

TECHNOLOGICAL PURCHASE AND FLOWS IN ANDALUSIA

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Over the latest decades, the emergency of knowledge society characterized by the use of intangible assets and advanced technologies (NTICs), of productive processes globalization based on the introduction of technological advances, have turned the innovation capacity and the purchase of technology by the companies in one of the main factors of economic growth at different territorial scales (Lichtenberg/Siegel, 1991; Fageberg, 1994; Freeman, 1994). In parallel with this, economic globalization and liberalization have speed up company internationalization, even in European convergence regions, especially those more dynamic through innovation. So these processes have turned into the most important factors to explain the change of their productive structures (regional and local).

The need to transform the innovative territories into open and adaptive systems is linked to the development of internationalization processes for companies at different levels (export, foreign direct investment, use of licences, franchises, etc.) and to the capacity of regions to accumulate many technology purchase contracts with institutions from other countries (Jordá and Ruiz, 2009) to increase the competitiveness and development level. All of this takes place since the innovation process at companies is based on the purchase of external technology and on R&D internal development to generate their own technology. In fact, both technological stages complement each other. The purchaser company has to assimilate the acquired technology to apply it, adapt it to their own technology and turn it into a new product, so the technology transfer takes place. But it is necessary that acquired technology is compatible to their knowledge previous bases (Fernández, 2005).

Actually, the purchase contracts between the economic agents from one or several territories require the development of capacities (Cohen y Levinthal, 1990, Arvanitis, 2003) by the companies. One of the most important one is absorption, to identify, assimilate and exploit the knowledge from outside to achieve and keep a competitive advantage (Lankhuizen, 2006; Kim, 2000). Therefore, the process of creation capacities allows to define companies as 'institutions, warehouses and sources of knowledge', and by extension, territories as 'smart', that is to say, social-technical systems, open, capable of learning and

permanently transforming to adapt to external and internal changes. In short, the technology purchase contracts turn into a problem of acquisition, learning and appropriation (Arvanitis, 2003), definition that could be applied to territory and firm.

In Andalusia, the size of cities (according to population) where the companies are located constitutes a key factor in technology purchase and in generation of technology transfer due to the need of external economy firms, and understanding that the more size, the more volume companies have. These external economies constitute a local or regional intangible asset that cannot be acquired on the market and firms located at the said territory benefit from. This means more ease to carry out learning and knowledge and technology spreading processes on a local and regional scale (Jordá and Ruiz, 2009). Actually, the industry and services are concentrated in the territories offering advantages to companies. The size of the centre of population, the location or closeness to a metropolitan area, being political-administrative headquarters, the volume of external economies offered by them and the existence of university do constitute interrelated factors that extraordinarily improve the development of innovation, the technology transfer and help the purchase of outside technology.

Andalusia's surface is 87,598 square kilometres (17.4% of Spain and 3.7% of the European Union) has 770 municipalities and 150 of them have more than 10,000 inhabitants and house the 80% of the population. Therefore, the region has a concentrated territorial model with 2,707 centres of population with 8,415,490 inhabitants (Register Advance 2011, Spanish National Statistics Institute), representing the 17.8% of Spanish population. Consequently, and according to the characteristics of Andalusian urban system, the centres with less than 10,000 inhabitants are catalogued as rural, those having from 10,000 to 100,000 medium cities, and those with more than 100,000 built-up urban areas or great cities according to the thresholds established by the regional autonomous government (Ministry of Public Works and Transport, 1999), and the regionalization study performed by Cano García (2002).

Moreover, most of companies that have acquired technology (from abroad, Andalusia or Spain), and despite that most are internationalized, form part of the Andalusian territory (through relations with the business tissue) through market (suppliers and/or customers or through technology transfers) generating networks. Actually, the relations are defined by the reach of the market of companies located at those nodes (local, regional, global), by sectorial matters (high-technology industry, low-technology industry...), by the size of external economies and by the type of synergies they keep with the rest of the productive, scientific and technological system, to transfer or to acquire technology and knowledge, according to the innovation level reached by the firms (quality management, engineering, design, R&D).

On the other hand, the internationalized innovative company buying technology is associated to the direct or indirect export (supplier of inputs to foreign companies) and to the import of specialized inputs on the international market (Jordá and Ruiz, 2009). This shows that innovative processes from these companies have not yet achieved to get connected to the internationalization capacity with plant delocalization formulas, but they have done so through subcontracting, purchase of high technology products and as supplier of medium and medium-high technology products. The requirements from the customers force to establish technological relations and to increase the technical capacities of the supplier to develop

processes and new products, thus requiring technological collaboration (Jordá and Relaño, 2009).

Therefore, as innovative companies are those acquiring more technology outside Andalusia and those creating more innovations (thus helping the growth/development of cities/centres), the main aims of this work are: 1. - To measure the magnitude of technology purchase flows of innovative companies from outside the region, specially from developed countries, since the most complex and advanced is supposed to be acquired there. 2. - To check if there is correlation between the intensity of technology purchase and the process of technological innovation-transfer in Andalusia. 3. - To discover the factors, through factorial analysis, with an influence over the technology purchase to know the key variables of this process. 4. - To study where the firms purchasing technology are concentrated (on metropolitan areas, medium cities or rural centres); 5. To distinguish companies groups through cluster analysis according to their behaviour before the external technology purchase and their capacity to transfer the said technology to the territory.

The information to achieve the aims is extracted from a survey-interview (duration: one hour and a half), that was performed over a sample of 263 innovative companies located in Andalusia throughout 2009-2010, financed by a research project of the Ministry of Education and Science (Spanish MEC). This sample represents the total amount of Andalusian innovative firms (the Directory of Andalusian Innovative Companies, DEIA, counts 1919 companies¹, chosen with stratified sampling so it gathers the multiplicity of characteristics they all represent (size, activity branch, technological capacity, territory location, etc.). A group of 88 variables (from a total of 650) were selected from the questionnaire, and they are related to the technology purchase by the company (number and expense of the acquired technology, supplier location and sector, time to adopt the acquired technologies, time to apply, to develop them and time to the competitors to adopt them, types of implicit agreements on purchase contracts), general characteristics (invoicing, location, company head office, sectors according to the classification by Pavitt and Soete-Miozzo², market, etc.), main capacities or resources of the companies (importance of human resources, organizational, technological and geographical resources), general organization (type of organization, strategic planning, knowledge register), work organization (role of routines, communication mechanisms), relations with suppliers (types of exchange -machinery, immaterial exchanges, electronic, etc.- according to expenses), and innovation (expense on R&D, design, engineering, other innovative activities, technology development, own technologies). And on the other hand, 193 companies have been identified as technology buyers, among a total of 263 polled, and 128 of them are internationalized. The sampling techniques used at these cases show that the sample is representative for the population object of study.

1 Performed and updated every year by professors (including the undersigned) of the Andalusian Geographical Research Group.

2 Pavitt (1984) classifies the industrial companies according to innovation patterns: Dominated by suppliers (DS), large-scale producers (LSP), Specialized Suppliers (SS) and Science-base (SC); Soete-Miozzo (1989) adapts this classification for the service sector, and makes the following difference: Dominated by suppliers (DS), Intensive Services on Production, Scale and Network Services (IPSN) and Technology and Science-Base Sectors Suppliers (TSBS).

The supplied information was used to build a database to: 1.- Manage the information with Access and Excel to perform previous analysis and to carry out a statistical descriptive treatment of technology purchase by the innovative companies; 2.- perform a factorial analysis to identify interdependence or interrelations between variables. Once the main technology purchase flows and the components with an influence over such purchase through the factorial analysis (9 factors) were known, then 6 groups of homogeneous companies/ establishments by cluster analysis were obtained, based on factorial punctuations. These analyses allowed to study and to establish a taxonomy of buyer technology companies and to explain the existing flows at each group.

The research results were the following:

In Andalusia, the number of innovative companies is limited. At these companies, and especially at the internationalized ones, plays an important role the innovative internal activities (R&D and other innovative activities), and the external activities (purchase of technology and R&D). However, according to results, the innovations introduced on the processes and products have not reduced the technological differences existing with foreign competitors since most of the acquired technology is used to modernize the productive process and R&D budget is low compared to the national average (€791,754.5) except on the cluster 5. This happens since the innovative business tissue is specially made up of: a) large scale production companies where the innovation comes from the needs to reduce costs, manufacturing products for great markets with certain degree of standardization; and b) science-based companies with high technological capacity companies and other companies with low added value.

Many companies from these sectors find more profitable to copy in a creative way the innovations developed by others since the strong competence and their low level of knowledge accumulation make unfeasible to transfer the cost of innovation to the product price. These innovation use to be related to process (equipment assets), and that is why it emigrates to competitors so easily. That is why, to increase the region technological level is needed to increase the expense on product innovation, the base of business knowledge and to diversify the tissue with medium-high and high technology companies (OECD, 1997).

The number of companies that have bought technology abroad (including the internationalized ones) is limited. Their purchase capacity is defined, according to the results of the factorial analysis, by four groups of components:

1. The existence of capacities or resources, both human, organizational and technological correlated with the generation of R&D (factors 1, 4 and 8). At present, the systematic R&D and through projects, requires introducing a group of interrelated processes: changes on the company general organization and work, and to include a training and encouraging policy. The type of technology transfer could be direct through the purchase of equipment assets, turnkey establishments, patents, know-how, etc.; or indirect through equipment maintenance agreements and other technologies (factors 2, 5 and 9).
2. The territorial variables (location and territorial reach of the market —export—) are related to the magnitude of the technology purchase abroad (Europe or rest of the world) (factors 3 and 7).

3. The company structure characteristics (origin of capital and size according to invoicing) have an influence over the volume of technology purchase expense (factor 3).

These factors, and from the cluster analysis, differentiate between the existence of a large group (cluster 3), where predominates the small company offering science-base services, with little expense on foreign technology since the knowledge lies in the high qualification of its human resources. These companies are key (intermediate inputs) for the technology transfer between local firms, especially in metropolitan areas where they are located, since they establish intense relations with customers, but not to increase the technological level to a quota similar to that of developed countries.

Clusters 4 and 5 (two thirds of the polled companies and almost the 70% of the expense on external technology), show how the expense on foreign technology helps the development of the territory. In Andalusia, the process of company innovation, the technology transfer and the success on the market is related to the geographical concentration of companies, so the territorial sectors obtaining a benefit from the said processes are the metropolitan areas in correlation to the external economies. Cluster 5 is the one with a greater investment in R&D and in internal and external technology (abroad), is also the one giving more value to the qualification and, finally, to the explicit and tacit knowledge to reach relevant technological results and to be competitive on the market. however, it would be necessary: a) To reduce the time to absorb technology at company level to create more competitive advantage opposite to competitors from mature technology sectors such as large-scale production; and b) to reduce the high territorial concentration of these companies and, therefore, to improve the development of external economies from medium cities to reduce the territorial differences existing in the region according to innovation and development terms.

From the point of view of the synergies the technology buyer companies generate, through territory and sector networks with suppliers, clusters 4 and 5 are remarkable since they show the greatest potential to transfer technology to the territory. On the one hand, the technology purchase in Europe and in the rest of the world (70% of companies) is related to space variables (metropolitan areas and reach of the export market) on groups 1, 4 and 5 and on the two companies showing different behaviours compared to the rest. The external economies of the metropolitan areas (communications, qualification of labour, concentration and competence between companies, etc.) help their interaction of information and knowledge at world scale. The metropolitan innovative company uses to turn to international suppliers, technological leaders on their respective branches, to include those leading technologies to modernize their productive processes and to increase the degree of innovation according to products and product terms.

But also innovation activities, especially those related to tacit knowledge transfer, need to be performed face to face, becoming stronger the geographical, cultural and social closeness factor. So, after analyzing the links to local suppliers through technology and market transactions, it is shown that a part of the companies acquiring technology in Andalusia and Spain do transfer it to the territory. The cluster analysis identifies the group of companies (61.77% of total) associating the external purchase with: 1) the development of their own technology; and 2) the ability to transfer technology acquired and/or generated by the company to its suppliers (groups 4 and 5). The technology and/or market exchanges from the

companies that have bought technology with Andalusian suppliers mean the 19% of the total (measured with monetary values). It is needed to underline that:

- a) The companies of group 4 represent the 7.6% of these exchanges and mainly transfer equipment asset technology, intangible assets and electronic inputs; and
- b) The firms from group 5 sum the 10.7% of transactions, establishing flows mainly with large-scale production and science-base industry to exchange electronic and intangible inputs.

So, the data show that technology buyer companies acquire a limited volume of local or regional consumables, since Andalusia has scant technology local suppliers. This happens since: a) innovative firms, and in particular, those with capacity to acquire technology, have the possibility to stock up with international standardized inputs in their own territory due to the localization of foreign supplier companies; and b) Andalusia is characterized by a regional innovation system with slender level of technological complexity unable to supply technology buyer companies.