Title: Do Spanish firms learn more from national or international networks?

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Abstract

In the present study, we compare the impact of the concentration of production, employment, export and import on the total factor productivity of Spanish firms. To this aim, we use a modified version of the Olley and Pakes method (1996) that allows us to control for possible endogeneity bias that emerges from the fact that firms may internalise the potential gains they could obtain from a localisation.

At the regional level, increasing production concentration of workers of determined industry, and exports and imports in general, would increase the total factor productivity of firms located in this region. Though, some congestion economies could occur at the industry level. Small plants are the firms that benefit more from the experience of other firms in the vicinity, especially from the one of exporters. Large firms and traders would also benefit from an increase in the production and internationalisation of other firms, in particular those of the same industry.

Key words Total factor productivity firm data, Spain, regional policies, cluster, internationalisation.

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1. Introduction

Cluster policies and internationalisation have been traditionally at the heart of economic policies and in particular of regional policies while there have been systematically treated separately. On one hand, policy makers are concerned by increasing aggregate exports and FDI. On the other hand, policy makers engage sometimes in expensive cluster policies with the belief that the gains in terms of productivity, production and employment growth will offset the costs. Firm-level analysis allows for better understanding of these phenomenons that may be useful for policymakers. Actually, the recent literature based on microeconometric studies tends to show that firms that become exporters are the most productive one, firms that import tend to be also more productive and agglomeration not always guarantees better productivity. Hence, productivity improvement at the firm level seems to be at the heart of the debate. In particular how agglomeration, internationalisation and productivity of firms interact remains an open question.

Productivity gains may arise from a broad range of processes like learning-by-doing, technical innovation through imports of intermediate goods and managerial effort for instance. Strategic localisation may also contribute to improve productivity. By locating nearby other firms in the same activity, in region with dense activity or in the proximity of clients and suppliers, firms may benefit from externalities on inputs, labour markets and knowledge externalities that enhance their productivity and in particular managerial capacities. With such ideas in mind, clusters policies appeared very attractive for policy makers.

Though, if numerous studies have pointed out the existence of some positive spillovers of this kind, the overall effect of agglomeration is not so straightforward. In

particular, such gains could be overcome by congestion problems. For instance, in the case of France, Martin et al. (2008) conclude that some clustering could generate substantial gains but the size of clusters should not be too large because congestions are likely to overcome the gains.

When quantifying the potential gains of agglomeration in terms of productivity, one also faces a causality problem. Firms may agglomerate in areas with better endowments or some areas are susceptible to attract more productive firms what would lead to overestimate agglomeration gains. Lastly, a selection bias may occur since most productive firms are more likely to resist to higher competition in clusters and to find more productive to locate nearby other producers or to take part of vertical linkages. Though, clusters could be composed of firms that are more productive thanks to other characteristics than the one of the region.

Since these phenomenons are essentially microeconomic in essence, firm-level datasets offer a very good opportunity to deep in their analysis. Our analysis is based on a sample of Spanish single-plants and their reaction to agglomeration at the regional level. Our contribution consists in comparing several measures of agglomeration and to correct for possible endogeneity biases. Actually, we compare the impact of concentration of production, employment, export and import on the total factor productivity of Spanish firms using a modified version of the Olley and Pakes method.

Our results confirm that benefits to be obtained from localisation are, at least in part, internalised by the firm when choosing its location. But apart from these expected gains, there are some additional gains to obtain when located nearby other firms. At the regional level, increasing production of determined industry, and exports and imports in general, would increase TFP of firms located in this region. Though, some congestion economies could occur at the industry level. Small plants are the firms that benefit more

from the experience of other firms in the vicinity, especially from the one of exporters. It seems that regions that export a lot, but overall those that import a lot will obtain considerable productivity gains. Then, a cheap and effective policy could consist in reducing the formal and informal barriers firms face when exporting or importing. Our results show that not only small firms and non-traders could benefit from an increase in the production and internationalisation of other firms but large firms and traders could also do. In particular, these total factor productivity of the largest firms benefit from the experience at producing, exporting and importing of other firms operating in the same industry as them. Then, to collaborate, sharing infrastructure, labour markets and information is to some extent fruitful for both type of firms.

The rest of the paper is organized as follows. In Section 2 we present the theoretical and empirical framework. In section 3 we describe the empirical strategy. Our findings are commented in Section 4. Finally, Section 5 provides some conclusions and policy implications of our study.

2 Theoretical and Empirical Framework

Theoretical models have highlighted different processes susceptible to improve productivity. We detail above the proposals of the theoretical literature and their empirical validations. The main channels are the following: openness to international trade, presence of foreign firms or joint ventures and agglomeration effects.

Concerning foreign exposure, Krugman (1979) and Helpman and Krugman (1985) suggested that openness ensures external and internal externalities (pro-competitive effects) in a context of homogeneous firms; Leibenstein (1966) and Schmidt (1997)

focussed on the reduction of X-inefficiency. Grossman and Helpman (1991), Ethier (1982), Markusen (1989) pointed that foreign competition may also affect the incentives to innovate; increases technology transfers or raises intra-firm productivity through an increase in the variety of intermediate inputs or capital goods due to higher quality and/or better technology. Openness can also foster technological spillovers through FDI (Coe and Helpman, 1995).

The theoretical predictions concerning how trade liberalisation affects domestic firms have been in general supported by empirical findings. Though, studies based on firms' data allow nuancing that conclusions and pointing that not all firms react in the same way. Pavcnik (2002) find robust evidence that foreign competition both reduces the market share of import-competing firms and reallocates from inefficient to efficient firms in Chile. She finds that these reallocations significantly contribute to productivity growth in the tradable sectors. For Columbia, Fernandes (2007) agrees that liberalisation raises productivity but this impact is more important for large firms and in sectors with less competition. This is mainly due to the increase in intermediary inputs. Studies of Schor, 2004; Topalova, 2004; Amiti and Konings, 2008; and Dovis and Milgram, 2009 found also evidence in the same sense. More mixed results are founded by Tybout and Westbrook (1995) in the case of Mexico and Driffield and Kambhampati (2003) point that the increase of Indian imports did not raise efficiency.

Another source of spillovers could arise from the presence (or joint venture) of foreign firms. On one hand, FDI may be an important source of technology transfer for local firms operating in the same industry that is, horizontal spillovers. On another hand, domestic firms that supply input to foreign firms can also benefit from vertical spillovers (see for instance Rodriguez-Claré (1996) and Markusen and Venables (1999) for a theoretical approach). Several recent empirical studies using firm level data find

positive productivity spillovers from FDI taking place through contacts between foreign affiliates and their local suppliers in upstream sectors (e.g., Javorcik, 2004; Gorodnichenko, 2007, Blalock and Gertler, 2008;). Barrios et al. (2009) find robust evidence of spillovers through backward linkages when taking into account that multinationals firms behave differently than domestic firms concerning their input sourcing behaviour. Chudnovsky et al., 2008 find evidence of positive spillovers from multinationals presence only on domestic firms with high absorptive capabilities.

Another source of productivity gains pointed earlier by the literature, concerns the benefits a firm can obtain by localising nearby other firms. The positive externalities that may emerge from localisation transit through different channels: sharing specialised labour market (Krugman, 1991), diffusion of information and technology (Glaeser et al. 1992), better matching of their needs concerning inputs (Ciccone &Hall, 1996), sharing infrastructures and reducing transport and transaction costs, knowledge spillovers in particular in R&D activities that may be facilitated by proximity (Bekes et al., 2008).

It is usual to distinguish urbanisation economies from localisation economies (Malmberg et al., 2000 for instance). The former relates to the spill over to be obtained from the local concentration of producers regardless of their activities (Jacobs, 1969) while the latter relate to spillover to be obtained from other firms conducing similar activities or interlinked activities (Marshall, 1920). Vertical versus horizontal spillover suggest different regional policies: the presence of localisation spillovers implies that policies should promote clusters (specialisation of a region in one or few industries), while the presence of urbanisation economies would indicate that access to larger variety of inputs should be favoured.

Bekes et al., 2008 also pointed that agglomeration economies can indirectly affect the possibility of firms to compete in foreign markets. First, interactions among agents

may reduce sunk costs at exporting by sharing some valuable information about their trading partners, about the markets, functioning of consumers, administrative norms, standards, etc... Second, concentration of producers makes more profitable a vertical specialisation through input sharing and allows them to reach scale requirements needed to export or to compete in larger markets. Business relationships at the local level may constitute networks that foster productivity, export and overall managerial capacities[2].

Though agglomeration processes have been widely defined by theoretical models, empirical validations studying their effects on export and productivity performance are few. They have to overcome two important issues that arise from agglomeration process. First, firms located in region with dense activities could be more productive because the region has natural characteristics that favour productivity of firms. In this case, firms would be naturally attracted by this location and agglomerate in this region. This is known as the simultaneity problem or "spatial selection". Second, firms are not all the same and positive gains from agglomeration could reflect a self-selection process as described by Melitz and Ottaviano (2008) in a general context and Baldwin and Okubo (2006) in the context of an economic geography model. Indeed, firms that choose to agglomerate could be *ex ante* those that are already more productive and able to resist to the concurrence of other firms in a dense region or firms that have a good absorptive capacity in order to take benefit from the sharing of inputs, knowledge, etc..[3].

Ciccone and Hall (1996) proposed a method to correct for the possible endogeneity bias. Using macro-data, they study the relation between employment density and

[2] Concerning the effect on export performance, there are several empirical articles as reviewed by Castillo and Requena (2006) and Greenaway and Kneller (2007) finding mixed results concerning the impact of agglomerations on export performance or probability to export.

[3] Guiiliani (2007) offers strong evidence that firm-specific characteristics should be considered to be central in the process of learning and innovation in clusters.

productivity of labour for the United States. Firms may choose their location based on unobserved characteristics of places that may enhance productivity. Then agglomeration can not be considered as strictly exogenous and OLS estimates may be spurious. After correcting for this endogeneity bias with instrumental variables, they still find a rather large and positive impact (elasticity of 5%) of employment density on productivity of labour. Brulhart et al. use a very different dataset and a System-GMM method but also focus on labour productivity using macro-data. They find that the dominant pattern is "urbanisation" economies and negative localisation economies that are "congestion costs" for manufacturing[4].

The availability of data at the firm level allows for a deeper understanding of agglomeration, a microeconomic phenomenon in essence and also allows taking into account heterogeneity of firms. Though, very recent studies try to tackle with the two issues at the same time. Cainelli (2008) shows that belonging to an industrial district and making product innovations are key factors in the productivity growth of firms. Békés et al. (2008) find the agglomeration premium measured as the elasticity of TFP to the number of employees for Hungarian firms is around 7%. They point that urbanisation economies play a similar and important role for traders and non traders (around 3%) while localisation seems to play a more obvious role for traders (3% against 1.6%). Martin et al. (2008) using a different methodology find for French firms, that there exist positive and significant localization economies measured by the number of workers of the industry (elasticity of 4-5%). The number of employees in the other sectors and same area has no significant impact. They show that agglomeration gains could be counteract by congestion costs since

[4] Thus, it is important to recall that productivity of labour gains are not systematically associated with employment growth depending on the characteristics of the elasticity of demand.

the relation between TFP gains and localisation is not linear and gains decrease after a certain level of concentration is overpassed.

3 Empirical Strategy

a. Data

We use data on Spanish manufacturing firms drawn from the Encuesta sobre Estrategias Empresariales (Survey on Enterprise Strategies; ESEE), an annual survey conducted by the SEPI Ministry of Industry. The ESEE is representative of Spanish manufacturing firms classified by industrial sector and size categories[5] and includes exhaustive information at the firm level. For each firm, we know the region where it is located and to which industry of the NACE-93 classification belongs the main part of its production. We cleaned the data in order to correct or eliminate problems due to missing data or misreporting. Here, we focus only on single-plant firms what considerably reduces our sample. As pointed by Martin et al. (2008), the ideal level would be the plant since we are interested in the localisation decision and firms may locate plants in different areas and benefit or generate different spillovers. Additionally, spillovers could take place among plants of the same firm. But since ESEE provides information at the firm level, we prefer to restrict our sample to single-plant firm.

Region corresponds to Comunidad Autonoma in Spain that is Nuts2 in Eurostat classification. Our data suffer from two important problems for this analysis. First, the division in region is rather large so we are not able to capture real "urban" agglomeration. This problem has no solution due to the lack of information. However, Ciccone (2002) and

[5] The survey participation rate was about 70 per cent for firms with more than 200 employees. Firms that employed between 10 to 200 workers (small firms) were randomly sampled by industry and size strata, accounting for 5 per cent of the population.

Brülhart and Mathys M. (2008) find evidence of positive spillover from production density at this geographic level on aggregated labour productivity. Second, the sampling of the survey does not ensure data to be representative at the region level. This is a common problem in this type of study but rarely mentioned. We try to overcome this restriction in two ways. First, we control that the aggregate of each industry-region calculated with our micro data is highly correlated with the corresponding indicators using macro data. Second, we use macro data to measure agglomeration. The externality of these indicators minors the problem of the potential selection bias of our sample.

b. Descriptive statistics

We use different type of indicators of agglomeration at the region level and region-industry level. Table 1 shows some indicators of the repartition of the activities among Spanish regions according to macroeconomic data. Production is largely concentrated (70%) in five regions: Cataluña, Madrid, Comunidad Valenciana, País Vasco and Andalusia. Though, these regions have very different size. Then, the density of activity (measured by production per squared kilometer) is overall important in Madrid (4.4 times the average), País Vasco (3.7 times the average), followed by Cataluña and Comunidad Valenciana with lower distance to the average since these areas are biggest. The repartition of exports follows more or less the repartition of production except that Cataluña appears as more export-oriented than the other. Concerning imports, differences among regions are less striking reflecting the well-known fact that demand patterns are more homogeneous among regions than supply ones.

Table 1: Macroeconomic data used in agglomeration indicators by region, for year 2002, Manufacturing.

	Production (%)	Production / Km2 (/National Mean)	Exports (%)	Imports (%)	Hours Worked (%)
Variable	*agglom2*	*agglom3*	*xagglom2*	*magglom2*	*hc*
REGION					
Cataluña	26,8	2,2	32,3	34,6	24,9
Madrid	13,1	4,4	11,5	23,3	10,2
C. Valenciana	11,2	1,3	12	9	13,8
Pais Vasco	10,1	3,7	11,1	6,4	8,6
Andalucia	8,1	0,2	5,9	4,5	9,0
Castilla-La Mancha	5,7	0,2	2,3	2	5,1
Galicia	5	0,5	5,9	4,3	6,2
Aragon	3,9	0,2	3,8	3	4,0
Castilla-Leon	3,2	0,1	3,9	3,6	4,5
Navarra	3,1	0,8	3,5	2,3	2,6
Asturias	2,2	0,6	1,6	1	2,0
Murcia	2,2	0,5	2,1	1,3	2,8
Cantabria	1,4	0,7	1,5	1	1,3
Canarias	1,2	0,5	0,2	2,1	1,5
La Rioja	1,1	0,6	1	0,5	1,2
Baleares	0,8	0,4	0,8	0,6	1,1
Extremadura	0,7	0,0	0,6	0,4	1,1
Total	99,8	1,0	100	99,9	100

Source: INE, Contabilidad regional de España; Dirección general de aduanas and Wikipedia.

In tables 2-6, we display some summary statistics concerning firms' characteristics like labour productivity, employees, export and import ratios. On average, firms of our sample have 138 employees and an export ratio of 17% and import ratio of 8% (Table 2). About three quarters of the firms are traders that means that they export or import at least once during the period 1996-2004. Labour productivity of firms that both export and import is about twice larger than firms that never exported, neither imported. Firms that did export but didn't import have an intermediate position in the labour productivity scale behind firms that imported but never exported. The same ranking applies for size: non traders are smaller than firms that only export, in turn these ones are smaller than the ones that only import and the largest ones are those that both export and import. Our data confirm the existence of some "superstars" firms as target by Mayer and Ottoviano (2008) that are superior in productivity, larger and well inserted in international networks exporting 27% of their production and importing 12% of their intermediate and capital goods.

Another important feature concerns the presence of foreign capital (Table 3). Firms with more than 10% of foreign capital are more than 4 times larger than the domestic firms, they have a greater productivity of labour, export 3 times more and import about a quarter of their input and capital goods while the import ratio of domestic firms is about 5%. Though, this type of firms represents less than 20% of our sample. We distinguish between "domestic" traders and "foreign" traders. Traders are firms that export or import or both. As already said, they display better performance and larger size than non traders. Domestic traders (firms with less than 10% of foreign capital) have a worse performance and are smaller than "foreign traders" that are inserted in the international chain in different way.

Turning to the size of the plants (Table 4), we observe that small plants have in effect a lower labour productivity on average and trade a lower share of their production than large plants do. However, large firms that do not trade have a similar labour productivity as small firms that trade. Then, trading seems to be a more distinctive feature for labour productivity than size.

In Table 5, we display the same statistics classified in four type of localisation: region with a high (or low) density of the production (production/km2 above (under) the average) and region with dense activity of the production in the industry (production of the industry/km2 above (under) the average). Results show that firms have a higher labour productivity in regions with dense activity but are not larger. Export and import ratios do not differ a lot depending on the density. Density of the production in the same industry and region makes also the workers more productive. Though, it is the overall density (not only the one of the industry in which the firm operates) that matters for firm's labour productivity. This points at a predominance of urbanisation economies in the Spanish case more than localisation economies. Though, these data should be

interpreted with cautious since at this stage, we are not controlling for other firms' characteristics and we are talking about labour productivity but not total factor productivity.

We also observe at the industry level (Table 6) the same correlation between high productivity, large size and openness. In particular, the industries of chemical products, Electrical equipment and transport equipment display higher performance in terms of value added per employee with larger plants and larger import and export ratios.

Table 2: Characteristics of importers, non-importers, exporters and non-exporters.

		Non-importers	Importers	Total
Non-exporters	Nb obs.	2.074	1.024	3.098
	Labour productivity	19	26	21
	Employees	27	55	36
	Export Ratio	0	0	0
	Import Ratio	0	7	2
Exporters	Nb obs.	933	6.653	7.586
	Labour productivity	23	35	33
	Employees	35	201	180
	Export Ratio	9	27	24
	Import Ratio	0	12	11
Total	Nb obs.	3.007	7.677	10.684
	Labour productivity	20	34	30
	Employees	30	181	138
	Export Ratio	3	23	17
	Import Ratio	0	11	8

Source: ESEE, Author's calculation. Data for the period 1996-2004.

Table 3: Characteristics of domestic and foreign firms, traders and non-traders.

		Domestic	Foreign	Total
Non-traders	Nb obs.	2.060	16	2.076
	Labour productivity	19	29	19
	Employees	26	155	27
	Export Ratio	0	0	0
	Import Ratio	0	0	0
Traders	Nb obs.	6.740	1.870	8.610
	Labour productivity	29	45	32
	Employees	105	383	165
	Export Ratio	17	37	22
	Import Ratio	7	22	10
Total	Nb obs.	8.800	1.886	10.686
	Labour productivity	27	45	30
	Employees	86	382	138
	Export Ratio	13	37	17
	Import Ratio	5	22	8

Source: ESEE, Author's calculation. Data for the period 1996-2004.

Table 4: Characteristics of small and large firms, traders and non-traders.

		NON-TRADERS	TRADERS	Total
Large	Nb obs.	130	4.225	4.355
	Labour productivity	24	39	39
	Employees	138	312	306
	Export Ratio	0	32	31
	Import Ratio	0	14	14
Small	Nb obs.	1.946	4.385	6.331
	Labour productivity	19	26	24
	Employees	20	24	23
	Export Ratio	0	12	8
	Import Ratio	0	6	4
Total	Nb obs.	2.076	8.610	10.686
	Labour productivity	19	32	30
	Employees	27	165	138
	Export Ratio	0	22	17
	Import Ratio	0	10	8

Source: ESEE, Author's calculation. Data for the period 1996-2004.

Table 5: Characteristics of firms and density of the activity.

			Density in the same industry and region		
			Low	High	TOTAL
Density of the region	Low	Nb obs.	5.138	800	5.938
		Labour productivity	27	28	27
		Employees	146	156	147
		Export Ratio	15	23	16
		Import Ratio	8	7	8
	High	Nb obs.	1.383	3.365	4.748
		Labour productivity	32	33	33
		Employees	131	126	127
		Export Ratio	20	18	18
		Import Ratio	9	9	9
	Total	Nb obs.	6.521	4.165	10.686
		Labour productivity	28	32	30
		Employees	143	132	138
		Export Ratio	16	19	17
		Import Ratio	8	9	8

Source: ESEE, Author's calculation. Data for the period 1996-2004.

Table 6: Characteristics of firms by industry.

Industry	Nb obs.	Labour prod.	Employees	Export ratio	Import ratio
Food, beverages, tobacco	1,352	27	110	10	4
Textiles, Leather and textile products	1,389	21	82	16	9
Wood, Paper and printing products	1,268	29	97	8	7
Chemical products	570	45	190	21	16
Rubber and plastic products	645	30	107	15	9
Other non-metallic mineral products	679	32	133	19	3
Basic metals and fabricated metal products	1,541	33	121	19	7
Machinery and equipment n.e.c.	856	33	132	24	9
Electrical and optical equipment	820	35	160	21	11
Transport equipment	688	35	490	32	15
Other manufactured products	878	20	67	15	5
Total	10,686	30	138	17	8

Source: ESEE, Author's calculation. Data for the period 1996-2004.

c. Estimation Strategy

We seek to evaluate the impact of different type of agglomeration measures on TFP. The challenge consists in measuring the effect of agglomeration taking into account possible selection and simultaneity biases. In fact, firms could select their location according to the return this location could bring them in terms of productivity that is "good place" makes firms better and firms internalise it. On the other hand, "best firms" may choose to agglomerate, then the location they chose may appear as a "good place".

To deal accurately with these issues, agglomeration should not be considered as a strictly exogenous determinant of TFP. Ciccone and Hall (1996) using macro data correct for the possible endogeneity bias using instrumental variables. Békés et al. (2008) and Martin et al.(2008) that share part of the objective of the present studies and also use firm level data, use instrumented regressions and GMM regressions to deal with the simultaneity bias. We prefer to use direct approach as in Fernandes (2007) and Amiti and Koning (2007), where we take into account autocorrelation at the firm level to estimate TFP. These authors implement this method with another aim. They study the impact of import penetration rate on TFP. Since IPR may suffer from the same endogeneity bias, they modify the Olley and Pakes (1996) approach to control for endogeneity bias. Agglomeration may shift productivity but this externality may be internalised by the firm when choosing their technology and levels of input. In this case, agglomeration should be considered as an endogenous input of the production function. Results are compared with plant fixed effects estimations and random effects estimations of the same production function. A problem with this last type of estimation arises if the contemporaneous level of TFP affect the current choice of variable input

factors, in which case inputs would be correlated with the error term (e.g., Levisohn and Petrin, 2003).[6]

Let us suppose that the technology of firm *i* is well described by a Cobb-Douglas production function:

$$Y_{it} = A(Agglo)_{it} L_{it}^{\beta_l} M_{it}^{\beta_m} K_{it}^{\beta_k}$$

where Y_{it} is the firm's output, L_{it} the input labour, M_{it} the intermediary consumptions, K_{it} is the capital and $A(Agglo)_{it}$ is the total factor productivity of firms susceptible to depend on the concentration of activity in the region where the firms is located (Agglo).

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_m m_{it} + \beta_k k_{it} + \omega_{it} + \eta_{it} \qquad (1)$$

where y_{it} is the logarithm of the firm's output, l_{it} the logarithm of the input labour, m_{it} the logarithm of the intermediary consumptions and k_{it} is the logarithm of the capital. The error as two components, the plant-specific productivity component given as ω_{it}, and η_{it}, an error term that is uncorrelated with input choices. The investment function is given as:

$$i_{it} = i_{it}(\omega_{it}, k_{it}) \qquad (2)$$

The investment function is monotonically increasing in ω_{it} (Pakes, 1994). We consider that the productivity not only depend on the state variable capital but also on

[6] Another alternative called "indirect approach" or "two-step method" consists in estimating TFP in a first step using Olley and Pakes' method and then to estimate the impact of agglomeration on TFP controlling for firm specific time invariant unobservables. This method has been widely used in recent years to study the effect of openness on productivity (see, Fernandes (2007), Dovis and Milgram (2009)). This method could be accurate if the endogeneity of agglomeration is not a crucial issue. Actually, if the impact of nearby activities on productivity has already been taken into account by the firm, then the lagged value of productivity usually introduced as a regressor in the two-step approach may depend on the agglomeration variable and produce some biased estimates for Agglomeration.

the characteristics of the location. Then, the plant-specific productivity component can be expressed as::

$$\omega_{it} = h_{it}\left(i_{it}, k_{it}, agglo_{IRt}\right) \quad (3)$$

Where $agglo_{IRt}$ is the logarithm of the indicator of agglomeration of the region *R* where the firm *i* is located and of the industry *I*, the firm operates in.

The higher the productivity is, the higher the investment will be. So, the production function can now be expressed as:

$$y_{it} = \beta_l l_{it} + \beta_m m_{it} + \phi_{it}\left(i_{it}, k_{it}, agglo_{IRt}\right) + \eta_{it} \quad (4)$$

Where

$$\phi_{it}\left(i_{it}, k_{it}, agglo_{IRt}\right) = \beta_0 + \beta_k k_{it} + \beta_a agglo_{IRt} + h_{it}\left(i_{it}, k_{it}, agglo_{IRt}\right) \quad (5)$$

Then, we can approximate the unknown function, ϕ_{it}, by a fourth order polynomial in k_{it}, $agglo_{IRt}$ and i_{it}. In the first stage, β_l, β_m and ϕ_{it} are estimated and the second stage evaluate the survival probability of the firm, P_{it}. The third stage of the routine identifies the coefficients β_k and β_a where productivity is assumed to evolve according to a first-order Markov process: $\xi_{it+1} = \omega_{it+1} - E\left[\omega_{it+1} \middle| \omega_{it}, X_{it+1} = 1\right]$, with $\xi_{it}+1$ the innovation in $\omega_{it}+1$. This final stage uses the estimations of β_l, β_m, ϕ_{it} and P_{it} to obtain β_k and β_a.

Capital stock is measured using the inventory perpetual method. We use a depreciation rate of 9 per cent based on the average depreciation rate as used in Mas et al. (2005). We use fixed assets (equipment, construction, etc.) as the initial capital stock level for the available initial year and then add investment flows by type of fixed assets. We only consider firms whose structure remained unchanged during the years they

answered the survey. If they were affected by a merge, acquisition or division, we selected the longest period without changes from among the periods that precede and follow the fusion, division, etc.

We measure agglomeration in several manners. Each indicator is susceptible to shed some light on the different hypothesis reviewed in section 2 concerning the benefits to be obtained from nearby firms operating in the same industries or in other industries. The indicators we consider are based either on production, exports, imports or hour worked. The variables considered are summarized in Table 7.

Table 7: Indicators of agglomeration

Agglom	"Production in the same industry: Regional / National"
agglom2	"Production all industries: Regional / National"
xagglom	"Exports of the same industry: Regional / National"
xagglom2	"Exports all industries: Regional / National"
magglom	"Imports of the same industry: Regional / National"
magglom2	"Imports all industries: Regional / National"
agglom3	"Regional production all industries / km2"
agglom0	"Regional production in the same industry / km2"
lochour	"Hours worked in the region, same industry"
urbhour	"Hours worked in the region, other industries"

Source: INE, Contabilidad regional de España; Dirección general de aduanas and Wikipedia.

Production is the most general indicator of the potential source of spillover that can emerge from experience at producing from other firms. We use the weight of production at the regional level in the national level to take into account the relative level of production of the region. As seen before, this may not reflect totally the concentration of activities since Spanish regions have very different size. To control for this, we alternatively use the density of production per km2.

Thus, externalities may arise from the specialization of labour markets and from sharing knowledge with other employees and managers, we also use the number of hours worked as a complementary indicator. Hours worked in other industries measure the potential urbanisation economies while the hours worked in the same industry measure the localisation economies.

Managerial capacities could also be improved in contact with foreign suppliers and clients. In particular, firms located nearby could share information concerning their international experience that could benefit each other. To capture this potential source of technology transfer, we also consider the amount of imports and exports at the region level for all industries and at the regional level in the same industry the firm operates in.

4 Results

In this section, we present the results of various sets of estimations. First, we study the average sensitivity of Spanish firms' TFP to the agglomeration indicators detailed above. Secondly, we check possible asymmetries among firms in terms of their reaction to local agglomeration. We show that reactions differ depending on their size, import and export status and foreign ownership.

a. Agglomeration Premium for a representative firm

Firm-level total factor productivity (TFP) is calculated following the Olley and Pakes (1996) method over the period 1994-2002, the longer period for which we were able to build the macroeconomic indicators of agglomerations detailed above. Estimations reported in Table 14 were run for 11 industries over the period 1994-2006. Coefficients are significant at the one per cent level in all cases and have a similar range to other studies. We replicate these estimations for only single-plant firms. Results are reported in Table 15. This shorter sample is the one used later on. Results do not change very much. When we estimate the production function for the all sector, the coefficients of labour, capital and intermediate consumption are similar to those obtained in the previous regressions by industries. Then we introduce a measure of agglomeration as an additional input of the firm. Estimations are then performed regardless to the industry

since the measure of agglomeration as in most cases an industry dimension. Results are reported in Table 8. As in Javornik (2004), if the Olley-Pakes procedure success- fully corrects for biases, one would expect to find a decrease in the coefficients on labour and material inputs and an increase in the capital coefficient relative to the panel estimations. Results from fixed effects and random effects estimations are reported in Table 16. We effectively observe that Olley and Pakes results move in the predicted directions in general. As expected, inputs are highly significant; the coefficient of capital lies between 0.245 and 0.299 which is in line with the results from other studies on production functions, except in three cases where results turn to be negative. Our results show that Spanish single-plant firms operate with constant returns to scale. As in Martin et al. (2008) we note that random and fixed effects lead to very different results in particular for capital and to a lesser extent for the measure of agglomeration. . It is particularly striking for capital, which coefficient is extremely low when firms fixed effects are taken into account which confirmed that Olley and Pakes method must be a most accurate method.

Table 8: Production estimates with the modified Olley and Pakes (1996) method, for single-plant firms with agglomeration indicators

		AGGLO	L	M	K
Agglom	"Production in the same industry: Regional / National"	0.550***	0.389***	0.361***	0.292***
		[0.055]	[0.027]	[0.038]	[0.012]
agglom0	"Regional production in the same industry / km2"	-0.019***	0.389***	0.386***	-0.049***
		[0.003]	[0.022]	[0.031]	[0.009]
lochour	"Hours worked in the region, same industry"	0.026***	0.373***	0.420***	0.245***
		[0.003]	[0.017]	[0.022]	[0.005]
xagglom	"Exports of the same industry: Regional / National"	0.344***	0.390***	0.387***	-0.071***
		[0.043]	[0.021]	[0.031]	[0.010]
magglom	"Imports of the same industry: Regional / National"	0.557***	0.389***	0.388***	0.287***
		[0.049]	[0.021]	[0.031]	[0.008]
agglom2	"Production all industries: Regional / National"	-0.053	0.389***	0.387***	0.268***
		[0.192]	[0.021]	[0.031]	[0.007]
agglom3	"Regional production all industries / km2"	0.027***	0.389***	0.386***	0.275***
		[0.006]	[0.022]	[0.031]	[0.007]
urbhour	"Hours worked in the region, other industries"	-0.004	0.375***	0.420***	-0.114***
		[0.006]	[0.017]	[0.022]	[0.010]
xagglom2	"Exports all industries: Regional / National"	0.448***	0.388***	0.387***	0.277***
		[0.044]	[0.021]	[0.031]	[0.008]
magglom2	"Imports all industries: Regional / National"	1.034***	0.389***	0.387***	0.299***
		[0.111]	[0.021]	[0.031]	[0.008]

*Source: Author's calculation. Standards errors are in parenthesis * significant at 10%, **at 5%; ***at 1%.*

We now focus to the results of the modified Olley and Pakes method displayed in Table 8 that shows us how the different measures of agglomeration affect TFP of Spanish firms.

The weight of the regional production in the national production for the manufacturing sector (agglom2) has no significant impact. Then, a bigger size of the manufacturing industry than the national average is not a sufficient condition for a firm to benefit from backward or forward linkages in terms of managerial capacities. In turn, the spatial density of this manufacturing production (agglom3) has a significant positive impact and an increase in 100 % of the production per km2 increases by 2.7% the TFP of the firms.

The weight of the regional production in the national production in the same industry (agglom) has a significant positive impact on production. If the weight of the production of the industry the firms belongs to in the national production doubles, the TFP of the firms would increase by 55%. On the opposite, when this production is

compared to the area of the region (agglom0), it has a negative and significant impact. It may be a proof of congestion diseconomies. Though, in this case the coefficient of capital turns to be negative also catching some doubts on the validity of these estimates.

Our results show that there exist positive and significant localization economies: for a firm, all other things being equal, a 10% increase in the number of hours worked in the same industry and region increases the production of that firm by around 0.26%. Though, an increase in the number of hours worked in the other industries has no significant effect on production.

Openness has a more obvious positive effect on production after controlling for standard input contribution. Both the concentrations of exports and imports at the industry level have a similar effect on production as the experience at producing of local firms in the same industry. Concerning the overall openness of the region regardless to the industry, to double the share of exports in national exports would increase by 44% the productivity while the same increase of imports would increase by 100% the production.

Urbanisation, in the sense of agglomeration of production or employment in a region, is not a sufficient condition for spillover to occur if the activity is not dense enough. The amounts of exports and imports have a most obvious positive impact on productivity of the firms in a region. Concerning the horizontal spillover likely to occur among firms with similar activities, our results confirm that they are significant and positive, both measured by production and hours worked. However, if the concentration is too dense some diseconomies may occur.

b. Comparing Agglomeration Premia for different type of firms

We replicate the same estimations as above for different groups of firms depending of their characteristics. Results are displayed in Table 9.

An important hypothesis in the literature on integration is that productivity may be improved when firms accessing foreign markets because their exposure to useful technological innovations from international contacts makes easier the technological diffusion and fosters a more efficient organisation of firms. For all these reasons, we expect traders to benefit in a different way from the experience of other firms since they may have a different absorptive capacity. We replicate the same estimations as above for traders and non-traders separately.

Another important source of asymmetries among firms concerns the origin of capital. Joint ventures or the participation of foreign companies in the capital brings new managerial abilities and techniques, which may increase firms' TFP. We are not able with our data to check if the presence of foreign companies has a positive influence on TFP of firms located nearby. Data concerning the number of foreign firms or their production or employment is not available at the macro level and we don't want to aggregate the information available at the firm level in case our sample were not representative of this issue. In turn, we check if foreign firms have a different absorptive capacity that makes them able to take benefit from the concentration of local clients, suppliers or firms in the same activity in a different way than domestic firms do. To this aim, we repeat the same exercise for foreign and domestic firms separately.

Finally, we split our sample in two groups depending on the size of the plant measured by the number of employees. We divide our sample in plants larger or lower than 50 employees.

Table 9: Production estimates with the modified Olley and Pakes (1996) method, for single-plant firms with agglomeration indicators for different groups of firms.

		ALL	TRADERS	NON-TRADERS	FOREIGN	DOMESTIC	LARGE	SMALL
Agglom	"Production in the same industry: Regional / National"	0.550***	0.402***	0.709***	0.074	0.612***	0.192***	0.848***
		[0.055]	[0.044]	[0.201]	[0.117]	[0.060]	[0.071]	[0.085]
agglom0	"Regional production in the same industry / km2"	-0.019***	-0.022***	0.029***	0.003	-0.015***	0.003	0.042***
		[0.003]	[0.004]	[0.009]	[0.004]	[0.003]	[0.005]	[0.005]
lochour	"Hours worked in the region, same industry"	0.026***	0.063***	-0.001	-0.008	0.038***	0.009*	0.040***
		[0.003]	[0.007]	[0.014]	[0.007]	[0.003]	[0.005]	[0.004]
xagglom	"Exports of the same industry: Regional / National"	0.344***	0.527***	0.600***	0.094	0.502***	0.157***	0.602***
		[0.043]	[0.050]	[0.186]	[0.058]	[0.042]	[0.049]	[0.056]
magglom	"Imports of the same industry: Regional / National"	0.557***	0.537***	0.142	0.099	0.547***	0.753***	0.596***
		[0.049]	[0.054]	[0.123]	[0.097]	[0.049]	[0.126]	[0.054]
agglom2	"Production all industries: Regional / National"	-0.053	-0.957***	0.300**	0.395***	0.483**	0.966***	0.843***
		[0.192]	[0.262]	[0.151]	[0.140]	[0.212]	[0.112]	[0.116]
agglom3	"Regional production all industries / km2"	0.027***	0.006	-0.002	0.071***	-0.005	-0.009	0.030***
		[0.006]	[0.008]	[0.017]	[0.020]	[0.013]	[0.009]	[0.011]
urbhour	"Hours worked in the region, other industries"	-0.004	0.015**	-0.001	-0.292***	0.032***	0.025***	0.005
		[0.006]	[0.007]	[0.021]	[0.025]	[0.009]	[0.006]	[0.014]
xagglom2	"Exports all industries: Regional / National"	0.448***	-0.136	0.940***	0.239**	0.646***	-0.018	1.117***
		[0.044]	[0.116]	[0.319]	[0.121]	[0.050]	[0.139]	[0.137]
magglom2	"Imports all industries: Regional / National"	1.034***	0.902***	0.720***	0.334	0.829***	0.967***	0.486***
		[0.111]	[0.112]	[0.150]	[0.217]	[0.092]	[0.177]	[0.073]

Note: We only display the coefficients of the Agglomeration measure, coefficients for capital, labour and material are available upon request.
*Source: Author's calculation. Standards errors are in parenthesis * significant at 10%, **at 5%; ***at 1%.*

The overall picture is that traders and large firms react in very similar way to agglomeration. Overall, they react in the same way as the whole sample concerning agglomeration at the industry level while they are less sensitive to agglomeration indicators calculated at the regional level. The congestion economies observed at the industry level for a representative firms is mainly due to traders since non-traders benefit from a dense activity. Large firms and traders, unlike other firms are positively influenced by urbanisation measured by hours worked, dense activity is not significant. The weight of production at the regional level influences positively large firms while negatively traders.

Small firms behave in a different manner than large firms and traders. Small plants are very positively affected by agglomeration indicators measured at the industry level. We guess that small plants decisions concerning localisation are less affected by the geographic, historical and other overall characteristics of the region because they may only develop their activity near their residence place. Though, their choice concerning their activity may be influenced the activity of other firms in the same industry since they may be more sensitive to competition. On the other hand, their decision may be influenced by the decisions of firms in other industries since they must act as suppliers or clients of other firms located nearby. Actually, small firms appear as positively affected by the density of production of the region like non-trades though hours worked in other industries is not significant for them.

A common feature to all type of firms is that the amount of imports in general and at the industry level affects all the firms positively and with large coefficient except for foreign firms. The amount of exports at the industry level also affect all the firms positively except for foreign firms. Though, the amount of exports for all sectors have no significant effect on large firms and traders.

Foreign firms are the firms that have a most outsider behaviour. They are not sensible to any kind of agglomeration indicators calculated at the industry level. Their TFP benefits positively form experience at producing of the region, from dense activity and large amount of exports but negatively to hours worked in other industries. Their TFP benefit positively from the experience of the region in general while the experience at the industry level is already taken into account when choosing the location and the level of inputs or does not affect their managerial capacities.

c. Robustness checks

It emerges from results of section b, that considering the weight of the regional production in the national production or the density of the production leads to different results. On the other hand, the hours worked are expressed in level and the results are not directly comparable to the ones obtained for exports and imports. Then we repeat these estimations with all the indicators of agglomeration expressed in levels, levels per squared kilometres, weight or levels excluding the proper firm. Results are displayed in Table 10-Table 13.

Results globally reinforce our previous conclusions concerning the positive effect of production, exports and imports in other industries and the non-significant effect or negative effect of the concentration of hours worked.

Concerning the potential spillovers at the industry level, our results confirm that positive externalities occur via labour force even when the density of the labour force is taken into account. In contrast, the density of exports and imports at the industry level do not have a positive impact on TFP while the levels (or weights) of export and import at the industry level do have a positive impact.

Table 10: Alternative measures for agglomeration: density per km2

		AGGLO	L	M	K
lagglom0	Production of the region in the same industry /km2	-0.019***	0.389***	0.386***	-0.049***
		[0.003]	[0.022]	[0.031]	[0.009]
lxagglom5	Exports of the region in the same industry /km2	-0.003	0.391***	0.387***	-0.092***
		[0.006]	[0.022]	[0.031]	[0.012]
lmagglom5	Imports of the region in the same industry /km2	-0.095***	0.392***	0.387***	-0.056***
		[0.006]	[0.022]	[0.031]	[0.009]
lochour5	Hours worked of the region in the same industry /km2	0.020***	0.374***	0.420***	0.255***
		[0.003]	[0.017]	[0.022]	[0.005]
lagglom3	Production of the region /km2	0.027***	0.389***	0.386***	0.275***
		[0.006]	[0.022]	[0.031]	[0.007]
lxagglom6	Exports of the region /km2	0.038***	0.390***	0.386***	0.255***
		[0.003]	[0.021]	[0.031]	[0.006]
lmagglom6	Imports of the region /km2	0.041***	0.392***	0.387***	0.276***
		[0.005]	[0.022]	[0.031]	[0.009]
urbhour6	Hours worked of the region /km2	-0.085***	0.372***	0.420***	-0.182***
		[0.008]	[0.017]	[0.022]	[0.012]

Table 11: Alternative measures for agglomeration: levels

		AGGLO	L	M	K
lagglom7	Production of the region in the same industry	-0.001	0.390	0.387	0.290***
		[0.001]	[0.000]	[0.000]	[0.011]
lxagglom7	Exports of the region in the same industry	0.040***	0.391***	0.387***	0.238***
		[0.003]	[0.021]	[0.031]	[0.007]
lmagglom7	Imports of the region in the same industry	0.046***	0.392***	0.387***	0.252***
		[0.005]	[0.021]	[0.031]	[0.008]
lochour7	Hours worked of the region in the same industry	0.026***	0.373***	0.420***	0.245***
		[0.003]	[0.017]	[0.022]	[0.005]
lagglom8	Production of the region , other industries	0.045***	0.391***	0.386***	0.246***
		[0.004]	[0.022]	[0.031]	[0.007]
lxagglom8	Exports of the region, other industries	0.041***	0.391***	0.387***	0.251***
		[0.003]	[0.022]	[0.031]	[0.007]
lmagglom8	Imports of the region, other industries	0.038***	0.392***	0.387***	0.255***
		[0.005]	[0.022]	[0.031]	[0.008]
urbhour	Hours worked of the region, other industries	-0.004	0.375***	0.420***	-0.114***
		[0.006]	[0.017]	[0.022]	[0.010]

Table 12: Alternative measures for agglomeration: levels excluding the firm

		AGGLO	L	M	K
lagglom7	Production of the region in the same industry	0.027***	0.306***	0.374***	0.192***
		[0.009]	[0.031]	[0.027]	[0.010]
lxagglom7	Exports of the region in the same industry	0.032***	0.381***	0.361***	0.236***
		[0.004]	[0.024]	[0.031]	[0.009]
lmagglom7	Imports of the region in the same industry	0.040***	0.383***	0.361***	0.221***
		[0.005]	[0.022]	[0.029]	[0.008]
lochour7	Hours worked of the region in the same industry	0.025***	0.374***	0.420***	0.245***
		[0.003]	[0.017]	[0.022]	[0.005]
lagglom8	Production of the region , other industries	0.009	0.342***	0.376***	0.234***
		[0.008]	[0.020]	[0.028]	[0.004]
lxagglom8	Exports of the region, other industries	0.027***	0.376***	0.377***	0.243***
		[0.006]	[0.020]	[0.027]	[0.007]
lmagglom8	Imports of the region, other industries	0.038***	0.395***	0.366***	0.249***
		[0.006]	[0.021]	[0.030]	[0.008]
urbhour	Hours worked of the region, other industries	-0.004	0.375***	0.420***	-0.114***
		[0.006]	[0.017]	[0.022]	[0.010]

Table 13 Alternative measures for agglomeration: weights

		AGGLO	L	M	K
lagglom	Production in the same industry: Regional / National"	0.550***	0.389***	0.361***	0.292***
		[0.055]	[0.027]	[0.038]	[0.012]
lxagglom	Exports of the same industry: Regional / National"	0.344***	0.390***	0.387***	-0.071***
		[0.043]	[0.021]	[0.031]	[0.010]
lmagglom	Imports of the same industry: Regional / National"	0.557***	0.389***	0.388***	0.287***
		[0.049]	[0.021]	[0.031]	[0.008]
lochour2	Hours worked of the same industry: Regional / National	-0.821***	0.375***	0.421***	-0.112***
		[0.073]	[0.017]	[0.022]	[0.010]
lagglom2	Production all industries: Regional / National"	-0.053	0.389***	0.387***	0.268***
		[0.192]	[0.021]	[0.031]	[0.007]
lxagglom2	Exports all industries: Regional / National"	0.448***	0.388***	0.387***	0.277***
		[0.044]	[0.021]	[0.031]	[0.008]
lmagglom2	Imports all industries: Regional / National"	1.034***	0.389***	0.387***	0.299***
		[0.111]	[0.021]	[0.031]	[0.008]
urbhour2	Hours worked all industries: Regional / National	0.827***	0.374***	0.421***	0.246***
		[0.058]	[0.017]	[0.022]	[0.003]

Conclusions and policy implications

Firm-level datasets like the Spanish one provide some valuable information concerning firms' behaviour and their reactions to agglomeration that is very useful for economic policy design. We have confirmed that traders, that is firms that import but overall those that export are special cases. Few of them accounts for a large amount of exports. They are different from other firms in the sense that they are bigger and have a

higher productivity. Other studies have highlighted that this higher productivity able them to face the sunk costs associated with exporting (see for instance Blanes et al. (2008) or Mañez et al (2008) in the Spanish case) and other studies demonstrate that export and import activities of the firm lead to a learning-by-trading process that also fosters the productivity of the traders (Dovis and Milgram, 2009) or increase their probability to export (Castillo and Requena. 2007 in the Spanish case). Studies like the ones of Eaton et al. (2004) and Mayer and Otttoviano (2008) also show that the increase in exports is generally due to an increase in the number of new exporters more than the exports of existing exporters.

These results have important policy implications. Governments should focus on policies that make easier the entry of new exporters more than favouring existing exporters. To this purpose, they should provide conditions for small firms to grow, they should help to reduce trade costs and sunk costs like information costs and administrative costs associated with exporting activities and with importing activities and finally, give firms the accurate framework for a growing of productivity.

This study brings new elements to this last point. Numerous local governments have developed cluster policies motivated by the thought that the productivity of a firm will increase when other firms conducing similar activities locate nearby. Since an important barrier for firms to become international is the low productivity and the lack of information about foreign markets, agglomeration could also foster indirectly internationalization by improving productivity. Internationalisation could in turn bring some additional productivity gains.

Our results confirm that benefits to be obtained from localisation are, at least in part, internalised by the firm when choosing its location but apart from these expected gains there are some additional gains to obtain when located nearby other firms.

Concerning horizontal linkages, our results show that there exist positive and significant localization economies but also risk of congestion costs. Significant and positive spillovers are likely to occur among firms with similar activities, both measured by production, hours worked, export and import. However, if the concentration is too dense some diseconomies may occur in particular for traders if the industry is too dense in a region. The geographical unit used corresponds to Nuts2 which is rather large. Industry level used is also rather large (Nace Clio more or less). Then, we are not able to conclude concerning the accuracy of cluster policies, which act as a very specialized level and for small geographical units. However, our results evidence some positive spillovers at the mentioned level and imply that encouraging specialization in some industries avoiding passing a crucial threshold in terms of density of concentration of the activity could have positive effects for TFP of firms in this activity.

Increasing imports at the regional level in a specific industry would lead to similar gains as an increase of production in the same proportion for the TFP of firms competing in this industry. Evidence concerning urbanisation economies is more mixed. However, an increase of imports will also benefit to the TFP of firms operating in other activities while it is less obvious for production. Exports' spillovers are an intermediate case. As imports, exports in a specific activity have positive impact on the productivity of firms in this activity (but less than production and imports). Like imports, exports favour the TFP in other activities but mainly for non-traders and small firms.

We also show that not all the firms benefit in the same way from the experience of other firms located nearby, probably because they have different absorptive capacities. In particular, traders and large firms share most features and behave differently than their small firms and non-traders competitors. But a common feature to all type of firms is that the amount of imports in general, and at the industry level in particular, affects all

the firms positively and with large coefficient (except for foreign firms). Promoting the international connection at the industry level both for access to foreign providers of inputs and capital goods but also the entry of products similar to the ones produced locally, have positive effect on TFP. This kind of policy is a natural complement of all the efforts that should be done to encourage specialization in some specific activities or training and I+D policies that affect productivity more directly.

Small plants are the firms that learn more from other firms. Since they operate with lower scale, sharing experience with other firms is vital for them. They learn from other firms and in particular from exporters how to make it better. Then, regional government policies should encourage in particular the agglomeration of small firms, their possibility to grow and their internationalization.

Our results show that large firms and traders would also benefit from an increase in the production and internationalisation of other firms, in particular those of the same industry. Then, the interest to collaborate, exchange information should be fruitful for both type of firms.

Promoting agglomeration is not a sufficient condition to promote productivity but our results confirm that firms have a lot to learn from each other. Results largely depend on the internationalisation of the region and of the firm, size of the production at the industry and regional levels and scale of the firm. It seems that regions that export a lot, but overall those that import a lot will obtain considerable productivity gains. Then, a cheap and effective policy could consist in reducing the formal and informal barriers firms face when exporting or importing.

Our study has focused on TFP since it is an important engine for medium term growth production and labour productivity. But obviously TFP growth not automatically translates in employment growth. Studying this link should received

further attention. Another complementary issue to study is the role played by the innovation of products, the number of products exported or produced, by firms and by regions. Actually, quality and diversification may play an important role in generating spillover among firms. In the same line, it would be important to study the effect of the number of producers, importers and exporters (in complement of the indicators of quantity we used in this study) but these indicators were not available at the regional level in the Spanish case.

References

Altomonte C., I. Colantone (2008), Firm heterogeneity and endogenous regional disparities, *Journal of Economic Geography Advance*, 8, 779-810.

Amiti M, Konings J, (2007) Trade Liberalization, Intermediate Inputs, and Productivity: Evidence from Indonesia, *American Economic Review*, 97, 5, 1611-1638.

Baldwin, R. E., and T. Okubo (2006): "Heterogeneous firms, agglomeration and economic geography: spatial selection and sorting," *Journal of Economic Geography*, 6(3), 323-346.

Barrios, S., H. Görg y E. Strobl, (2009) Spillovers through backward linkages from multinationals: Measurement matters!, Conference ETSG 2009, http://www.etsg.org/ETSG2009/papers/goerg.pdf.

Békés G., Harasztosi P. (2008) *Agglomeration Premium and Trading firms*, mimeo, Institute of Economics, Hungarian Academy of Sciences.

Blalock, G., Gertler, P. J., (2008). "Welfare gains from Foreign Direct Investment through technology transfer to local suppliers," *Journal of International Economics*, 74(2), 402-421, March.

Blanes Cristobal, J. V., Marion D., J. Milgram-Baleix, A. I. Moro-Egido (2008) Do sunk exporting costs differ among markets? Evidence from Spanish manufacturing firms , *Economics Letters*, 101(2), November 2008, 110-112.

Brülhart, N.A. Mathys (2008), "Sectoral agglomeration economies in a panel of european regions", *Regional Science and Urban Economics,* 38, 348–362.

Cainelli, G., Lupi, C., (2008),"Does Spatial Proximity Matter? Micro-evidence from Italy," *Economics & Statistics Discussion Papers esdp08042*, University of Molise, Dept. SEGeS.

Castillo, J. and F. Requena (2007), "Information Spillovers and the Choice of Export Destination: A Multinomial Logit Analysis of Spanish Young SMEs", *Small Business Economics*, 28, 69-86.

Chudnovsky D., A. Lopez, G. Rossi, (2008),"Foreign Direct Investment Spillovers and the Absorptive Capabilities of Domestic Firms in the Argentine Manufacturing Sector (1992-2001)," *The Journal of Development Studies*, 44(5), 645-677.

Ciccone, A., (2002). "Agglomeration effects in Europe," *European Economic Review*, 46(2), 213-227, February.

Ciccone, A., Hall, R. E, (1996). "Productivity and the Density of Economic Activity," *American Economic Review*, 86(1), 54-70, March.

Coe, D.T. and E. Helpman (1995), 'International R&D and Spillovers', *European Economic Review*, 39, 859-887.

Dovis M., J. Milgram Baleix (2009) Trade, Tariffs and Total Factor Productivity: The Case of Spanish Firms, *The World Economy*, 32 4 (04) 575-605.

Driffield, N.L. and U.S. Kambhampati (2003), 'Trade Liberalisation and the Efficiency of Firms in Indian Manufacturing', *Review of Development Economics*, 7, 3, 419-430.

Eaton, J., S. Kortum, F. Kramarz (2004), "Dissecting trade: Firms, Industries, and Export destinations", *American Economic Review,* 94, 2, 150-154.

Giuliani E., 2007. "Towards an understanding of knowledge spillovers in industrial clusters," *Applied Economics Letters*, 14(2), 87-90.

Ethier, W. (1982), 'National and International Returns to Scale in the Model Theory of International Trade', *American Economic Review*, 72, 3, 389-405.

Fernandes, A.M. (2007), 'Trade Policy, Trade Volumes and Plant-level Productivity in Colombian Manufacturing Industries', *Journal of International Economics*, 71, 1, 52-71.

Glaeser, E. L., Kallal, H. D., Scheinkman, J. A. & Shleifer, A. (1992), `Growth in cities', *Journal of Political Economy* 100(6), 1126{52.

Giuliani E., 2007. "Towards an understanding of knowledge spillovers in industrial clusters," *Applied Economics Letters*, 14(2), 87-90.

Gorodnichenko, Y., J. Svejnar and K. Terrell (2007), *When does FDI have positive spillovers? Evidence from 17 Emerging Market Economies*, IZA Discussion Paper 3079

Greenaway D., R. Kneller, (2007). "Firm heterogeneity, exporting and foreign direct investment," *Economic Journal*, 117(517), F134-F161, 02.

Grossman, G. and E. Helpman (1991), *Innovation and Growth in the Global Economy* (Cambridge, MA: MIT Press).

Helpman, E. and P. Krugman (1985), *Market Structure and Foreign Trade* (Cambridge, MA: MIT Press).

Jacobs, J. (1969), The Economy of Cities, Random House, New York.

Javorcik B. S., 2004. "Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillovers Through Backward Linkages," *American Economic Review*, 94(3), 605-627, June.

Krugman, P. (1991), `Increasing returns and economic geography', *Journal of Political Economy* 99(3), 483-499.

Krugman, P.R. (1979), 'Increasing returns, monopolistic competition and international trade', *Journal of International Economics*, 9, 469-479.

Leibenstein, H., 1966. Allocative efficiency vs. 'X-efficiency. *American Economic Review* 56(1), 392-415.

Malmberg A., B. Malmberg, P. Lundequist (2000) Agglomeration and firm performance: economies of scale, localisation, and urbanisation among Swedish export firms *Environment and Planning A*, 32, 305-321

Mañez, J.A., M.E. Rochina and J.A. Sanchis, (2008). "Sunk Costs Hysteresis in Spanish Manufacturing Exports," *Review of World Economics*, 144(2), 272-294, July.

Markusen, J.R. (1989), 'Trade in producer services and in other specialized intermediate inputs', *American Economic Review*, 79, 1, 85-95.

Markusen, J.R. and Venables, A.J., 1999. Foreign direct investment as a catalyst for industrial development. *European Economic Review* 43, pp. 335–356.

Marshall, A. (1920), *Principles of Economics*, Prometheus Books.

Martin, P. and T. Mayer and F. Mayneris (2008), "Spatial concentration and firm-level productivity in France", CEPR DP 6858.

Mas, M., F. Pérez and E. Uriel (2005), 'El stock de capital en España y su Distribución Territorial (1964-2002)' (Bilbao: Fundación BBVA).

Mayer, T., G.I.P. Ottaviano, (2008), `The happy few: The internationalisation of European firms', *Intereconomics: Review of European Economic Policy*, 43(3), 135-148.

Melitz, M.J., G.I.P. Ottaviano (2008): "Market Size, Trade, and Productivity," *Review of Economic Studies*, 75(1), 295-316.

Olley, G.S. and A. Pakes (1996), 'The dynamics of productivity in the telecommunications equipment industry', *Econometrica*, 64, 1263– 1297.

Pavcnik, N. (2002). Trade liberalization, exit, and productivity improvements: evidence from chilean plants. *Review of Economic Studies*, 69, 245–276

Rodriguez-Clare, Andres, 1996. "Multinationals, Linkages, and Economic Development," *American Economic Review*, 86(4), 852-73, September.

Schor, A., 2004. Heterogeneous productivity response to tariff reduction. Evidence from Brazilian manufacturing firms. *Journal of Development Economics* 75, 373-396.

Topalova, P., 2004. Trade liberalisation and firm productivity: the case of India. IMF Working Paper 04/28.

Tybout, J.R., Westbrook, D., 1995. Trade Liberalisation and Dimensions of Efficiency Change in Mexican Manufacturing Industries. *Journal of International Economics* 39, 53-78.

Annex

Table 14: Production estimates with the Olley and Pakes (1996) method, by industry.

		L	K	M	N
1	Food, beverages, tobacco	0,173***	0,24***	0,596***	2774
		(0,019)	(0,007)	(0,031)	
2	Textiles, Leather and textile products	0,313***	0,03***	0,555***	2074
		(0,022)	(0,014)	(0,019)	
3	Wood, Paper and printing products	0,333***	0,158***	0,553***	2165
		(0,026)	(0,009)	(0,024)	
4	Chemical products"	0,231***	0,136***	0,666***	1199
		(0,03)	(0,01)	(0,035)	
5	Rubber and plastic products	0,273***	0,134***	0,632***	1051
		(0,023)	(0,011)	(0,023)	
6	Other non-metallic mineral products	0,301***	0,217***	0,538***	1289
		(0,037)	(0,018)	(0,034)	
7	Basic metals and fabricated metal products	0,368***	0,126***	0,566***	2539
		(0,023)	(0,01)	(0,025)	
8	Machinery and equipment n.e.c.	0,313***	0,202***	0,551***	1393
		(0,03)	(0,022)	(0,025)	
9	Electrical and optical equipment	0,327***	0,136***	0,586***	1590
		(0,03)	(0,011)	(0,027)	
10	Transport equipment	0,292***	0,131***	0,637***	1313
		(0,033)	(0,019)	(0,036)	
11	Other manufactured products	0,24***	-0,099***	0,601***	1297
		(0,025)	(0,025)	(0,019)	

*Source: Author's calculation. Standards errors are in parenthesis * significant at 10%, **at 5%; ***at 1%.*

Table 15: Production estimates with the Olley and Pakes (1996) method, by industry for single-plant firms.

		COEFL	COEFK	COEFMAT	EN
1	Food, beverages, tobacco	0.223***	0.246***	0.547***	1236
		(0.031)	(0.018)	(0.047)	
2	Textiles, Leather and textile products	0.331***	0.132***	0.509***	1059
		(0.034)	(0.008)	(0.029)	
3	Wood, Paper and printing products	0.306***	0.141***	0.579***	1216
		(0.026)	(0.010)	(0.030)	
4	Chemical products"	0.250***	0.123***	0.649***	574
		(0.053)	(0.010)	(0.075)	
5	Rubber and plastic products	0.312***	-0.063***	0.587***	591
		(0.037)	(0.025)	(0.035)	
6	Other non-metallic mineral products	0.225	0.213***	0.544***	629
		(0.054)	(0.014)	(0.042)	
7	Basic metals and fabricated metal products	0.399***	0.139***	0.544***	1498
		(0.035)	(0.017)	(0.038)	
8	Machinery and equipment n.e.c.	0.338***	0.122***	0.547***	763
		(0.040)	(0.008)	(0.035)	
9	Electrical and optical equipment	0.316***	0.108***	0.610***	771
		(0.034)	(0.010)	(0.025)	
10	Transport equipment	0.249***	0.114***	0.659***	702
		(0.049)	(0.015)	(0.051)	
11	Other manufactured products	0.269***	0.139***	0.609***	738
		(0.038)	(0.012)	(0.026)	

*Source: Author's calculation. Standards errors are in parenthesis * significant at 10%, **at 5%; ***at 1%.*

Table 16: Production estimates with panel fixed effect and ramdom effects for single-plant firms.

			l		k		mat		tp		year	Industry	Province	Constant		Observations	R-squared
	-4	re	0.437***	[0.006]	0.129***	[0.004]	0.452***	[0.004]			x	x	x	4.756***	[0.075]	10710	
	-5	fe	0.380***	[0.008]	0.065***	[0.005]	0.396***	[0.004]			x	x	x	6.073***	[0.073]	10710	0.69
lagglom	-6	re	0.445***	[0.007]	0.132***	[0.004]	0.445***	[0.004]	0.355***	[0.109]	x	x	x	4.345***	[0.074]	8758	
	-7	fe	0.378***	[0.010]	0.062***	[0.006]	0.375***	[0.005]	0.123	[0.240]	x	x	x	6.363***	[0.090]	8758	0.68
lagglom0	-8	re	0.437***	[0.006]	0.129***	[0.004]	0.452***	[0.004]	0.008**	[0.003]	x	x	x	4.761***	[0.075]	10710	
	-9	fe	0.379***	[0.008]	0.065***	[0.005]	0.396***	[0.004]	0.008**	[0.003]	x	x	x	6.166***	[0.075]	10710	0.69
lochour	-22	re	0.436***	[0.006]	0.129***	[0.004]	0.451***	[0.004]	0.038***	[0.010]	x	x	x	4.194***	[0.166]	10710	
	-23	fe	0.378***	[0.008]	0.064***	[0.005]	0.395***	[0.004]	0.070***	[0.016]	x	x	x	4.879***	[0.289]	10710	0.69
lxagglom	-18	re	0.436***	[0.006]	0.129***	[0.004]	0.451***	[0.004]	0.309***	[0.074]	x	x	x	4.754***	[0.075]	10710	
	-19	fe	0.379***	[0.008]	0.065***	[0.005]	0.396***	[0.004]	0.442***	[0.124]	x	x	x	6.017***	[0.074]	10710	0.69
lmagglom	-20	re	0.437***	[0.006]	0.129***	[0.004]	0.452***	[0.004]	0.181	[0.116]	x	x	x	4.755***	[0.075]	10710	
	-21	fe	0.379***	[0.008]	0.065***	[0.005]	0.396***	[0.004]	0.047	[0.178]	x	x	x	6.067***	[0.076]	10710	0.69
lagglom2	-10	re	0.436***	[0.006]	0.130***	[0.004]	0.451***	[0.004]	2.254**	[0.890]	x	x	x	4.734***	[0.076]	10710	
	-11	fe	0.379***	[0.008]	0.066***	[0.005]	0.395***	[0.004]	2.577***	[0.866]	x	x	x	5.784***	[0.121]	10710	0.69
lagglom3	-12	re	0.437***	[0.006]	0.130***	[0.004]	0.452***	[0.004]	0.186**	[0.075]	x	x	x	3.721***	[0.421]	10710	
	-13	fe	0.379***	[0.008]	0.065***	[0.005]	0.396***	[0.004]	0.209***	[0.073]	x	x	x	5.228***	[0.305]	10710	0.69
urbhour	-24	re	0.437***	[0.006]	0.129***	[0.004]	0.452***	[0.004]	0.009	[0.035]	x	x	x	4.235***	[0.613]	10710	
	-25	fe	0.379***	[0.008]	0.065***	[0.005]	0.396***	[0.004]	0.096***	[0.037]	x	x	x	4.194***	[0.730]	10710	0.69
lxagglom2	-26	re	0.437***	[0.006]	0.129***	[0.004]	0.452***	[0.004]	0.616	[0.386]	x	x	x	4.753***	[0.076]	10710	
	-27	fe	0.380***	[0.008]	0.065***	[0.005]	0.396***	[0.004]	0.679*	[0.377]	x	x	x	5.996***	[0.084]	10710	0.69
lmagglom2	-28	re	0.437***	[0.006]	0.130***	[0.004]	0.452***	[0.004]	-0.779*	[0.415]	x	x	x	4.758***	[0.075]	10710	
	-29	fe	0.380***	[0.008]	0.065***	[0.005]	0.396***	[0.004]	-0.303	[0.407]	x	x	x	6.109***	[0.088]	10710	0.69

*Source: Author's calculation. Standards errors are in parenthesis * significant at 10%, **at 5%; ***at 1%.*