GEOGRAPHY, PRODUCTIVITY AND TRADE: DOES SELECTION EXPLAIN WHY SOME LOCATIONS ARE MORE PRODUCTIVE THAN OTHERS?

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Abstract

Two main hypotheses are usually put forward to explain the productivity advantages of larger cities: agglomeration economies and firm selection. Combes et al. (2012) propose an empirical approach to disentangle these two effects and fail to find any impact of selection on local productivity differences. We theoretically show that selection effects do emerge when asymmetric trade and entry costs and different spatial scale at which agglomeration and selection may work are properly taken into account. The empirical findings confirm that agglomeration effects play a major role. However, they also show a substantial increase in the importance of the selection effect when asymmetric trade costs and a different spatial scale are taken into account.

Key words: agglomeration economies, firm selection, market size, entry costs, openness to trade.

JEL classification: c52, r12, d24.

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1. Introduction

The economic world is not flat. At any geographical scale, there is always a clear hierarchy in the distribution of the economic activities. More productive firms and workers usually concentrate in denser areas and primary cities. This relationship is well established in the empirical literature (see the seminal work by Ciccone and Hall, 1996, and the reviews by Rosenthal and Strange, 2004, and Melo, Graham, and Noland, 2009). Estimates of the elasticity of productivity with respect to city population range between 0.02 and 0.10, and the evidence is confirmed for several countries and sectors.[1]

If the existence of productivity differences in favor of larger cities seems to be undisputed, the debate on the mechanisms originating such differences is still open. Two main hypotheses have been put forward in order to explain productivity premium associated to spatial concentration: the existence of agglomeration economies and the effect of firm selection.

For a long time, the explanation based on agglomeration economies prevailed. Starting from Marshall (1890), several economic mechanisms have been proposed to explain the positive relationship between spatial concentration and productivity. Duranton and Puga (2004) summarize these mechanisms into three main forces: sharing (i.e. the possibility to share local indivisible public goods that raise productivity), matching (i.e. thick labor markets facilitate the matching between firms and workers), and learning (i.e. the frequent face to face interactions between workers and firms in the agglomerated areas generate localized knowledge spillovers).

However, more recently, the alternative explanation based on firm selection has gained consensus, building on works by Melitz (2003) and Melitz and Ottaviano (2008); according to the latter model, larger markets attract more firms and make competition tougher, thus leading less productive firms to exit from the market.

With the purpose of disentangling agglomeration from firm selection effects when explaining local productivity differences, Combes et al. (2012) nest a generalized version of a firm selection model into a standard theoretical set-up featuring agglomeration economies. Morever, they introduce a novel non parametric empirical methodology that is totally grounded on theory and that allows for a simultaneous estimation of the different forces shaping productivity distributions at the local level. According to their evidence on French data, local productivity

[1] In a recent analysis on Italian manufacturing firms, Di Giacinto et al. (2012) detect local productivity advantages for both types of agglomerated areas they take into consideration, that is urban areas, which typically display a huge concentration of population and host a wide range of economic activities, and industrial districts, which exhibit a strong concentration of small firms producing roughly the same products; the authors also find that advantages are much larger for urban areas.

differences are entirely explained by agglomeration while selection effects are not statistically significant.

These findings appear to mark a striking difference with the previous empirical literature on selection effects. For the concrete industry, featuring high trade costs and geographically segmented markets, Syverson (2004a) finds that local market size reduces productivity dispersion and increases the strength of selection effects. In another paper (Syverson, 2004b), the author examines again the relationship between selection and productivity dispersion: he finds that the elasticity of substitution among varieties in narrowly defined industries is negatively correlated with productivity dispersion and positively related with its median level. Del Gatto, Ottaviano and Pagnini (2008) resort to a similar empirical setting and show that industries that are more opened to external trade display a lower dispersion in productivity and hence more intense selection effects.

Our paper extends the Combes et al. (2012)[2] theoretical model and shows how the disappearance of the selection effect observed in the data can be motivated by three alternative explanations: 1) regional heterogeneity in market access; 2) different spatial range of agglomeration/selection effects; 3) differentiated entry costs across locations.

As for the market access hypothesis, the relatively simple geography assumed by Combes et al. (2012) may turn out to be too streamlined to allow for the selection effects to stand out properly in the empirical analysis. The authors assume that iceberg trade costs are symmetric across cities, thus implying that the intensity of selection solely depends on the local market size. On the contrary, once trade costs are allowed to differ across locations, it can be shown that selection effects will be more intense in those cities having a better access to other local markets. This implies that we should consider proxies for local market access, as those based on market potential, as possible alternative determinants of the strength of the selection effects.[3]

The second explanation relates to possibly differentiated spatial scales underlying the functioning of agglomeration and selection forces. Firms are usually assumed to be able to gain from agglomeration economies only when they are located closely to each other within narrow spatial boundaries (e.g., Rosenthal and Strange, 2003 and 2008). At the same time, the market on which firms actually compete to sell their output may extend its range far beyond the spatial

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[2] Other theoretical contributions nesting selection and agglomeration effects as well as firm sorting include Behrens and Nicoud (2008) and Behrens, Duranton and Nicoud (2010).

[3] Although in a completely different theoretical set-up, our contribution is closer in this respect to those by Eaton and Kortum (2002) and Bernard et al (2003). These authors actually combine in a unified model heterogeneous firms and heterogeneous trade costs in the context of Bertrand competition. Trade costs have a relevant impact both on trade flows and on the shape of productivity distribution. For some recent empirical evidence about selection effects along those lines in Italy see, Finicelli et al. (2013).

boundaries delimiting the range of agglomeration economies. In this set up, a comparison of the productivity distributions at the city level, while correctly detecting agglomeration effects, will fail to uncover differential selection effects across the two cities, as the latter is related to overall size of the broader market area in which they are jointly embedded, rather than to the individual city size.

As a final extension, we allow for the existence of asymmetric entry costs at the local market level, contrary to Combes et al. (2012), who assume that entry costs are the same across all areas. When at least part of these sunk costs (e.g. transaction costs in the real estate market or fees charged by professional service firms) is increasing in more densely populated cities, an anti-competitive effect may ensue, reducing the strength of firm selection in larger locations.

Using a large firm-level data set, covering more than 48,000 Italian manufacturing companies during the period 1995-2006, and the same estimation approach set forth in Combes et al. (2012), we empirically test the predictions of the above three theoretical model extensions. Estimation results confirm the relevance of agglomeration economies that stand out as the main driver of the productivity advantage of larger cities. In two of the proposed extensions (heterogeneous market potential and different spatial scale of agglomeration and selection effects), results show also a substantial increase in the relevance of firm selection effects. The empirical influence of differentiated entry costs on estimated selection effects appears instead to be essentially negligible.

The rest of the paper is organized as follows. In section 2 the theoretical model is illustrated, starting from the baseline version of Combes et al. (2012) and then introducing alternative hypotheses on entry costs, market potential, and spatial scale. Section 3 presents the data set. Section 4 discusses the econometric results for the baseline model. Section 5 discusses the evidence for the extended versions. Section 6 summarizes and concludes.

2. Theoretical predictions

In this section we extend the Combes et al. (2012) model of agglomeration and selection along three different lines: (i) differences in market access across regions, (ii) the spatial scale issue, and (iii) asymmetric entry costs.

2.1 The basic setup

The basic setup relies on Melitz and Ottaviano (2008), compounded with a standard model featuring agglomeration economies (Fujita and Ogawa, 1982; Lucas and Rossi-Hansberg, 2002).

An individual consumer utility is given by:

$$U = q^0 + \alpha \int_{k \in \Omega} q^k dk - \frac{1}{2}\gamma \int_{k \in \Omega} \left(q^k\right)^2 dk - \frac{1}{2}\eta \left(\int_{k \in \Omega} q^k dk \right)^2 , \tag{1}$$

where q^0 indicates the consumption of a homogeneous nummeraire good, that is freely traded across locations, and q^k is the consumption of a variety *k* belonging to a set Ω of differentiated goods. Parameters α and γ are assumed to be both positive and indicate a higher preference for the differentiated good with respect to the nummeraire. Parameter $\eta > 0$ represents consumer preferences for variety, the higher η the larger the love for variety in the differentiated goods set.

Standard maximization under budget constraint (for further details, see Ottaviano, Tabuchi and Thisse, 2002; Melitz and Ottaviano, 2008) leads to the following Marshallian demand for the differentiated good:

$$q^k = \frac{1}{\gamma + \eta\omega}\left(\alpha + \frac{\eta}{\gamma}\omega P\right) - \frac{1}{\gamma} p^k \quad \text{if} \quad p^k \leq \overline{h} \equiv P + \frac{\gamma(\alpha - P)}{\gamma + \eta\omega} \tag{2}$$

and zero otherwise. ω is the measure of the set of varieties $\tilde{\Omega}$ actually produced in the economy. $P \equiv \frac{1}{\omega} \int_{j \in \tilde{\Omega}} p_j dj$ is the average price faced by a consumer. $\overline{h}$ is the price threshold that immediately follows from the restriction $q^k \geq 0$. It should be noted that varieties with a price higher than a certain threshold $\overline{h}$ will not be consumed in this economy. This is due to the utility function (1), in which marginal utility is bounded.

The production of the nummeraire good is obtained under constant returns to scale with a one-to-one technology; this implies that one unit of labor is needed to produce one unit of this kind of good.

Differentiated products are produced under monopolistic competition. Upon paying a sunk cost *s*, firms can start the production process, by using *h* units of labor to produce one unit of output. This implies that *h* is the marginal cost. Firms are heterogeneous in terms of *h*, the latter being randomly drawn by a known distribution function *G(h)* common to all locations (*g(h)* denotes the continuous density function). As usual in this literature we assume that firms decide first whether to enter the market and then they are able to observe their true productivity (*1/h*). All firms with a marginal cost above the price threshold pay the fixed cost and then exit.

The economy is made of *R* locations (cities) in which production may take place. Firms may be created and shut down in each city, but they cannot relocate.[4] Whenever a firm is set in a city, it can export its differentiated good to other locations upon paying an iceberg trade cost $\tau \geq 1$. This implies that an exporting firm should ship τ units of its good to deliver one unit to another city. For the moment, we assume that the trade cost matrix is symmetric and constant, that is, given two locations *i* and *j*, $\tau_{ij} = 1$ if *i=j* and $\tau_{ij} = \tau$ if $i \neq j$. Since all varieties enter symmetrically in the utility function, we can index firms by their marginal cost realization *h*.

The equilibrium operating profits that a firm located in city *i* is able to attain in city *j* are:

$$\pi_{ij}(h) = \frac{N_j}{4\gamma}\left(\bar{h}_j - \tau_{ij} h\right)^2 \qquad (3)$$

where N_j is the population in city *j*.

Due to free entry in each market, ex-ante firm profits are driven to zero. This implies that expected operation profits before entry must equalize the sunk cost:

$$\frac{N_i}{4\gamma}\int_0^{\bar{h}_i}\left(\bar{h}_i - h\right)^2 g(h)dh + \sum_{j\neq i}\frac{N_j}{4\gamma}\int_0^{\bar{h}_j/\tau}\left(\bar{h}_j - \tau h\right)^2 g(h)dh = s \qquad (4).$$

Let us now turn to the agglomeration component of the model and its effects on firm productivity. Each worker is endowed with one unit of labor, inelastically supplied to firms. Individual productivity, however, is positively influenced by the face to face interactions with other workers, although the positive externalities generated through this channel are subject to a spatial decay (Fujita and Ogawa, 1982; Lucas and Rossi-Hansberg, 2002). This implies that the effective labor supply by a worker located in city *i* is equal to $a\left(N_i + \sum_{j\neq i}\delta N_j\right)$, where $a(0) = 1$, $a' > 0$, $a'' < 0$ and $\delta \in [0,1]$, which represents the strength of cross-city interactions. Since workers are mobile across sectors, per capita labor income is equal to $a\left(N_i + \sum_{j\neq i}\delta N_j\right)$. In anticipation of the empirical part, this *Agglomeration* effect will be measured by $A_i \equiv \ln\left[a\left(N_i + \sum_{j\neq i}\delta N_j\right)\right]$. A firm in city *i* with a unit labor requirement *h* hires

[4] For models respectively combining firm relocation choices with Melitz (2003) and Melitz and Ottaviano (2008) setups, see Baldwin and Okubo (2006) and Okubo, Picard and Thisse (2010). Nocke (2006) pursues a similar line of research however moving from the tenets of oligopoly theory.

$l_i(h) = \sum_j \frac{Q_{ij}(h)}{a\left(N_i + \sum_{j\neq i} \delta N_j\right)}$ workers at a total cost $a\left(N_i + \sum_{j\neq i} \delta N_j\right) l(h) = \sum_j Q_{ij}(h)$, where $Q_{ij}(h)$ is the total production of firm *h* located in city *i* and sold to market *j*.

Agglomeration effects could be also heterogeneous across firms. Combes et al. (2012) suppose that while agglomeration economies raise the productivity for all firms in larger cities, they can have a stronger effect on more productive firms (*Dilation* effect). In order to introduce this idea in a tractable way, they suppose that the Agglomeration effect is stronger for more efficient firms (i.e. those with a lower *h*). Analytically, the effective labor supply for an employee living in city *i* and hired by firm *h* is $a\left(N_i + \sum_{j\neq i} \delta N_j\right) h^{-(D_i - 1)}$, where $D_i \equiv \ln\left[d\left(N_i + \sum_{j\neq i} \delta N_j\right)\right]$ and $d(0) = 1$, $d' > 0$ and $d'' < 0$.

The natural logarithm of the productivity of a firm with marginal cost *h* and located in city *i* is $\phi_i(h) = \ln\left(\frac{\sum_j Q_{ij}(h)}{l_i(h)}\right) = A_i - D_i \ln(h)$.

In anticipation of the empirical section, we can now write the cumulative density function of the log of productivities:

$$F_i(\phi) = \max\left\{0, \frac{\tilde{F}\left(\frac{\phi - A_i}{D_i} - S_i\right)}{1 - S_i}\right\} \tag{5}$$

where $\tilde{F}(\phi) \equiv 1 - G(e^{-\phi})$ is the underlying cumulative density function of the log productivities absent any agglomeration, dilation and selection effect. $S_i \equiv 1 - G(\bar{h}_i)$ denotes the proportion of firms that fail to survive competition in city *i*.

We can now turn to the core results of this paper, by looking at the (heterogeneous) effects of city size on the Agglomeration, Dilation and Selection components. Combes et al. (2012) show that, if cities are ranked in terms of population: $N_1 > N_2 > ... > N_{R-1} > N_R$:

1. The agglomeration and the dilation effects are stronger for larger cities, i.e. $A_1 > A_2 > ... > A_{R-1} > A_R$ and $D_1 > D_2 > ... > D_{R-1} > D_R$;

2. The selection effect is stronger in larger cities, i.e. $\overline{h}_1 < \overline{h}_2 < ...\overline{h}_{R-1} < \overline{h}_R$.

We refer to their paper for a formal proof.

These results imply that by comparing a small and a large region, the local productivity distribution in the latter is rightward shifted due to agglomeration, less compressed because of dilation and more left truncated following the presence of tougher selection. Hence, these three mechanisms will have distinct effects on the shape of the productivity distribution. In particular, while agglomeration forces positively affect the productivity of all the firms located in larger areas by the same amount, selection in the large sized market (due to tougher competition) will influence the lower tail of the distribution by increasing the minimum productivity level below which firm survival in the local market is not possible. Dilation, instead, raises relatively more the productivity of the firms at the right tail of the distribution. The identification of the three sources of local productivity advantages will be based on their different impact on the shape of the productivity distribution.

These results are based on two relevant hypotheses. First, market size is exogenous and hence the number of workers in each location is assumed as given implying also that workers are not mobile across cities. Second, agglomeration and selection are represented as they were forces acting independently from one another. While removing the first assumption is relatively innocuous apart for the fact that the complexity of the theoretical setup will increase, the second one is crucial to guaranteeing the empirical tractability of the model. Allowing for an interaction between agglomeration and selection forces is certainly an important topic that we leave for future research.[5]

2.2 Asymmetric trade costs

We first show the role that differences in terms of market access across cities might have on the intensity of competition at local level. In their model, Combes et al. (2012) assume that trade costs are the same across locations. In what follows, we will remove this assumption.

<u>Proposition 1.</u>

Consider three cities *i,j k*. Let us assume that the geography of the country is such that $\tau_{ij} < \tau_{ik} < \tau_{jk}$ and that trade costs are bilaterally symmetric, i.e. $\tau_{xy} = \tau_{yx}$ $\forall x, y = i, j, k$ and $x \neq y$, and that cities are symmetric in terms of size, i.e. $N_i = N_j = N_k = N$.

[5] On all these aspects see the discussion in Combes et al (2012).

1. The agglomeration and the dilation effects are the same in the three locations, i.e. $A_i = A_j = A_k$ and $D_i = D_j = D_k$;

2. $\bar{h}_i < \bar{h}_j < \bar{h}_k$, i.e. the local intensity of the selection effect increases as the local accessibility to different local markets improves.

Proof

See Appendix a1 □

Proposition 1 shows the relevance of the market access in the determination of the local productivity cut-off point. In particular, it demonstrates that the productivity threshold does not solely depend on local market size (to remark this aspect we actually assume that local markets are symmetric in size) but also on the possibility for local firms to access other local markets. This feature was neglected by Combes et al. (2012) due to the simplified geography of their model. As a direct implication of Proposition 1, whenever trade costs increase with distance a region that is close to other large markets will have a better market access and hence will be characterized by stronger selection effects. Accordingly, market access will concur with local market size to determine the strength of these effects. In the empirical section we cope with this issue by taking into account market access when tracing the boundary between the firm populations whose productivity distributions have to be compared.[6]

2.3 The spatial scale issue

A related issue concerns the spatial scale at which agglomeration and selection effects operate. In their model, Combes et al. (2012) implicitly assume that the spatial range of agglomeration, dilation and selection effects is the same. This assumption seems questionable for different reasons. As far as agglomeration effects are concerned, both the theoretical and empirical literature seems to suggest that they operate at a very local level, i.e. they exert their effects within narrowly restricted spatial boundaries.[7] On the contrary, trade costs, that are crucial

[6] It should be noted that the market access issue is strictly related to the choice of a generic distribution G(.) for productivities. By using a Pareto distribution, instead, Meliz and Ottaviano (2008) show that a country's threshold solely depends on the local population size.

[7] See Rosenthal and Strange (2003 and 2008) for evidence on the rapid spatial decay of information and human capital spillovers and Puga (2010) for a survey on the same topic.

to identify the market area where selection effects take place, may significantly differ only at a broader spatial scale.

Following these remarks, in this Section we show how the basic model can be restated in a set up allowing agglomeration and selection effects to operate at different spatial scales. To this purpose, assume that economic space is partitioned in two macro-regions. Each macro-region hosts a number of localities (or cities) inside its borders. Define total population in the two macro-regions as $P_1 = \sum_i N_{1i} \quad P_2 = \sum_j N_{2j}$, where *i* and *j* denote the different localities, and assume that $P_1 > P_2$. Agglomeration and dilation effects are assumed to display their effects at local level. At the same time, each macro-region is assumed to represent a unified market, i.e. trade costs between localities of the same macro-region are zero. On the contrary, trade between macro-regions is costly: in order to export one unit of the good from 1 to 2 a producer in macro-region 1 has to ship $\tau \geq 1$ units of the same good.

<u>Proposition 2</u>

Consider 2 cities: *r* belongs to macro-region 1 and *s* to macro-region 2. *r* and *s* have the same population ($N_r = N_s$), but macro-region 1 is bigger than 2.

1. The agglomeration and the dilation effects are the same in the two cities, i.e. $A_r = A_s$ and $D_r = D_s$;
2. The selection is stronger in location *r*.

<u>Proof</u>

See Appendix a2 □

Proposition 2 states the importance of the identification of the relevant market of the final output for the determination of the local cut-off points. This characteristic was actually neglected by Combes et al. (2012) and it may have relevant consequences on the outcome of the estimation process. In particular, we can observe an attenuation of the estimated selection effects when one focuses strictly on the individual city size - instead of the size of the corresponding macro-region - when identifying local cut-off points in the firm-level productivity distribution. In the empirical section we show how it is possible to cope with this issue at the estimation stage.

2.4 Asymmetric entry costs

In this section, we allow for the existence of differentiated entry costs, which are increasing with the resident population in the city. There are two possible reasons for this assumption. The first is linked to imperfections in the markets for land. Setting up a business entails a number of physical investments in real estate (buying a lot and building or refurbishing an establishment); although these costs should be more correctly considered as fixed rather than sunk costs, in the presence of imperfect markets, part of the fixed cost can turn sunk. This implies that in denser areas (with higher land prices) the possible loss in case the firm decides to exit the market is larger, thus increasing entry costs. The second channel is related to non tradable inputs. Starting a new enterprise implies a number of administrative burdens that are usually carried by using consultants or experts. In denser areas, high land prices may end up in larger fees charged for administrative set-up activities, leading to a more costly entry.

For these reasons, in this section we proxy entry costs with land costs.

As land prices are usually higher in densely populated areas, this assumption implies that entry costs can be ordered as follows: $s(N_1) > s(N_2) > ... > s(N_{R-1}) > s(N_R)$.

Consider now city *i* and *j*, characterized by different population size. Equation (4) can now be rewritten, respectively, as:

$$\frac{N_i}{4\gamma}\int_0^{\bar{h}_i}(\bar{h}_i - h)^2 g(h)dh + \frac{N_j}{4\gamma}\int_0^{\bar{h}_j/\tau}(\bar{h}_j - \tau h)^2 g(h)dh + \sum_{\substack{k\neq i\\ k\neq j}}\frac{N_k}{4\gamma}\int_0^{\bar{h}_k/\tau}(\bar{h}_k - \tau h)^2 g(h)dh = s(N_i) \qquad (6)$$

$$\frac{N_j}{4\gamma}\int_0^{\bar{h}_j}(\bar{h}_j - h)^2 g(h)dh + \frac{N_i}{4\gamma}\int_0^{\bar{h}_i/\tau}(\bar{h}_i - \tau h)^2 g(h)dh + \sum_{\substack{k\neq i\\ k\neq j}}\frac{N_k}{4\gamma}\int_0^{\bar{h}_k/\tau}(\bar{h}_k - \tau h)^2 g(h)dh = s(N_j) \qquad (7)$$

By subtracting (7) from (6) we obtain:

$$N_i\upsilon(\bar{h}_i, \tau) - N_j\upsilon(\bar{h}_j, \tau) = s(N_i) - s(N_j) \qquad (8)$$

where $\upsilon(\bar{h}_x, \tau) = \int_0^{\bar{h}_x}(\bar{h}_x - h)^2 g(h)dh - \int_0^{\bar{h}_x/\tau}(\bar{h}_x - \tau h)^2 g(h)dh \quad \forall x = i, j$.

We can now state the conditions for the agglomeration, dilation and selection effects.

<u>Proposition 3.</u>

If $N_i > N_j$ and $s(N_i) > s(N_j)$:

1. The agglomeration and the dilation effects are stronger for the larger city, i.e. $A_i > A_j$ and $D_i > D_j$;
2. If productivities are Pareto distributed, the selection effect is stronger in the larger cities, i.e. $\bar{h}_i < \bar{h}_j$, if and only if $s'(N) < \frac{s(N)}{N}$.

Proof

See Appendix a3 □

In the Appendix we provide a similar condition on $s'(N)$, when firm marginal costs are drawn from a generic distribution function *G(.)*.

Proposition 1 states that the effects of population size on selection can be attenuated and, in some cases, eventually reversed when the entry cost, expressed as a function of the local population size, is steep enough. The intuition is quite simple: when the entry cost sharply increases with population size, more crowded cities experience an anti-competitive effect, thus allowing the survival of more inefficient firms. We test this prediction in the empirical section of the paper.

3. Data and Descriptive statistics

The empirical analysis is carried out on a large panel of more than 48,000 Italian manufacturing firms, observed over the period 1995-2006.

The panel was built as follows (see also Di Giacinto et al., 2012, where the same dataset is utilized to map local productivity differentials in Italy). Yearly balance-sheet figures on value added, fixed capital investment and capital stock (at book value) were drawn from the Chamber of commerce-Company Accounts Data Service database (Centrale dei Bilanci / Cerved). Additional firm level data, including the sector of economic activity, firm location (municipality where the firm is established) and number of employees were also included as auxiliary information in the database (see Appendix a4 for technical details on the construction of the dataset, in particular with reference to the imputation of unreported employment data).

The capital stock at firm level has been estimated from book value investment data using the permanent inventory method and accounting for sector-specific depreciation rates as derived from the Italian National Accounts database provided by Istat. The capital stock in the initial year has been estimated using the deflated book value, adjusted for the average age of capital calculated from the depreciation fund (for more details, see Di Giacinto et al., 2012). Nominal value added and consumption of intermediate goods figures were deflated using industry specific price indexes.

Firms with less than 5 employees were removed from the sample, since data were very noisy for firms in this size class.

We end up with an unbalanced panel with about 345,000 observations and 48,000 firms (Table 1): this means that on average we can rely of 7 yearly balance-sheet figures for each firm over the 12-years period 1995-2006. Notice that we are not able to establish the reasons behind firm entry (exit) into (from) the sample. In other words we cannot establish for instance whether a firm exit is due either to bankruptcy or to the fact that it failed to provide data in that year. Accordingly, we are not able to link the observation of a firm in certain years to selection processes.

Geographical information on the municipalities where firms (not plants) are located allows us mapping them into Local Labor Markets Areas (LLMA). LLMA are defined on the basis of data on daily commuting flows from place of residence to place of work, available for the 8,100 municipalities in Italy. Contiguous locations with relevant commuting patterns are then aggregated into LLMA. Through this procedure, within LLMA labor mobility is maximized while mobility across LLMA is minimized. The outcome of this procedure mapped the Italian territory into 784 LLMA in 1991 (686 in 2001).[8] LLMA represent an ideal partition to analyze many agglomeration effects, provided that most of them are conveyed though the interactions taking place within the local labor market.

Two alternative criteria were considered in order to separate large and small cities: population count and population density.

Population size represents our preferred gauge, as it more closely identifies large urban areas within Italian LLMA. When we consider density as a measure of local scale we actually find out that a number of relatively small LLMA attain high levels of population density, while they clearly

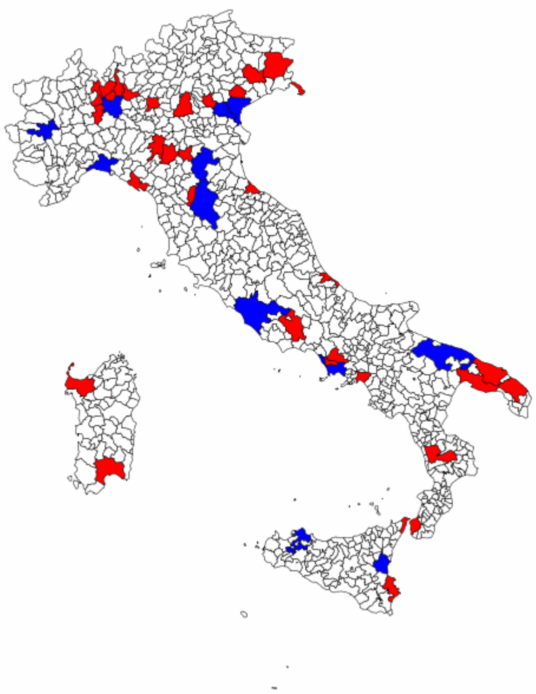
[8] In the following, the empirical analysis is carried out on the basis of the 1991 map of LLMA. The choice is motivated by the opportunity of using a classification that is predetermined with respect to the sample period considered in the analysis.

do not qualify as large urban systems according to size or other indicators that typically denote large urban areas.

As a baseline operational definition, Urban Areas (UA) are identified as those LLMA with a resident population above the threshold of 200,000 inhabitants (figure 1 maps the corresponding urbanization patterns across the Italian territory). Although Italy was historically known as the "country of one hundred cities", it has not experienced the development of urban giants as is the case of several developed and developing countries. Hence, setting a relatively low threshold level to define UA seems to be consistent with the overall low degree of urbanization in the Italian economy. However, in what follows, we will also check the robustness of our results using a higher threshold (500,000 inhabitants).

About a half of the firm-level observations refer to firms in UA (Table 1), while the sectoral distribution reveals that about 45 per cent of the observations are related to the Italy's traditional sectors of specialization (metal and metal products, mechanical and machinery, textiles and apparel industries).

Fig. 1 - Map of LLMA in 1991: Urban Areas with population > 500,000 (in blue),Urban areas with population between 200,000 and 500,000 (in red), non urban areas with population below 200,000 (in white)



Source: Our computations on the 1991 census data produced by Istat

4. Estimation procedures

4.1 TFP estimation

In order to allow for a comparison of productivity across firms and areas, total factor productivity (TFP) levels have to be first estimated. Following a standard approach, we obtain TFP estimates at firm-level as the residual of an estimated production function.

The following standard Cobb-Douglas production function was considered:

$$Q_{i\in(r,s)t} = \Phi_{it} L_{it}^{\alpha_s} K_{it}^{\beta_s} \tag{9}$$

where L and K denote labor and capital inputs used to produce the amount of output Q in the year t by firm i belonging to sector s and located in LLMA r;[9] α_s and β_s are the production function coefficients, that are allowed to vary across sectors. We do not impose constant returns to scale technology.

After log transformation the following estimating equation ensues (lowercase letters denote logs):

$$q_{it} = \alpha_s l_{it} + \beta_s k_{it} + \phi_{it} \tag{10}$$

from which the firm-level log-TFP can subsequently be computed as the residual:

$$\hat{\phi}_{it} = q_{it} - \hat{\alpha}_s l_{it} - \hat{\beta}_s k_{it} \tag{11}$$

provided that consistent estimates of parameters α_s and β_s are available.

Equation (11) was estimated by ordinary least squares (LS), individual firm fixed effects (FE) and Levinsohn and Petrin (LP) methods to control for input-output simultaneity, (see Levinsohn and Petrin, 2003). Distinct regressions for each industry at the two digits level of the SEC

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[9] To avoid cluttering notation, in the following we drop the reference to the LLMA and the sector when indexing variables referring to the individual firm.

classification were considered. As mentioned before, firms with less than 5 employees were dropped from the sample prior to estimation.[10]

It has to be noted that, if smaller firms are generally less efficient than the industry average, the choice of dropping them from the sample may involve a loss of information in the left tail of the firm-level TFP-distribution, which in principle might be relevant for the identification of selection effects. However, balance sheet information for micro enterprises is usually very inaccurate and may introduce a source of measurement error potentially biasing *all* the estimates of the model structural parameters. Balancing the two sources of potential biases, following Combes et al. (2012) we chose to preserve data quality by considering only firms with a minimum of 5 employees.[11]

Overall, results obtained according to the three estimation methods do not show large differences, although the LS estimates exhibit slightly larger values of the labor input coefficients as compared to those resulting from FE and LP methodology, thus confirming the likely presence of the expected positive simultaneity bias. LP estimates show generally larger elasticities for the capital input and correspondingly lower estimates for the labor input as compared to FE, the sum of the two coefficients attaining very close values in the two cases. Decreasing returns to scale (RTS) seem to be the prevalent regime in our estimates, although a formal test of constant RTS did not reject the null for the majority of sectors considered in the analysis. Estimated TFP levels are highly correlated across the three estimation methods, the Pearson correlation coefficient attaining values equal to 0.95 or higher.

The results comparing productivity levels across different locations and estimated with the Levinsohn-Petrin method are reported in Table 2. They clearly indicate that the estimated TFP is generally higher in urban areas.

4.2 - Econometric approach

To obtain estimates of the parameters measuring the intensity of selection and agglomeration effects in the theoretical model detailed in section 2, we implemented the methodology set forth in Combes et al. (2012), which makes use of non parametric techniques

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[10] Following the same line of reasoning, firms attaining extreme values of the K/L ratio, i.e. those below the 1st percentile or above the 99th percentile of the sample distribution, were also excluded. As a result, the final sample size was equal to about 28,700 firms per year.

[11] Note also that, since the econometric approach implemented in the paper is routed around the comparison of quantiles of the empirical TFP distributions in large and small urban areas, dropping smaller firms from the sample would only affect estimation results if those firms were disproportionally included in the UA or in the non UA samples.

exploiting only the information conveyed by the empirical cumulative distribution of log productivities in each city.

The estimation procedure is developed on the basis of the assumption that the cumulative density function F_i of log TFP observed in city *i* can be derived by dilating by a factor D_i, shifting rightwards by A_i and left-truncating a share S_i of the values of some underlying distribution with cumulative density function $\tilde{F}$.

Under this assumption, the authors prove that the cumulative densities of log productivity in cities *i* and *j* are related by the following formulas:

$$F_i(\phi) = \max\left\{0, \frac{F_j\left(\frac{\phi - A}{D}\right) - S}{1 - S}\right\}, \qquad \text{if } S_i > S_j \qquad (12)$$

$$F_j(\phi) = \max\left\{0, \frac{F_i(D\phi + A) - \frac{-S}{1-S}}{1 - \frac{-S}{1-S}}\right\}, \qquad \text{if } S_j > S_i \qquad (13)$$

where

$$D = \frac{D_i}{D_j}, \qquad A = A_i - DA_j, \qquad S = \frac{S_i - S_j}{1 - S_j}. \qquad (14)$$

Only parameters *A*, *S* and *D*, providing a relative measure of agglomeration, selection and dilation effects on productivity in large versus small cities, can be identified and estimated from the empirical cumulative distributions.

Rewriting the above relations in terms of the quantiles of the two distributions yields, after a suitable change of variable, the key relationship that can be exploited to fit the model to the data:

$$\lambda_i(r_S(u)) = D\lambda_j(S + (1 - S)r_S(u)) + A, \qquad u \in [0,1] \qquad (15)$$

where $\lambda_h(u) = F_i(u)^{-1}$, $h \in [i, j]$, and $r_S(u) = \max\left(0, \frac{-S}{1-S}\right) + \left[1 - \max\left(0, \frac{-S}{1-S}\right)\right]u$.

Estimation can be carried out on the basis of equation (15) by resorting to the class of estimators introduced in Gobillon and Roux (2010). Letting $\theta = (A, S, D)$, the Gobillon and Roux estimator is defined as

$$\hat{\theta} = \arg\min_{\theta}\left(\int_0^1 [\hat{m}_\theta(u)]^2 du\right) \qquad (16)$$

where

$$\hat{m}_\theta(u) = \hat{\lambda}_i(r_S(u)) - D\hat{\lambda}_j(S + (1-S)r_S(u)) - A \qquad (17)$$

and where the theoretical quantiles λ_i and λ_j have been replaced by the corresponding estimators $\hat{\lambda}_i$ and $\hat{\lambda}_j$.

A more robust estimator, which treats the quantiles of the two distributions symmetrically, is derived by the authors by considering also the following alternative set of equations

$$\hat{\tilde{m}}_\theta(u) = \hat{\lambda}_j(\tilde{r}_S(u)) - \frac{1}{D}\hat{\lambda}_i\left(\frac{\tilde{r}_S(u) - S}{1-S}\right) + \frac{A}{D} \qquad (18)$$

where $\tilde{r}_S(u) = \max(0, S) + [1 - \max(0, S)]u$.

Considering jointly relations (17) and (18) yields the following estimator

$$\hat{\theta} = \arg\min_{\theta} M(\theta), \qquad \text{where } M(\theta) = \int_0^1 [\hat{m}_\theta(u)]^2 du + \int_0^1 [\hat{\tilde{m}}_\theta(u)]^2 du \qquad (19)$$

which is the one actually implemented in our empirical analysis.

A measure of goodness of fit $R^2 = 1 - \frac{M(\hat{A}, \hat{S}, \hat{D})}{M(0,1,0)}$ can be subsequently derived from the optimization problem in (19), assessing what share of the mean squared quantile differences between the large and small city distributions is accounted for by the estimated set of model parameters.

The advantages of this methodology are manifold. First, it is entirely grounded on theory and allows for a simultaneous assessment of selection and agglomeration effects. Second, it does not impose parametric assumptions about the shape of *G*. Third, unlike a traditional quantile regression approach, it is based on a comparison of basically all the quantiles of the two distributions and not only of specific percentiles, thereby improving robustness and efficiency of parameter estimation. This degree of generality, however, is achieved at a cost. The procedure actually only allows to compare locations according to a single profile (e.g. urban versus non urban areas). In this sense the methodology can be deemed to implement essentially a univariate approach. Should factors other than agglomeration and firm selection in thick local markets affect the TFP distribution at the city level, it would be difficult to control for such confounding effects when bringing the model to the data. At the same time a discrete classification of cities in agglomerated vs. non-agglomerated has to be enforced a priori in order to estimate the model. Compared to the use of continuous measures of city size or density, this approach inevitably involves some degree of arbitrariness in empirical applications. All in all and despite its limitations, we believe that this new methodology represents a substantial advancement in the literature, especially as it significantly enlarges our ability to discriminate between rival theoretical models.

Before moving to the empirical section, an important clarification is needed. The parameterization of agglomeration effects in the model could be compatible with other forces that influence the productivity of all the firms in a specific city. For instance a large region could attract economic activities due to natural advantages.[12] In turn the latter might positively affect the productivity of local firms without any need to resort to agglomeration forces to explain the sources of these local productivity advantages. In this perspective, we could interpret our empirical methodology as it were testing selection versus an entire set of forces that raise the productivity of all the firms in large markets by the same amount and in the same direction.

5. Results

5.1 – Baseline exercise

We first check whether the Combes et al. (2012) results are confirmed for the Italian LLMA by replicating their estimation procedure on the sample data detailed in Section 3.

We average TFP at firm level across years, setting $\hat{\phi}_i = \sum_{t=1}^{T_i} \hat{\phi}_{it} / T_i$, in order to further reduce any remaining noise in the empirical TFP estimates.

As anticipated above, a threshold level of 200,000 residents is our baseline choice in order to identify large cities and it is also the value adopted by Combes et al. (2012) for part of their empirical analyses. Estimates of parameters A, S and D obtained considering the baseline spatial

12 For the role of the natural advantages in explaining agglomeration see Ellison and Glaeser (1999). Bernard et al (2007) introduce natural advantages in a trade model with heterogeneous firms.

partition are separately displayed in Table 3 for the 2-digits SEC industries. Our results are largely in line with the evidence reported by Combes et al. (2012). Positive agglomeration effects on TFP levels are found out for most sectors. Based on bootstrapped standard errors, estimates of the A parameter are significantly different from zero in all but one sector. The cross-industry average estimate of A implies a 5.5 per cent increase in TFP when firms localize within large urban areas compared to other locations. The effect is smaller compared to the estimates obtained by Combes et al. (2012) using French firm panel data (9.5 per cent) but, nonetheless, it provides evidence of a substantial right shift of the TFP distribution in large urban areas.

At the same time, no evidence of stronger firm selection in larger cities is detected, estimates of S being all very close to zero and never statistically significant.

Allowing for dilation effects improves substantially the model fit. Estimates of the D parameter are mostly larger than one in size, with a cross-industry average of 1.09, and are statistically significant for five sectors.

The estimated dilation parameter, assuming a value of S=0 (no selection), implies that the TFP surplus in denser areas is equal to 8 per cent at the top quartile and is smaller (4.7 per cent) at the bottom quartile.[13] This evidence is in line with the results of a quantile regression analysis performed on individual TFP estimates by Di Giacinto et al., 2012 showing that the urban productivity premium increases when firms in the upper tail of the TFP distribution are considered.[14]

To check for robustness of the above results with respect to the choice of the population threshold separating small from large employment areas, we replicated the estimation procedure considering a larger threshold value for the LLMA population (500,000 people).

Estimation results, displayed in Table 4, are qualitatively unchanged, although on average a greater productivity shift due to agglomeration effects is now observed in larger urban areas. The cross-industry average of the estimated A's rises in this case to 0.084. A smaller increase is recorded on average for the dilation parameter (from 1.09 to 1.10), while the estimated S coefficient remains very close to zero for all industries.

To provide a further term of comparison the model was estimated also considering a grouping of employment areas according to population density. Table 5 reports the estimation

[13] We exclude the sector "coke, petroleum and nuclear fuel" as we had too few observations to carry out a reasonable analysis.

[14] For similar results obtained through a quantile regression analysis for France, see Briant (2010). The results on selection instead are partially at odds with those in Syverson (2004a) and Arimoto et al. (2009) that found significant selection effects in the case of the concrete industry in the US and in the silk industry in Japan at the beginning of the 20th century.

results obtained comparing productivity in employment areas above vs. below mean density. The overall pattern of results is not substantially affected with respect to the baseline case, apart for one sector (Chemicals), where parameter estimates strongly diverge from results obtained when urban scale is measured by population level.

As a final check, in an unreported exercise the model was fitted using as reference spatial units LLMA defined according to the 2001 census, which are on average a bit larger and less numerous compared to the 1991 definition. Also in this case, no significant deviation appears to stand out compared to baseline estimation results.

5.2 – Results for the extended specifications

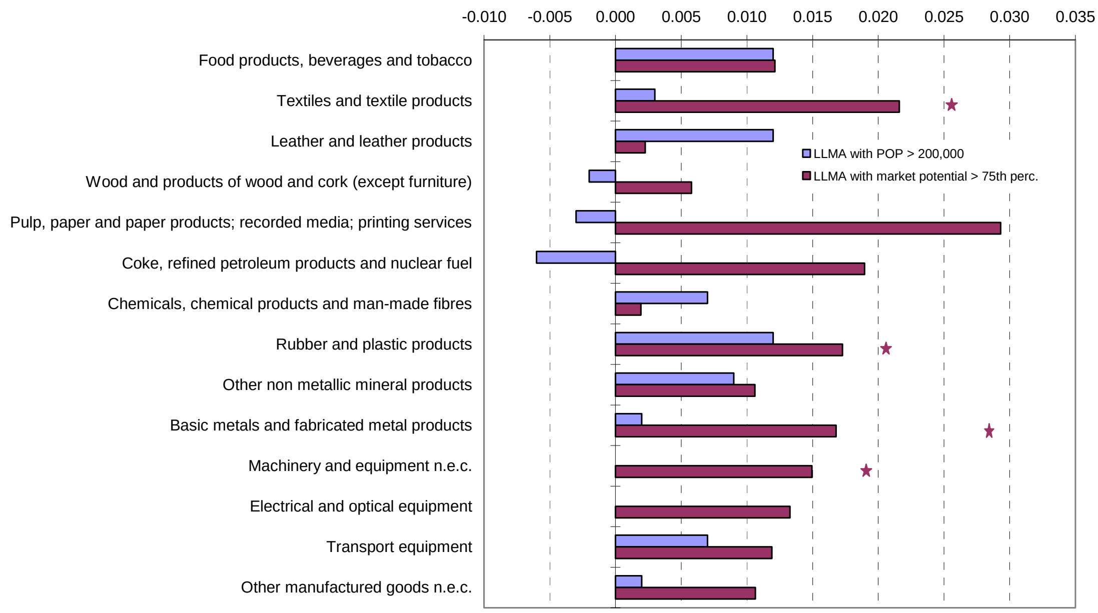
In this section we analyze how our baseline empirical findings on the impact of agglomeration and selection on firm productivity are affected when we relax the hypotheses on trade costs, spatial scale and entry costs.

Trade costs – We first turn to the issue of differences in market access that are not related to the size of the local employment area and that may uncover a selection process that is not strictly driven by urbanization. In their empirical analysis, Combes et al (2012) address the problem of market access by dropping from their sample those firms established in local areas with a market potential below the median and show that the main results do not change. Market potential is computed as a distance weighted average of the population density in the other domestic locations.

In this section we explore this issue in a more detailed way by considering both domestic and foreign market access.

As a proxy for access to domestic markets, we use a simple measure of market potential defined as follows: $MP_i = \sum_{j \neq i} N_j / d_{ij}$ where N_j denotes the population in the LLMA j and d_{ij} is the geodesic distance between city i and j. Locations with a good access to domestic markets are defined as those LLMA with a market potential above the 75 percentile. Parameter estimation results are reported in Table 6 and Figure 2.

Fig. 2 Comparing Selection effects: local market size versus domestic markets access (1)



(1) The figure plots the estimates of the *S* parameter for individual industries obtained by grouping firms according to the size of their LLMA (blue histrogram) or to their market potential (red histrograms). The stars indicate that the parameter is significant at 5 per cent.

As predicted by the extended theoretical model set forth in Section 2.2, the empirical TFP distributions appear to display a more marked left truncation in LLMA with better access to domestic markets. According to the new estimation procedure, the *S* parameter increase considerably in all but two sectors and is now positive for all industries. The estimated selection parameter is significant at the 5 percent level in the case of four sectors (textile, rubber and plastic, metal and machinery products; see Figure 2), is significant at the 10 percent level for the electrical and optical equipment sector and is close to significance for the food products industry (p-value=0.13). On the whole, the empirical findings appear to confirm the occurrence of sizeable selection effects for about half of the industries considered in the analysis.

As in the baseline specification, significant agglomeration effects, i.e. a rightward shift of the entire TFP distribution in locations with high market potential, are also detected. Better connections with other markets could contribute to enlarge the geographical reach of positive externalities and hence to reinforce the intensity of agglomeration economies. However, we do not find evidence of dilation when comparing locations with good and bad market access to domestic markets.

Given that our proxy for market access and local market size can be positively correlated (the correlation coefficient with the log of local population is equal to 0.4 and is significantly different from zero), our results could be at least partially driven by an urbanization effect rather than the variability across LLMA of market access to domestic markets. To address this problem, we net out the effects of the local market size by dropping from the sample those firms located in LLMA with a population below 50,000 people.[15] We then replicated the estimation for *A*, *S* and *D* for this reduced sample obtaining very similar results to those illustrated in Table 6 (to save on space these results are not reported).

By considering internal market potential only, we implicitly assume that either Italy is a closed economy or that the differences in trade costs with other countries across employment areas are not empirically relevant. This is not likely to be the case for the Italian economy. Italy is characterized by a large and export-oriented industrial base, whose distribution is very unbalanced across space (Cannari and Franco, 2010).

Consequently, we re-estimated the model allowing also for the effects of differences in foreign market access across locations. To get a proxy for local access to foreign markets, we resort to a data set recently made available by the Italian National Institute of Statistics (Istat). Specifically, for the 684 LLMA defined according to the 2001 census, we have data on the number of employees working in exporting firms (data refer to 2006). These figures, when normalized by the total number of employees in the manufacturing activities within the LLMA, provide a reasonable proxy of foreign market access for the local manufacturing sector.

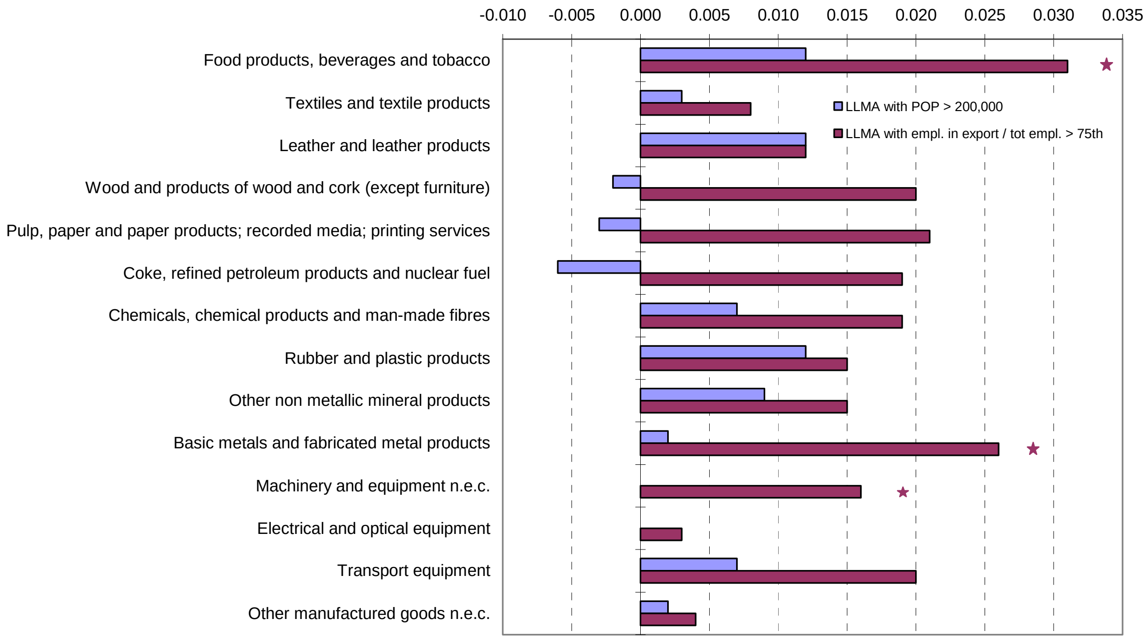
Data on the number of workers employed in exporting plants are available for the entire manufacturing sector only, hence our proxy measures an average market access at LLMA level. The use of this measure has drawbacks and advantages. On the one hand, the use of an average value is likely to reduce the precision of our estimates. Transport costs, indeed, may differ across industries and areas. For example, consider an LLMA that produces both cars and fresh food and is located close to port but far from motorways. Since cars are more frequently traded by sea and fresh food is transported by truck, this LLMA is likely to have a high foreign market access in the motor industry, while it is much lower in the other sector of specialization. By attributing a single value for all sectors, we are likely to underestimate the real market access for cars and overestimate the one for fresh food. On the other hand, the use of averages is likely to limit the potential reverse causality bias due to the fact that productivities are likely to determine the export penetration into foreign markets by the local firms.

[15] When we rule out these small LLMA the correlation coefficient drops to .09 and is not significantly different from zero.

In our baseline estimation we identify areas with a better access to foreign markets as the ones for which the share of employment in exporting firms exceed the third quartile of the distribution of this variable across LLMA.

Estimation results are displayed in Table 7. As in the case of access to domestic markets, locations with a better connection to foreign countries are found out to exhibit stronger selections effects. The estimated *S* parameter always takes on positive values and is significant at the 5 percent level for three industries (see Figure 3) and close to statistical significance for the chemicals sector (p-value=0.12). Agglomeration effects are also confirmed. For many sectors, we also obtain a negative and significant dilation effect (the coefficient is well below one in many occurrences). The evidence of a compression of the TFP distribution in the more export-oriented locations is not entirely new and might reflect the fact external trade generates learning effects that are beneficial especially for the less efficient firms (Lileeva and Trefler, 2010).

Fig. 3 Comparing Selection effects: local market size versus foreign markets access (1)



(1) The figure plots the *S* parameters in the different industries obtained by grouping firms according to the size of their LLMA (blue histrogram) or to their market access to foreign markets (red histograms). The stars indicate that the parameter is significant at 5 per cento.

As in the case of the market access to domestic locations, we net out the effects of the local market size by dropping from the sample those firms located in LLMA with a population below

50,000 people. Again the results are qualitatively the same as those obtained for the full sample and are not reported.

The ranking of selection effects across industries does indeed change according to the choice of the proxy for market access. This variability may reflect the fact that technological differences across industries interact with the definition of the relevant market thereby making it very difficult to draw general conclusions on that ground. In a next stage of our research project we will investigate the issue in deeper details.

Overall, the above empirical findings appear to confirm out theoretical predictions stating that local differences in market access to national and foreign markets contributes to shaping local TFP distributions over and above the effects of urbanization.

Spatial scale – As for the spatial scale problem, we re-estimate A, D and S using a different zoning system based on the 103 Italian provinces as defined in 1992. Unlike for the LLMA, the borders of these areas are set for strictly administrative reasons and, moreover, on average they are much larger than LLMA's both in terms of population and surface. Results are reported in Tables 8 and 9, where we use the mean population count and the mean population density for the grouping of the provincial markets. Our findings clearly indicate that agglomeration effects still prevail even at this different spatial scale (they are particularly intense when we use the mean population density to discriminate across provinces). Dilation effects basically disappear. But the most important result points to the fact that the parameter S is now positive in many industries and in some occurrences it is almost significantly different from zero at standard confidence levels, actually being statistically significant for two industries when LLMAs are discriminated according to the mean population density threshold. Our interpretation is that provincial markets being larger on average than LLMAs could offer a better, while still imperfect, representation of a relevant market for manufacturing products and hence allow firm selection effects to partially emerge from the data.

Entry costs – In Section 2.4 we have shown how heterogeneous entry costs that are increasing in city size may operate as a confounding factor on the observed level of firm selection, possibly reversing the positive effect of a larger market size on the selection of more productive firms.

Ideally, in order to correctly proxy for sunk entry costs, we should use either administrative costs for setting up a business or the prices of professional services (solicitors, business consultants, market experts). However, these data are not available at a detailed geographical level and we consequently decided to resort to land price statistics, which are available at a very fine spatial scale. As explained in Section 2.4, land prices may provide a quite satisfactory proxy of unobservable sunk cost under reasonable assumptions.

Parameter estimates for the model extended to allow for heterogeneous entry costs are subsequently derived by referring to a restricted set of local employment areas, obtained by ruling out the locations that are more likely to be denoted by confounding effects due to abnormally high set up costs.

To this purpose, we first estimate the $s(N)$ function for individual Italian LLMAs (a detailed illustration of the statistical approach that we implemented to obtain empirical estimates of the local entry cost function is given in Appendix a5). Following the argument of Proposition 3 and of its extension to the case of several locations, we subsequently exclude from the sample the areas for which large estimated values of $s'(N)$ are obtained. We consider two alternative thresholds: in the first case we exclude all areas with $s'(N)$ greater than the 75th percentile of the distribution; in the second we drop all LLMAs with $s'(N)$ greater than the 90th percentile.[16] By removing from the sample locations denoted by more steeply increasing entry costs, the underlying monotonic relation between urban scale and the intensity of firm selection should be restored.

Estimation results obtained under this empirical strategy are reported in Tables 10 and 11 respectively for the 75th and 90th percentile thresholds. Overall, our baseline results on the importance of agglomeration and dilation effects in shaping the TFP distribution across different locations are confirmed. However, our data fail to find a significant effect of differentiated entry costs on selection. Indeed, the estimated selection parameter S turns out to be generally positive but never significant at standard reference levels. It should be noted, however, that the fact that the selection coefficient appears to be rather imprecisely measured could be also attributed to the reduced sample size.

A general caveat applies to all the empirical estimates reviewed in this Section. As explained in Section 3, our data set refers to firms and not to individual plants. This implies that firm location is referred to the company's headquarters rather than to those of its productive sites. This is certainly an issue for large multiplant firms since they tend to locate their headquarters in large cities and their plants in other non-urban localities. Whenever large, multiplant firms are more productive, this may create an upward bias in the estimates of parameters A, S and D.

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[16] Other thresholds deliver very similar results.

This is a serious issue since our data does not allow to distinguish multiplant from monoplant firms. In order to provide a robustness check, we replicated estimation results reported in Tables 3-11 by dropping from the sample large-sized firms, i.e. those with a number of employees above the 75th percentile computed at industry level. To save on space, we report only results replicating our base line specification (Table 3) and those on market potential (Table 6) and foreign market access (Table 7) in Tables 12-14. Despite the fact that precision of estimations is reduced due to the diminished sample size, all in all these new results confirm that our findings are not driven by the localization of multiplant firms.

6. Final remarks

Agglomeration economies and firm selection in large markets represent two competing explanations for the fact that firms are generally more productive in urban areas than in less densely populated areas. Combes et al. (2012) introduce a generalized version of a firm selection model nesting a standard model of agglomeration. In assessing the relative importance of agglomeration and firm selection they find that local productivity differences are mostly explained by agglomeration, while no significant selection effects are uncovered.

In this paper we provide three possible explanations for the observed lack of selection effects, by introducing asymmetric entry costs, heterogeneous market potentials, and by differentiating the spatial scale at which the effects of agglomeration and selection operate.

When testing our theoretical predictions on a large dataset of Italian manufacturing firms, we still find that agglomeration is the main driver of TFP differential even for the Italian economy. However, when we control for differences in market access or heterogeneity in the spatial scale of agglomeration and selection effects, our estimates appear to provide some support for the existence of a sizeable selection effect. On the contrary, asymmetric entry costs, at least when they are proxied by local land prices, appear to exert a negligible influence on the shape of the firm-level productivity distribution.

Summing up, our theoretical and empirical results confirm that selection forces do play a role in explaining why local market size and productivity are positively correlated. The re-emergence of selection effects is closely associated with the enrichment of the baseline model through a more complex and realistic geography. In particular, since at least in the manufacturing sector factor (labor) and products markets tend to be quite distinct, the spatial scope at which agglomeration and selection display their effect do not necessarily coincide.

In this perspective, our paper shows that even when using very simple proxies for defining market access or relevant markets in the manufacturing sector, a substantial selection effect does emerge consistently with what could be expected from the theoretical model. Clearly, our definitions of geographical markets have been partially driven and constrained by the current availability of data. Our future research agenda will include an attempt at going deeper into these definitions. Provided we could improve on them, even stronger selection effects will be expected to emerge from the data.

TABLES

Table 1

The sample: number of firms

Sectors	Non urban areas	200,000<pop< 500,000	pop>500,000	Total
Food products, beverages and tobacco	1,884	615	609	3,108
Textiles and textile products	2,845	1,882	859	5,586
Leather and leather products	1,690	230	488	2,408
Wood and products of wood and cork (except furniture)	888	313	205	1,406
Pulp, paper and paper products; recorded media; printing services	1,014	614	1,161	2,789
Coke, refined petroleum products and nuclear fuel	60	27	60	147
Chemicals, chemical products and man-made fibres	534	315	670	1,519
Rubber and plastic products	1,329	619	598	2,546
Other on metallic mineral products	1,759	527	407	2,693
Basic metals and fabricated metal products	5,204	2,572	2,336	10,112
Machinery and equipment n.e.c.	2,977	1,685	1,642	6,304
Electrical and optical equipment	1,736	928	1,589	4,253
Transport equipment	720	289	492	1,501
Other manufactured goods n.e.c.	2,194	945	687	3,826
Total	**24,834**	**11,561**	**11,803**	**48,198**

Source: Elaborations on Centrale dei Bilanci, Cerved.

Table 2

Descriptive statistics: Total Factor Productivity per Firm

Sectors	Average			Median		
	Non urban areas	200,000 <pop< 500,000	pop> 500,000	Non urban areas	200,000 <pop< 500,000	pop> 500,000
Food products, beverages and tobacco	1.033	1.139	1.266	0.931	0.989	1.086
Textiles and textile products	1.031	1.097	1.136	0.960	1.009	1.046
Leather and leather products	1.041	1.050	1.119	1.003	0.960	1.048
Wood and products of wood and cork (except furniture)	1.018	1.033	1.149	0.977	0.988	1.125
Pulp, paper and paper products; recorded media; printing services	0.997	1.029	1.122	0.943	0.980	1.039
Coke, refined petroleum products and nuclear fuel	1.182	1.214	1.131	1.083	1.149	1.006
Chemicals, chemical products and man-made fibres	1.001	1.075	1.188	0.936	0.969	1.070
Rubber and plastic products	1.003	1.044	1.095	0.977	0.997	1.037
Other on metallic mineral products	1.027	1.069	1.099	0.997	1.026	1.058
Basic metals and fabricated metal products	1.011	1.038	1.087	0.975	1.006	1.032
Machinery and equipment n.e.c.	1.012	1.044	1.094	0.968	0.999	1.040
Electrical and optical equipment	0.992	1.021	1.148	0.940	0.963	1.054
Transport equipment	1.020	0.990	1.132	0.976	0.957	1.096
Other manufactured goods n.e.c.	1.016	1.055	1.132	0.974	1.006	1.062

Source: Elaborations on Centrale dei Bilanci, Cerved.

Estimations of average Total Factor Productivity level at the firm level, by adopting the procedure of Levinsohn and Petrin. Period: 1995-2006. Individual TFP levels are expressed as ratios to the sample industry mean.

Table 3

Estimates of Agglomeration (A), Selection (S) and Dilation (D).
Urban areas: population > 200,000

Sectors	A *(s.e.)*	S *(s.e.)*	D *(s.e.)*	Obs. for non UA	Obs. for UA	R2
Food products, beverages and tobacco	0.111	0.012	1.143	1,826	1,200	0.967
	*(0.02)**	*(0.01)*	*(0.05)**			
Textiles and textile products	0.058	0.003	1.086	2,781	2,686	0.970
	*(0.01)**	*(0.01)*	*(0.03)**			
Leather and leather products	0.029	0.012	1.121	1,639	704	0.907
	*(0.01)**	*(0.01)*	*(0.07)*			
Wood and products of wood and cork (except furniture)	0.060	-0.002	1.013	872	508	0.937
	*(0.02)**	*(0.01)*	*(0.07)*			
Pulp, paper and paper products; recorded media; printing services	0.069	-0.003	1.150	994	1,735	0.966
	*(0.01)**	*(0.00)*	*(0.05)**			
Coke, refined petroleum products and nuclear fuel	-0.049	-0.006	1.191	60	87	0.895
	(0.30)	*(0.75)*	*(0.41)*			
Chemicals, chemical products and man-made fibres	0.107	0.007	1.160	521	966	0.922
	*(0.04)**	*(0.03)*	*(0.09)*			
Rubber and plastic products	0.047	0.012	1.058	1,288	1,193	0.912
	*(0.01)**	*(0.01)*	*(0.06)*			
Other on metallic mineral products	0.047	0.009	0.994	1,710	916	0.958
	*(0.01)**	*(0.01)*	*(0.05)*			
Basic metals and fabricated metal products	0.046	0.002	0.996	5,090	4,809	0.981
	*(0.00)**	*(0.00)*	*(0.02)*			
Machinery and equipment n.e.c.	0.049	0.000	1.045	2,917	3,261	0.983
	*(0.01)**	*(0.00)*	*(0.03)*			
Electrical and optical equipment	0.085	0,000	1.183	1,702	2,466	0.989
	*(0.01)**	*(0.00)*	*(0.04)**			
Transport equipment	0.045	0.007	1.061	701	767	0.929
	*(0.01)**	*(0.01)*	*(0.06)*			
Other manufactured goods n.e.c.	0.052	0.002	1.118	2,148	1,599	0.961
	*(0.01)**	*(0.01)*	*(0.04)**			

Source: elaborations on Centrale dei Bilanci, Cerved.
Estimations of Average Total Factor Productivity per firm, by adopting the procedure of Levinsohn and Petrin. Period: 1995-2006. Standard errors, reported in brackets, are computed from 50 bootstrapped replications. *: for A and S significantly different from 0 at 5%, for D significantly different from 1 at 5%.

Table 4

Estimates of Agglomeration (A), Selection (S) and Dilation (D).
Urban areas: population > 500,000

Sectors	A *(s.e.)*	S *(s.e.)*	D *(s.e.)*	Obs. for non UA	Obs. for UA	R2
Food products, beverages and tobacco	0.136 *(0.11)*	0.004 *(0.57)*	1.158 *(0.12)*	2,444	600	0.970
Textiles and textile products	0.041 *(0.02)**	-0.001 *(0.01)*	1.193 *(0.05)**	4,635	842	0.889
Leather and leather products	0.046 *(0.02)**	0.015 *(0.02)*	1.109 *(0.08)*	1,854	480	0.891
Wood and products of wood and cork (except furniture)	0.112 *(0.04)**	-0.002 *(0.06)**	1.092 *(0.14)*	1,178	201	0.969
Pulp, paper and paper products; recorded media; printing services	0.089 *(0.01)**	-0.010 *(0.01)*	1.159 *(0.05)**	1,599	1,131	0.979
Coke, refined petroleum products and nuclear fuel	0.092 *(0.32)*	-0.252 *(0.60)*	0.916 *(0.44)*	87	48	0.791
Chemicals, chemical products and man-made fibres	0.135 *(0.04)**	-0.012 *(0.04)*	1.134 *(0.09)*	833	651	0.961
Rubber and plastic products	0.068 *(0.02)**	0.003 *(0.02)*	1.047 *(0.08)*	1,905	589	0.891
Other on metallic mineral products	0.042 *(0.03)*	0.011 *(0.04)*	1.069 *(0.09)*	2,219	399	0.925
Basic metals and fabricated metal products	0.055 *(0.01)**	0.001 *(0.00)*	1.069 *(0.03)**	7,616	2,293	0.948
Machinery and equipment n.e.c.	0.057 *(0.01)**	-0.001 *(0.00)*	1.107 *(0.03)**	4,572	1,611	0.973
Electrical and optical equipment	0.120 *(0.01)**	-0.001 *(0.00)*	1.157 *(0.04)**	2,612	1,560	0.988
Transport equipment	0.108 *(0.04)**	-0.003 *(0.07)*	1.028 *(0.11)*	989	483	0.911
Other manufactured goods n.e.c.	0.071 *(0.03)**	0.004 *(0.05)*	1.176 *(0.10)*	3,067	675	0.985

Source: elaborations on Centrale dei Bilanci, Cerved.
Estimations of Average Total Factor Productivity per firm, by adopting the procedure of Levinsohn and Petrin. Period: 1995-2006. Standard errors, reported in brackets, are computed from 50 bootstrapped replications. *: for A and S significantly different from 0 at 5%, for D significantly different from 1 at 5%.

Table 5

Estimates of Agglomeration (A), Selection (S) and Dilation (D).
Urban areas: population density above the mean level

Sectors	A *(s.e.)*	S *(s.e.)*	D *(s.e.)*	Obs. for non UA	Obs. for UA	R2
Food products, beverages and tobacco	0.081 *(0.02)**	-0.002 *(0.01)*	1.116 *(0.05)**	1,216	1,836	0.967
Textiles and textile products	0.064 *(0.01)**	0.006 *(0.01)*	1.101 *(0.04)**	1,230	4,241	0.946
Leather and leather products	0.047 *(0.02)**	0.013 *(0.01)*	0.919 *(0.07)*	343	2,014	0.962
Wood and products of wood and cork (except furniture)	0.043 *(0.02)*	-0.010 *(0.04)*	1.049 *(0.08)*	581	793	0.881
Pulp, paper and paper products; recorded media; printing services	0.108 *(0.02)**	0.001 *(0.02)*	1.063 *(0.08)*	478	2,262	0.955
Coke, refined petroleum products and nuclear fuel	0.037 *(0.29)*	0.013 *(0.93)*	1.146 *(0.42)*	42	103	0.402
Chemicals, chemical products and man-made fibres	-0.012 *(0.09)*	0.128 *(0.08)*	1.423 *(0.21)**	235	1,223	0.782
Rubber and plastic products	0.072 *(0.02)**	0.009 *(0.01)*	0.970 *(0.07)*	660	1,833	0.948
Other on metallic mineral products	0.062 *(0.02)**	0.013 *(0.01)*	0.997 *(0.06)*	986	1,643	0.910
Basic metals and fabricated metal products	0.028 *(0.01)**	0.001 *(0.00)*	0.973 *(0.02)*	2,841	7,074	0.947
Machinery and equipment n.e.c.	0.027 *(0.01)**	-0.002 *(0.00)*	1.005 *(0.03)*	1,488	4,687	0.870
Electrical and optical equipment	0.822 *(0.11)**	0.011 *(0.01)*	1.189 *(0.04)**	943	3,221	0.965
Transport equipment	0.052 *(0.02)**	0.002 *(0.04)*	1.025 *(0.10)*	379	1,094	0.841
Other manufactured goods n.e.c.	0.038 *(0.02)**	0.005 *(0.03)*	1.057 *(0.06)*	1,251	2,497	0.861

Source: elaborations on Centrale dei Bilanci, Cerved.
Estimations of Average Total Factor Productivity per firm, by adopting the procedure of Levinsohn and Petrin. Period: 1995-2006. Standard errors, reported in brackets, are computed from 50 bootstrapped replications. *: for A and S significantly different from 0 at 5%, for D significantly different from 1 at 5%.

Table 6

Estimates of Agglomeration (A), Selection (S) and Dilation (D).
LLMA's with market potential > 75th percentile (275,417 pop-no internal distance)

Sectors	A *(s.e.)*	S *(s.e.)*	D *(s.e.)*	Obs. for non UA	Obs. for UA	R2
Food products, beverages and tobacco	0.152	0.012	1.034	1469	1566	0.980
	(0.018)*	(0.008)	(0.049)			
Textiles and textile products	0.076	0.022	0.997	1662	3780	0.951
	(0.014)*	(0.01)*	(0.039)			
Leather and leather products	0.058	0.002	0.990	1019	1341	0.965
	(0.015)*	(0.009)	(0.052)			
Wood and products of wood and cork (except furniture)	0.082	0.006	1.046	741	636	0.943
	(0.015)*	(0.014)	(0.08)			
Pulp, paper and paper products; recorded media; printing services	0.088	0.029	0.975	963	1747	0.969
	(0.015)*	(0.013)*	(0.053)			
Coke, refined petroleum products and nuclear fuel	0.066	0.019	1.177	82	64	0.786
	(0.183)	(0.403)	(0.308)			
Chemicals, chemical products and man-made fibres	0.101	0.002	0.948	427	1065	0.951
	(0.025)*	(0.022)	(0.07)			
Rubber and plastic products	0.115	0.017	0.924	797	1686	0.966
	(0.017)*	(0.017)	(0.062)			
Other on metallic mineral products	0.133	0.011	0.837	1180	1450	0.945
	(0.017)*	(0.017)	(0.058)			
Basic metals and fabricated metal products	0.062	0.017	0.955	3578	6274	0.975
	(0.007)*	(0.007)*	(0.019)			
Machinery and equipment n.e.c.	0.055	0.015	0.949	1668	4492	0.990
	(0.009)*	(0.005)*	(0.031)			
Electrical and optical equipment	0.079	0.013	0.971	1553	2598	0.968
	(0.013)*	(0.008)	(0.04)			
Transport equipment	0.032	0.012	0.872	758	706	0.929
	(0.019)	(0.013)	(0.054)			
Other manufactured goods n.e.c.	0.086	0.011	1.024	1892	1842	0.941
	(0.013)*	(0.01)	(0.039)			

Source: elaborations on Centrale dei Bilanci, Cerved.
Estimations of Average Total Factor Productivity per firm, by adopting the procedure of Levinsohn and Petrin. Period: 1995-2006 Standard errors, reported in brackets, are computed from 50 bootstrapped replications. *: for A and S significantly different from 0 at 5%, for D significantly different from 1 at 5%. LMMA are defined in 2001.

Table 7

Estimates of Agglomeration (A), Selection (S) and Dilation (D).
LLMA with better access to foreign markets: LMMA with a ratio between local employees in exporting plants and total employees
> 0.2705 (the 75^ percentile of this variable across LMMA)

Sectors	A *(s.e.)*	S *(s.e.)*	D *(s.e.)*	Obs. for non UA	Obs. for UA	R2
Food products, beverages and tobacco	0.194 *(0.02)**	0.031 *(0.02)**	1.067 *(0.06)*	1,397	1,613	0.984
Textiles and textile products	0.062 *(0.02)**	0.008 *(0.01)*	0.922 *(0.04)**	1,986	3,477	0.937
Leather and leather products	0.121 *(0.07)*	0.012 *(0.08)*	1.020 *(0.13)*	678	1,674	0.952
Wood and products of wood and cork (except furniture)	0.087 *(0.02)**	0.020 *(0.02)*	0.892 *(0.06)*	454	917	0.967
Pulp, paper and paper products; recorded media; printing services	0.115 *(0.02)**	0.021 *(0.02)*	0.866 *(0.04)**	763	1,961	0.955
Coke, refined petroleum products and nuclear fuel	0.129 *(0.23)*	0.019 *(0.25)*	1.203 *(0.38)*	79	67	0.854
Chemicals, chemical products and man-made fibres	0.169 *(0.03)**	0.019 *(0.01)*	0.873 *(0.06)**	344	1,142	0.994
Rubber and plastic products	0.142 *(0.02)**	0.015 *(0.01)*	0.867 *(0.05)**	590	1,897	0.988
Other on metallic mineral products	0.149 *(0.02)**	0.015 *(0.02)*	0.784 *(0.05)**	1,097	1,529	0.975
Basic metals and fabricated metal products	0.102 *(0.01)**	0.026 *(0.01)**	0.930 *(0.03)**	2,494	7,355	0.986
Machinery and equipment n.e.c.	0.092 *(0.01)**	0.016 *(0.01)**	0.974 *(0.03)*	1,119	5,048	0.988
Electrical and optical equipment	0.106 *(0.02)**	0.003 *(0.02)*	0.884 *(0.05)**	1,077	3,093	0.964
Transport equipment	0.072 *(0.02)**	0.020 *(0.01)*	0.881 *(0.05)**	570	892	0.974
Other manufactured goods n.e.c.	0.102 *(0.02)**	0.004 *(0.01)*	0.874 *(0.06)**	1,017	2,733	0.920

Source: elaborations on Centrale dei Bilanci, Cerved.
Estimations of Average Total Factor Productivity per firm, by adopting the procedure of Levinsohn and Petrin. Period: 1995-2006. Standard errors, reported in brackets, are computed from 50 bootstrapped replications. *: for A and S significantly different from 0 at 5%, for D significantly different from 1 at 5%. LMMA are defined in 2001.

Table 8

Estimates of Agglomeration (A), Selection (S) and Dilation (D).
Urban Areas: Italian provinces with population above the mean level (554,467 people)

Sectors	A *(s.e.)*	S *(s.e.)*	D *(s.e.)*	Obs. for non UA	Obs. for UA	R2
Food products, beverages and tobacco	0.065	-0.001	1.063	1377	1674	0.943
	(0.037)	(0.048)	(0.076)			
Textiles and textile products	-0.029	-0.001	1.035	2440	3035	0.923
	(0.009)	(0.004)	(0.031)			
Leather and leather products	0.008	0.032	1.134	1128	1197	0.881
	(0.015)	(0.018)	(0.071)			
Wood and products of wood and cork (except furniture)	0.061	0.010	0.937	645	730	0.970
	(0.018)*	(0.012)	(0.056)			
Pulp, paper and paper products; recorded media; printing services	0.066	-0.004	0.971	774	1958	0.900
	(0.016)*	(0.006)	(0.047)			
Coke, refined petroleum products and nuclear fuel	0.104	-0.009	1.269	51	96	0.894
	(0.247)	(0.361)	(0.422)			
Chemicals, chemical products and man-made fibres	0.056	0.056	1.221	365	1106	0.841
	(0.047)	(0.04)	(0.113)			
Rubber and plastic products	0.070	0.021	1.039	847	1635	0.962
	(0.018)*	(0.019)	(0.075)			
Other on metallic mineral products	0.024	0.014	1.056	1144	1482	0.915
	(0.014)	(0.008)	(0.044)			
Basic metals and fabricated metal products	0.044	0.008	1.020	3477	6412	0.934
	(0.005)*	(0.004)	(0.02)			
Machinery and equipment n.e.c.	0.042	0.001	1.007	2160	4020	0.962
	(0.006)*	(0.004)	(0.029)			
Electrical and optical equipment	0.081	0.002	1.072	1224	2945	0.968
	(0.011)*	(0.005)	(0.041)			
Transport equipment	0.047	0.010	1.024	518	950	0.908
	(0.026)	(0.034)	(0.084)			
Other manufactured goods n.e.c.	0.018	0.010	1.030	1742	1995	0.951
	(0.009)	(0.006)	(0.037)			

Source: elaborations on Centrale dei Bilanci, Cerved.
Estimations of Average Total Factor Productivity per firm, by adopting the procedure of Levinsohn and Petrin. Period: 1995-2006. Standard errors, reported in brackets, are computed from 50 bootstrapped replications. *: for A and S significantly different from 0 at 5%, for D significantly different from 1 at 5%. LMMA are defined in 2001.

Table 9

Estimates of Agglomeration (A), Selection (S) and Dilation (D).
Urban Areas: Italian provinces with population density above the mean level (242.12)

Sectors	A *(s.e.)*	S *(s.e.)*	D *(s.e.)*	Obs. for non UA	Obs. for UA	R2
Food products, beverages and tobacco	0.126 (0.02)*	0.001 (0.01)	1.042 (0.04)	1722	1329	0.985
Textiles and textile products	0.050 (0.01)*	0.014 (0.01)*	1.036 (0.03)	1878	3573	0.936
Leather and leather products	0.032 (0.02)*	0.017 (0.02)	1.056 (0.06)	1149	1192	0.910
Wood and products of wood and cork (except furniture)	0.066 (0.02)*	0.003 (0.03)	0.944 (0.07)	707	672	0.929
Pulp, paper and paper products; recorded media; printing services	0.093 (0.02)*	-0.004 (0.01)	1.009 (0.04)	833	1899	0.912
Coke, refined petroleum products and nuclear fuel	0.049 (0.26)	-0.017 (0.51)	1.210 (0.43)	63	83	0.781
Chemicals, chemical products and man-made fibres	0.105 (0.06)	0.011 (0.05)	1.091 (0.13)	398	1088	0.883
Rubber and plastic products	0.076 (0.02)*	0.020 (0.01)	0.991 (0.06)	942	1537	0.943
Other on metallic mineral products	0.060 (0.02)*	0.019 (0.01)	0.991 (0.05)	1525	1088	0.971
Basic metals and fabricated metal products	0.053 (0.01)*	0.013 (0.00)*	0.997 (0.02)	4202	5660	0.971
Machinery and equipment n.e.c.	0.046 (0.01)*	-0.002 (0.00)	1.005 (0.03)	2526	3652	0.960
Electrical and optical equipment	0.093 (0.01)*	0.007 (0.01)	1.144 (0.03)*	1341	2825	0.968
Transport equipment	0.061 (0.02)*	0.011 (0.01)	1.046 (0.06)	594	873	0.971
Other manufactured goods n.e.c.	0.043 (0.01)*	0.007 (0.01)	1.005 (0.04)	1722	2019	0.909

Source: elaborations on Centrale dei Bilanci, Cerved.
Estimations of Average Total Factor Productivity per firm, by adopting the procedure of Levinsohn and Petrin. Period: 1995-2006. Standard errors, reported in brackets, are computed from 50 bootstrapped replications. *: for A and S significantly different from 0 at 5%, for D significantly different from 1 at 5%. LMMA are defined in 2001.

Table 10

Estimates of Agglomeration (A), Selection (S) and Dilation (D).
Urban areas: population > 200,000, excluding LLMA with s'> 75th percentile

Sectors	A *(s.e.)*	S *(s.e.)*	D *(s.e.)*	Obs. for non UA	Obs. for UA	R2
Food products, beverages and tobacco	0.076 *(0.08)*	0.013 *(0.48)*	1.091 *(0.10)*	1346	671	0.905
Textiles and textile products	0.052 *(0.01)**	0.011 *(0.01)*	1.027 *(0.04)*	1975	1941	0.928
Leather and leather products	0.013 *(0.02)*	0.012 *(0.02)*	1.137 *(0.14)*	1229	310	0.796
Wood and products of wood and cork (except furniture)	0.037 *(0.04)*	-0.004 *(0.13)*	1.002 *(0.11)*	626	346	0.830
Pulp, paper and paper products; recorded media; printing services	0.035 *(0.02)**	-0.001 *(0.01)*	1.021 *(0.07)*	738	747	0.745
Coke, refined petroleum products and nuclear fuel	-0.048 *(0.29)*	0.081 *(0.47)*	1.102 *(0.37)*	42	31	0.159
Chemicals, chemical products and man-made fibres	0.018 *(0.04)*	0.060 *(0.04)*	1.164 *(0.14)*	374	375	0.891
Rubber and plastic products	0.030 *(0.02)*	0.012 *(0.02)*	1.011 *(0.09)*	887	731	0.869
Other on metallic mineral products	0.055 *(0.05)*	-0.000 *(0.23)*	0.916 *(0.10)*	1170	567	0.899
Basic metals and fabricated metal products	0.044 *(0.00)**	0.002 *(0.00)*	0.939 *(0.03)**	3689	3116	0.988
Machinery and equipment n.e.c.	0.031 *(0.01)**	0.003 *(0.00)*	1.000 *(0.03)*	2165	1970	0.950
Electrical and optical equipment	0.034 *(0.02)*	-0.001 *(0.04)*	1.066 *(0.07)*	1274	1157	0.887
Transport equipment	0.017 *(0.06)*	0.006 *(0.21)*	0.982 *(0.16)*	549	441	0.882
Other manufactured goods n.e.c.	0.026 *(0.03)*	-0.023 *(0.07)*	1.053 *(0.10)*	1602	1022	0.828

Source: elaborations on Centrale dei Bilanci, Cerved.
Estimations of Average Total Factor Productivity per firm, by adopting the procedure of Levinsohn and Petrin. Period: 1995-2006. Standard errors, reported in brackets, are computed from 50 bootstrapped replications. *: for A and S significantly different from 0 at 5%, for D significantly different from 1 at 5%.

Table 11

Estimates of Agglomeration (A), Selection (S) and Dilation (D).
Urban areas: population > 200,000, excluding LLMA with s'> 90th percentile

Sectors	A *(s.e.)*	S *(s.e.)*	D *(s.e.)*	Obs. for non UA	Obs. for UA	R2
Food products, beverages and tobacco	0.091 *(0.07)*	0.007 *(0.19)*	1.110 *(0.09)*	1658	847	0.948
Textiles and textile products	0.050 *(0.01)**	0.003 *(0.01)*	1.039 *(0.04)*	2566	2172	0.923
Leather and leather products	-0.004 *(0.02)*	0.009 *(0.01)*	1.041 *(0.08)*	1518	511	0.920
Wood and products of wood and cork (except furniture)	0.033 *(0.02)*	0.001 *(0.04)*	1.029 *(0.09)*	786	400	0.932
Pulp, paper and paper products; recorded media; printing services	0.025 *(0.02)*	-0.006 *(0.01)*	1.058 *(0.06)*	915	915	0.942
Coke, refined petroleum products and nuclear fuel	0.009 *(0.25)*	-0.021 *(0.63)*	0.938 *(0.31)*	52	43	0.786
Chemicals, chemical products and man-made fibres	-0.001 *(0.04)*	0.053 *(0.03)*	1.203 *(0.13)*	438	439	0.852
Rubber and plastic products	0.022 *(0.02)*	0.009 *(0.01)*	1.056 *(0.06)*	1184	829	0.894
Other on metallic mineral products	0.048 *(0.02)**	0.004 *(0.01)*	0.982 *(0.06)*	1545	672	0.957
Basic metals and fabricated metal products	0.033 *(0.00)**	0.001 *(0.00)*	0.949 *(0.02)**	4602	3660	0.988
Machinery and equipment n.e.c.	0.032 *(0.01)**	0.002 *(0.00)*	1.013 *(0.03)*	2642	2303	0.981
Electrical and optical equipment	0.041 *(0.01)**	-0.001 *(0.01)*	1.066 *(0.05)*	1597	1394	0.978
Transport equipment	0.030 *(0.03)*	0.008 *(0.04)*	1.014 *(0.08)*	651	588	0.927
Other manufactured goods n.e.c.	0.027 *(0.02)*	-0.000 *(0.03)*	1.078 *(0.05)*	1960	1243	0.954

Source: elaborations on Centrale dei Bilanci, Cerved.
Estimations of Average Total Factor Productivity per firm, by adopting the procedure of Levinsohn and Petrin. Period: 1995-2006. Standard errors, reported in brackets, are computed from 50 bootstrapped replications. *: for A and S significantly different from 0 at 5%, for D significantly different from 1 at 5%.

Table 12

Estimates of Agglomeration (A), Selection (S) and Dilation (D).
Urban areas: population > 200,000, excluding firms above the 75th percentile of the employment at industry level

Sectors	A (s.e.)	S (s.e.)	D (s.e.)	Obs. for non UA (1)	Obs. for UA (1)	R2
Food products, beverages and tobacco	0.088 (0.02)*	0.001 (0.01)	1.040 (0.06)	1419	871	0.904
Textiles and textile products	0.052 (0.01)*	0.001 (0.01)	1.079 (0.04)*	2066	2042	0.915
Leather and leather products	0.019 (0.02)	0.012 (0.01)	1.129 (0.10)	1221	537	0.895
Wood and products of wood and cork (except furniture)	0.064 (0.03)	-0.007 (0.10)	0.967 (0.11)	644	390	0.891
Pulp, paper and paper products; recorded media; printing services	0.077 (0.01)*	-0.002 (0.01)	1.099 (0.08)	750	1303	0.966
Coke, refined petroleum products and nuclear fuel	0.108 (0.36)	-0.049 (1.04)	1.146 (0.57)	50	59	0.928
Chemicals, chemical products and man-made fibres	0.020 (0.08)	0.046 (0.24)	1.274 (0.15)	421	680	0.461
Rubber and plastic products	0.052 (0.02)*	0.019 (0.02)	1.118 (0.09)	972	882	0.925
Other on metallic mineral products	0.057 (0.05)	0.010 (0.26)	0.996 (0.10)	1299	670	0.941
Basic metals and fabricated metal products	0.047 (0.01)*	0.005 (0.01)	1.008 (0.02)	3835	3582	0.975
Machinery and equipment n.e.c.	0.046 (0.01)*	0.003 (0.00)	1.035 (0.03)	2181	2451	0.980
Electrical and optical equipment	0.065 (0.01)*	-0.003 (0.01)	1.150 (0.05)*	1293	1831	0.964
Transport equipment	0.044 (0.04)	0.007 (0.12)	1.076 (0.12)	541	562	0.932
Other manufactured goods n.e.c.	0.046 (0.02)*	0.007 (0.03)	1.175 (0.07)*	1616	1190	0.966

Source: elaborations on Centrale dei Bilanci, Cerved.
Estimations of Average Total Factor Productivity per firm, by adopting the procedure of Levinsohn and Petrin. Period: 1995-2006 Standard errors, reported in brackets, are computed from 50 bootstrapped replications. *: for A and S significantly different from 0 at 5%, for D significantly different from 1 at 5%.
(1) The total number of observations utilized for parameter estimation in each sector may differ between Tables 12, 13 and 14 because of the process of trimming of sample TFP estimates, which involves the discarding of the observations below (above) the 1st (99th) percentile of the distribution both in UAs and non UAs.

Table 13

Estimates of Agglomeration (A), Selection (S) and Dilation (D).
LLMA with better access to foreign markets: LMMA with a ratio between local employees in exporting plants and total employees > the 75^ percentile

Sectors	A *(s.e.)*	S *(s.e.)*	D *(s.e.)*	Obs. for non UA (1)	Obs. for UA (1)	R2
Food products, beverages and tobacco	0.124	0.004	0.950	1156	1132	0.962
	(0.02)*	(0.01)	(0.05)			
Textiles and textile products	0.108	0.010	0.940	1305	2791	0.969
	(0.02)*	(0.01)	(0.04)			
Leather and leather products	0.041	0.000	0.987	762	1011	0.855
	(0.02)*	(0.02)	(0.08)			
Wood and products of wood and cork (except furniture)	0.093	0.004	0.991	565	471	0.919
	(0.02)*	(0.02)	(0.09)			
Pulp, paper and paper products; recorded media; printing services	0.086	0.017	0.965	746	1296	0.931
	(0.02)*	(0.01)	(0.06)			
Coke, refined petroleum products and nuclear fuel	-0.008	0.038	1.318	60	48	0.722
	(0.27)	(0.43)	(0.44)			
Chemicals, chemical products and man-made fibres	0.103	0.003	1.007	319	799	0.951
	(0.03)*	(0.02)	(0.09)			
Rubber and plastic products	0.124	0.010	0.875	618	1249	0.946
	(0.08)	(0.08)	(0.17)			
Other on metallic mineral products	0.160	-0.003	0.801	932	1048	0.927
	(0.02)*	(0.02)	(0.08)			
Basic metals and fabricated metal products	0.069	0.019	0.960	2619	4768	0.975
	(0.01)*	(0.01)*	(0.03)			
Machinery and equipment n.e.c.	0.051	0.015	0.953	1272	3348	0.991
	(0.01)*	(0.01)*	(0.03)			
Electrical and optical equipment	0.076	0.019	0.969	1149	1961	0.965
	(0.01)*	(0.01)*	(0.04)			
Transport equipment	0.031	0.010	0.851	571	530	0.872
	(0.06)	(0.07)	(0.12)			
Other manufactured goods n.e.c.	0.093	0.014	1.023	1397	1399	0.932
	(0.01)*	(0.01)	(0.04)			

Source: elaborations on Centrale dei Bilanci, Cerved.
Estimations of Average Total Factor Productivity per firm, by adopting the procedure of Levinsohn and Petrin. Period: 1995-2006. Standard errors, reported in brackets, are computed from 50 bootstrapped replications. *: for A and S significantly different from 0 at 5%, for D significantly different from 1 at 5%.
(1) The total number of observations utilized for parameter estimation in each sector may differ between Tables 12, 13 and 14 because of the process of trimming of sample TFP estimates, which involves the discarding of the observations below (above) the 1st (99th) percentile of the distribution both in UAs and non UAs.

Estimates of Agglomeration (A), Selection (S) and Dilation (D). LLMA's with market potential > 75th percentile excluding firms above the 75th percentile of the employment at industry level

Sectors	A *(s.e.)*	S *(s.e.)*	D *(s.e.)*	Obs. for non UA (1)	Obs. for UA (1)	R2
Food products, beverages and tobacco	0.142	0.027	1.007	1112	1149	0.964
	(0.02)*	(0.01)	(0.06)			
Textiles and textile products	0.085	0.003	0.929	1676	2428	0.951
	(0.02)*	(0.01)	(0.04)			
Leather and leather products	0.114	0.015	1.025	533	1232	0.942
	(0.09)	(0.10)	(0.21)			
Wood and products of wood and cork (except furniture)	0.083	0.041	0.960	358	665	0.955
	(0.02)*	(0.02)*	(0.08)			
Pulp, paper and paper products; recorded media; printing services	0.122	-0.001	0.813	609	1444	0.931
	(0.02)*	(0.02)	(0.05)			
Coke, refined petroleum products and nuclear fuel	0.073	0.000	1.081	63	48	0.673
	(0.29)	(4.76)	(0.44)			
Chemicals, chemical products and man-made fibres	0.184	0.026	0.925	259	856	0.995
	(0.03)*	(0.02)	(0.09)			
Rubber and plastic products	0.141	0.013	0.860	486	1378	0.984
	(0.02)*	(0.01)	(0.06)			
Other on metallic mineral products	0.156	0.016	0.810	905	1064	0.952
	(0.02)*	(0.03)	(0.08)			
Basic metals and fabricated metal products	0.103	0.032	0.958	1867	5509	0.976
	(0.01)*	(0.02)	(0.05)			
Machinery and equipment n.e.c.	0.082	0.018	0.991	885	3738	0.977
	(0.01)*	(0.01)	(0.04)			
Electrical and optical equipment	0.104	0.005	0.878	826	2299	0.966
	(0.01)*	(0.01)	(0.05)			
Transport equipment	0.053	0.022	0.897	472	623	0.952
	(0.03)	(0.04)	(0.09)			
Other manufactured goods n.e.c.	0.106	0.006	0.897	779	2035	0.892
	(0.02)*	(0.02)	(0.01)			

Source: elaborations on Centrale dei Bilanci, Cerved.
Estimations of Average Total Factor Productivity per firm, by adopting the procedure of Levinsohn and Petrin. Period: 1995-2006. Standard errors, reported in brackets, are computed from 50 bootstrapped replications. *: for A and S significantly different from 0 at 5%, for D significantly different from 1 at 5%.
(1) The total number of observations utilized for parameter estimation in each sector may differ between Tables 12, 13 and 14 because of the process of trimming of sample TFP estimates, which involves the discarding of the observations below (above) the 1st (99th) percentile of the distribution both in UAs and non UAs.

Appendix

Appendix a1

Proof of proposition 1:

Compare the free entry conditions for the three cities *i* and *j* and *k*. It follows:

$$\frac{N_i}{4\gamma}\int_0^{\bar{h}_i}(\bar{h}_i-h)^2g(h)dh+\frac{N_j}{4\gamma}\int_0^{\bar{h}_j/\tau_{ij}}(\bar{h}_j-\tau_{ij}h)^2g(h)dh+\frac{N_k}{4\gamma}\int_0^{\bar{h}_k/\tau_{ik}}(\bar{h}_k-\tau_{ik}h)^2g(h)dh=s \quad \text{(a1)}$$

$$\frac{N_j}{4\gamma}\int_0^{\bar{h}_j}(\bar{h}_j-h)^2g(h)dh+\frac{N_i}{4\gamma}\int_0^{\bar{h}_i/\tau_{ij}}(\bar{h}_i-\tau_{ij}h)^2g(h)dh+\frac{N_k}{4\gamma}\int_0^{\bar{h}_k/\tau_{jk}}(\bar{h}_k-\tau_{jk}h)^2g(h)dh=s \quad \text{(a2)}$$

$$\frac{N_k}{4\gamma}\int_0^{\bar{h}_k}(\bar{h}_k-h)^2g(h)dh+\frac{N_i}{4\gamma}\int_0^{\bar{h}_i/\tau_{ik}}(\bar{h}_i-\tau_{ik}h)^2g(h)dh+\frac{N_j}{4\gamma}\int_0^{\bar{h}_j/\tau_{jk}}(\bar{h}_j-\tau_{jk}h)^2g(h)dh=s \quad \text{(a3)}$$

Subtracting (a2) from (a1) it yields:

$$\left[N_i\upsilon(\bar{h}_i,\tau_{ij})-N_j\upsilon(\bar{h}_j,\tau_{ij})\right]=N_k\left[\int_0^{\bar{h}_k/\tau_{jk}}(\bar{h}_k-\tau_{jk}h)^2g(h)dh-\int_0^{\bar{h}_k/\tau_{ik}}(\bar{h}_k-\tau_{ik}h)^2g(h)dh\right] \quad \text{(a4)}$$

Assume now that N_i=N_j= N_k =N. Equation (a4) will change as follows:

$$\upsilon(\bar{h}_i,\tau_{ij})-\upsilon(\bar{h}_j,\tau_{ij})=\int_0^{\bar{h}_k/\tau_{jk}}(\bar{h}_k-\tau_{jk}h)^2g(h)dh-\int_0^{\bar{h}_k/\tau_{ik}}(\bar{h}_k-\tau_{ik}h)^2g(h)dh$$

Given that the expression on the right hand side of this equation is negative, that is city *i* has a better market access to city *k* as compared to location *j*, this will imply that $\upsilon(\bar{h}_i,\tau_{ij})<\upsilon(\bar{h}_j,\tau_{ij})$ and hence, given that $\frac{\partial\upsilon}{\partial h}>0$, $\bar{h}_i<\bar{h}_j$. In words, selection effects will be stronger in the city with better market access to the other markets despite the assumption that local market size is the same in the two regions. Thus, differences in market access may contribute together with market size to shape productivity distributions at local level.

To complete the proof now compare selection effect in city *j* and *k*. Subtracting (a3) from (a2) it yields:

$$\left[N_j\upsilon(\bar{h}_j,\tau_{jk})-N_k\upsilon(\bar{h}_k,\tau_{jk})\right]=N_i\left[\int_0^{\bar{h}i/\tau_{ik}}(\bar{h}_i-\tau_{ik}h)^2g(h)dh-\int_0^{\bar{h}_i/\tau_{ij}}(\bar{h}_i-\tau_{ij}h)^2g(h)dh\right] \text{(a5)}$$

We remind that regions are again assumed to be equal in terms of market size, i.e. N_i=N_j= N_k =N. Following the same kind of logic adopted in the previous case and checking by inspection that expression on the right hand side is negative, it can be easily proofed that $\bar{h}_j < \bar{h}_k$. This completes the demonstration on the ranking of the selection effects across regions with differentiated market access.

Appendix a2

Proof of proposition 2.

As before, the proof of point 1 directly follows from the definition of A_i, A_j, D_i and D_j, when $\delta < 1$. The selection effect will take place instead at macroregion level. This implies that for the two regions eq. (3) can be written as follows:

$$\frac{P_1}{4\gamma}\int_0^{\bar{h}_1}(\bar{h}_1-h)^2g(h)dh+\frac{P_2}{4\gamma}\int_0^{\bar{h}_2/\tau}(\bar{h}_2-\tau h)^2g(h)dh=s$$
$$\frac{P_2}{4\gamma}\int_0^{\bar{h}_2}(\bar{h}_2-h)^2g(h)dh+\frac{P_1}{4\gamma}\int_0^{\bar{h}_1/\tau}(\bar{h}_1-\tau h)^2g(h)dh=s$$

Subtracting these two equation we obtain:

$$P_1\upsilon(\bar{h}_1,\tau)=P_2\upsilon(\bar{h}_2,\tau).$$

Since $P_1 > P_2$, it must hold that $\upsilon(\bar{h}_1,\tau)<\upsilon(\bar{h}_2,\tau)$. Note, however that

$\frac{\partial\upsilon(z,\tau)}{\partial z}=2\left[(\tau-1)\int_0^{z/\tau}hg(h)dh+\int_{z/\tau}^{z}(z-h)g(h)dh\right]>0$, this implies that $\bar{h}_1 < \bar{h}_2$.

Appendix a3

Proof of proposition 3.

The proof of point 1 directly follows from the definition of A_i, A_j, D_i and D_j, when $\delta < 1$.

The proof of point 2 is more involved. First suppose that $G(h)=\left(\frac{h}{h_M}\right)^k$, where h_M is the upper bound of the support of the realization of h. Equation (6) can now be rewritten as:

$$\upsilon(\overline{h}_1(N_1),\tau)=\frac{s(N_1)+K}{N_1} \quad where \quad K=N_2\upsilon(\overline{h}_2,\tau)-s(N_2)$$

Differentiating with respect to N_1 we obtain:

$$\frac{\upsilon(\overline{h}_1(N_1),\tau)}{\partial\overline{h}_1}\frac{d\overline{h}_1}{dN_1}=\frac{s'(N_1)N_1-s(N_1)}{(N_1)^2}-\frac{K}{(N_1)^2}$$

And hence given that $\frac{\upsilon(\overline{h}_1(N_1),\tau)}{\partial\overline{h}_1}>0$ and the quantity $\frac{K}{(N_1)^2}$ tends to zero for N_1 sufficiently large, it follows that:

$$\frac{d\overline{h}_1}{dN_1}\geq 0 \quad iff \quad \frac{s'(N_1)N_1-s(N_1)}{(N_1)^2}\geq 0 \quad or \quad s'(N)\geq\frac{s(N)}{N}$$

Furthermore, we show that the condition for selection we found in Proposition 1 for a Pareto distribution also holds for a generic cumulative distribution $G(h)$ and for an R-cities economy.

Assume that the economy is divided into *R* regions (*R>2*), that the entry cost function is continuous, increasing and twice differentiable w.r.t. *N* and with s'>0 and S">0. We prove the following proposition.

Proposition A1

In a R-cities economy with asymmetric entry costs and positive trade costs, the equilibrium cutoff levels will change in response to a change in the market size in market 1 (the largest market) as follows:

a) for market 1:

$$\frac{d\overline{h}_1}{dN_1}>0 \quad iff \quad s'(N_1)>\Phi_1$$

where it will be shown later that Φ_1 is positive whatever the equilibrium solutions in terms of the cut-offs are.

b) for market j (j $\neq$1) :

$$\frac{d\bar{h}_j}{dN_1} < 0 \quad iff \quad s'(N_1) > \Phi_0 \quad (j = 2,..., R)$$

c) Moreover, it can be shown that:

$$\Phi_1 > \Phi_0$$

d) Finally, under the assumption of symmetric and constant trade costs, we obtain:

$$\frac{d\bar{h}_1}{dN_1} = \Phi_{1s}$$

where Φ_{1s} will be negative for all the equilibrium solutions.

<u>Proof A1a</u>

Rewrite the free entry conditions for our case:

$$\frac{N_1}{4\gamma}\int_0^{\bar{h}_1} (\bar{h}_1 - h)^2 g(h)dh + \frac{N_2}{4\gamma}\int_0^{\bar{h}_2/\tau} (\bar{h}_2 - \tau h)^2 g(h)dh + ... + \frac{N_R}{4\gamma}\int_0^{\bar{h}_R/\tau} (\bar{h}_R - \tau h)^2 g(h)dh = s(N_1)$$

....

$$\frac{N_j}{4\gamma}\int_0^{\bar{h}_j} (\bar{h}_j - h)^2 g(h)dh + \frac{N_1}{4\gamma}\int_0^{\bar{h}_1/\tau} (\bar{h}_1 - \tau h)^2 g(h)dh + ... + \frac{N_R}{4\gamma}\int_0^{\bar{h}_R/\tau} (\bar{h}_R - \tau h)^2 g(h)dh = s(N_2)$$

....

$$\frac{N_R}{4\gamma}\int_0^{\bar{h}_R} (\bar{h}_R - h)^2 g(h)dh + \frac{N_1}{4\gamma}\int_0^{\bar{h}_1/\tau} (\bar{h}_1 - \tau h)^2 g(h)dh + ... + \frac{N_{R-1}}{4\gamma}\int_0^{\bar{h}_{R-1}/\tau} (\bar{h}_{R-1} - \tau h)^2 g(h)dh = s(N_R)$$

Assume that an equilibrium for this economy does exist and totally differentiate equations above w.r.t. N_1:

$$\left[2N_1\int_0^{\bar{h}_1} (\bar{h}_1 - h)g(h)dh\right]d\bar{h}_1 + \left[\frac{2N_2}{\tau}\int_0^{\frac{\bar{h}_2}{\tau}} (\bar{h}_2 - \tau h)g(h)dh\right]d\bar{h}_2 + ... + \left[\frac{2N_R}{\tau}\int_0^{\frac{\bar{h}_R}{\tau}} (\bar{h}_R - \tau h)g(h)dh\right]d\bar{h}_R = s'(N_1)4\gamma dN_1 - \left[\int_0^{\bar{h}_1} (\bar{h}_1 - h)^2 g(h)dh\right]dN_1$$

$$\left[\frac{2N_1}{\tau}\int_0^{\frac{\bar{h}_1}{\tau}} (\bar{h}_1 - \tau h)g(h)dh\right]d\bar{h}_1 + \left[2N_2\int_0^{\bar{h}_2} (\bar{h}_2 - h)g(h)dh\right]d\bar{h}_2 + ... + \left[\frac{2N_R}{\tau}\int_0^{\frac{\bar{h}_R}{\tau}} (\bar{h}_R - \tau h)g(h)dh\right]d\bar{h}_R = -\left[\int_0^{\frac{\bar{h}_1}{\tau}} (\bar{h}_1 - \tau h)^2 g(h)dh\right]dN_1$$

...

$$\left[\frac{2N_1}{\tau}\int_0^{\bar{h}_1/\tau}(\bar{h}_1-\tau h)g(h)dh\right]d\bar{h}_1+\left[\frac{2N_2}{\tau}\int_0^{\bar{h}_2/\tau}(\bar{h}_2-\tau h)g(h)dh\right]d\bar{h}_2+\ldots+\left[2N_R\int_0^{\bar{h}_R}(\bar{h}_R-h)g(h)dh\right]d\bar{h}_R=-\left[\int_0^{\bar{h}_1/\tau}(\bar{h}_1-\tau h)^2g(h)dh\right]dN_1$$

Now rewrite the system in matrix notation as follows:

$$\begin{pmatrix} a_1+d_1 & a_j & a_R \\ a_1 & & \\ & a_j+d_j & \\ & & \\ a_1 & a_j & a_R+d_R \end{pmatrix}\begin{pmatrix} d\bar{h}_1 \\ \\ d\bar{h}_j \\ \\ d\bar{h}_R \end{pmatrix}=\begin{matrix} [s'(N_1)4\gamma-z]dN_1 \\ -ldN_1 \\ -ldN_1 \\ \\ -ldN_1 \end{matrix}$$

or in a more compact way:

$$(D+ia')x=y$$

where:

$$d_j=\int_0^{\bar{h}_j}(\bar{h}_j-h)g(h)dh-\int_0^{\bar{h}_j/\tau}(\bar{h}_j-\tau h)^2g(h)dh \quad and\ a_j=\int_0^{\bar{h}_j/\tau}(\bar{h}_j-\tau h)^2g(h)dh$$

$$D=diag(d_1,d_2,\ldots,d_R)\quad and\ d_j>0\quad a'=(a_1,\ldots,a_R)\quad and\ a_j>0\quad i'=(1,\ldots 1)$$

and

$$x'=(d\bar{h}_1,\ldots,d\bar{h}_R)\quad and\quad y'=([s'(N_1)4\gamma-z]dN_1,-ldN_1\ldots,-ldN_1)$$

$$z=\left[\int_0^{\bar{h}_1}(\bar{h}_1-h)^2g(h)dh\right]\quad and\quad l=\left[\int_0^{\bar{h}_1/\tau}(\bar{h}_1-\tau h)^2g(h)dh\right]$$

Notice that d_j and a_j are the j^{th} elements of the vectors *d* and *a* respectively while *z* and *l* are two scalars. It can be easily proofed that the *d*'s are always positive.

After some algebra, it can be shown that the solutions are:

$$x=(D+ia')^{-1}y=\left(\left[-l-\frac{a_1}{d_1}(s'(N_1)4\gamma-z+l)\right]t+\frac{(1+a't)}{d_1}(s'(N_1)4\gamma-z+l)e_1\right)\frac{dN_1}{1+a't}$$

where $t'=(1/d_1,\ldots,1/d_R)\quad and\ e_1=(1,0,\ldots,0)$.

Although this expression is quite involved, it can be used to obtain the sign of the first element of vector *x* and for a generic *j* element (the latter are all the same).

Consider the first element of vector of solutions x and observe that the term outside the big parentheses is always positive, then the sign of x_1 will depend on the term within the parentheses. After some tedious but straightforward computations we can obtain the following condition:

$$\frac{d\bar{h}_1}{dN_1} > 0 \quad iff \quad s'(N_1) > \frac{[d_1(1+a't)-a_1]z - [d_1(a't)-a_1]l}{4\gamma[d_1(1+a't)-a_1]} = \Phi_1 > 0$$

where both the numerator and the denominator of Φ_1 can be proved to be always positive whatever the equilibrium solutions are.

Proof A1b

Consider an element j of the vector x with j different from 1, it is easy to show that :

$$\frac{d\bar{h}_j}{dN_1} < 0 \quad for \quad s'(N_1) > \frac{a_1 z - l(1+d_1)}{4\gamma a_1} = \Phi_0 \quad \forall j \neq 1$$

Notice that this condition is the same across the different markets and does not depend on the number of regions considered.

Proof A1c

To show that $\Phi_1 > \Phi_0$, compare directly the two:

$$\frac{[d_1(1+a't)-a_1]z - [d_1(a't)-a_1]l}{4\gamma[d_1(1+a't)-a_1]} > \frac{a_1 z - (1+d_1)l}{4\gamma a_1}$$

$$z - \frac{[d_1(a't)-a_1]l}{[d_1(1+a't)-a_1]} > z - \frac{(1+d_1)l}{a_1}$$

$$-\frac{-a[d_1(a't)_1]}{[d_1(1+a't)-a_1]} > -\frac{(1+d_1)}{a_1}$$

$$a_1[a_1 - d_1(a't)] < (1+d_1)[d_1(1+a't)-a_1]$$

The last inequality is always satisfied given that the second expression on the left hand side is always negative and all the other terms on both sides of the inequality are positive.

Proof A1d

It immediately follows from the solutions to the free entry condition system of equations in the case of symmetric entry costs.

Corollary Proposition A1

Now let us start from an equilibrium where even in the case of asymmetric entry costs solutions are such to obey to the ordering of markets in terms of the intensity of selection effects as represented by Combes et al (2012) in the case of symmetric entry costs ie :

$$N^*_1 > N^*_2 > \ldots > N^*_{R-1} > N^*_R \text{ implies } \bar{h}_1 < \bar{h}_2 < \ldots < \bar{h}_{R-1} < \bar{h}_R$$

Let us perturb these equilibrium conditions by increasing N_1. From propositions A1 a and b, we know that $\bar{h}_1$ will increase and $\bar{h}_j$ will decrease as a reaction to the shock, provided $s'(N_1) > \Phi_1$. How can we guarantee that by continuously increasing market size in city 1 we can end up with an equilibrium where the ranking in terms of the intensity of the selection effect is perverted, ie where $\bar{h}_1 > \bar{h}_2$? Consider the previous assumptions about *s(N)* and add the following condition:

$$s''(N_1) > \frac{d\Phi_1}{dN_1} > \frac{d\Phi_0}{dN_1} \quad for \quad N_1 \geq N_1^*$$

Under these additional assumptions, $\bar{h}_1$ will augment while $\bar{h}_j$ will keep on decreasing, thereby leading to an equilibrium solution where $\bar{h}_1 > \bar{h}_2$.

A clear cut implication deriving from proposition A1 is that whatever the equilibrium solutions for the cutoffs, there will always exist a threshold level such that when the slope of the entry cost function is below it, an increase in market size will have a pro-competitive effect (i.e. it will increase the toughness of competition and lower the cutoffs). On the contrary, when $s'(N_1)$ will be above that threshold, an augmented market size will allow more inefficient firms to survive to market competition (i.e. it will induce less selection and hence higher cutoffs).

Moreover the cut-offs in the large and in the small market will be affected in opposite directions by an increase in market size. Specifically, the one in the large market will augment implying a less intense competition while the one in the small market will decrease leading to tougher competition. Finally under the additional conditions described above, an implication of this result is that if we start from an equilibrium in which $\overline{h}_1 < \overline{h}_2$ and there is an increase in market size for the large market, then the new resulting equilibrium may end with $\overline{h}_1 > \overline{h}_2$ provided the slope of the entry cost function is sufficiently large.

Appendix a4

This appendix provides some details on the construction of the employment data in the dataset. In the original sample, only one third of the firms in the database report employment data. To overcome this shortcoming, missing employment figures were imputed by means of a statistical procedure, using total labor cost as the main auxiliary information in order to recover missing data on the number of employees. In fact, unlike the information on the number of employees, data on total labor costs are available for all the firms in the sample. Average unit labor cost measured on the sub-sample of firms for which employment counts information is available provides the information needed to recover missing labor input data. To allow for possible heterogeneity in mean wages, the sample was stratified according to a number of relevant firm characteristics. In particular, mean wages are allowed to vary across sector, geographical area and type of local labor market. Additional firm-level wage heterogeneity is also controlled for by stratifying the sample according to firm size, measured by value added, and profitability. Larger firms may feature a different skill composition of the labor force, and consequently different mean wages. At the same time, more profitable firms are more likely to pay wage premiums, thus sustaining higher total labor cost for given number of employees. In each stratum the median of observed firm-level average labor cost was computed, and these estimates were subsequently used to impute missing employment data by taking the ratio of total firm labor cost to the median wage of the stratum in which the firm is classified.

A robustness check carried out on a subsample of firms for which actual employment figures could be recovered from the Italian Nation Security Institute database proved the overall accuracy of the data imputation methodology (see Di Giacinto et al., 2012).

Appendix a5

This Appendix describes the method we adopted to produce an estimate for the $s(N)$ function. Data on land prices are obtained from the Italian Land Registry Office ("Agenzia del Territorio" - AdT). The AdT reports information on house prices by type of house (villas and cottages, mansions, economic houses, typical houses, establishments), and the state of the building (poor, normal, excellent) and for industrial establishments in each Italian municipalities. We focus on the value for squared meters of establishments in a normal state. All data are aggregated at Local Labor Market (LLM) level by using population weights for each municipality within LLM. Each data-point represents the 2003-2005 average of the LLM value. This leaves us with 784 observations.

We estimate the following equation:

$$\ln(P_{LLM}) = f[\ln(POP_{LLM})] + \varepsilon$$

Where P_{LLM} is the average price level (in Euro) for buying an industrial establishments in the LLM for the period 2003-2005, POP_{LLM} is its population, and $f[\cdot]$ is an unknown function.

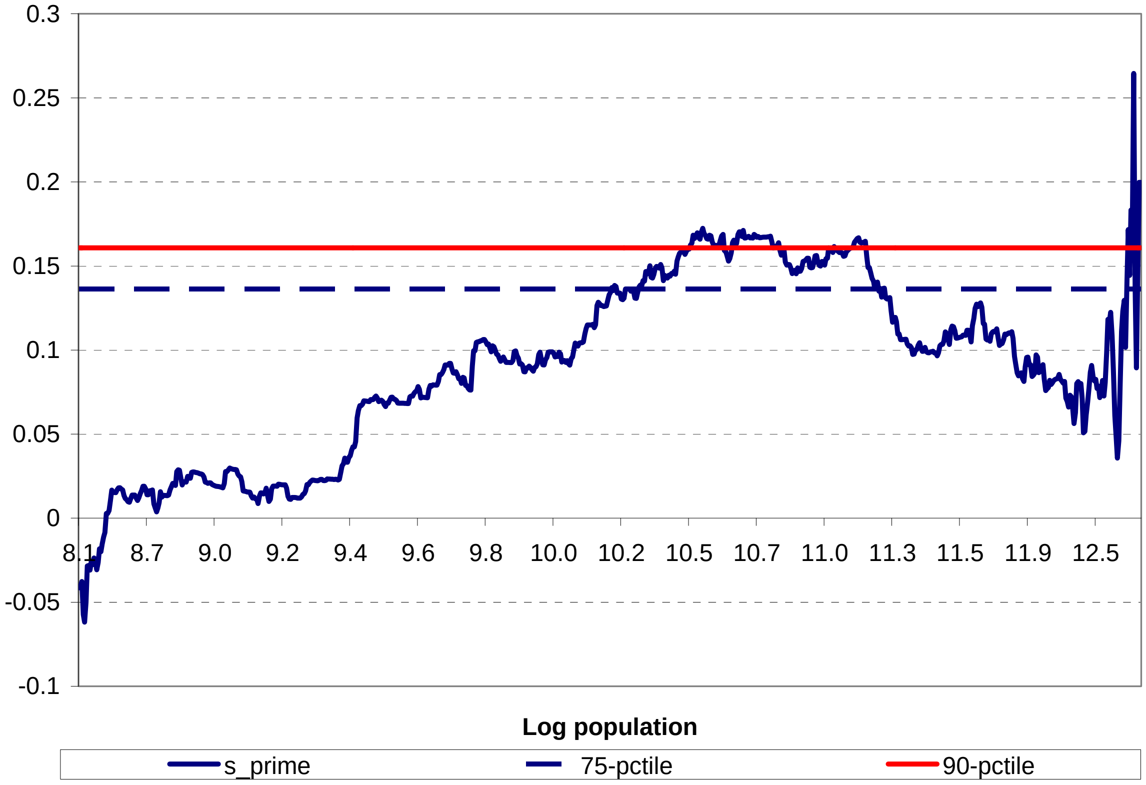
$f[\cdot]$ is estimated by using a kernel local polynomial smoothing (Epanechnikov kernel).

The fitted value of equation (A3.1) are used to calculate the values for $s(N)$ and s' employed in the empirical part. In particular, $s(N)$ is the value of the fitted prices, while s' is calculated as the Newton's difference quotient: $s'(N_{LLM}) = \dfrac{s(N_{LLM+1}) - s(N_{LLM})}{N_{LLM+1} - N_{LLM}}$.

Results of the estimates for $s'(N)$ are in figure A3.1, where the solid line represents our estimate for the $s'(N)$ function and the two horizontal lines represent the 75th and 90th percentile of the $s'(N)$ distribution.

Fig. A5.1

***S'(N)* FUNCTION**



Source: Authors' calculations on AdT data.

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