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**TITLE OF COMMUNICATION**: Knowledge and performance in innovative firms: An analysis of district and inter-district effects.

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## ABSTRACT

The paper aims first to analyse the presence of knowledge in innovative firms located in industrial districts (ID) in order to compare with similar non-district (NID) firms. This approach assumes the presence of an *industrial district effect*, i.e., the presumption of a better performance of knowledge and economic results in the first group of firms. We also try to identify the existence of an *interdistrict effect*, i.e., the emergence of gaps in the knowledge of ID innovative firms of different technological intensity.

In both cases we focuse on Valencian ID in Spain. We introduce the idea of innovative firms (IF) as a unit of analysis on the assumption that: a) they reflect superior use of knowledge resources as inputs for business innovation generation; and b) their greater use of these resources facilitates the absorption of knowledge spillovers flowing through the district.

The empirical analysis uses an original database containing information on 5,553 innovative companies in the region. The mean analysis applied allows us to identify variables with statistically significant differences as a preliminary to isolating groups of firms with more pronounced central values.

The results show the presence of differences characterizing companies with different levels of innovation in ID and NID, as well as the groups of innovative firms belonging to districts with differing technological levels. In the first case, the superiority of innovative companies does not emerge, consequently, we cannot confirm the existence of a district effect. However, we can detect some evidence of an inter-industry effect in the performance of innovation firms in footwear, textiles and ceramics.

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## 1. Introduction

This paper investigates the presence of: a) a so-called district effect, which contrasts the performance and behaviour of companies located in industrial districts (ID) with non-district firms in Local Labour Systems (LLS); and b) what we call an inter-district effect. We define the latter as occurring as a consequence of better economic performance in the ID from increased level of technology. Based on the economic specialization of ID in the region, we focus on have adopted the ID of ceramics, textiles and footwear

In order to study these effects, we take the innovative firm (IF) in the Region of Valencia as our unit of analysis for two reasons. a) we want to test the above effects on the usual firm financial variables as well as firm knowledge variables; b) according to previous research on Italian and Spanish ID, the district effect appears in a wide set of firm economic variables[2] and is often based on the presence of knowledge spillovers – the Marshallian metaphor for industry environment. These externalities give rise to increasing returns that confer economic advantage on district as opposed to non district firms.

We assume that IF absorb these spillovers more easily because of their superior knowledge resources. Because of the, difficulties involved in identifying knowledge territorial variables, we consider IF because we assume that this type of firm, by definition, uses more knowledge in its production, organization and commercial processes and exhibits explicit knowledge through patents and licences. This assumption adds a corollary to our hypotheses. For both types of variables IF should display a better performance: a) in ID compared to location outside an ID; and b) in ID of higher technological level compared to lower technology level ID.[3]

The paper is organized as follows. Section 2 provides a brief review of the literature on district effects in ID. Section 3 summarizes the methodology for the IF survey and the statistical analysis. Sections 4 and 5 present the main results for the existence of a district effect and an inter-district effect in the variables analysed. Section 6 concludes.

## 2. The district effect in the literature on ID

The theoretical framework related to ID (Marshall, 1992; 2003; 2009; Becattini, 2003; 2009) is complemented by a wide set of empirical studies. Early work tried to delimit the

[2] See surveys by Blasio (2009), Boix (2010) and Lopez-Estornell (2010).

[3] IF are appropriate if we assume, as would seem reasonable, that this type of company more strongly reflects the use of knowledge resources, codified or contextual, as essential inputs for generating innovations. Their existence in non-innovative companies can often go unnoticed because of their general lower level ability.

Italian ID and their territorial boundaries (Sforzi (1987, 1992); Sforzi & Lorenzini (2002), ISTAT (1997, 2005, 2006), Istituto G. CENSIS & Tagliacarne (1995). ID activity in Italy was promoted by a law (1991) that established ID as potential targets for economic policy. The demarcation of districts was performed in Spain (SMEs DG (2005), Boix, 2007, 2009, Molina 2007) and the UK although it has been subject to certain constraints (Boix & Galletto, 2006, 2008; Cannari & Signorini 2000; Iuzzolino 2000, 2005). Some works introduce multi-dimensional elements and propose multicluster classifications.

A second group of empirical contributions, initiated by Signorini (1994),[4] tests the existence of a district effect. This line of research analyses whether firms located in districts achieved better economic performance than similar non-district firms and whether behaviour patterns differ between district and non-district firms. Some studies examine the economic results of profitability, efficiency, productivity, inclination to export, labour market and relative wages, entrepreneurial activity, credit markets and innovation sources among the features of ID specialised firms. The research on a district effect is not conclusive although those that believe in its existence are in the majority. It should be remembered, however, that that same variable can lead to opposite conclusions depending upon the temporal period adopted and the variables analysed.

## 3. Collection and analysis of statistical information

We gathered data from around 25 administrative sources to obtain statistical information to find evidence of a district effect in IF headquartered in the Region of Valencia. Based on the information gathered we developed an original database. We first surveyed all IF, based on fulfilling criteria including of receipt of public support, patenting and licensing activity, contractual links with a regional university, association of firms with regional technological institutes,[5] spins-off, regional firm included in SABI,[6] NACE 73 (R&D services) category, etc.. We integrated individualized information on firms in the database. Note that our data has some limitations,[7] none of which impact heavily on the quality of our

[4] Surveys can be found in Blasio (2007; 2009) and López-Estornell (2010).

[5] Information gathered end 2008 and early 2009. We have identified 14 partner firms of Technological Institutes (TTII).

[6] SABI is a firm accounting database based on Spanish/European rules, which is publicly available.

[7] SABI excludes individual businesses; in our case the consequences are a small loss of information, because innovative activity usually leads to the adoption of various corporate forms, for commercial and financial reasons. The criterion for inclusion in the survey was location of the firm headquarters in the region. This resulted in loss of information on IF with branches in Valencia but headquarters in other regions. However, there exists information that points out the reduced influence of these firms on regional innovation expenditure.

information. After several reviews of the information to find inconsistencies, the final sample was 5,553 IF, assigned to a LLS, either ID or non-ID, which is in line with previous research (Boix, 2006; Ybarra, 2008)[8]. Finally, we have selected as ID those LLS that matched in both authors, with the result of 40 ID and 41 NOID[9].

*Descriptive results*

39.3% of our IF are part of an ID, the remaining 60.7% are non district firms. The concentration of IF in non-district IF is notable, mainly because the city of Valencia absorbs two thirds of the total. In 2006, regional IF employed a total of 171,662 workers (up from 137,159 in 2000) of which 69,074 (40.2%) were employed by ID firms. Both shares are close to the above figures and in line with value added and turnover. Some general results for some key variables are presented in **Table 1**.

**Table 1. Annual growth in turnover, employment, value added and value added/worker 2000-2006 (%) (Authors' classification)**

| | 1. Agriculture, mining, power prod. and distrib. | 2. HTM-MHTM | 3. MLTM | 4. LTM | 5. Building | 6. Services (7and 8 not included) | 7. HTS | 8. Education, community and individual services | Total |
|---|---|---|---|---|---|---|---|---|---|
| **Turnover** | 6.13 | 6.44 | 7.89 | 4.26 | 13.78 | 8.08 | 11.16 | 12.45 | 6.86 |
| **Employment** | 3.7 | 3.0 | 2.67 | 1.56 | 6.96 | 4.96 | 7.2 | 8.74 | 3.26 |
| **Added Value** | 7.0 | 7.1 | 6.3 | 3.7 | 14.3 | 9.1 | 12.7 | 14.2 | 6.8 |
| **Added Value/worker** | 3.2 | 4 | 3.6 | 2.1 | 6.9 | 4.0 | 5.1 | 5.0 | 3.4 |

Note: HTM-MHTM: high and medium high-tech manufacturing; MLTM: medium-low technology manufacturing; LTM: low-tech manufacturing; HTS: high-tech services; IF: innovative firm, ID: industrial district; NOID: not industrial district. Nominal values.

Source: Our own elaboration

The financial profitability of IF achieved 9.65% in 2006. There is a gap for this variable between the building sector (above 20% in ID and non-district firms) and other economic activities. Similarly, the economic clusters directly or indirectly related to building, such as mining, production and distribution of power, water and gas, show above average returns. The production of codified knowledge by regional IF consists mainly of utility models (503 companies) and patents (359 firms): 775 companies (14% of total IF) applied for intellectual property protection[10].

[8] Interaction with the authors was very open for which we are very grateful.

[10] 2000-2006 for patents and in 2000-2008 for utility models. The data of utility models in 2000 are likely underestimated. The economic relevance of the different intellectual property titles –national patents, European patents, PCT patents, utility models- is not homogeneous, depending on the economic returns expected. As this data are unknown, we have tried to obtain a first approach to a homogeneous value by means of a weighting based on the administrative costs of the applications necessary to request the approval of patents and utility models from governmental offices.
Other variables include production and intensity of innovation in IF, estimated by aggregating the budgets of actions supported by IMPIVA and the amount charged by universities to IF for their services. This enabled a rough classification of support types and respective economic values. We also classified innovation actions

*Statistical methodology*

After estimating the mean and median values, we checked whether each variable, after applying a univariate analysis, had any influence on specific groups. In the case of continuous variables the statistical procedure used has been the comparison of the means for several groups (two in the case of the t test, three or more in the application of ANOVA). If equality of means for a variable existed in the groups considered, we assume that it does not significantly affect the presence of IF in one or other group. Before the use of the t test for the contrasts of means between two groups, -in our case DI and NODI-, we have applied a Levene test to verify the assumption of homoscedasticity. To the variables that did not meet this requisite, we have applied the Welch t test, because of its robustness in absence of variance equalities.

We have utilized the ANOVA test to contrast the means of more than two groups - in our case footwear, textiles and ceramics districts. The ANOVA has been applied to the variables that, after fulfilling the Levene test, were originally homoskedastic and also to the variables that met this test after a Box-Cox transformation. When it has not been possible to utilize the letter, we have made use of the Welch t test 2 to 2 because of their robustness in absence of homoskedastic, even when the size groups differ. After identifying the variables that did not have equal means, by means of the tests of Scheffe, Dunn-Sidak and LSD of Fisher, we have delimitated the group or groups responsible for the differences.

To categorical variables we have applied the contrast $\chi 2$ for contingency tables. The goal has been to verify, for each variable, the existence of homogeneity of frequencies among the groups; i.e., a similar way to that we have explained above on continuous variables. After obtaining the relative frequencies of the categorical variables, we have tested the variables with frequencies below five because, in this case, the $\chi 2$ test results can be unreliable. Because of this possibility, when necessary we have conducted the Fisher probability test as it is more appropriate for reduced frequencies.

Even after following the appropriate procedure, the *post hoc* tests ($\chi 2$ test with Yates correction and $\chi 2$ test without Yates correction) could not detect significant differences. In these cases, we have not rejected the null hypothesis. For the remainder variables we have delimited the groups with differences.

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according to the level of R&D in order to distinguish between 'strong' and 'weak' innovation. The resulting proportions are 53% of financial resources for strong innovation and of 47% for weak.

## 4. Presence of a district effect in IF in the Valencia Region: outcomes.

*Variables used*

The continuos and categorical variables used to detect district and inter-district effects are gathered in **Table 2**. The units analyzed to detect a district effect are all the IFs both district and non-district. To identify an inter-district *effect*, we have selected the IF belonging to the sector of specialisation in the respective district, along with other IF that might be considered as a complementary link of the chain value. Both groups of firms might be understood as the ID core, a relevant subset of the *filière*.[11] The number of IF tested has been 312 in the textiles ID, 248 in footwear and 203 in the ceramics ID. The location of these firms corresponds, respectively, to seven ID in textiles, and eleven in footwear as well in ceramics.

*Variables related to economic accounts*

*Contrast of means*

The use of the t test for continuous variables, in order to detect a district effect, reveals the existence of 13 variables with means that show statistical significant differences (**Table 3**). Three are related to firm economic performance: financial profitability (2006), rate of growth of turnover, average rate of increase in apparent labour productivity (value added per employee), and average expenditure per employee in 2000 to 2006. In these variables, the central values obtained have been higher in the IF of NOID.

The remaining variables, with significantly different means from a statistical point of view, have more pronounced values for the district IF, caused by their bigger size and correlative higher absolute values of related variables. This is the case for employment and turnover (in 2006 and average 2000-2006), added value (2000), capital and reserves, material and total assets, value of annual depreciation and financial and assimilated expenditures (all referring to 2006). The presence of significant differences in turnover, employment and added value for 2000 and their absence in 2006, may result from a simultaneous approximation of both groups of firms –ID and non-ID - as a consequence of the better economic dynamism achieved by non-district firms.

[11] López-Estornell (2010).

| Table 2. Continues and categorical variables related to economic accounts and knowledge in innovative firms | | | |
|---|---|---|---|
| **Continuous variables related to knowledge in innovative firms** | | **Continuous variables related to the economic accounts of innovative companies** | |
| **Generation of codified knowledge** | **Human capital and inventive density** | **Economic Performance** | Intangible Assets 2006 (k €) |
| Total patent applications of all types 2000-2006 | Average No. of employees 2000-2006 | % Financial profitability 2006 | Tangible assets 2006 (k€) |
| Total utility model applications 2000-2006 | Staff expenditure per employee (K€) 2006 | % EBITDA/ Turnover 2006 | Total fix assets 2006 (k€) |
| Total patents and utility models applications/100 workers 2000-2006 | Inventive density for each 10,000 units of human capital | Turnover annual growth rate in 2000-2006 % | Allocation depreciation/Total assets 2006 (%) |
| Total equivalent value of patents 2000-2006 | **Intensity of each type of innovation (2000-2006)** | Employment annual growth rate 2000-2006 (%) | **Firm outputs** |
| Total equivalent value of utility models 2000-2006 | Intensity of Type 1 Innovation production (K€) | Added Value/Employee annual growth rate 2000-2006 (%) | Turnover 2006 (k€) |
| Total equivalent value of patents and utility models applied for each 100 workers 2000-2006 | Intensity of Type 2 Innovation production (K€) | Average Added Value/Average employees (2000-2006) (k €) | Turnover 2000 (k€) |
| Total equivalent value of patents and utility models per each 10000 human capital units in 2001 | Intensity of Type 3 Innovation production (K€) | Added Value/Employee 2006 (k€) | Average Turnover 2000-2006 (k €) |
| **Relationships with offices and institutions for the creation of knowledge** | Intensity of Type 1&2 Innovation production (K€) | Added Value/Employee 2000 (k€) | Added Value 2006 (k €) |
| No Technological Institutes to which the firm is associated with | Intensity of Types 1&3 Innovation production (K€) | **Firm inputs** | Added Value 2000 (k €) |
| Total contribution of firms and IMPIVA, budget 2000-2006 (K€) | Intensity of Types 2&3 Innovation production (K€) | Employment 2006 | Average Added Value 2000-2006 (k €) |
| Total value of contracts agreed with regional public universities 1999-2003 (K€) | Intensity of Type 1, 2,3 Innovation production (K€) | Employment 2000 | **Firm funds** |
| | Intensity of Innovative production: 'Strong' Innovation Type (K€) | Estimated staff cost 2006 (k €) | Capital and reserves 2006 (k €) |
| | Intensity of Innovative production: 'Weak' Innovation Type (K€) | Estimated average staff expenditure per employee 2006 (k €) | Financial expenses and similar 2006 (k €) |
| **Knowledge categorical variables of innovative firms** | | Average employees 2000-2006 | Annual profits 2006 (k€) |
| **Innovation relationships** | Other IF relationships with university 1999-2003 1/0 | Inputs: Materials 2006 (k€) | EBITDA 2006 (k€) |
| Presence of immaterial assets in IF 2006 1/0 | IF receiving IMPIVA grants for setting up new companies 2000-2006 1/0 | Endowment depreciation 2006 (k €) | Financial expenses/Turnover 2006 (%) |
| IF partially held by other firms 1/0 | IF receiving IMPIVA grants for other technological innovations 2000-2006 1/0 | | |
| IF witch holds other firms 1/0 | IF receiving IMPIVA grants for other non technological actions 2000-2006 1/0 | **Categorical variables related to economic accounts of innovative companies** | |
| Export IF 1/0 | **Type of innovation produced** | **Sector** | **Firm size** |
| Association of innovative firm to TTII 1/0 | Innovation production Type 1 1/0 | 1. Agric., extrac., production and distrib. of power | Microenterprise |
| IF relationship with university 1/0 | Innovation production Type 2 1/0 | 2. High and medium high-tech manufacturing | Small |
| IF relationship with IMPIVA 2000-2006 1/0 | Innovation production Type 3 1/0 | 3. Medium-low technology manufacturing | Medium |
| IF relationship with CDTI 2003-2006 1/0 | Innovation production Type 1&2 1/0 | 4. Low-tech manufacturing | Big |
| **Explicit/codified knowledge** | Innovation production Type 1&3 1/0 | 5. Building | **Firm age** |
| IF Patent Applications 2000-2006 | Innovation production Type 2&3 1/0 | 6. Services except for 7 and 8 | Before 1960 |
| IF Utility Model Applications 2000-2006 | Innovation production Type 1&2&3 1/0 | 7. High-tech services | 1960-1975 |
| IF Patents AND Utility Model Applications 2000-2006 1/0 | Production of strong innovation 1/0 | 8. Education, community and personal services | 1976-1985 |
| Papers published in ISI journals 1/0 | Production of weak innovation 1/0 | | 1986-1995 |
| **Type of support/relationship with IMPIVA and university** | **Wages** | | 1996 and following |
| Contribution of IF and IMPIVA for R&D 2000-2006 1/0 | University technological support/consulting to IF 1999-2003 1/0 | Staff estimated average expenses in IF (-) Staff estimated average expenses of the whole of regional IF 1/0 | Staff estimated average expenses in IF (-) Staff estimated average expenses of a sample of the whole of regional IF that have applied for patents and/or utility models 1/0 |
| Presence of R&D contracts IF-university 1999-2003 1/0 | IF receiving IMPIVA grants for technological cooperation among companies 2000-2006 1/0 | Staff estimated average expenses in IF (-) Staff estimated average expenses of the whole of regional IF that belong to the same NACE 1/0 | **Note: k €, thousands of Euros Source: Our own elaboration** |

| Table 3: Contrast ID/NOID, continuous variables related to economic accounts of enterprises" in industrial districts (ID) and non-industrial (NOID) with means significantly different | | | | | | |
|---|---|---|---|---|---|---|
| | Higher mean | | | | | |
| Variable | ID | NOID | Statistic t | P-value t | test t Welch | P-value t Welch |
| Total fix assets 2006 (k€) | X | | -3,027 | 0,002 | 2,843 | 0,0044 |
| Tangible assets 2006 (k€) | X | | -3,739 | 0,000 | -3,474 | 0,0005 |
| % Financial profitability 2006 | | X | 2,283 | 0,224 | 2,363 | 0,0186 |
| Capital and reserves 2006 (k€) | X | | -2,334 | 0,019 | 2,289 | 0,022 |
| Turnover 2006 (k€) | X | | -3,144 | 0,002 | 3,010 | 0,0019 |
| Turnover annual growth rate in 2000-2006 % | | X | 3,304 | 0,000 | 3,310 | 0,0009 |
| Average Turnover 2000-2006 (k €) | X | | -2,215 | 0,027 | 2,210 | 0,0271 |
| Employment 2000 | X | | -1,995 | 0,046 | -1,992 | 0,0464 |
| Added value 2000 (k€) | X | | -3,027 | 0,002 | -2,926 | 0,0034 |
| Added Value/Employee annual growth rate 2000-2006 (%) | | X | 3,08 | 0,002 | 3,189 | 0,0014 |
| Endowment depreciation 2006 (k €) | X | | -3,895 | 0 | 3,752 | 0,0001 |
| Financial expenses and similar 2006 (k €) | X | | -4,152 | 0 | -3,883 | 0,0001 |
| Estimated average staff expenditure per employee 2006 (k €) (1) | | X | 4,952 | 0 | 5,342 | 0 |
| (1) To limit empty values, we have calculated estimations using as reference the average for the whole IF. Note: k €, thousands of Euros Source: Our own elaboration | | | | | | |

*Contrasts of frequencies*

The use of frequency contrasts for two groups, in the case of categorical variables (**Table 4**), has pointed out the presence of significant statistical differences in two of them -micro and small enterprises-, which presence has been more frequent in NOID and ID, respectively. For the IF variables related to the sector's technological intensity, we have found that the IF district have produced more medium-low and low technological level products, in coincidence with the technological intensity of the main regional ID. On the contrary, the IF of NOID have showed a higher presence of sectors of activities not classified and of high technologies –high and medium-high manufacture levels or high-tech services. Likewise, NODI stand out because of a denser implementation of non sophisticated services. The results found are consistent due to the presence, among these NOID, of LLS which integrate the metropolitan/urban areas of Valencia and Alicante. The IF of agricultural and building, mainly based on several forms of natural resources exploitation, are also more frequently implemented in NOID, because they often coincide with areas where there exist important tourist and residential markets as well as more developed-intensive agriculture.

| Table 4. Contrast ID/NOID, categorical variables related to economic accounts of innovative firms | |
|---|---|
| Variables | P-value test X2 |
| Economic Activities Classification (1/8) | 0.0000 |
| Micro sized firms | 0.0047 |
| Small sized firms | 0.0382 |
| p-Value<0,05 Source: Our own elaboration | |

*Knowledge variables*

*Contrast of means*

After applying the t-test, the results have revealed the existence of significant statistical differences among several knowledge variables (**Table 5**): the average personnel expenditure[12], the homogenous value of patents and utility models[13] and the inventive density[14]. In the case of the two first variables, the IF with highest values have belonged to NOID, and the third variable to the IF of ID. These results seem to obey to the following explanation: in the two initial variables, the IF of NOID could have developed more complex innovations, while the higher density of the IF inventiveness in ID could correspond to a better creative efficiency of their human capital. This assumption is plausible if we accept that ID, as knowledge systems: a) Achieves a more pronounced expertise, either from the firm, or from skilled workers, technological institutes and other support institutions and b) Can make use of a knowledge accumulated over a long period of time.

The payment of lower wages in ID (measured, as proxy, by the average staff expenditure) is also a feature noticed in the Italian ID but these results are inconclusive. Some explanations developed to justify this result have been related to the existence in ID of a higher quality of life and a wider stock of public goods next to social needs (Blasio, 2009) but it may also proceed from levels more reduced of formal education (Dalmazzo, 2005).

The values concerning the IF of ID have been higher in the remaining variables with significant statistical differences. Among them, we have found some related to the intensity of innovation production[15], that are characteristic of weak innovation and, therefore, of a kind of innovation that either does not include R&D or it does so partially. We think that the difference in favour of ID for the budget of activities supported by IMPIVA has arisen because the projects submitted to this government office have also kept a relationship with the firm size, higher in the IF of ID. Besides, the fluid relationship between IMPIVA and the traditional manufacturing sectors of the Region may be a consequence of direct and indirect existing linkages (mainly through technological institutes).

[12] This variable appears in both blocks analysed, as input cost of labour and as a proxy of efficiency wages.

[13] In order to achieve a homogeneous value for patents and utility models we have used a weighting that has taken into account, as reference values, an estimate of the administrative costs necessary to apply for the approval of governmental intellectual property offices.

[14] We have obtained an *Index of inventive density (IID)* from the amount of patents and utility models applied for every LLT knowledge agent (firms, people, inventors, researchers, universities...) divided by each 10,000 unities of human capital estimated for the respective LLT (year 2001).

[15] As we have indicated, the value of such intensity depends on the kind of relationship that firms have held with several government offices, particularly IMPIVA, and the regional public universities.

| Table 5. Contrast ID/NOID, Knowledge continuous variables with means signicantly different | | | | | | |
|---|---|---|---|---|---|---|
| | Highest value | | | | | |
| Variable | ID | NOID | t Statistic | P-value t | t Welch test | P-value t Welch |
| Total equivalent value of patents and utility models applied for each 100 workers 2000-2006 | | X | 2,564 | 0,010 | 2,69 | 0,007 |
| Total innovation intensity: innovation items types 1,3 | X | | -3,825 | 0,000 | -3,527 | 0,000 |
| Total innovation intensity: items weak innovation | X | | -6,361 | 0,000 | -5,811 | 0,000 |
| Total innovation intensity: innovation items type 2 | X | | -3,803 | 0,000 | -3,568 | 0,000 |
| Total innovation intensity: innovation items type 3 | X | | 5,951 | 0,000 | -5,256 | 0,000 |
| Total contribution of firms to complement IMPIVA grants 2000-2006 (K€) | X | | -3,667 | 0,000 | -3,345 | 0,000 |
| Staff expenditure per employee (K€) 2006 | | X | 4,952 | 0,000 | 5,342 | 0,000 |
| Total equivalent value of patents and utility models for each 10000 human capital units in 2001 | X | | -5,922 | 0,000 | -5,694 | 0,000 |
| Source: Our own elaboration | | | | | | |

*Contrast of Frequencies*

The contrast of frequencies applied to knowledge categorical variables has pointed out a lack of homogeneity of frequencies for the group of variables collected in **Table 6**. Thus, the IF of ID have been significantly different in the following variables: exporting company, firm linked to technological institutes, company applying for utility models, firm related to IMPIVA, and company with grants received from this government organization either for developing other technological purposes, or for non technological actions or for setting up new enterprises. Among the different ways to produce innovations, the IF of ID have excelled in projects don't related to R&D. The results confirm the obtained in the continuous variables referred to the intensity of innovation production.

| Table 6. ID/NOID contrast, Knowledge categorical variables | | | |
|---|---|---|---|
| Variable | P-value test X2 | Variable | P-value test X2 |
| IF shared by other firms 1/0 | 0,035 | IF that has hired other services to university 1999-2003 1/0 | 0,000 |
| IF export 1/0 | 0,000 | IF with IMPIVA support 2000-2006 1/0 | 0,000 |
| IF associated to TTII 1/0 | 0,000 | IF with IMPIVA support for technological and entrepreneurial cooperation 2000-2006 1/0 | 0,002 |
| IF with university contracts 1999-2003 1/0 | 0,000 | IF with IMPIVA support for setting up 2000-2006 1/0 | 0,000 |
| IF that has applied for utility models 2000-2006 1/0 | 0,000 | IF with IMPIVA support for other technological innovation actions 2000-2006 1/0 | 0,000 |
| IF that has applied for utility models and/or patents 2000-2006 1/0 | 0,000 | IF with IMPIVA support for other goals different from already mentioned 2000-2006 1/0 | 0,000 |
| IF that has hired R&D to university 1999-2003 1/0 | 0,002 | IF with only innovation Type 1 (R&D) 2000-2006 1/0 | 0,039 |
| IF that has hired technological support/consulting to university 1999-2003 1/0 | 0,000 | IF with only innovation Types 2&3 2000-2006 1/0 | 0,000 |
| Source: Our own elaboration | | | |

On the other hand, the features significantly different and more intense in the IF of NOID have been the following: firm that has signed more contracts with regional universities for R&D as well as for technological support, consulting and other goals. Besides, it has more frequently published in scientific journals, which are another modality of codified knowledge. The frequency in the production of innovations has also been higher as a consequence of the investments in R&D.

The contrast between the characteristics of both groups of firms, as we have noted, indicates different patterns in the use of knowledge resources. The profile of an IF located in a

regional ID suggests a type of innovation less complex and closer to the firm location, originated in technological institutes or by means of new combinations of knowledge already present in the district. This innovation has not generally materialized in formal protections or, in any case, it has often opted for a less complicated and expensive instrument, such as the utility model. It is a firm broadly supported by the regional administration for the reasons already mentioned and, because of this interactions, it has received grants for different purposes, including the set up of new firms -a fact that highlights the dissemination of an entrepreneurial spirit which is also frequent in Italian ID (Casavola, 2000; Omiccioli & Quintiliani 2000). However, we cannot forget that, in our case, three of the four regional Business Innovation Centres (BICs) are located in ID[16].

Unlike ID, the IF of NOID has more intensely sought diversified sources of innovative knowledge, including the relationship with universities. This firm pattern has more frequently protected its innovations through patents, probably because they have been the output of R&D projects of expansive costs and extensive trade horizons. In line with these innovation preferences, it is a company that has sought public support to tackle the above-mentioned actions. In the capital of this company there is an increased presence of other firms that had contributed an additional source of technological, commercial and organizational knowledge[17].

However, we must notice that some characteristics of both groups have just affected a small number of companies. Thus, the R&D projects in collaboration with universities have been higher in the IF of NOID but they have just reached a 5% of these firms, compared to a 3.2% of ID. Taken together, innovation actions based solely on R&D have included 8% of NOID innovative enterprises and 6.4% of those located in ID.

## 5. Presence of district effect in innovative companies of Valencia Region: first outcomes.

As we have proposed, the inter-district effect attempts to capture the presence of asymmetric behaviours among innovative companies which belong to industrial districts but also to sectors of specialization with a different technological level. Implicitly, this effect is

[16] Elx, Alcoi y Castelló. The BICs have as target to enhance entrepreneurial projects capable of diversifying the main economic activity of their respective area of influence.

[17] Several differences are similar to those analysed in Lombardy, in particular the lesser relationship of ID firms with universities and research centres, the smaller use of innovation based on R&D, and the greater utilization of district knowledge resources. Despite these resemblances, the use of real service centres – that could be an institution close in some aspects to technological institutes in Valencia- seems to have influenced more the innovative activity of NODI firms (Muscio, 2006).

based on two assumptions: a) The presence of distances among technological levels corresponds to different ways of approaching the innovation process and, therefore, the generation of new knowledge in companies and districts; b) The existence of technological distances among sectors, due to their diverse strategies and necessities, might influence the economic performance of firms and, to some extent, of the whole district -for example, stimulating a greater or a lesser demand of qualified human capital. Consequently, we have assumed that the sector does not act neutrally on the innovative activity of firms. In favour of this influence they are the international classifications of the OECD on technological intensity (Hatzichronoglou, 1997) and other taxonomies of economic literature (Pavitt, 1984). This influence is not homogeneous but, generally, the economic sector contributes to modulate the intensity and composition of firm innovative patterns and it reinforces the initial plausibility of the inter-district effect.

**The Knowledge Variables of Innovative Firms.**

*ANOVA*

As we needed to know if the mean differences of the concerned variables were statistically significant, we have applied ANOVA, identifying as variables without equality of means those listed in Table 7, in which we also have reflected the origin of these differences.

**Table 7. ANOVA of knowledge continuous variables of IF with mean differences statistically significant located in ID of Region of Valencia, specialized in textile, footwear and ceramics 2006**

| Variable | P-value ANOVA | Difference among ID of |
|---|---|---|
| **Wage differences** | | |
| Staff expenditure per employee (1) | 0,000 | TEX/FOT/CER |
| **Knowledge creation: productivity** | | |
| Total equivalent value of patents and utility models per each 10000 human capital units in 2001 (innovative density) | 0,000 | TEX de FOT and CER |

Notes (1) Empty values previously obtained taking as reference the average of the whole IF
P-valor de ANOVA, p*<0.05 Fuente: Elaboración propia.

From the above results we might infer that in one variable all groups have been different from each other: staff expenses per employee, with the IF of ceramics ID reaching magnitudes higher than in the other groups of ID. In the case of the variable of inventive density, textile ID have distanced themselves from the rest, indicating their greater capacity to generate knowledge from their human capital. In any case, the reported results indicate a low number of variables with significant differences.

*Contrast of Frequencies*

After calculating the frequencies of categorical variables, the results of the respective contrasts are in Table 8, with the origin of differences shown in Table 9.

| Table 8. Contrast Textiles/ Footwear/ Ceramics knowledge categorical variables | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Variable** | **Estad. X2** | **gl** | **P-valor test χ2** | **Frec.< 5?** | **Prob. Fisher** | **Variable** | **Estad. X2** | **gl** | **P-valor test χ2** | **Frec.< 5?** | **Prob. Fisher** |
| Inmaterial assets_2006 (1/0) | 33,1 | 2 | 0,000 | no | | Presence of R&D contracts IF-university 1999-2003 1/0 | 25,53 | 2 | 0,000 | sí | 0,000 |
| IF partially held by other firms 1/0 | 71,89 | 2 | 0,000 | no | | IF receiving IMPIVA grants for setting up new companies 2000-2006 1/0 | 7,50 | 2 | 0,0235 | no | |
| IF witch holds other firms 1/0 | 52,8 | 2 | 0,000 | no | | Innovation production Type 1&2&3 1/0 | 9,03 | 2 | 0,0109 | no | |
| Export IF 1/0) | 41,24 | 2 | 0,000 | no | | Production of strong innovation 1, 1.1, 1.3, 1.2.3 (1/0) | 6,99 | 2 | 0,0303 | no | |
| Association of innovative firm to TTII 1/0 | 12,41 | 2 | 0,002 | no | | Production of weak innovation 2, 3, 2.3 (1/0) | 6,99 | 2 | 0,0303 | no | |
| IF relationship with university 1/0 | 18,72 | 2 | 0,0001 | no | | Staff estimated average expenses in IF (-) Staff estimated average expenses of the whole of regional IF that belong to the same NACE 1/0 | 51,33 | 2 | 0,000 | no | |
| IF relationship with CDTI 2003-2006 1/0 | 12,38 | 2 | 0,002 | sí | 0,003 | Staff estimated average expenses in IF (-) Staff estimated average expenses of a sample of the whole of regional IF that have applied for patents and/or utility models 1/0 | 214,01 | 2 | 0,000 | no | |
| Papers published in ISI journals 1/0 | 7,57 | 2 | 0,023 | sí | 0,023 | | | | | | |
| Note: We must point out that $\chi$ test has obtained a p-value 0,0551 for variable University technological support/consulting to IF 1999-2003. We have not rejected the nulle hipotheses because such p-value is slightly superior to 0,05, which is the value fixed as limit for acceptance. Source: Our own elaboration. | | | | | | | | | | | |

| Table 9. Contrast *post-hoc* Textiles/ Footwear/ Ceramics with continuity correction of Yates, knowledge categorical variables | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Variable** | **Contrast between Textile and Footwear** | **Contrast between Textile and Cerámics** | **Contrast between Footwear and Ceramics** | **Variable** | **Contrast between Textile and Footwear** | **Contrast between Textile and Cerámics** | **Contrast between Footwear and Ceramics** |
| | **P-valor test χ2** | **P-valor test χ2** | **P-valor test χ2** | | **P-valor test χ2** | **P-valor test χ2** | **P-valor test χ2** |
| Presence of immaterial assets in IF 2006 1/0 | 0,000 | 0,540 | 0,000 | Presence of R&D contracts IF-university 1999-2003 1/0 | 0,743 | 0,000 | 0,000 |
| IF partially held by other firms 1/0 | 0,333 | 0,000 | 0,000 | IF receiving IMPIVA grants for setting up new companies 2000-2006 1/0 | 0,258 | 0,012 | 0,185 |
| IF witch holds other firms 1/0 | 0,016 | 0,000 | 0,000 | Innovation production Type 1&2&3 1/0 | 0,015 | 0,695 | 0,007 |
| Export IF 1/0) | 0,391 | 0,000 | 0,000 | Production of strong innovation 1, 1.1, 1.3, 1.2.3 (1/0) | 0,199 | 0,173 | 0,011 |
| Association of innovative firm to TTII 1/0 | 0,050 | 0,096 | 0,001 | Production of weak innovation 2, 3, 2.3 (1/0) | 0,199 | 0,173 | 0,011 |
| IF relationship with university 1/0 | 0,233 | 0,006 | 0,000 | Staff estimated average expenses in IF (-) Staff estimated average expenses of the whole of regional IF that belong to the same NACE 1/0 | 0,001 | 0,000 | 0,000 |
| IF relationship with CDTI 2003-2006 1/0 | 0,202 | 0,051 | 0,002 | Staff estimated average expenses in IF (-) Staff estimated average expenses of a sample of the whole of regional IF that have applied for patents and/or utility models 1/0 | 0,037 | 0,000 | 0,000 |
| Note: p*<0,05 for p-value Chi-cuadrado test; p**<0.016666...for contrasts among groups. Grey colour indicates different groups. Source: Our own elaboration. | | | | | | | |

The above results indicate that the IF of ceramics ID have been again the most distanced from the other ID. In particular, ceramics and footwear have significantly differed over four variables. In the first two, of relational type –relationship with CDTI and TTII partnership- ceramics have overcome ID footwear. The first result was expected due to several causes: the prevalent type of innovation in this sector, the smaller dimension of its firms, the lower level of information and development of relational capital and the greater difficulty in observing the

formal requirements needed for drawing public support. The other two variables have corresponded to the kind of innovation adopted: ID of ceramics have stood out in the strong type, while footwear in the weak type. The IF of textile ID have occupied an intermediate position between the other sectors. These results might be considered consistent because ceramics requires more sophisticated innovation, while footwear often identifies itself with incremental innovations of reduced technological intensity.

A difference between textiles and ceramics has corresponded to grants for new businesses. For this variable, textile ID have achieved less presence of such a support, unlike ceramics, with footwear in an intermediate position. In our opinion, these results may reflect the uneven activity of the respective BICs, as well as the superior demographic and economic dimensions of Elx and Castelló ID, which could have enhanced the likelihood of the setting up of new entrepreneurial activities.

In other four variables, IF of ID ceramics have distanced themselves from textile and footwear ID. The variables involved coincide with some aspects of relational capital, either by being shared, to export or to hold relationships with the university, in particular for R&D projects. The bigger closeness of IF in ceramics ID with the above variables has revealed that these companies are found often in business groups: a feature also noticed in firms of Sassuolo ceramics district (Italy), which has experienced a strong process of industrial concentration (Conigliani, 2004). The remaining two variables, related to the university, have also supported the singularities of ceramics ID. Let us note that this may have responded to the presence or proximity of public and firm research resources with mutual relationships, as well as to the greater human capital endowment of firms, the links among the sector'd technicians, and the strength of the employers' organization. On the other hand, the greater inclination towards R&D projects is a consequence of the presence in ID of inducers and promoters of innovations, such as suppliers of frits and enamels or trade branches of machinery manufacturers.

In other two variables, the IF of footwear ID have moved away from textiles and ceramics. The first variable, -low intangible assets in the firm- matches prevailing productive techniques, informal knowledge diffusion, strong rotation of business, -which does not facilitate the consolidation of intangibles-, and a firm strategy more focused on brand and design than to R&D. Likewise, the IF of footwear ID have gone away from the other two groups due to the use of the innovation type undertaken, which includes a full spectrum of modalities, from R&D projects to activities that just require some modality of technical assistance. Therefore, it is not visible a defined and comprehensive strategy.

In the remaining variables, all the three ID groups have shown significant differences among them. Frequencies of these variables have been, in all cases, higher in ceramics ID, followed by textiles and, finally, by footwear. Such has been the case for innovative companies sharing capital of other firms, the difference between the estimated wage average of the IF, in a particular group of ID, and the average for the whole of the regional IF belonging to the same sector. A similar result has arisen when the comparison has adopted, as reference, a selected group of Valencia's firms which have applied for patents or utility models. The already mentioned tenure of equities shows that, in ceramics, the cross shareholdings have worked in both directions, with a sufficient intensity to go away from the remaining ID analyzed. Additionally, the above results, about wage gaps, could remark that the superiority of intra-district wages has reached higher frequencies in ceramics, unlike textile and, especially, unlike footwear. These differences have probably reflected the productivity gaps among specialized sectors of ID.

*Variables related to the economic accounts of innovative firms*

*ANOVA*

The application of ANOVA to variables of the three ID groups has disclosed the existence of significant differences among their means (**Table 10**). In this Table we have also indicated the origin of the respective differences.

**Table 10. ANOVA continuous variables, economic accounts of IF with mean differences statistically significant, located in ID of Region of Valencia specialized in textile, footwear and ceramics 2006**

| Economic performance | P-valueANOVA | Differences among ID of | | Inputs de la empresa | P-valor ANOVA | Differences among ID of | |
|---|---|---|---|---|---|---|---|
| Turnover annual growth rate in 2000-2006 % | 0,001 | CER vs TEX | CER vs FOT | Employment 2000 | 0,000 | CER vs TEX | CER vs FOT |
| % EBITDA/ Turnover 2006 | 0,011 | CER vs TEX | CER vs FOT | Estimated average staff expenditure per employee 2006 (k €) | 0,000 | CER vs TEX vs FOT | |
| Average Added Value/Average employees (2000-2006) (k €) | 0,000 | CER vs TEX | CER vs FOT | Total fix assets 2006 (k€) | 0,000 | CER vs TEX vs FOT | |
| Added Value/Employee 2006 (k€) | 0,000 | CER vs TEX | | Tangible assets 2006 (k€) | 0,000 | CER vs TEX vs FOR | |
| | | | | Allocation depreciation/Total assets 2006 (%) | 0,000 | CER vs TEX vs FOR | |
| Note: P-value of ANOVA, p*<0.05 Source: Our own elaboration. | | | | | | | |

Four have been the variables for which the means of the three groups have resulted different. Three of them correspond to economic firm concepts closely related, as it was expected: total assets, material assets and the provision for depreciation. The IF of ceramics ID have again occupied a dominant position in those variables with regard to textiles and footwear; a consequence of the distant technological requirements and the ratio capital-labour of each sector. The distance between the three groups has spread to the average wage per

employee and again the differences in relative productivities offer a plausible explanation. The mean analysis has also revealed the existence of five variables in which the ceramics ID have significantly diverged from the remaining sectors. In particular, variables linked to firm economic performance, such as turnover growth (2000-2006), proportion reached by EBITDA in turnover (2006), and apparent productivity of labour (2006 and average in 2000-2006). Finally, significant differences have appeared in average employment due to the bigger size of the IF in ceramics ID.

*Contrast of Frequencies*

In order to know if there have been significant differences between the three groups, we have considered the homogeneity of frequencies for each variable concerned, obtaining the values shown in Table 11.

**Table 11. Contrasts Textiles/ Footwear/ Ceramics, categorical variables, Economic accounts of IF**

| Variable | Estad. X2 | gl | P-value test $\chi 2$ | Frec. <5? | Prob. Fisher | | Estad. X2 | gl | P-valuetest $\chi 2$ | Frec. <5? | Prob. Fisher |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Microenterprise | 27,44 | 2 | 0,000 | no | | Firm sets up before 1960 (1/0) | 9,42 | 2 | 0,009 | sí | 0,006 |
| Small firm | 17,31 | 2 | 0,000 | no | | Firm sets up from 1960 to 1975 (1/0) | 27,33 | 2 | 0,000 | no | |
| Medium firm | 97,61 | 2 | 0,000 | no | | Firm sets up from 1976 to 1985 (1/0) | 3,34 | 2 | 0,188 | no | |
| Big firm | 21,03 | 2 | 0,000 | sí | 0,000 | Firm sets up from 1986 to 1995 (1/0) | 9,62 | 2 | 0,008 | no | |
| p*<0,05 | | | | | | Firm sets up in 1996 and afterwards(1/0) | 4,96 | 2 | 0,084 | no | |

Source: Our own elaboration.

From the above results, the categorical variables without homogeneity of frequencies for the groups concerned are listed in Table 12, which also reflects the origin of the differences among ID.

**Tabla 12. Contrast *post-hoc* Textiles/ Footwear/ Ceramics with continuity correction of Yates, categorical categóricas of firm economic accounts**

| | Contrasts | | |
|---|---|---|---|
| Variable | Contrast between Textile and Footwear | Contrast between Textile and Cerámics | Contrast between Footwear and Cerámics |
| **Structural variables** | **P-value test $\chi 2$** | **P-value test $\chi 2$** | **P-value test $\chi 2$** |
| **Firm size** | | | |
| Microenterprise | 0,439 | 0,000 | 0,000 |
| Small firm | 0,808 | 0,000 | 0,000 |
| Medium firm | 0,120 | 0,000 | 0,000 |
| Big firm | 0,908 | 0,003 | 0,003 |
| **Antigüedad de empresa** | | | |
| Firm sets up before 1960 (1/0) | 0,093 | 0,238 | 0,005 |
| Firm sets up from 1960 to 1975 (1/0) | 0,000 | 0,976 | 0,000 |
| Firm sets up from 1986 to 1995 (1/0) | 0,024 | 0,455 | 0,005 |

Note: p*<0,05 for p-value Chi-cuadrado test; p**<0.016666...for contrasts among groups. Grey colour indicates different groups
Source: Our own elaboration.

In particular, categorical variables related to the size of innovative firm have highlighted that the ceramic group is different from the rest: in micro and small enterprises

because of its reduced presence and in medium and large companies for the opposite cause. Variables reflecting the age of the IF have indicated, overall, a younger age in the footwear IF: 72% were set up after 1986, compared to 59% of ceramics and 55% of textile ID[18].

## 6. Conclusions

As we have previously advanced, we have departed from our own database on the regional IF, constructed after a laborious task of collecting and debugging administrative data. The census has reached 5.553 firms and the information linked to each company has allowed us to analyse the presence of district effect and of a new economic relationship which we have named inter-district effect.

With the limitations mentioned above, we have distinguished two possible innovative models in the firms analysed. Generally speaking, ID have hosted larger companies than NOID, although the respective differences seem to have decreased from 2000 to 2006. The IF located in ID have reflected lower wages and an informal and lighter innovation. This type of innovation works without or with little doses of R&D and has frequently requested more utility models than patents. Nevertheless, the IF of ID have achieved a heavier inventive density, absorbing information from other markets due to their greater propensity to export. Besides, these firms have maintained wider relationships with technological institutes and regional administration, and reached more support for most of the public incentive programs, except for those related to R&D. In the case of the IF located in NOID areas, our results have pointed out that they are a type of company of smaller size, with better economic results from 2000 to 2006, that has invested more in R&D, developed denser relationships with universities, obtained a more intense creative productivity and paid higher wages to their staffs. Consequently, for the period analysed, the results suggest a modest presence of district effect as it has not materialized in most of the variables traditionally associated with more advanced innovation patterns.

On the other hand, we have found several signs of the existence of inter-district effect. The differences have highlighted the features of the IF in ceramics ID as the most prominent, in knowledge as well as in economic-financial variables. In any case, the recent evolution of the sectors studied has been rather distant. The expansion of Spanish building and the domestic business atmosphere, in the recent past, has mainly favoured the ceramics industry.

[18] It is necessary to clarify that the apparent youth of footwear firms does not necessarily implies a similar characteristic of their owners, as consequence of the intense rotation of firms, with the same holder, before economic adverse situations.

Consequently, these factors could also explain, to some extent, the increasing distance noticed among the IF of ceramics and the other two groups of IF.

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