Urbanization Externalities, Market Potential and Spatial Sorting of Skills and Firms[*]

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Abstract

Using a matched employer-employee panel data on Italian workers we look at the spatial distribution of wages among provinces. Even when controlling for individual and firm characteristics we find evidence of both urbanization externalities and market potential. Although these two forces are, to some extent, not separately identifiable our results suggest that market potential has a stronger impact on wages. Moreover, spatial sorting of skills and firms is at work in the sense that "good" workers and firms are attracted by location with high density and/or good access to consumers' markets. Sorting actually dampens both estimates. Another issue we deal with is the interaction between the firm-size premium, individual skills and location. Our results suggests, coherently with Abowd, Kramarz, and Margolis (1999), that the correlation between the the size of the employing firm and skills is very strong. However, this correlation is not simply the outcome of a co-location phenomenon, suggesting that there is a deeper complementarity between firms and workers.

Keywords: Spatial Externalities, Panel-data, Skills, Firms' heterogeneity, Sorting.

JEL Codes: J31, J61, R23, R30.

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1 Introduction

Imbalances in terms of wages, GDP per capita, growth, and labor markets' outcomes are pervasive features of the economic space. Spatial disparities are in fact large in both developed and developing countries attracting a lot of political concern and, in the case of EU, they are so strategically important to be ranked first in the political agenda.[1] As for wages, Glaeser and Mare (2001) find that they are 33% higher is US cities compared to outside metropolitan areas. Data evidence on EU as a whole is less systematic. However, a number country-based studies, like for instance Combes, Duranton and Gobillon (2004), show that wages vary considerably across space. Moreover, looking at manufacturing sectoral earnings, Amiti and Cameron (2004) provide evidence of large and persistent spatial disparities in Indonesia.

So far, many explanations have been put forward to explain such imbalances, concerning for instance the availability of natural resources, infrastructures, technology, the impact of crime, cultural and social factors, etc.[2] In this paper we focus, although not exclusively, on the role of spatial externalities and skills using information on individual wages coming from a matched employer-employee database for Italy. More specifically, we work on panel version of an administrative database provided by INPS (the Italian Social Security Institute), in which we can follow workers overtime, merge information of individuals and firms characteristics, and follow workers when they migrate from one location to another. The advantage of using such a rich database is that we can control for both observable and non-observable individual characteristics that may (and actually they do) interact with spatial externalities.

The starting point of our analysis is a spatial equilibrium model in which two types of externalities are considered simultaneously and subsequently estimated. The first one, which is more rooted in the literature, refers to the positive impact of density on local economic performances (urbanization externalities). The idea that the agglomeration of economic activities fosters local productivity and growth comes back to Marshall (1890). These ideas have been formalized (among others) by Abdel Rahman and Fujita (1990) and have been the object of an intensive applied research.[3] The second source of spatial disparities that we consider here are the (relatively new) pecuniary externalities stemming from increasing returns to scale, transportation costs and

[1]The reduction of income disparities among EU regions involve much of the political debate with Structural and Cohesion Funds, both aiming at the reduction of imbalances, correspond to approximately one third of the EU budget in the period 1994-1999.

[2]See Beeson and Eberts (1989) and Moretti (2004) among others.

[3]See Sveikauskas (1975), Ciccone and Hall (1996) and Ciccone (2002) among others.

proximity to demand. The new economic geography literature (NEG), started with the work of Krugman (1991), has provided a collection of general equilibrium models, explicitly dealing with space, and capable to account for many salient features of the economic landscape.[4] In particular, a core-periphery structure endogenously emerges in these models leading to higher wages in those locations that provide a better access to demand (usually referred as market potential).

One contribution of this paper is the assessment of the absolute and relative importance of density and market potential externalities within a unified model-based framework. In fact, the existing literature either focus on one single externality,[5] or use some proxy for the other (like in Amiti and Cameron, 2004) just as a control.[6] To this respect our results suggest that, even after controlling for individual characteristics and endogeneity, both density and market potential have a positive and significant impact on wages. Although, as we will show later on, these two externalities cannot be fully disentangled, our estimates further indicate that market potential has the strongest effect. Both the nominal and the standardized elasticity of density are in fact considerably lower than those of market potential. This suggest that, at least for Italy, pecuniary externalities play a crucial role in the spatial distribution of wages. These findings are coherent with those of Mion (2004) who finds evidence of sizeable agglomeration externalities in Italy.

The interplay between individual skills and spatial externalities is also a noticeable contribution of our paper. That fact that skills' distribution may be at the hearth of systematic wage differences is well-known in labor economics. However, most of the research has focused on wage differential across industries rather than across space.[7] Glaeser and Mare (2001), and Duranton and Monastiriotis (2002) are relevant exceptions. However, the closest reference to our framework is certainly the paper of Combes, Duranton, and Gobillon (2004) that has been extremely inspiring for much of our analysis. Using a very similar dataset, the authors show that skills explain a great deal of the observable variation in French wages. Moreover, they are highly correlated with location-specific variables and in particular with economic density. Skills are thus sorted in space and this dampens estimates of the elasticity of wages with respect to density. Our results confirms the fact that accounting for skills reduces the impact of spatial externalities, and further identify a positive link with market potential. The only framework that deals with market potential and

[4]See Fujita, Krugman and Venables (1999), and Fujita and Thisse (2002) for a review of the literature.
[5]See Combes and Lafourcade (2001), Mion (2004), Redding and Venables (2004), and Hanson (2005)
[6]Combes, Duranton and Gobillon (2004) try to put some NEG features in their analysis using the mean of the log of density in adjacent areas as a proxy for market potential. However, the equation they estimated is not a reduced form of a structural model and the proxy they use can arguably be related to market potential.
[7]See Gibbons and Katz (1992) and Abowd, Kramarz, and Margolis (1999).

education (which is the closest proxy to skills) is Redding and Schott (2003). The authors develop a NEG model in which they show that, if skill-intensive sectors have higher trade costs, more pervasive input-output linkages or stronger increasing returns to scale, then remoteness depresses the skill premium and therefore reduces incentives for human capital accumulation. The positive correlation between market potential and skills that we find is thus coherent with their analysis.

A final issue that we deal with is the relation between firms' characteristics, skills and location: our paper is, to our knowledge, the first framework dealing with the connection between these three features. According to the recent literature on heterogeneous firms, and in particular with Melitz and Ottaviano (2004), firms are also sorted in space with bigger and more productive firms being attracted by local market size. Indeed, in our data the size of firms is positively correlated with density; a result that has already be documented by Campbell and Hopenhayn (2002). Now, as larger firms are known to pay higher wages, controlling for this feature further reduce the magnitude of of spatial externalities. This result is confirmed by the fixed individual and firms effects estimator *à la* Abowd, Kramarz, and Margolis (1999) that allows to treat firms' heterogeneity in a very flexible way.

However, theory also suggests that there may be important complementarities between firms and individual characteristics. Indeed, Abowd, Kramarz, and Margolis (1999) show that firm size is strongly correlated with skills (individual fixed effects). To thi respect, the fact that we specifically deal with space allow us to go a bit further. Actually, the link between skills and firm size may be in principle due to a simple co-location effect of skilled workers and big firms in cities. However, we show that there exist a strong correlation between skills and plant-size *conditionally* on spatial characteristics like density and market potential (that are precisely those that are linked to co-location) suggesting that there is a deeper complementarity between these two characteristics.

The rest of the paper is organized as follows. Section 2 presents our theoretical model, which comes form the analytical framework of the NEG, while in Section 3 we point out how to estimate density and market potential. In Section 4 we present the data and some descriptive statistics. Section 5 is devoted to the econometric analysis, in which we also deepen the endogeneity issue. Finally, conclusions are reported in Section 6.

2 The Model

In this Section, we present an enriched version of Krugman (1991) and Helpman (1998) models in which we introduce urbanization economies and consider more than two locations. The model represents the theoretical ground on which we will construct the econometric analysis.

Imagine an economy consisting of Φ locations, two sectors (the manufacturing sector M and the housing sector H), and one production factor (labor). The M-sector produces a continuum of varieties of a horizontally differentiated product under increasing returns to scale, using labor as the only input. Each variety of this differentiated good can be traded among locations incurring in iceberg-type transportation costs.[8] Referring to two generic locations as j and k ($j, k = 1, 2, ..., \Phi$), we thus have that for each unit of good shipped from j to k, just a fraction $v_{j,k} = T(d_{j,k})$ of it arrives to destination, where $d_{j,k}$ is distance between the two locations and $T(.)$ is a decreasing function. The H-sector provides instead a homogeneous good, housing, that cannot be traded and whose amount in each location (H_j) is supposed to be exogenously fixed. Its price $P_{H,j}$ can therefore differ from one place to another and is determined by the equilibrium between local supply and demand.

Labor is supposed to be freely mobile, and its (exogenous) total amount in the economy is equal to L. The equilibrium spatial distribution of our workers-consumers is thus determined by both wages (w_j), and prices prevailing in each location. We will denote L_j, with $\sum_{j=1}^{\Phi} L_j = L$, as labor in location j, and $\lambda_j = L_j/L$ as the corresponding share of total workers.

Preferences do not directly depend upon the location where consumption and production take place, but only indirectly through prices. As usual in NEG models, preferences are described by the standard Cobb-Douglas utility function with CES type sub-utility for the differentiated product, i.e.:

$$U = (C_M)^{\mu} (C_H)^{1-\mu} \qquad 0 < \mu < 1 \tag{1}$$

where C_M stands for an index of the consumption of the M-sector varieties, while C_H is housing consumption. We assume that the modern sector provides a continuum of varieties of (endogenous) size N, the consumption index C_M is thus given by:

[8] The term transportation costs does not simply refer to shipment costs but in general to all costs and impediments of doing business in different markets, like information costs, language differences, etc.

$$C_M = \left[\int_0^N c_m(s)^\rho ds\right]^{1/\rho} \qquad 0 < \rho < 1 \tag{2}$$

where $c_m(s)$ represents the consumption of variety $s \in [0, N]$. Hence, each consumer has a love for variety and the parameter $\sigma \equiv 1/(1-\rho)$, varying from 1 to ∞, represents the (constant) elasticity of substitution between any two varieties. If Y denotes the consumer income, then the demand function for a variety s coming from utility maximization is:

$$c_m(s) = p_m(s)^{-\sigma} \, \mu Y (P_M)^{\sigma-1} \qquad s \in [0, N] \tag{3}$$

where $p_m(s)$ is here the consumer-price (or delivered price) of our generic variety and P_M is the price-index of the differentiated product given by:

$$P_M \equiv \left[\int_0^N p_m(s)^{-(\sigma-1)} ds\right]^{-1/(\sigma-1)} \tag{4}$$

Technology is, by contrast, not the same across locations. Each variant of the differentiated product needs labor to be produced. The relation between the amount of labor used ($l_j(s)$) and the quantity of variant s produced ($c_j(s)$) is given by:

$$l_j(s) = f + \beta_j c_j(s) \tag{5}$$

where f and β_j are, respectively, the fixed and the marginal labor requirements. The fixed component is identical across space while, contrary to the standard formulation of Krugman (1991) and Helpman (1998), the marginal one is supposed to depend on the density of economic activities: $\beta_j = L_j^{-\eta}$. The idea that market size has a positive impact on local productivity comes back to Marshall (1890) and have been formalized by Abdel Rahman, and Fujita (1990) and Schulz and Stahl (1996) among others.[9] Ciccone and Hall (1996) and Combes (2000) provide a strong evidence in favor of the positive role of density, and these externalities are often referred to urbanization economies. We decided to introduce a density effect in the production function in order to derive the implication of this assumption for the reduced-form equation of the model that we will subsequently estimate.

[9] There are various mechanisms leading economic density to foster growth and productivity like knowledge cross-fertilization, increasing returns to scale in a non-tradable intermediate goods sector, matching of differentiated skills, etc. See Duranton and Puga (2004) for a discussion of the microfoundations of agglomeration economies.

Firms know consumers' demand and choose prices in order to maximize their profits given by:

$$\pi_j(s) = p_{m,j}(s)c_j(s) - w_j[f + \beta_j c_j(s)] \tag{6}$$

where w_j is wage paid by our generic firm and $c_j(s)$ is its output. However, when they look at demand structure, i.e. equation (3), they consider Y_j and $P_{M,j}$ as given. Since each of them has a negligible influence on the market, it may accurately neglect the impact of a price change over both consumers' income and the price index. Consequently, (3) implies that each firm faces an isoelastic downward sloping demand with elasticity given by our parameter σ. Solving first order conditions yields the usual equilibrium relation between the optimal price, elasticity of demand, and marginal cost:

$$p_{m,j}(s) = \frac{w_j \beta_j}{1 - (1/\sigma)} \tag{7}$$

Under free entry, profits are zero. This implies, together with equation (7), that the equilibrium output is:

$$c_j(s) = (\sigma - 1)f/\beta_j \tag{8}$$

In equilibrium a firm's labor requirement is unrelated to firms' distribution. In fact, using equation (5) one gets:

$$l_j(s) = l = \sigma \ f \tag{9}$$

Now, combining equations (3), (7), and (9) we finally obtain the following reduced-form equation for wages that will be the theoretical basis for our estimations (in logarithm):

$$\ln(w_j) = \ln(\kappa) \ + \ \frac{(\sigma-1)\eta}{\sigma} \ln L_j \ + \ \frac{1}{\sigma} \ln\left(\sum_{k=1}^{\Phi} Y_k (P_{M,k}\, v_{j,k})^{\sigma-1}\right) \tag{10}$$

with $\kappa \equiv \rho\,[\mu/(\sigma-1)f]^{1/\sigma}$.

3 Market Potential vs Urbanization Externalities

Equation (10) states that nominal wages in location j depends positively on the local economic density (L_j) and on the weighted sum over space of incomes (Y_k) and prices ($P_{M,k}$) of all locations with weights inversely related to distance ($v_{j,k} = T(d_{j,k})$). The density related component stands for urbanization externalities. It has thus a fully local nature, and can be easily measured by employment or population density like in Ciccone and Hall (1996) and Combes (2000). The spatially weighted part is the counterpart of those pecuniary externalities, stemming from transportation costs, product differentiation and increasing returns to scale, which leads to agglomeration of economic activities in NEG models. This term is much more tricky to deal with as it contains the local price variables $P_{M,k}$ for which proper data do not generally exist. One possible solution, used by Head and Mayer (2004) and Redding and Venables (2004), is to use data on bilateral trade flows and location dummies. In equilibrium the total value of exports ($Exp_{j,k} = n_j p_j c_{j,k}$) equals imports and, using consumers' demand (3) to get $c_{j,k}$, one obtains:

$$Exp_{j,k} = n_j p_j x_{j,k} = n_j \; {p_{m,j}}^{1-\sigma} \, \mu Y_k (P_{M,k})^{\sigma-1} v_{j,k}^{(\sigma-1)} = s_j \; m_k \; v_{j,k}^{(\sigma-1)} \tag{11}$$

where $s_j = n_j \; {p_{m,j}}^{1-\sigma}$ ($m_k = \mu Y_k (P_{M,k})^{\sigma-1}$) depends only on $j(k)$ and can be estimated as a location specific fixed effect in a gravity regression of export flows over a measure of transportation costs $v_{j,k}^{(\sigma-1)}$. Given the availability of trade flows, it would thus be possible to recover the m_k corresponding to each province, which gives the information we need on the average prices and income. Unfortunately, this methodology cannot be applied in our case because, as far as we know, there are no data on commodity flows among Italian provinces even at a very (sectoral) aggregate level. However, even if these data were available, intra-national commodity flows does not necessarily correspond to actual trade among regions because goods shipped to border areas may just reflect *international* trade.[10]

An alternative strategy, used by Hanson (2005) and Mion (2004), is to assume that mobility of labor is perfect so that real wages equalize:

$$\frac{w_j}{(P_{M,j})^{\mu} \, (P_{H,j})^{1-\mu}} = \frac{w_k}{(P_{M,k})^{\mu} \, (P_{H,k})^{1-\mu}} \qquad \forall j,k = 1,2,...,\Phi \tag{12}$$

from which $P_{M,j}$ can be expressed as function of w_j - which is observable - and $P_{H,j}$ that -further

[10] See Anderson and van Wincoop (2003).

using the equilibrium on the housing market- is a function of the local housing stock (H_j) that is also observable. However, this strategy - and in particular underlying assumption (12) - is notably inappropriate in our case for at least two reasons. On the one hand, perfect mobility is at odds with the persistent wage and unemployment rate spatial differentials that characterize the Italian landscape.[11] On the other hand, contrary to Mion (2004), the identification of the role of spatial variables by means of the time variation in the data requires here to properly capture the dynamics of migrations. For example, in the within dimension, only 14% of the variability of density is actually due to density changing over time in a given location with the remaining 86% coming from workers' migration from one location to another.[12] The problem is that migration choices are made not only upon wages but also depending on local amenities, provision of public goods, working opportunities, etc. Therefore, even admitting that mobility is perfect, condition (12), which is based on wages and prices only, is probably too far from reality.

The solution we will actually implement is based on the concept of market potential as originally introduced by Harris (1954), which was developed by the author to measure the "potential"demand for goods and services produced in a location $j = 1, 2, .., \Phi$ with an index of a location proximity to consumers' markets given by:

$$MP_j = \sum_{k=1}^{\Phi} Y_k d_{jk}^{-1} \tag{13}$$

where Y_k is an index of purchasing capacity of location k (usually income), $d_{jk}$is the distance between two generic locations j and k. By comparing equations (10) and (13) one can notice that (13) is actually a particularization of the spatially weighted term in (13) where $P_{M,k} = 1 \; \forall \; k$, and $v_{j,k}^{\sigma-1} = T(d_{j,k}) = d_{jk}^{-1}$.[13] The main advantage of the Harris' formulation compared to the more rigorous one is that data on prices are not needed. If the scope of the analysis is to structurally estimated the model, like in Hanson (2005) and Mion (2004), then this simplification would be certainly unacceptable. However, our goal here is to give a measure of the magnitude of

[11] See Eichengreen (1993), and Overman and Puga (2002).

[12] In order to compute these shares of the within variance we first attribute to each worker the same (initial) location for the entire period and then we compute the (migration free) within variance of density. Finally, we compare this within variance with the no-restricted variance that includes workers' movements.

[13] It is interesting to note that Harris (1954) did not provide any model to justify its concept of market potential. This is not surprising since general equilibrium models dealing with increasing returns to scale, space, and product differentiation have been introduced only recently. In particular, Fujita and Krugman (1995), and Fujita, Krugman and Venables (1999) show that market potential functions can be obtained from many spatial general-equilibrium models, thus providing the theoretical background for the use of such an approach.

agglomeration economies, as well as to link them with the heterogeneity of individuals and firms, in the more possible rigorous way without pretending to interpret estimate as the parameters of our underlying model. Furthermore, when comparing Harris' market potential with a more structural measure, Head and Mayer (2004) did not find any strong evidence in favor of the latter in terms of predictive power and magnitude. All this being said, our solution thus seems fairly acceptable for our purposes.

One of the main goal of our paper is to compare the relative strength and magnitude of market potential compared to urbanization externalities. In particular we measure density like in Combes (2000) and Ciccone and Hall (1996) as:

$$Dens_{j,t} = \ln\left[\frac{empl_{j,t}}{size_j}\right] \tag{14}$$

where $empl_{j,t}$ is employment in location j at time t, while $size_t$ is a location surface in square km. As standard, we consider here the log, and we do the same for all the other location variables, in order to interpret parameters as elasticities and to ease the comparison. As for market potential, we have to decide between two alternatives. The first solution consists in taking the log of (13). However, this solution has a couple of drawbacks that come from the fact that, when taking the sum across space, one has to consider for the market potential of j the income coming from region j itself. When considering such a term, there is a first problem of calculating internal distances. One solution, introduced by Head and Mayer (2000), is to assume that locations can be approximated by a disk of area A in which production occurs at the center while consumers are uniformly distributed throughout the rest of the area. This leads to an average distance among consumption and production equal to 0.376 $A^{0.5}$. However, this solution is not universally accepted in literature because it implicitly assumes that the shape on the transportation technology is the same between long (external) and short (internal) distances. Indeed, as shown in Disdiez and Head (2004), the elasticity of trade with respect to distance is higher for intra-continental compared to inter-continental flows.

A second complication arises because of the high correlation between the internal-distance corrected income (that is a kind of density) and the density of employment. Since the two are very close to each other and the weight $(d_{j,j}^{-1}/\sum_{k=1}^{\Phi} d_{j,k}^{-1})$ given to Y_j in equation (13) is fairly high (roughly 0.25 in our data) then our measure of market potential turns out to be strongly correlated with economic density.

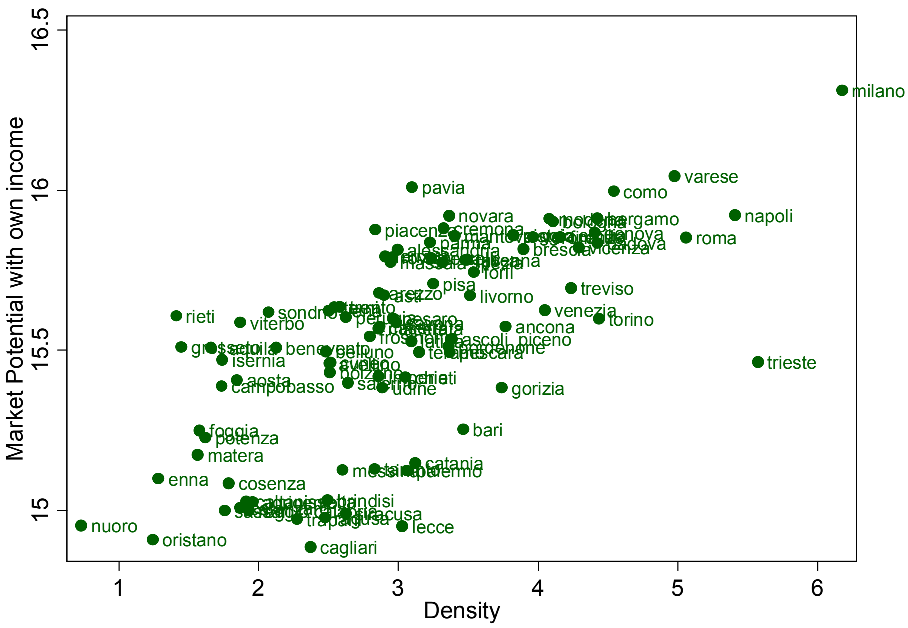

Figure 1: Correlation between density and market potential with own income.

This strong link is clearly evident in Figure 1, in which we plot the (time) average density and market potential of the 95 Italian provinces which reports a correlation of around 0.80. One direct consequence of this problem is that including market potential, as defined in equation (13), in regressions makes the coefficient of density insignificant in many cases. Both to avoid such multicollinearity problem and to weaken endogeneity problems due to the spatial nature of data, we consider (as in Mion, 2004 and Hanson, 2005), the following measure of Harris market potential:

$$MP_{j,t} = \ln \left[\sum_{k \neq j} Y_{k,t} \ d_{jk}^{-1} \right] \tag{15}$$

where we exclude the income of region j in the computation of $MP_{j,t}$. By dropping own income, the correlation between the two variables falls down to 0.25. Figure 2 shows the new scatter plot. As one can see, densely populated cities like "Milano", "Torino", "Roma" and "Napoli" are now characterized by having a moderate market potential, while small neighbor locations like "Pavia", "Novara", and "Rieti" largely benefit from the proximity to such big markets (so having a high $MP_{j,t}$).

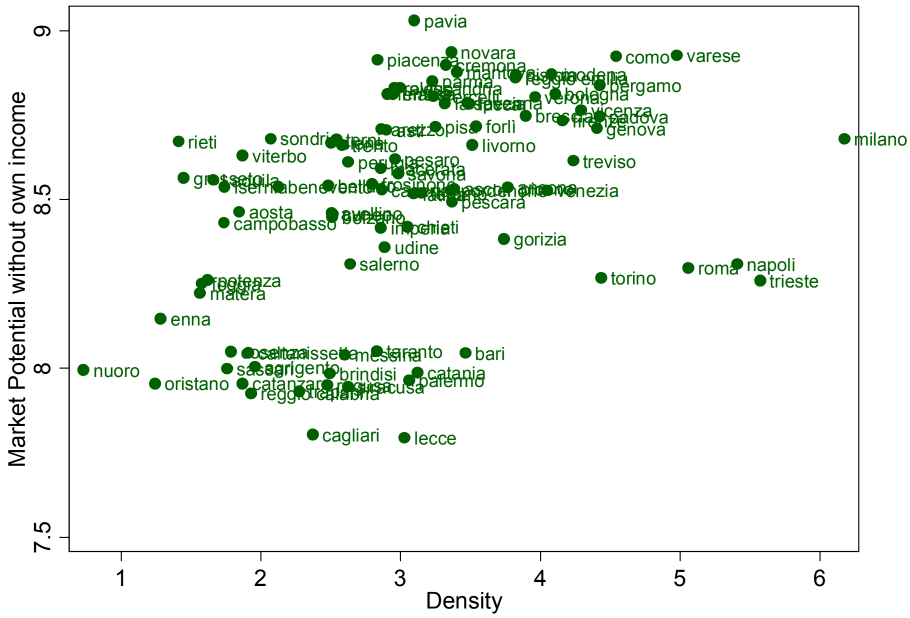

Figure 2: Correlation between density and market potential without own income.

Obviously, although this strategy avoids the multicollinearity problem, it does not provide us with a “pure” measure of market potential and economic density. This comes from the fact that, at very local level, these two forces are virtually impossible to disentangle. Consequently, we will use the following “unstructural” counterpart of equation (10) in our estimations:[14]

$$\ln(w_{j,t}) = \delta_t + \gamma_1 Dens_{j,t} + \gamma_2 MP_{j,t} = \delta_t + \gamma_1 \ln\left[\frac{empl_{j,t}}{size_j}\right] + \gamma_2 \ln\left[\sum_{k\neq j} Y_{k,t}\ d_{jk}^{-1}\right] \qquad (16)$$

In the next Section we will present the datasets used, the way we have constructed our regressors and instruments as well as some simple descriptive statistics that gives a flavor of the spatial variability of wages.

[14]We call equation (16) “unstructural” because, although it comes almost directly from the structural equation (10), the proxies we use for the variable of interest are different from the model for the coefficients γ_1 and γ_2, and cannot be interpreted as structural parameters.

4 Data Description and Variables

4.1 Data sources

In this paper we use an administrative database provided by INPS (the Italian social security institute). More specifically, we work on a panel version of this database, elaborated by ISFOL[15], which matches employer and employee data - like the one used by Kramarz, Abowd, and Margolis (1999) - and that has been recently used for instance by Garibaldi and Pacelli (2004). The sample units are salaried full-time workers[16] in all private sectors but agriculture. The panel is an employer-employee database, constructed merging INPS employee information database with the employer information database and covers 14 years from 1985 to 1998. The sample scheme has been set up to follow individuals born on the 10^{th} of March, June, September and December, and therefore the proportion of this sample on the Italian employees population is approximately of 1/90.

As far as workers' information is concerned, the database contains many individual information like age, gender, qualification, place and date of birth, province where the job takes place, date of beginning and end of the current worker contract, the social security contributions, if the worker is either part time or full time, the yearly wage, and the number of worked weeks and days.

For firms this database contains the following information: plant location (province), headquarter location (province), the average number of employees, the sector and the date of start up and the one of shut down (if any). This means that, contrary to other datasets, we are able to exactly identify here where a job takes place since the headquarter and plant location are two separate information. This is particularly important for us because job location is a crucial element in our analysis.

As far as job location is concerned, we use data on the 95 Italian provinces.[17] The choice of provinces represents a good compromise between a detailed classification of the Italian territory and data availability. Provinces are in fact sufficiently big to entirely cover cities area and small enough to provide a rich data variability. Furthermore, Mion (2004) uses the same spatial

[15] For a detailed explanation of this database see Centra and Rustichelli (2005).

[16] Apprenticeships and part time workers are excluded from the dataset, since the attention is focused on standard labor market contracts (blue collar, white collar and managers). Further, self-employed are not included in our sample.

[17] Actually, in 2005 the Italian provinces are 103. The transition between 95 and 103 took place in 1995. In this paper we consider the initial classification of 95 provinces, converting subsequent changes in definitions on our data.

disaggregation in its structural analysis of agglomeration externalities. Data on yearly sectoral employment at the provincial level are provided by INPS and refers to the period 1986-1998. The corresponding sectoral decomposition is the ATECO 81, which splits the Italian economy in 52 sectors (at 2digit level). This choice should provide us with sufficient information to properly account for sectoral heterogeneity. Province data on households' disposable income (period 1991-2000) social infrastructures (year 1995), mountain surface, and proximity to the sea are instead provided by the "Istituto Tagliacarne"

As for historical data, information about province population in 1861, 1881, and 1901 comes from a re-elaboration of population census by municipalities operated by ISTAT. Data on local sectoral specialization for the year 1951 comes from the "Ateco51-91" database, which is still provided by ISTAT. Finally, data on surface crow-fly distances among provinces comes from Arcview GIS software.

4.2 Variable construction

In our empirical analysis we focus on the period 1991-1998 for which all individual and spatial data are jointly available. Our unit of analysis is a worker i at year t. As for job records of a worker, we consider only one employer-employee match per year. In particular, we assign to each individual i the monthly wage and job characteristics of the longest job record in year t. The choice of the monthly wage - reconstructed from yearly wage and worked weeks - is meant to control for both the actual time worked during a year as well as for differences in actual vs reported working days vs weeks which can systematically vary across space.[18] We further eliminate those extreme observations below (above) the 1^{st} (99^{th}) percentile of the yearly wage distribution and consider only workers with at least two observations in order to be able to perform a within transformation on all our data. This lead us to an unbalanced panel of 92,579 individuals corresponding to 560,040 observations over the period 1991-1998.

However, in the paper we actually use a smaller dataset. In particular only male individuals with age between 24 and 39 (when they first enter in the database) are considered, *i.e.* 24,353 workers and 175,700 observations. The choice to consider only male workers is quite standard

[18] More precisely, as wage variable we use the yearly wage paid by the firm to the employee, divided by the number of worked weeks, and then reporting the week wage at the monthly level. We did not use the information of the worked days because Ginzburg (1998) claimed that this variable in the south could be underestimated, leading to higher daily wages in this region, which is indeed supposed to be the poorest Italian area.

in the wage equation setting.[19] Women wage dynamics is in fact often affected by non-economic factors, meaning that standard economic and spatial covariates are less important in explaining their carriers. Furthermore, as we discussed in the previous Section, workplace changes are crucial for estimations and young male workers represents a relatively homogeneous category with respect to migration. Indeed, the related literature (See Borjas (1987) usually focuses on them.[20]

The dependent variable in our regression is the (log) of before tax monthly wage in thousands of Italian liras. Data have been deflated and the base year is 1991. As for individual characteristics, we focus on the standard covariates usually used in a mincerian equation: gender dummy (one for female), age, age^2, and two other dummies for blue collar and white collar with the residual category being managers, and time and sectoral dummies.

Moreover, in order to capture firms' heterogeneity we extensively use the log of firm size. The positive and strongly significant relation between wages and firm size has been extensively studied in labor economics. The seminal papers are probably the ones of Krueger and Summers (1988) and Brown and Medoff (1989), and more recently the well-known paper of Burdett and Mortensen (1998) that derives this result using a general equilibrium matching model with frictions. In particular, this literature points out a persistent positive effect of firm size on wages, identifying several different explanations that have been put forward in order to explain such a relation. [21]

As spatial variables we consider both employment density and market potential as defined (respectively) in (14) and (15). Both variables are in log (to be interpreted as elasticities), and stand for urbanization economies as apposed to pecuniary externalities stemming from transportation costs, product differentiation and increasing returns to scale. Although we focus on the comparison among these two forces, in the urban literature there is also a substantial interest for the so-called localization externalities, which concern the productivity gain stemming from the concentration of a specific industry in a given location (local specialization). Both the theoretical models of Henderson (1974) and Duranton and Puga (2004) and the empirical findings of Glaeser et al (1992), Henderson (2003) and Rosenthal and Strange (2003) suggest that these externalities

[19] See for instance Topel (1991) and Altonji and Shakotko (1987).

[20] It is for example well known that male prime-age workers are more mobile. Indeed, in our full sample of 92,579 workers 10.49% of them change location at least one time in the observation period against the 13.54% of male prime-age.

[21] For instance, some papers claim that only more productive and big size firms can afford to pay efficiency wages in order to attract and keep skilled workers (Krueger and Summers, 1988), while other papers stress the importance of unions power in big size firms and the consequent impact on wages (see Podgursky, 1986). Further, another explanation concerns the fact that big size firms make use of a better screening device in order to select high skilled workers. For a survey concerning all this literature see Oi and Idson (1999).

play an important role in local growth and productivity. Consequently, we decide to include them in the analysis even though, compared to density and market potential, we are less able to tackle the related endogeneity issues. Nevertheless, as we will see later on, neglecting them does not alter substantially the results. As a proxy for such externalities, we use a measure of local sectoral specialization as in Combes (2000):

$$Spec_{j,s,t} = \ln\left[\frac{empl_{j,s,t}/empl_{j,t}}{empl_{s,t}/empl_{t}}\right], \tag{17}$$

where the specialization index for sector s in province j is defined as the ratio of the employment share of sector s in province j divided by the same ratio at the national level. Descriptive statistics of the main variables used in our sample are given in Table 1.

4.3 Some basic stylized facts

From descriptive statistics some basic elements concerning the goals of our paper come out quite clearly. First of all, spatial distribution of wage does not seem uniform across Italian provinces, meaning that location matters. This does not have to be taken for granted, since Italy is a country characterized by a very important centralize wage setting, where each sectoral national contract has to respect several constraints, like a minimum wage. For this reason we were expecting a more uniform distribution of wages. However, it is worth noting that firms are allowed to integrate the national sectoral contract with a company specific contract, in which for example the minimum wage can be increased. Besides, since several standard economic theories suggest that fixing wages above the minimum wage level might represent an efficient solution for the firm (for instance the efficiency wage approach, the insider outsider and/or the wage setting in presence of unions etc.), it is not surprising that wage distribution is affected by economic location.

First of all, it is interesting to remark that the ratio between the province with highest average wages and the lowest one is (considering time averages over the period) 1.52 and this ratio is increasing overtime (1.46 in 1991 and 1.56 in 1998). This result still holds even if the different qualifications are taken into account. For instance, the same rate is equal to 1.40 for blue collar workers, 1.53 for while collar and 2.82 for managers. Even considering a less extreme indicator than the max/min as the $90^{th}/10^{th}$ percentile ratio we still derive interesting results. This ratio for all workers is 1.24, 1.22 for blue collar, 1.17 for white collar and 1.33 for managers, confirming that there is a substantial wage spatial distribution.

When considering the relation between province average wages (across individuals) and density (mean 1991-1998), it is possible to derive a clear positive correlation leading to an R^2 of 0.36. Market potential is also a powerful explanatory variable, with the R^2 of the regression on province average wages being 0.28. However, coherently with Combes, Duranton and Gobillon (2004), we find that individual skills, and in particular education, are also important to understand spatial wage disparities. In fact, the share of people with an High School degree in a given province explains alone 42% of the differences among aggregated wages. The spatial literature has paid little attention to the issue of skills and much more on spatial externalities. In this paper we contribute to filling this gap thanks to individual data and in the following Section we will show, using more rigorous econometric techniques, the implication of the unequal skills' distribution on the estimated magnitude of spatial externalities.

5 Econometric Analysis

5.1 The importance of matched employer-employee panel data

The goal of our empirical analysis is the estimation of (10) and in particular of its "unstructural" counterpart in equation (16). We use a matched employer-employee panel data and this certainly represents one of the main contributions of this paper. Most of the studies that has dealt with the measurement of location-specific externalities, like Glaeser et al (1992), Ciccone and Hall (1996), and Mion (2004), use in fact aggregate data on labor and/or productivity. Compared to them, we can thus control here for a possible composition effect due to individual characteristics like age, gender and qualification. Indeed, in our data both the age and the gender of workers are strongly correlated with economic density and the same apply, although to a smaller extent, to market potential. In particular, female workers can be found more easily in big cities with the working population being a little older. Since female workers earn less while wage is positively correlated with age, the sign of the bias coming from omitting these variables on economic density is (in this case) undetermined a priori.

Another important element in our analysis is firms' heterogeneity. On the one side, there is in fact an important literature focusing on the positive relation between firm size and wages. Nevertheless, as long as there is no correlation between firm size and location characteristics, then omitting this variable would have no impact on the estimates of spatial externalities. To this respect, the recent literature on heterogeneous firms/workers and the costs of trade (started with the work of Melitz, 2003) has something to say about that. In particular, Melitz and Ottaviano (2004) build a model in which the size of the local market is positively related to firm size and productivity. The bottom line of their argument is that local competition lead to a self-selection of firms in which less productive ones exit the market. Indeed, in our data firm size in positively correlated with density (0.12), and this correlation is strongly significant even after introducing sectoral dummies. All of this suggests that controlling for firm size may provide useful insights to our spatial analysis. In order to better explore this topic we will also perform the very general estimation technique introduced by Abowd, Kramarz, and Margolis (1999) that, allowing for firm specific fixed effetcs, should enable us to better control for firms' heterogeneity than simply using firm size and sectoral dummies.

In the paper, we also deal with the issue of individual skills. First of all, higher skilled workers earn higher wages. This is certainly a clear-cut statement and there is an old literature in labor economics focusing on the returns of education.[22] However, the focus of this paper is not to measure "the value of education", but to control for those individual characteristics that are unobservable and related to skills. As argued by Glaeser and Mare (2001) those skills are, to some extent, a stock variable that is subject to accumulation. However, in our short time period (1991-1998) one can reasonably consider them as fixed. All this being said, the use of individual fixed effects to proxy for individual skills seems to be a reasonable choice.[23] However, our goal here is to provide consistent estimations of spatial externalities. In this light, the need for individual effects is thus (again) conditional on the presence of a significant correlation with our spatial regressors that (if neglected) would bias our results. Glaeser and Mare (2001), Moretti (2004), and Redding and Schott (2004) provide the rationale for an interplay between skills and space. In particular, these frameworks suggest that skilled workers should locate in regions characterized by high density and market potential.

As for the interaction between individual and firm heterogeneity, some recent models suggest that there may be some important complementarities at work. For example, Yeaple (2005) shows that firms who choose to be high tech are more productive, bigger and have a skill-biased technology. Consequently, bigger firm should be observed to hire more skilled workers and, even after controlling for skills, to have a residual productivity advantage. The link between firms' size

[22] See for instance Mincer (1974) and Card (1999).

[23] This type of choice is usually made in labor economics, see for instance Krueger and Rouse (1998) and Moretti (2004).

and skills have already be found empirically by Abowd, Kramarz, and Margolis (1999), but we are able here to go a bit further here by assessing whether the observed correlation is just due to co-location of both agents in big cities or not. Furthermore, the interaction of skills with firm size can create (if not accounted) a feedback bias on the spatial variables whose sign and magnitude cannot be predicted a priori.

Once established the importance of using matched employer-employee data we can proceed to the estimation of equation (16). Characterizing this equation by adding individual and time labels (i, t), as well as a set of controls for individuals and sectoral characteristics (both variables refers to vectors):

$$w_{i,t} = \mathbf{B}_1^{'}\mathbf{I\_C}_{i,t}+\mathbf{B}_2^{'}\mathbf{F\_C}_{f(i,t),t}+\gamma_0 Spec_{j(i,t),\ s(f(i,t),t),\ t}+\gamma_1 Dens_{j(i,t),t}+\gamma_2 MP_{j(i,t),t}+\delta_t+u_i+\varepsilon_{i,t} \quad (18)$$

where the dependent variable is the logarithm of before tax monthly wage, u_i is an individual effect (skills) , and δ_t is a time effect. The term $\mathbf{I\_C}_{i,t} = \{Gender_i,\ Age_{i,t},\ Age^2_{i,t},\ Bc\ dummy_{i,t},\ Wc\ dummy_{i,t}\}^{'}$ is a battery of individual characteristics while $\mathbf{F\_C}_{f(i,t),t}$ contains variables that controls for firm f features. The latter is given either by $\mathbf{F\_C}_{f(i,t),t} = \{\mathbf{i}_{s(f(i,t),t)},\ \ln(FirmSize_{f(i,t),t})\}^{'}$, where $\mathbf{i}_{s(f(i,t),t)}$ is a set of industry dummies and $\ln(FirmSize_{f(i,t),t})$ is log of firm f size (both time varying), or by a fixed effect $\mathbf{F\_C}_{f(i,t)}$ (one for each firm) as in Abowd, Kramarz, and Margolis (1999). Finally $Spec_{j(i,t),\ s(f(i,t),t),\ t}$, $Dens_{j(i,t),\ t}$ and $MP_{j(i,t),\ t}$ indicate specialization, density and market potential as defined in (17), (14) and (15). It is worth noting that in our notation both the sectoral index s (referring to the 52 Ateco81 sectors), the location index j (referring to the 95 provinces), and the firm index f depend ultimately upon the couple (i, t) because they vary when an individual change sector and/or province and/or firm at time t.

5.2 First Results

In order to give a clearer overview of the relation between wages, skills, firms and spatial externalities we present in this Subsection estimations of (18) based on OLS, GLS, Within as well as the firm and individual fixed effects estimator (ABM) of Abowd, Kramarz, and Margolis (1999). Endogeneity of spatial variables and the migration issue are discussed in the next Subsection.

Table 2 shows the results obtained using our sample of male prime age workers for all sectors. Columns (1) to (5) contains (respectively) OLS, GLS, within without firm size, within with firm size and ABM. In all specifications, except ABM where sectoral dummies cannot be separately identified from firm effects, a complete set of time and sectoral dummies are included.

First of all, our estimates on the impact of $Age_{i,t}$ and $Age^2_{i,t}$, and the two dummies for blue and white collar are in line with previous findings (Naticchioni and Panigo, 2004). Moreover, the impact of localization externalities, as proxied by our specialization measure, is always very low (between 0.55% and 0.15%) and weakly significant in within estimations of column (3). This is also consistent with other works and in particular with those of Cingano (2003) and de Blasio and Di Addario (2002) who did not find any strong evidence in favor of a positive wage differential in highly specialized areas (Industrial Districts). These variables are not of direct interest in our analysis and thus we will not discuss them further.

The Spatial Sorting of Skills and Firms

As for density and market potential, going from column (1) to (3) it is quite straightforward to see that taking into account individual effects dampens simple OLS results. Nevertheless, these variables are always significant and elasticities are in line with economic meaningful values. In fact, according to OLS, doubling density increases wages of 2.21%. Previous findings of Ciccone and Hall (1996) for US and Combes, Duranton and Gobillon (2004) for France found (respectively) something around 5% and 3%. Our rather low value is probably due to the already mentioned fact that in Italy there is a sectoral bottom floor that is fixed at national level and this can reasonably limit spatial variation of wages. However, taking into account individual effects further reduce this estimate. When considering (uncorrelatd) random effects the effect of density drops to 1.87%, while allowing this effects to be correlated with regressors in the within estimations of column (3) leads to only 0.74%.[24] This simple estimates suggest a strong positive correlation between individual skills, as measured by u_i, and density. Indeed, our within estimations give a (significant) correlation of 0.20 among the two, which suggest that sorting of skills in space is at work. These findings confirm those of Combes, Duranton and Gobillon (2004) for France.

Concerning market potential, spatial sorting is also at work. OLS estimates suggest that doubling market potential lead to a 10.88% increase in wages. Interestingly, in their aggregate analysis of the impact of market potential on sectoral EU wages, Head and Mayer (2005) find a very similar result. However, taking into account individual skills push down elasticity to 5%

[24]Although this elasticity might seem really low, Di Addario and Patacchini (2005) find a very close result. Using a similar database on individual wages where they also have information of workers' education the authors find that doubling density leads to a 0.53% increase in wages.

in the within estimates. The (significant) correlation between the u_i and market potential is 0.08 which is significantly lower than the one with density but still suggestive of a positive link between skills and those agglomeration externalities stemming from NEG models. This result is consistent with the theoretical and empirical findings of Redding and Schott (2003).

In columns (4) and (5), we further account for firms' heterogeneity by means of (respectively) firm size and firm fixed effects and this is, to our knowledge, the first framework dealing with the firm content of spatial externalities. Considering column (4), the elasticity with respect to wages is 1.94%, which is in line with previous findings for other countries. For instance, Brown and Medoff (1989) derive an elasticity value of around 3% for the US. As for the impact on spatial variables, considering firm size further decrease the elasticities of density (0.56%) and market potential (4.56%). Indeed, the size of firms is significantly correlated with both and in particular with density (0.12), which is the one that experiences the strongest fall. These findings are confirmed by the more general AKM estimation in which the elasticity of density further drops to 0.45% while market potential remains substantially stable.[25] The idea that firms' heterogeneity may lead to dampen the magnitude of spatial externalities was already put forward by Baldwin and Okubo (2004). Our results suggest that, although important, the bias induced by firms' heterogeneity is smaller than the one linked to individual characteristics and in particular to skills.

The Interaction between Skills, Firms and Space

Another interesting issue we deal with is the relation between workers skills and firms attributes. Yeaple (2005) is an example of a model in which there are complementarities between the two agents. The author shows that firms who choose to be high-tech are endogenously bigger and have a skill-biased technology. Consequently, big size firms are expected to hire more skilled workers and, even after controlling for skills, to have a residual productivity premium. This in indeed the case in our regressions where the firm-size effect is always significant. Furthermore, the correlation between the individual effects and firm size is very strong (0.35) and significant. A similar result have been found in Abowd, Kramarz, and Margolis (1999). However, the fact

[25] In particular, we use the order independent method where firm and individual fixed effects are estimated in a complete separate way. Sample size is smaller for AKM estimations because separate identification of firm and individual effects requires employer mobility. As for the conditioning variables Z we use the interactions between (mean) individual characteristics (age, age^2, density, and market potential) and (mean) firms characteristics (firm size, firm size^2, and a 9 industry classifications based on Ateco 81 one digit. It is also important to notice than when using AKM technique sectoral dummies cannot anymore be identified.

that we specifically deal with space in our framework allow us to go a bit further. Actually, the link between skills and firm size may be in principle due to a simple co-location effect. Melitz and Ottaviano (2004) suggest that big and more productive plants should locate in big markets. At the same time, according to Glaeser and Mare (2001) and Moretti (2004), skilled workers should be expected to be found disproportionately in big cities. However, the partial correlation between individual effects and plant size *conditional* on spatial characteristics (density and market potential) is 0.33 which is just slightly smaller than the unconditional one and still highly significant. This suggest that there is a deeper underlying economic relation between skills and firms' characteristics.

Sectoral Robustness of the Spatial Sorting

In Table 2 we consider only male aged 24-39 because they represent an homogeneous group that is better suited to deal with migrations and also because their behavior should better reflect the kind of forces we want to investigate. However, one can reasonably wonder to what extent our results still hold in the full sample of workers. We have explored this issue and in unreported estimations, which are available upon request, we have found qualitatively similar results. An issue we decided to deal in the paper is the sectoral scope of our analysis. One can in fact reasonably argue that there may be a considerable sectoral heterogeneity with respect to spatial externalities. In Table 3, which is the counterpart of Table 2, we show estimations of (18) obtained on the sub-sample of manufacturing workers. These estimates have the advantage of being based on a set of economic activities that are more directly comparable and testify that the sorting of skills and firms still operates Furthermore, all elasticities are still positive and significant with magnitudes comparable to those referring to all activities with two interesting exceptions. On the one hand, localization externalities seems to be stronger and more significant for manufacturing and this is somehow expected since the idea that specialization fosters growth and productivity is historically related to such activities. However, the difference between comparable estimates is in most cases not significant and caution is needed. The other interesting difference is with respect to market potential. In the subsample of manufacturing, market potential seems to matter less than for other activities. Punctual estimates are in fact (in within and AKM estimations) almost half of their counterpart in the sample of all activities. This may suggest that other sectors, and in particular services -that usually display higher transportation costs- are more sensitive to market centrality. However, the difference between comparable estimates is again not significant and caution is needed.

5.3 Endogeneity, amenities and location

In this Subsection we explore the issues of endogeneity, local amenities and the location choice of migrants. Although within and AKM estimations can give useful insights on the issue of spatial sorting, the reliability of computed elasticities are in fact conditional upon the validity of the underlying moments' restrictions. In particular, it is assumed that $\text{Cov}(\varepsilon_{i,s}, \mathbf{X}_{i,t})$, where $\mathbf{X}_{i,t}$ represents the vector of all covariates, is equal to zero $\forall\ s,\ t$. However, as pointed out by Combes, Duranton, and Gobillon (2004), some local characteristics are likely to be endogenous to local wages. For instance, provinces experiencing a positive technology shock at time t may attract migrants and thus lead to a positive correlation between density and/or market potential and the residual term. In particular, exogeneity of the location choice is violated whenever workers make their employment choice on the basis of the actual wages at date t. Combes, Duranton, and Gobillon (2004) show that the bias is much reduced in a dynamic context when workers make their employment decision on the basis of both current and future (expected) wages. Nevertheless, the issue of endogeneity of density, market potential and, to some extent, also of the sector choice with the related specialization variable remains open. We deal with endogeneity in by means of IV estimations that exploits the idea of Ciccone and Hall (1996) and Combes, Duranton and Gobillon (2004) of using deeply lagged values of the endogenous variables as instruments. Crucially, test on over-identifying restriction accepts the validity of such instruments while parameters are in line with economic meaningful values.[26] It is also important to stress that the AKM method cannot be used with endogenous covariates. Therefore, we are forced here to use a within-IV with firm size and sectoral dummies as controls for firm heterogeneity.

In Table 4 we show our within-IV results, which we believe are the most reliable estimates of spatial externalities we can provide. In particular, column (4) represents our preferred specification. In Column (1) to (5) we actually use as instruments for spatial variables data on specialization in 1951, density of population in 1861, 1881, and 1901, as well as a proxy for market potential, calculated replacing aggregate disposable income of a province by its population in equation (15), for the years 1861, 1881, and 1901. The use of deeply lagged levels of specializa-

[26] In a previous version of the paper we also experimented Dynamic Panel Data GMM estimation to solve endogeneity. However, results were very bad both in terms of parameter estimates and test on over-identifying restrictions. The short span of the panel (8 years) and the issue of migration are probably the reason of this failure.

tion, density and market potential obey to the logic (expressed in Ciccone and Hall, 1996) that, as long as early pattern of agglomeration do not reflect factors that influence productivity today, then they can be used as instruments. To this respect, the presence of a structural break, would provide the condition for a natural experiment. Ciccone and Hall (1996) use late US 19th century data that are previous to both world war one and two, right after the civil war, and just at the beginning of railroad network construction. Our instruments of density and market potential for Italy meet these needs as the Italian State was created just after Garibaldi expedition in 1860 and the railroad network did not really develop until late 19th century. Unfortunately, we could not find very old data on specialization but this variable is not central in our analysis and we will see that omitting localization externalities does not alter results. Crucially, the Sargan test on the one over-identifying restriction does not reject the validity of our instruments, and this is quite a strong result considering that with almost 200,000 observations the power of the test should be very high.

We Start by discussing column (1) which is the direct counterpart of column (4) of Table 1. As one can see, accounting for endogeneity alter the magnitude of spatial externalities. Compared to within estimation in column (4) of Table 1, density goes from 0.56% to 0.20%. By contrast market potential, which is not properly measured in Combes, Duranton and Gobillon (2004), is just slightly affected going from 4.53% to 4.64%. Nevertheless, these differences are not significant at 1% and caution is needed. Finally, the elasticity with respect to specialization is still not significant. As for the relative importance of density and market potential, all our estimations suggest that the latter is more important in explaining spatial wage variation. The elasticity corresponding to market potential is in fact always higher (with a gap that is statistically significant) and, when considering "standardized" elasticities, this result still holds with the one corresponding to density (market potential) being 0.0067 (0.0366). Such standardized (or beta) coefficients are defined as the product of the estimated coefficient and the standard deviation of its corresponding independent variable, divided by the standard deviation of the dependent variable. They actually convert the regression coefficients into units of sample standard deviations giving a measure of how much variability of the dependent variable may be explained by the regressor.[27] Both absolute and beta elasticity thus suggest that, at least for Italy, pecuniary externalities play a crucial role in the spatial distribution of wages. These findings are coherent with those of Mion

[27] See Wooldridge (2003, Section 6.1) for a further description of this transformation.

(2004) who finds evidence of sizeable agglomeration externalities in Italy.

Robustness Checks

In column (2) we perform the same estimation as in column (1) except from the fact the we now exclude both the specialization variable $Spec_{j(i,t),s(i,t),t}$ and the sectoral dummies $\mathbf{i}_{s(i,t)}$. Although we are able to reasonably instrument for the endogeneity linked to location specific variables, we cannot say the same for the sectoral variables. The sector choice is in fact certainly endogenous and, although specialization in 1951 may not be such a bad instrument, we do not really have something to instrument sectoral dummies. Therefore, we have performed in column (2) a restricted estimation that intentionally avoids the choice of sector. The results we got for density and market potential are nevertheless almost identical. Furthermore, the Sargan test on over-identifying restrictions does not detect any bias from omitted variables. We interpret these results as an evidence that location and sector choice are quite independent from each other, implying that our estimates of agglomeration externalities are robust to the misspecification of the sector choice.

In column (3) we replicate, for comparability, the same estimation methodology used by Combes, Duranton and Gobillon (2004). The authors assume in their estimation equation, which is very similar to (18), that there is a further time-location specific error component ($v_{j(i,t),t}$) that can be thought as an idiosyncratic technological shock. In order to control for this additional source of heterogeneity, the authors perform a first-step within estimation in which they include a full set of time-location dummies ($\beta_{j(i,t),t}$) that capture all the variation in the time-space dimensions. Subsequently, they recover the parameters of density and their proxy for market potential in a second step regression $\beta_{j(i,t),t} = \gamma_1 Dens_{j(i,t),t} + \gamma_2 MP_{j(i,t),t} + v_{j(i,t),t}$ using a two-steps least squares estimator and deeply lagged values as instruments. Compared to our strategy, their methodology has the advantage of accounting for the heteroschedasticity that comes from time-location technological shocks $v_{j(i,t),t}$. In other words, although our IV estimates would still be unbiased, the standard errors may not. However, when they first recover their dummies without instrumenting, the endogeneity of spatial variables is still at work and can seriously bias their estimates of $\beta_{j(i,t),t}$. In order to get some insights on the relative advantages of the two procedures we have fully implemented their estimation techniques with the exception that we have just considered location dummies in the first stage (i.e. $\beta_{j(i,t),t} = \beta_{j(i,t)}$). We do not have in fact enough time span and migrations to be able to identify all possible time-locations effects. Comparing results of column (1) and (3) reveals that the difference between the two sets of estimates is actually very small for density but not for market potential. We interpret the latter result as being due to an endogeneity bias. Indeed, the Sargan test in column (3) does not accept the validity of instruments in the second step. This may be due to the fact that first step estimates in the procedure of Combes, Duranton, and Gobillon (2004) suffer from endogeneity. However, this may also come from the restriction of the time-invariance of $\beta_{j(i,t),t}$ that we were forced to impose. Interestingly, the increase in standard errors that is expected as a consequence of heteroschedasticity is very small suggesting that location heterogeneity is very small compared to that of individuals.

In columns (4) we perform and additional estimation of (18) in order to control for job changing, migration and amenities. As we have already established, variability induced by migration is in fact the dominant component of variability in the within dimension. To this respect, it is worth noting that in our database migration decisions are always generated by job change decisions: a worker decides to change job in order to achieve an improvement in working conditions, and in some cases this implies a migration. Therefore, we should actually care of both. Now, as long as those individual characteristics and local factors (like amenities) behind workplace choice (and in general to job change) are correlated to our spatial variables than there may a selection bias. Combes, Duranton and Gobillon (2004) have the same problem but they simply neglect it. As an attempt to tackle this issue we first consider 3 dummy variables to captures the following effects: 1) general decisions to change a job (no matter if voluntary or involuntary); 2) a voluntary decision to change a job (defined as absence of unemployment spells between two jobs, as in Abowd, Kramarz and Margolis (1999); 3) a decision to move in another provinces to work. We then further interact these 3 indicators with both individual (age, blue collar and white collar dummies) and location (share mountain surface, sea border, social infrastructures) features leading to a total number of 3+3*6=21 new regressors. In particular the precious variable social infrastructures measures the availability of social and cultural facilities (schooling, health care, sport, teathers, etc.) which can be very important for the local quality of life. As one can see, adding these variables in column (4) does not alter results dramatically except for the market potential estimate, which now reduces by 30% but still remains bigger and more significant than density.

Finally, in column (5) we partitioned Italian provinces in four subsamples according to four macro areas (North-East, North West, Center, South).[28] For each subsample, we have thus performed separate estimations. Coefficients and standard errors reported are actually the average of the corresponding values of the four regressions. The reason of this exercise is twofold. On the one hand, we want to check whether spatial effects are possibly due to different returns on age, profession, or firm size across space. On the other hand we want to be sure that the North is not driving our results and particularly the one on market potential. As for the first issue, our estimations confirms that the positive impact of density and market potential on individual wages is robust even after introducing heterogeneity in individual characteristics' returns. In particular, both elasticities increases although the difference with pooled estimations is not significant. Moreover, looking at macro-area specific estimates, while the coefficient of density is very stable across space around its mean of 0.58% the same is not true for market potential that ranges from 2.24% for the North-East to the 10.12% of the South. This relatively unstable effect of market potential may be due to the fact that the Southern Italian economy heavily relies on the richer North that is (by contrast) much more export oriented.[29] In fact, we did not consider international demand in the construction of market potential and so the proximity of the North to the economic core of Europe is actually neglected. However, in all four cases estimates are positive and significant suggesting that market effect is a pervasive spatial force.

6 Conclusions

In this paper we use wages from a matched employer-employee panel data on Italian workers in order to estimate the absolute and relative magnitude of urbanization externalities and market potential. Our results suggest that, after controlling for individual and firm characteristics, skills, and endogeneity, both externalities are positive and significant. However, both absolute and standardized elasticities suggest that market potential has the stronger impact. These findings are coherent with those of Mion (2004) who finds evidence of sizeable agglomeration externalities in Italy.

The analysis of the interaction between spatial externalities, skills and firms heterogeneity is the major contributions of this paper. In particular we provide evidence that spatial sorting is

[28] The four macro areas are made by the following regions (according to the official classification): 1) Northwest: Valle d'Aosta, Piemonte, Liguria, Lombardia; 2) North-east: Veneto, Trentino, Friuli Venezia Giulia, Emilia Romagna; 3) Center; Toscana, Marche, Umbria, Lazio; 4) South; Abbruzzo, Molise, Campania, Puglia, Basilicata, Calabria, Sicilia and Sardegna.

[29] Interestingly, Mion (2004) also finds that market potential has a bigger impact for the South of Italy.

at work in the sense that "good" workers and firms are disproportionately located in provinces characterized by high density and/or good access to consumers' markets. In the paper, we provide links to several theoretical arguments that can justify the sorting. In particular, Melitz and Ottaviano (2004) suggest that big and more productive plants should locate in big markets. At the same time, according to Glaeser and Mare (2001) and Moretti (2004), skilled workers should be expected to be found disproportionately in big cities. Our data confirm these arguments and further suggest that, as suggested by Baldwin and Okubo (2004), sorting dampens previous estimates of spatial externalities.

Another issue we deal with is the relation between the firm-size premium, individual skills and location. Our results suggests, coherently with Abowd, Kramarz, and Margolis (1999), that the correlation between the size of the employing firm and skills is very strong. However, this correlation is not simply the outcome of a co-location phenomenon, suggesting that a deeper complementarity relation is at work.

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Table 1. Sample Statistics On Male Prime-Age Workers

Variable	Observ.	Mean	Std. Dev.	Min	Max
ln(wage)	175700	6.4824	0.3625	3.1180	8.2036
Age	175700	34.1257	5.0713	21.0000	48.0000
Age^2	175700	1190.2820	350.7040	441.0000	2304.0000
Firmsize	175700	4.6278	2.7433	0.0000	12.2699
Bc Dummy	175700	0.6528	0.4761	0.0000	1.0000
Wc Dummy	175700	0.3319	0.4709	0.0000	1.0000
Specialization	175700	0.0622	1.0412	-8.7156	4.9706
Density	175700	3.9525	1.2167	0.6903	6.2398
Market Potential	175700	8.5566	0.2864	7.7637	9.0872
Specialization in 1951	175700	-0.0679	0.8887	-7.2878	3.6926
Density pop in 1861	175700	4.7640	0.6980	2.9671	6.7048
Density pop in 1881	175700	4.9202	0.6847	3.0494	6.8617
Density pop in 1901	175700	5.0708	0.7029	3.1931	6.9914
Market Potential in 1861	175700	12.5091	0.0667	12.4026	12.7018
Market Potential in 1881	175700	12.6485	0.0638	12.5404	12.8337
Market Potential in 1901	175700	12.7721	0.0633	12.6706	12.9480
Share Mountain	175700	-6.7235	8.1624	-18.4207	0.0000
Sea Border	175700	0.3919	0.4882	0.0000	1.0000
Social Infrastuctures	175700	4.5978	0.2947	3.6297	5.1011

All variables (except Sex, Age, Ageˆ2 , Bc Dummy, and Wc Dummy) are, coherently with their definition in the text, expressed in natural logarithm. Wages are in log of thousands liras while Market Potential is in log of billions liras. Both are in real terms (base 1991). Market Potential and Density in 1861-1901 are computed on the basis of inhabitants.

Table 2. Regression results for male prime-age workers: all industries. Dependend valiable ln(wage)

	(1)	(2)	(3)	(4)	(5)
Age	0.0481***	0.0485***	0.0456***	0.0466***	0.0416**
	(0.0015)	(0.0010)	(0.0080)	(0.0080)	(0.0201)
Age^2	-0.0005***	-0.0005***	-0.0005***	-0.0005***	-0.0006***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Firmsize				0.0194***	
				(0.0004)	
Bc Dummy	-0.7619***	-0.3567***	-0.2132***	-0.2149***	-0.2183***
	(0.0049)	(0.0037)	(0.0041)	(0.0041)	(0.0104)
Wc Dummy	-0.4891***	-0.1771***	-0.1452***	-0.1466***	-0.1469***
	(0.0049)	(0.0031)	(0.0031)	(0.0031)	(0.0080)
Specialization	0.0055***	0.0030***	0.0015*	0.0008	-0.0012
	(0.0006)	(0.0008)	(0.0008)	(0.0008)	(0.0018)
Density	0.0221***	0.0187***	0.0074***	0.0056***	0.0045***
	(0.0005)	(0.0008)	(0.0010)	(0.0011)	(0.0019)
Market Potential	0.1088***	0.0912***	0.0500***	0.0453***	0.0458***
	(0.0021)	(0.0039)	(0.0058)	(0.0058)	(0.0133)
Estimation mehtod	OLS	GLS	Within	Within	AKM
Time & Sector Dummies	Yes	Yes	Yes	Yes	Time only
Firm effects	No	No	No	No	Yes
Corr(u_i, Xbη			0.2559	0.3075	0.2115
R^2	0.5249	0.4974	0.3596	0.4412	
N. of individuals	24353	24353	24353	24353	14646
N. of observations	175700	175700	175700	175700	106478

Standard errors in parentheses with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels.

Table 3. Regression results for male prime-age workers: manufacturing only. Dependend valiable ln(wage)

	(1)	(2)	(3)	(4)	(5)
Age	0.0539***	0.0446***	0.0453***	0.0468***	0.0529**
	(0.0019)	(0.0013)	(0.0073)	(0.0074)	(0.0260)
Age^2	-0.0006***	-0.0005***	-0.0004***	-0.0004***	-0.0005***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Firmsize				0.0228***	
				(0.0007)	
Bc Dummy	-0.8263***	-0.3927***	-0.2404***	-0.2417***	-0.2300***
	(0.0070)	(0.0054)	(0.0060)	(0.0060)	(0.0152)
Wc Dummy	-0.5322***	-0.1997***	-0.1625***	-0.1653***	-0.1548***
	(0.0071)	(0.0046)	(0.0045)	(0.0046)	(0.0111)
Specialization	0.0084***	0.0058***	0.0046***	0.0033**	0.0018
	(0.0009)	(0.0011)	(0.0013)	(0.0013)	(0.0030)
Density	0.0207***	0.0190***	0.0081***	0.0060***	0.0072**
	(0.0007)	(0.0012)	(0.0015)	(0.0016)	(0.0035)
Market Potential	0.1084***	0.0875***	0.0251***	0.0233***	0.0228**
	(0.0031)	(0.0058)	(0.0095)	(0.0095)	(0.0107)
Estimation mehtod	OLS	GLS	Within	Within	AKM
Time & Sector Dummies	Yes	Yes	Yes	Yes	Time only
Firm effects	No	No	No	No	Yes
Corr(u_i, Xb)			0.1915	0.2229	0.0427
R^2	0.5146	0.4879	0.3525	0.4245	
N. of individuals	13149	13149	13149	13149	8111
N. of observations	87056	87056	87056	87056	51373

Standard errors in parentheses with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels.

Table 4. IV within regression results for male prime-age workers: all industries. Dependend valiable ln(wage)

	(1)	(2)	(3)	(4)	(5)
Age	0.0455***	0.0466***	0.0452***	0.0432***	0.0598***
	(0.0079)	(0.0080)	(0.0079)	(0.0079)	(0.0067)
Age^2	-0.0005***	-0.0005***	-0.0005***	-0.0005***	-0.0004***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Firmsize	0.0193***	0.0194***	0.0191***	0.0192***	0.0185***
	(0.0004)	(0.0004)	(0.0004)	(0.0005)	(0.0010)
Bc Dummy	-0.2114***	-0.2148***	-0.2112***	-0.1937***	-0.1944***
	(0.0041)	(0.0041)	(0.0041)	(0.0048)	(0.0091)
Wc Dummy	-0.1461***	-0.1466***	-0.1456***	-0.1355***	-0.1302***
	(0.0031)	(0.0031)	(0.0031)	(0.0034)	(0.0072)
Specialization	-0.0037		0.0009	-0.0047	0.0059
	(0.0035)		(0.0008)	(0.0034)	(0.0122)
Density	0.0020**	0.0024**	0.0020*	0.0022**	0.0062**
	(0.0009)	(0.0009)	(0.0012)	(0.0010)	(0.0031)
Market Potential	0.0464***	0.0503***	0.0991***	0.0319***	0.0642***
	(0.0114)	(0.0115)	(0.0125)	(0.0127)	(0.0229)
Estimation mehtod	IV - Within	IV - Within	Two-Steps	IV - Within	IV - Within
Time & Sector Dummies	Yes	Time only	Yes	Yes	Yes
Job change, migration and amenities controls	No	No	No	Yes	No
Separate Estimations	No	No	No	No	Geography
Endog. Test (df=4)	1.1722	1.0870	35.3053***	1.0974	0.4326
N. of individuals	24353	24353	24353	24353	24353
N. of observations	175700	175700	175700	175700	175700

Standard errors in parentheses with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels.
Data in Columns (5) are averages of the separate regressions (by geography).