presents the variables that were used to build these four factors.

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[INSERT TABLE 3 ABOUT HERE]

Structural Equations Analysis to Identify the Relationship between Knowledge Spillovers and Absorptive Capacities

During the second stage of the analysis we build a structural equation model with causal modelling to establish the relationship between absorptive capacities and knowledge spillovers. Using the technique of causal modelling it is possible to incorporate both first and second order factors and identify the most important determinants of knowledge spillovers and absorptive capacities and the relationship between them. However, due to data size restrictions, we divided the construction of the model into two stages. The results

from the structural equation model provide information to flesh out the most important knowledge spillover mechanisms, and the most important determinants of absorptive capacities. We will also identify the determinants of the relationship between knowledge spillovers and absorptive capacities. Figure 1~~Figure 1~~ presents the structural equation model to identify the relationship between absorptive capacities and knowledge spillovers and the importance of each indicator of knowledge spillovers and absorptive capacities.

[INSERT FIGURE 1 ABOUT HERE]

The following equation expresses the structural equation model to establish the relationship between absorptive capacities and knowledge spillovers.

$$F_{KS} = \alpha_1 F_{AC} + \varepsilon_1$$

where:
F_{KS} is the indicator of knowledge spillovers;
F_{AC} is the indicator of absorptive capacities.

4. Main Findings

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4.1 Large Firms' Knowledge Spillovers

To obtain the indicator of knowledge spillovers we included different variables related to three of the mechanisms of large firms' knowledge spillovers (backward linkages, human capital accumulation and mobility, and training) and identified four main factors related to large firms' knowledge spillovers. Table 4~~Table 4~~ presents the rotated component matrix with the factorial charges for each one of the variables.

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[INSERT TABLE 4 ABOUT HERE]

Backward Linkages

The variables related to linkages with clients are distributed in factors 1, 3 and 4. The variable about length of the relationship is grouped in factor 1, which encloses most of the variables related to more knowledge intensive types of interaction. Thus we can argue that longer time relationships with clients promote a virtual circle type of interaction that can lead to an upgrade in SMEs' technological capabilities. Formal contracts with clients are associated with factor 4, which suggests that more experienced managers tend to establish more formal contracts with their clients, which could lead to a better planning of SMEs' activities.

These results suggest that backward linkages play an important role in stimulating knowledge spillovers in this specific industry and locality.

i) Human Capital Accumulation and Mobility

The highest factorial charges for each variable indicate a high correlation with the other variables in the same factor. We can observe from **Table 4**~~**Table 4**~~ that most of the variables considered for the entrepreneurs' mobility mechanism are grouped in factor four (mobility), except for experience in management that is grouped in factor two (managerial). This variable is closely related to the importance of training by larger firms and different types of interactions with clients, such as, recommendations related to the lay-out, technical advice, sharing knowledge to export, geographic proximity, and other recommendations by clients. This result suggests that owners with experience in management have the ability to establish efficient networks with clients and have a positive influence toward benefiting from knowledge spillovers. Similar results were found by Vera-Cruz and Dutrénit (2005). Thus, accumulation of experience, particularly related to management, plays an important role for knowledge spillovers in the sector and locality analysed.

The variable for employee mobility is grouped in factor 1, together with formal linkages with clients and different forms of interaction that require a certain level of technical expertise, such as calibration of equipment, design and production capacities, incorporation of technology and sharing machinery and equipment. This result suggests that employees with previous experience in large firms facilitate technical interaction with clients and bring positive effects toward establishing formal contracts.

Training

The variables associated with training have been grouped in factors 2 and 3. The number of employees trained by large firms is grouped in factor 3, which is related to informal relationships with clients, but also to some formal interactions, such as joint projects. The importance of training by large firms is linked to some specific types of interactions with large firms such as technical advice, sharing knowledge to export, and other recommendations. These results suggest that training is an important channel for knowledge spillovers in this specific sector.

4.2 SMEs Absorptive Capacities

To obtain the indicator of absorptive capacities we identified the significant variables and obtained five factors related to SMEs' absorptive capacities using the extraction of principal factors technique. Table 5~~Table 5~~ presents the rotated component matrix with the factorial charges for each one of the variables.

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[INSERT TABLE 5 ABOUT HERE]

Entrepreneur and Employees' Background

The high factorial charges for each variable indicate a high correlation with each one of the other variables grouped in the same factor. From Table 5 we can observe how each one of the variables is grouped in the factors. The variables associated with entrepreneurs and employees' background are grouped mainly in factors 1 and 3. Factor 1 is related to employees' technical knowledge and experience. These variables are also correlated with technology embedded in equipment and formal contracts with clients. These results suggest higher employees' technical experience is linked to the use of more sophisticated equipment and to the production of more complex products (Marin and Bell, 2006), which is also linked to the establishment of formal contracts with clients. Factor 3 is associated with firms' structural characteristics, such as firm size and distribution of employees. These variables are also correlated with some learning and innovation activities such as acquisition of machinery and equipment, documentation, training and new marketing programs.

Technology Embedded in Equipment

All the variables associated with technology embedded in equipment are grouped in factor 1, which are also connected to employees' technological capabilities. This suggests that the equipment acquired by firms is directly related to employees' experience. Hence, we argue that this indicator is important to differentiate SMEs to access other type of market niches.

Organisational Capabilities

The variables associated with organisational capabilities are distributed mainly along factors 1 and 2. Formal contracts with clients and SMEs have been grouped in factor 1, together with technology embedded in equipment and employees' technical experience, which suggests that firms with higher absorptive capacities related to technical capabilities and technology embedded in equipment establish more formal contracts with clients. The variables that have been grouped in factor 2 are related to the importance of the decision-making process and quality certificates. They are also correlated with knowledge codification and projects with suppliers and clients, where activities are knowledge intensive. These results suggest that organisational capabilities can be important determinants of absorptive capacities.

Learning and Innovation Activities

Learning and innovation activities are grouped in three main factors. Engagement in projects and process documentation activities are grouped in factor 2. These are associated with more interactive and advanced activities that can lead to virtual circles of knowledge flows between clients and suppliers. These variables are also related to organisational capabilities associated with the decision-making process. The variables grouped in factor 3 are associated with shorter-term innovation activities that can have an immediate impact on SMEs such as acquisition of equipment, process documentation, training and marketing. These variables are also linked to the number of employees and engineers in SMEs. Activities related to product and process innovations are grouped in factor 5, which refers to higher/more intense innovation.

Linkages with Other Local Agents

The last indicator of absorptive capabilities is grouped in factor 4. Linkages with other local agents require a certain level of absorptive capacities, but this level also increases with higher interaction with other agents as firms can benefit from external knowledge.

4.3 Relationship between Knowledge Spillovers and Absorptive Capacities

To identify the relationship between knowledge spillovers and absorptive capacities and the specificities of this relationship, first we build a correlation matrix that explains the relationship between the different indicators (see Table 6~~Table 6~~).

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[INSERT TABLE 6 ABOUT HERE]

The entrepreneur and employees' background has a direct and important relationship with both the technology embedded in equipment and the innovation and learning activities. On the other hand, innovation and learning activities have a direct relationship with the backward linkages and the SMEs' organisational capabilities. Employees' experience has a high correlation with the type of linkages established with firms.

Secondly we build a structural equation model to identify the most important determinants of absorptive capacities and the most important mechanisms that generate knowledge spillovers, and also the correlation between knowledge spillovers and absorptive capacities. The following relationships are analysed:

a) Between absorptive capacities and: i) entrepreneur and employees' background; ii) technology embedded in equipment; iii) organisational capabilities; iv) learning and innovation activities; and v) linkages with other local agents.
b) Between knowledge spillovers and: i) entrepreneurs' mobility; ii) employees' mobility and training; iii) formalisation of linkages with clients; and iv) type of linkages established with clients.
c) Between absorptive capacities and knowledge spillovers.

The indicators of knowledge spillovers and absorptive capacities (second order factors) are placed at the right side of the diagram and each one of the different indicators for knowledge spillovers and absorptive capacities (first order factors) are placed at the left side of the diagram. The arrows show the relationship between second and first order factors.

[INSERT FIGURE 2 ABOUT HERE]

The structural equations results indicate the impact of first order factors on second order factors, and the correlation between absorptive capacities and knowledge spillovers. In

relation to absorptive capacities, the indicators that have the highest impact are innovation and learning activities, and organisational capabilities, as 91 per cent and 63 per cent of these indicators explain SMEs' absorptive capacities respectively. Entrepreneur and employees' background have a medium impact on absorptive capacities. The indicators that have the lowest impact on absorptive capacities are linkages with other local agents and technology embedded in equipment, as 42 per cent and 37 per cent of these factors explain SMEs' absorptive capacities respectively.

In relation to large firms' knowledge spillovers, the indicators that have a higher impact are related to the backward linkages mechanism – 76 per cent of the type of linkages with clients and 66 per cent of formal linkages explain large firms' knowledge spillovers. This correlation suggests that the SMEs are strongly influenced by their clients.

The factor of employees' mobility explains 52 per cent of large firms' knowledge spillovers, which indicates that previous experience of employees is an important mechanism for knowledge spillovers within the sector and locality analysed. On the other hand and in contrast with the findings by Görg and Greenaway (2001), Fosfuri *et al*. (2001), and Vera-Cruz and Dutrénit (2005),[2] the factor that has the lowest impact and even has a negative value is related to entrepreneurs' mobility. We argue that the variables used to build this indicator do not explain knowledge spillovers through the entrepreneurs' mobility. Different arguments contribute to explaining such a result: i) there is a small percentage of entrepreneurs with professional background in the sector, and the lack of formal education hinders knowledge absorption and application to their own new firms; and ii) as they do not have formal education, they usually do not have access to top management positions in large firms, and they cannot absorb more complex organisational and technological knowledge to transfer it later into their own firms.

Regarding the relationship between absorptive capacities and knowledge spillovers, Table 7~~Table 7~~ lists the correlation level that was obtained by the structural equations analysis. The correlation between SMEs' absorptive capacities and large firms' knowledge spillovers is 0.82, which indicates a positive and strong relationship between these two concepts within the sector and locality analysed.

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As we found a strong correlation between absorptive capacities and knowledge spillovers, our empirical evidence suggests that it is easier for SMEs with higher levels of absorptive capacities to reap the benefits from large firms' knowledge spillovers. SMEs with higher

absorptive capacities have a higher number of engineers per firm, which leads to a better task distribution, thus owners can spend more time in activities related to management and planning. These SMEs usually have employees with higher skills in CNC, computer aided manufacturing (CAM), design, measuring, calibration, and quality systems. They also have a higher proportion of advanced equipment, such as NC and CNC, and they use CAM to programme their production, which permits a more efficient use of the machinery and to produce more complex products, which is important for increasing their market shares. We also observed that a higher percentage of firms with higher absorptive capacities have formal contracts with their clients.

5. Conclusions

This paper focuses on the analysis of SMEs' absorptive capacities in a low-tech and mature sector and large firms' knowledge spillovers from the automotive and home appliances sectors operating in a locality. Drawing on the existent literature and exploring the use of *ad hoc* indicators and structural equations, it has been possible to reach a better understanding of the determinants of absorptive capacities, the mechanisms of knowledge spillovers and the relationship between these two concepts in a specific context.

The most important channels that explain knowledge spillovers are related to the backward linkages mechanism. This suggests that there are important knowledge flows that increase SMEs' production capabilities during the interactions, and that SMEs in this sector are strongly influenced by their clients. Hence, to strengthen large firms' knowledge spillovers, it is important to increase the types of interaction between large firms and SMEs and the knowledge that flows during such interactions. This result confirms the findings by Jordaan (2005), as backward linkages are an important mechanism for local firms to use their resources more efficiently to meet their clients' requirements. Backward linkages are also important for upgrading the type of products and the type of interaction and knowledge that flows between SMEs and their clients. Employees' mobility is the second most important mechanism for knowledge spillovers, which confirms the findings by Girma and Görg (2005) and Jordaan (2005). On the other hand and in contrast with the findings by Fosfuri *et al*. (2001) and Vera-Cruz and Dutrénit (2005), the entrepreneurs' mobility does not represent an important mechanism for knowledge spillovers in the sector and locality analysed. This result can be explained by the characteristics of the local system, the inclusion of large domestic

firms rather than only MNCs, and the type of experience that entrepreneurs accumulate, which is mostly related to production and quality control activities, and to a lesser extent, managerial activities.

The most important determinants of SMEs' absorptive capacities are organisational capabilities and innovation and learning activities. The latter is one of the preferred indicators for absorptive capacities, as found by Escribano *et al*. (2009) and Marin and Bell (2006). The former, organisational capabilities, has seldom been considered as an indicator for absorptive capacities. This research suggests that organisational capabilities are strongly related to absorptive capacities in this sector, particularly as they are influenced by entrepreneurs' experience and background. Technology embedded in equipment and linkages with other local agents have a lower impact on SMEs' absorptive capacities, but still determine firms' absorptive capacities. The result of the former determinant is in line with findings by Escribano *et al*. (2009) and Marin and Bell (2006), but the literature has not discussed the latter.

These results suggest that to increase SMEs' absorptive capacities it is necessary to reinforce their organisational capabilities and innovation and learning activities, by strengthening the owners' managerial abilities and employees' technical abilities. As most of the knowledge within this sector is tacit, firms and industrial associations can design and implement new schemes that promote knowledge sharing within the firm and apprenticeship programs. These activities can have a positive impact on technology that is embodied in equipment, which is closely linked to employees' expertise.

However, it is necessary to pay closer attention to the different variables that determine learning and innovation activities, and organisational capabilities, to foster the development of SMEs with higher absorptive capacities. SMEs with lower levels of absorptive capacities seem to be trapped in a vicious circle, as most of them lack human resources and equipment, or those organisational capabilities necessary for upgrading and accessing other types of market niches that demand more complex products, thus they are usually not sought by clients as potential suppliers.

From this research we identified that important variables associated with learning and innovation activities within this sector are not necessarily related to R&D activities, but with developing projects with clients, training, and acquisition of equipment to produce new products. On the other hand, organisational capabilities in this sector are relevant and are associated with managerial experience and the establishment of systems for quality control. Thus, SMEs have several challenges to build these characteristics to be able to engage in a

type of virtual spiral to foster their absorptive capacities. Training owners and employees to acquire technical and organisational abilities needed in the sector seems to be the first step to take. SMEs also have the challenge to engage in supply networks that allow a gradual upgrading of their technological capabilities – these networks can include the participation of public research centres or industrial associations that serve as networking agents. They also have the challenge to certify the quality of their products.

We found that large firms' knowledge spillovers are strongly correlated with SMEs' absorptive capacities within this specific sector and locality. More specifically, we found that the spillover mechanisms of backward linkages and employees' mobility have a strong and direct impact on two absorptive capacity determinants, innovation and learning activities and technology embedded in equipment. Hence, we can argue that those SMEs with higher absorptive capacities appropriate more knowledge spillovers, upgrading their technological and organisational capabilities and accessing other market niches that demand more complex products, and the use of more sophisticated equipment to produce them.

These results have policy implications – programmes to incentivise the establishment of backward linkages between large firms and local SMEs may certainly foster large firms' knowledge spillovers. In terms of policies to foster SMEs' absorptive capacities, it is important to create and strengthen educational programs in community colleges, and promote apprenticeship schemes within both SMEs and large firms. Specific mechanisms to foster the relationship between knowledge spillovers and absorptive capacities are related to promoting the establishment of backward linkages between large firms and SMEs created by previous employees of large firms, as they are more likely to have the technical capacities to engage in virtuous circles of production and upgrade the characteristics of the products. In addition, it is possible to stimulate the creation of SMEs that are spin-offs of larger firms and to promote schemes for the acquisition of equipment targeted to those particular SMEs.

The variables considered in this study focus on the analysis of this specific sector and locality, but they might well differ across sectors. Future studies can focus on identifying a set of variables that can fit the analysis of knowledge spillovers and absorptive capacities from a variety of sectors and regions to perform comparative analysis. Further analysis should also consider the exploration of more knowledge spillover mechanisms that have been identified by other authors. Another important aspect that was not considered in this paper due to data restrictions is the direction of the correlation between knowledge spillovers and absorptive capacities. The evidence allows us to argue *a priori* that absorptive capacities determine knowledge spillovers, and only SMEs with a minimum level of absorptive capacities can

appropriate the benefits of such spillovers. At the same time, the absorption of such knowledge spillovers increases SME absorptive capacities, creating a sort of virtual circle or spiral between absorptive capacities and knowledge spillovers.

Notes

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1. In the hub and spoke productive arrangements, some large firms act as anchors or hubs to the regional economy, with suppliers that spread out around them like spokes of a hub (see Markusen, 1996). In the sector and locality analysed, there are some key large firms and many SMEs have established around them to become their suppliers.
2. Vera-Cruz and Dutrénit (2005) analysed the same sector in another Mexican locality. They concluded that owners' mobility from MNCs to SMEs is one of the most important mechanisms for knowledge spillovers.

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Table 1: Main Characteristics of the Machining Industry Located in Querétaro

Main characteristic	Total
% of owners with a bachelor's degree	36.4%
% of entrepreneurs with experience in other organisations	90.9%
Years of experience on average	18.2
% of owners with experience in top management	4%
% of owners with experience in engineering	16.8%
% of owners with experience in quality control	21.7%
% of owners with experience in production	61.3%
Number of employees (total)	1,077
% of employees with engineer's degree	6.8%
Engineers per firm (including the owner)	0.9
Employees with experience in CNC per firm	0.6
Employees with experience in design per firm	2.1
Employees with experience in CAM per firm	0.2
Technology embedded in equipment	
Conventional equipment per firm	4.1
Numerical Control (NC) machinery per firm	0.4
Computer Numerical Control (CNC) machinery per firm	0.3

Main characteristic	Total
% of firms that use CAM	16%
Number of product innovations per firm	1.9
Number of process innovations per firm	1.3
Annual total sales (thousands USD)	$14,420.00
Average sales per firm (thousands USD)	$138.00

Source: Authors' own.
Sample: 110 firms
Note: Product and process innovation are new to firms.

Table 2: Variables Associated with the Indicators for SMEs' Absorptive Capacities

First order factor	Variable	Kind of variable	Missing values	Mean	SD
Entrepreneur and employees' background	Entrepreneur's degree	Ordinal	8	-	-
	No. of employees	Numeric	0	11.13	22.43
	No. of engineers	Numeric	1	0.72	1.57
	% of engineers	Numeric	0	0.10	0.23
	Employees with experience in CNC	Numeric	0	2.19	5.41
	Employees with experience in design	Numeric	0	11.77	16.71
	Employees with experience in Computer Aided Manufacturing (CAM)	Numeric	0	1.20	6.56
	Employees with experience in measurement	Numeric	0	15.11	31.05
	Employees with experience in quality control	Numeric	0	3.82	17.00
Technology embedded in equipment	CAM programming	Dummy	31	-	-
	No. NC and CNC equipment	Numeric	0	0.71	1.66
	Years of NC and CNC equipment	Numeric	0	1.61	3.23
	Tolerance for products	Ordinal	2	-	-
Organisational capabilities	Years in the market	Numeric	11	11.11	9.21
	Past experience with decision-making processes	Dummy	0	-	-
	Technical knowledge for decision-making processes	Dummy	0	-	-
	Formal contracts with clients	Dummy	1	-	-
	Sales per employee	Numeric	0	3.01	2.01
	Quality certification	Dummy	0	-	-
	Materials quality certificates	Ordinal	4	-	-
	Time delivery certificates	Ordinal	3	-	-
Learning and innovation activities	Projects with suppliers	Dummy	0	-	-
	Projects with clients	Dummy	0	-	-
	Process documentation	Dummy	0	-	-
	Acquisition of machinery and equipment	Dummy	3	-	-
	Documentation of changes in process	Dummy	3	-	-
	Training programs to develop new products	Dummy	6	-	-
	New marketing programs	Dummy	7	-	-
	Product innovation	Numeric	14	1.59	5.85
	Process innovation	Numeric	16	1.10	4.45
wit h oth er loca	Importance of linkages with suppliers	Ordinal	0	-	-
	Importance of linkages with clients	Ordinal	0	-	-

First order factor	Variable	Kind of variable	Missing values	Mean	SD
	Importance of linkages with competitors	Ordinal	0	-	-
	Importance of linkages with technical organisations	Ordinal	0	-	-
	Importance of linkages with industrial associations	Ordinal	0	-	-

Source: Author's own.

Table 3: Variables Employed to Build Indicators of Large Firms' Knowledge Spillovers

First order factor	Variable	Kind of variable	Missing values	Mean	SD
Entrepreneur's mobility	Years of experience	Numeric	6	17.04	11.54
	Experience in large firms	Dummy	10	-	-
	Experience in management	Dummy	5	-	-
	No. of training courses in large firms	Numeric	0	1.36	1.82
Employees' mobility and training	Number of SME's employees trained by large firms	Numeric	0	1.33	12.89
	Importance of training by large firms	Ordinal	0	-	-
	No. of employees with experience in large firms	Numeric	11	3.65	12.50
Formal linkages with clients	Years of client-supplier relationship	Numeric	9	7.49	7.95
	Formal contracts	Dummy	1	-	-
	Informal relationships	Dummy	0	-	-
Type of linkages established with clients	Calibration of equipment	Dummy	0	-	-
	Product certification	Dummy	0	-	-
	Sharing design capacities	Dummy	0	-	-
	Sharing production capacities	Dummy	0	-	-
	Supporting the incorporation of technologies	Dummy	0	-	-
	Recommendations related to the lay out	Dummy	0	-	-
	Sharing machinery and equipment	Dummy	0	-	-
	Letting SMEs access large firms' plants	Dummy	0	-	-
	Technical advice	Dummy	0	-	-
	Joint projects	Dummy	0	-	-
	Sharing knowledge to export	Dummy	0	-	-
	Geographic proximity	Dummy	0	-	-
	Other recommendations	Dummy	0	-	-

Source: Authors´ own.

Table 4: Rotated Component Matrix of Knowledge Spillovers

Indicator (First order factor)	Variable	Factor			
		Technical (1)	Managerial (2)	Joint projects (3)	Mobility (4)

Indicator (First order factor)	Variable	Factor			
		Technical (1)	Managerial (2)	Joint projects (3)	Mobility (4)
Entrepreneur's mobility	Years of experience	-.033	-.298	-.181	**.414**
	Experience in large firms	.065	.041	.141	**-.689**
	Experience in management	.095	**-.375**	.169	-.224
	No. of training courses in large firms	.035	.126	.145	**.700**
Employees' mobility and training	Number of SME's employees trained by large firms	-.126	.122	**.599**	.243
	Importance of training by large firms	-.076	**.413**	-.050	-.028
	No. of employees with experience in large firms	**.577**	.104	.353	.297
Formal linkages with clients	Years of client-supplier relationship	**.220**	-.076	-.007	-.066
	Formal contracts	-.181	-.228	-.162	**-.490**
	Informal relationships	-.149	.352	**.370**	.310
Type of linkages established with clients	Calibration of equipment	**.585**	-.029	.006	-.059
	Product certification	.208	.006	**.541**	-.225
	Sharing design capacities	**.506**	.460	-.074	-.153
	Sharing production capacities	**.484**	.224	.204	-.257
	Supporting the incorporation of technologies	**.615**	.287	.234	-.083
	Recommendations related to the lay out	.150	**.347**	.321	-.068
	Sharing machinery and equipment	**.506**	-.024	-.048	.237
	Letting SMEs access large firms' plants	**.583**	.277	.085	.216
	Technical advice	.429	**.503**	-.075	.040
	Joint projects	.101	-.023	**.765**	-.049
	Sharing knowledge to export	.323	**.592**	.022	.046
	Geographic proximity	.006	**.716**	.164	.054
	Other recommendations	.079	**.492**	.247	.065

Source: Authors' own.
Software: SPSS
Extraction method: Principal factor analysis.
Rotation method: Varimax with Kaiser Normalization.
Rotation converged in 6 iterations
Variance explained 39.4%

Table 5: Rotated Component Matrix of Absorptive Capacities

First order factor	Variable	Component				
		Technical capabilities (1)	Organisational capabilities (2)	Firms' characteristics (3)	Linkages (4)	Innovation (5)
Entrepreneur and employees' background	Entrepreneur's degree	.171	.065	.275	.184	**-.318**
	No. of employees	.288	.104	**.572**	.141	-.045
	No. of engineers	.083	.054	**.746**	-.093	-.242
	% of engineers	-.161	-.053	**.341**	-.085	-.259
	Employees with experience in CNC	**.748**	-.003	.083	-.076	.009

First order factor	Variable	Component				
		Technical capabilities (1)	Organisational capabilities (2)	Firms' characteristics (3)	Linkages (4)	Innovation (5)
	Employees with experience in design	**.518**	.128	-.116	.207	-.187
	Employees with experience in computer Aided manufacturing (CAM)	.302	-.087	.157	**.765**	-.226
	Employees with experience in measurement	**.838**	.140	.009	-.045	.092
	Employees with experience in quality control	**.807**	.172	.077	-.104	.194
Technology embedded in equipment	CAM programming	**-.535**	.080	-.343	-.341	.250
	No. NC and CNC equipment	**.659**	.026	.198	-.066	.029
	Years of NC and CNC equipment	**.348**	-.032	.351	.215	-.183
	Tolerance for products	**.240**	.159	-.155	.129	.143
Organisational capabilities	Years in the market	**.260**	-.073	.217	-.114	.173
	Past experience for decision-making processes	-.010	**-.634**	-.144	-.002	.290
	Technical knowledge for decision-making processes	-.065	**.587**	.087	-.002	-.304
	Formal contracts with clients	**-.358**	-.108	-.063	-.064	.016
	Sales per employee	-.032	.113	**-.398**	.088	-.307
	Quality certification	-.011	.021	**-.649**	-.197	.201
	Materials quality certificates	.068	**.701**	.140	-.076	.154
	Time delivery certificates	.216	**.655**	.244	-.013	-.024
Learning and innovation activities	Projects with suppliers	.208	**.595**	-.163	.237	.084
	Projects with clients	.163	**.637**	-.044	.226	.036
	Process documentation	.107	**.638**	-.025	.042	.141
	Acquisition of machinery and equipment	.254	.214	**.435**	.014	.105
	Documentation of changes in process	.364	.295	**.430**	.054	.170
	Training programs to develop new products	.304	.306	**.622**	.081	.252
	New marketing programs	-.180	.091	**.512**	.054	.256
	Product innovation	.025	.084	-.009	.068	**.738**
	Process innovation	.083	-.007	.038	.073	**.716**
Linkages with other local agents	Importance of linkages with suppliers	-.112	.135	.074	**.713**	.059
	Importance of linkages with clients	-.056	.264	-.025	**.633**	.161
	Importance of linkages with competitors	-.194	.428	.041	**.407**	.105
	Importance of linkages with technical organisations	-.012	.028	.030	**.631**	.076
	Importance of linkages with industrial associations	.100	-.024	.007	**.705**	-.072

Source: Authors' own.
Software: SPSS
Extraction method: Principal factor analysis.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 6 iterations
Variance explained: 45.72

Table 6: Correlation Matrix of Absorptive Capacities and Knowledge Spillovers

	FORMA	TECNO	CAPORG	INNOVA	VINC	EXPERP	EXPERE	VCP	TIPO
FORMA	**1.000**								

TECNO	0.503	**1.000**							
CAPORG	0.309	0.084	**1.000**						
INNOVA	0.502	0.323	0.594	**1.000**					
VINC	0.084	0.092	0.252	0.365	**1.000**				
EXPERP	-0.103	-0.246	0.124	0.005	0.116	**1.000**			
EXPERE	0.065	-0.068	0.386	0.340	0.191	0.067	**1.000**		
VCP	0.281	0.324	0.366	0.509	0.525	0.066	0.310	**1.000**	
TIPO	0.322	0.261	0.298	0.565	0.395	-0.098	0.471	0.466	**1.000**

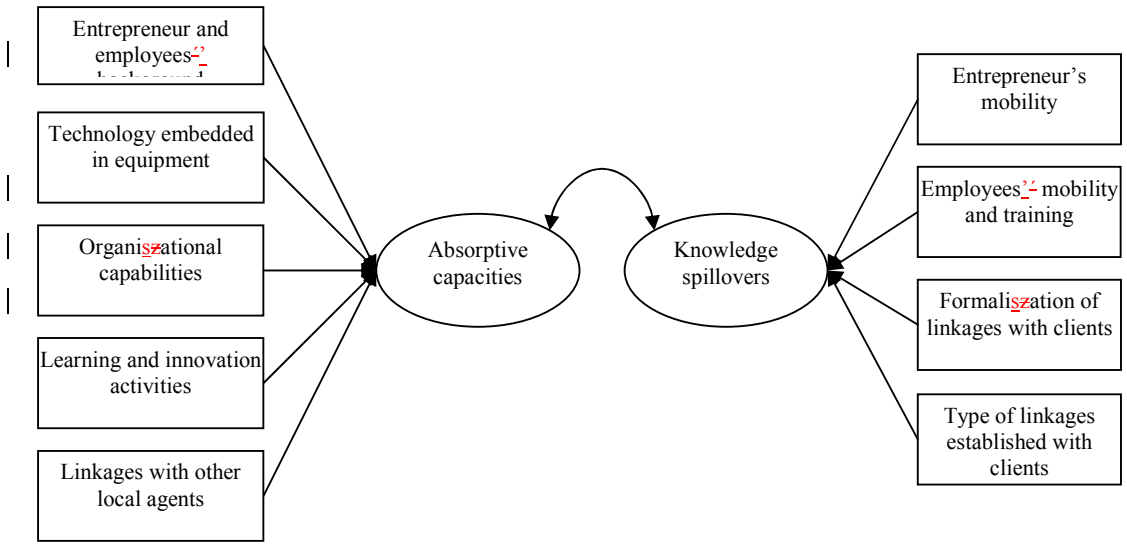
Source: Authors' own. Survey applied to SMEs machining shops located in Querétaro, México, UAM-X, 2005.
LISREL
Note:
For absorptive capacities: FORMA – Entrepreneur and employees´ background; TECNO – technology embedded in equipment; CAPORG – organisational capabilities; INNOVA – learning and innovation activities; VINC – linkages with other local agents.
For knowledge spillovers: EXPERP – entrepreneurs' mobility; EXPERE – employees' mobility and training; VCP – formal linkages with clients; and TIPO – type of linkages established with clients.

Table 7: Correlation of Absorptive Capacities and Knowledge Spillovers

	Absorptive capacities	Knowledge spillovers
Absorptive capacities	**1.000**	
Knowledge spillovers	0.820 (0.054)	**1.000**

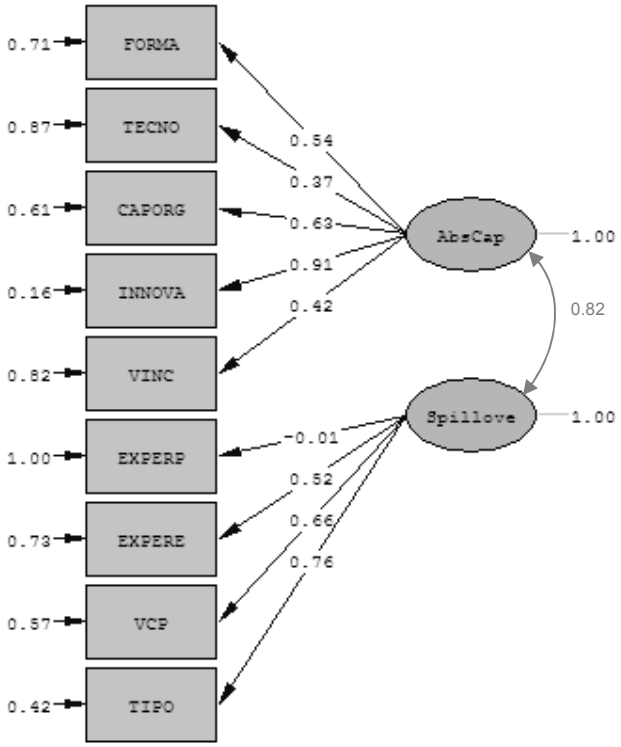
Source: Authors´ own.
Number of Iterations = 22
LISREL Estimates (Maximum Likelihood)

Figure 1: Structural Equation Model for SMEs' Absorptive Capacities and Large Firm's Knowledge Spillovers



Source: Authors' own

Figure 2: Structural Equations Analysis Diagram between SMEs' Absorptive Capacities and Large Firms' Knowledge Spillovers



Chi-Square=144.50, df=26, P-value=0.00000, RMSEA=0.160

LISREL

Sample size: 110 observations.

Note:

For absorptive capacities: FORMA – Owners and employees' background; TECNO – technology embedded in equipment; CAPORG – organisational capabilities; INNOVA – learning and innovation activities; VINC – linkages established with other local agents.

For knowledge spillovers: EXPERP – entrepreneurs' mobility; EXPERE – employees' mobility and training; VCP – formal linkages with clients; and TIPO – type of linkages established with clients.

According to the indexes of goodness fit statistics this model is acceptable. Our sample size was 110, and the indexes CFI, IFI, and GFI are higher than 0.81, RMR and RMSEA indexes are 0.105 and 0.160 respectively.