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SKILL-BIASED AGGLOMERATION EFFECTS AND AMENITIES: THEORY WITH AN APPLICATION TO ITALIAN CITIES

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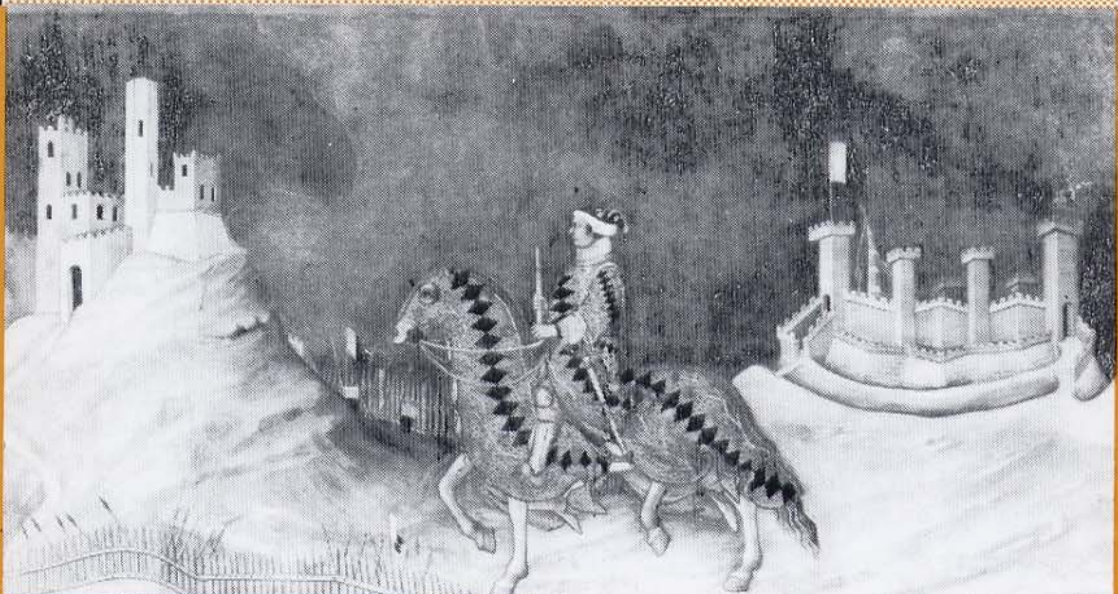

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Abstract
By exploiting the Roback model, we analyze the impact of agglomeration on both production and consumption. We postulate that the evaluation of urban amenities may vary across skill-groups. Empirically, we use the Bank of Italy's SHIW dataset, and find evidence of a substantial urban rent premium, while we do not find support for an urban wage premium. We conclude that urban agglomeration is predominantly a source of positive amenities for residents and, in particular, highly-educated individuals seem to care about the welfare effects of agglomeration more than their less-educated counterparts. Survey results also suggest that urban skilled workers benefit from jobs of higher quality, and from shopping possibilities and cultural consumption opportunities, such as cinemas, theaters, and museums.

Keywords: agglomeration, cities.
JEL Classification: R0.

I. Introduction

Traditionally, urban agglomeration was seen as a source of productivity advantages for firms, but also as a font of disamenities, such as congestion and crime, for resident workers and households. Some recent literature, however, has emphasized the specific role of cities as providers of services, consumption goods and social interaction (see Glaeser and Gottlieb 2006, Glaeser et al. 2001, among others). Differently from manufactured goods which can be basically bought everywhere, restaurants, theaters, schools, and hospitals are local goods. By the same token, the variety of metropolitan social interactions cannot be entirely replicated in smaller places. However, the consumption effects of agglomeration are unlikely to be enjoyed at the same rate by everybody. For example, highly-educated people appear to care more about the availability of cultural amenities than the less-educated (see, for instance, Glaeser et al. 2001, Shapiro 2006, Carlino and Saiz 2008).

To investigate these issues, we exploit the Roback (1988) spatial equilibrium model where firms and workers are fully mobile across locations, and heterogeneity in individual preferences is allowed. In particular, we assume that urban amenities are valued relatively more by the more educated. This framework has a number of implications. First, it shows that when positive urban amenities prevail, rents -but not necessarily wages- will be higher in larger cities. Moreover, it also shows that when the more educated are particularly sensitive to urban amenities, they will be willing to accept a less favorable mix of rents and wages to live in larger cities, relative to the less educated.

The implications of the model are tested by exploiting a unique dataset on Italian workers, the Bank of Italy's SHIW, which provides detailed information on both wage and rent determinants. The data also allow us to have a look at the role played by some non-wage advantages of urban agglomeration, such as job quality (see Rosenthal and Strange, 2004), certain public goods and cultural amenities.

Our regression results support the view that urban agglomeration is a source of positive amenities for residents. In particular, agglomeration has a stronger impact on rents rather than wages. Moreover, our empirical findings are consistent with the view that the more educated value urban amenities more than the less educated. Indeed, highly-educated people are willing to pay high rents and accept relatively larger wage discounts to live in cities. As for the sources of urban amenities, our survey results suggest that urban scale affects job satisfaction for high-skill individuals. In particular, they benefit more from a better working environment and the consideration received by others. Results are more mixed about quality-of-life determinants. Highly-educated individuals who live in large centers are particularly satisfied both with shopping possibilities and the wide array of cultural amenities made available by the concentration of cinemas, theaters, and museums. Instead, other aspects of the urban quality of life such as transportation or crime are likely to affect all residents, no matter their education level.

The paper is structured as follows. Section II presents the model and its implications. Section III describes the data and presents the evidence obtained. We first estimate the relation between agglomeration, rents and wages. Then, we attempt to shed some light on the sources of urban amenities. Section IV concludes.

II. A Roback General-Equilibrium Model

The Roback model we use here is based on two main components. First, agglomeration affects both production and consumption. Second, the more educated are supposed to valuate the effects of agglomeration more than the less educated.

Traditional analysis of agglomeration has focused on the ability of cities to enhance *productivity*. Several mechanisms have been postulated, such as better access to specialized inputs, lower transportation costs for suppliers and customers, or externalities such as knowledge spillovers: see Glaeser (2008) for an overview. While the urban productivity premium is commonly measured with wages, as in Glaeser and Marè (2001), the benefits for workers have not to be limited to compensations. For instance, workers may be better matched in large cities, as suggested by Rosenthal and Strange (2004). Further, urban market size makes specialization possible: see Baumgartner (1988). At the same time, agglomeration also affects the *utility* of residents. Yet, whether cities are good or bad for residents is an open question. Conventional urban economics has stressed the disamenities of large metropolitan areas, such as pollution and crime: see, for instance, O' Sullivan (2003). However, some recent papers have argued that cities enhance consumption opportunities: see Glaeser et al. (2001), Glaeser and Saiz (2003), Glaeser and Gottlieb (2006), Shapiro (2003), and Carlino and Saiz (2008). For instance, services such as opera and restaurants, or aesthetic and physical attractions such as architecture, may be available in cities but not elsewhere. Moreover, cities may allow for the provision of specialized goods[1] or public goods that would not be available in smaller places.

Further, the evaluation of the utility effects of agglomeration may vary by skill-groups. More educated people are likely to care more about the quality-of-life and quality-of-job aspects of the area where they live. In particular, the idea that the skilled seem to enjoy some urban amenities more than the unskilled has found some empirical support in the US case. Adamson et al. (2004) show that returns to education for the skilled decline with the urban scale and interpret this finding as implying that urban amenities primarily affect skilled workers. Glaeser et al. (2001) notice that in cities with more educated populations rents have risen more quickly than wages since the Seventies, and interpret this as evidence that while productivity has gone up in places with more educated workers, the quality of life has risen even faster. See also Shapiro (2003).

[1] By looking at the radio listening patterns and newspaper purchases, Waldfogel (2003) and George and Waldfogel (2003) show that large markets allow goods to be tailored to the consumers' preferences.

We exploit the spatial equilibrium model originally introduced by Roback (1988) to consider the effects of agglomeration (city size) on both firms' productivity and utility of differently educated individuals. In particular, we assume that city residents have a taste for local amenities that depends on *their individual education level*.[2] The economy is partitioned in C non-overlapping areas, indexed by c=1,2,..C. There are two types of workers, skilled and unskilled, which are imperfect substitutes in production and supply inelastically one unit of labour. Moreover, workers and firms are assumed to be perfectly mobile across locations, while the supply of land, L_c, is fixed in each area. Land is used in both production and consumption, and landowners are absentee, which is, they do not live in the economy considered. Both production and utility functions are Cobb-Douglas, as in the basic spatial equilibrium model illustrated in Glaeser (2008). Such functions depend on the local level of agglomeration, defined by S_c. It holds that $S_c = \hat{n}_c + n_c$, where $\hat{n}_c$ and n_c denote, respectively, the supply of skilled and unskilled workers in area c. Local populations are endogenous, and their equilibrium values are derived and discussed in Appendix 1.

Firms are competitive and produce a homogeneous tradable good Y by using "land" and both types of labor with a constant-returns technology. The price of the good, p, is taken as the numeraire. The production function of firm j in area c is:

$$Y_{jc} = (S_c{}^{\sigma}) \cdot L_{jc}{}^{1-\alpha-\beta} \cdot \hat{N}_{jc}{}^{\alpha} \cdot N_{jc}{}^{\beta} \qquad (1)$$

where $(\alpha, \beta) > 0$, $\alpha + \beta < 1$; $\hat{N}_{jc}$ and N_{jc} denote, respectively, the skilled and unskilled labour input of firm j, and L_{jc} its use of land. The term $S_c{}^{\sigma}$ captures the impact of agglomeration S_c on local productivity. Drawing on existing evidence[3], we postulate that agglomeration has an unambiguously positive effect on productivity: that is, we assume that $\sigma > 0$. Since p=1, profit maximization implies that:

$$1 = \frac{r_c{}^{1-\alpha-\beta} \cdot \hat{w}_c^{\alpha} \cdot w_c^{\beta}}{\xi \cdot S_c{}^{\sigma}} \qquad (2)$$

where $\xi \equiv (1-\alpha-\beta)^{1-\alpha-\beta} \cdot \alpha^{\alpha} \cdot \beta^{\beta}$. Because of constant returns to scale, firms make zero profit in equilibrium and expression (2) can be interpreted as a "free-entry condition" in the product market.

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[2] Moretti (2008) also postulates heterogeneity in preferences depending on education levels. Differently, Brueckner et al. (1999) develop a model which treats urban amenities as normal goods. In their perspective, an increase in the "demand" for amenities will be simply driven by higher income. Since the educated earn more on average than the less educated, the educated will demand more amenities even *without* any preference bias (see also the discussion in Roback 1988, p.29). By contrast, Oreopoulos and Salvanes (2009) show that education strongly affects individuals' preferences *even after* controlling for income. Our results, see footnote n. 26, also suggest that preferences are heterogeneous across differently educated consumers.

[3] See e.g. Ciccone and Hall (1996) and Moretti (2008) among many others.

The utility of an *unskilled* individual *k* who lives and works in area *c* is given by:

$$U_{kc} = (S_c{}^{\rho}) \cdot L_{kc}^{1-\mu} \cdot Y_{kc}^{\mu} \qquad (3)$$

and is maximized under the budget constraint $w_c = r_c \cdot L_{kc} + Y_{kc}$, with $\mu \in (0,1)$. Here, L_{kc} denotes unskilled worker *k*'s consumption of land, and Y_{kc} denotes his consumption of the freely-tradable homogeneous good. The term $S_c{}^{\rho}$ picks the effects of agglomeration on the utility of worker *k* living in *c*. In principle, the parameter ρ can be either sign: city size may either raise or reduce the utility of residents due, e.g., to greater variety of services or more pollution.

The utility of a *skilled* individual *i* who lives and works in area *c* has the following form:

$$\hat{U}_{ic} = (S_c{}^{\rho}) \cdot (S_c{}^{\theta}) \cdot L_{ic}^{1-\mu} \cdot Y_{ic}^{\mu} \qquad (4)$$

and is maximized under the budget constraint $\hat{w}_c = r_c \cdot L_{ic} + Y_{ic}$. Here, L_{ic} denotes skilled worker *i*'s consumption of land, and Y_{ic} his consumption of the good. As for the unskilled, the term $S_c{}^{\rho}$ picks agglomeration effects on utility. However, we postulate that agglomeration can have a differential effect on the utility of a *skilled worker* also through the shifter $S_c{}^{\theta}$. Our maintained assumption is that larger cities offer consumption possibilities that educated individual are ready to evaluate more, relative to the less educated. For this reason, we postulate that $\theta \geq 0$.

In equilibrium, free-mobility implies that an unskilled worker will obtain the same level of utility v in each area *c*. Similarly, mobility will also entail that a skilled worker will enjoy the same utility $\hat{v}$ in each area of the economy.[4] Thus, maximization of utilities (3) and (4), together with free-mobility, imply the following:

$$v = \eta \cdot (S_c{}^{\rho}) \cdot \frac{w_c}{r_c^{1-\mu}} \qquad (5)$$

and

$$\hat{v} = \eta \cdot (S_c{}^{\rho+\theta}) \cdot \frac{\hat{w}_c}{r_c^{1-\mu}} \qquad (6)$$

[4] Formally, in equilibrium it must holds that $v_{kc} = v_{kc'} = v$ and $\hat{v}_{ic} = \hat{v}_{ic'} = \hat{v}$, for any $(c, c') = 1,2,....C$.

where $\eta = (1-\mu)^{1-\mu}\mu^{\mu}$. Expressions (2), (5) and (6) constitute a system of three equations in $(\hat{w}_c, w_c, r_c)$. The equilibrium values of local rents and wages are such that, given the level of agglomeration S_c across locations, no firm and no worker will have an incentive to move elsewhere.

As shown in Appendix 1, agglomeration S_c has the following effects on (the log of) local equilibrium prices:

$$\frac{d\log r_c}{dS_c} = \left(\frac{-1}{\Delta \cdot S_c}\right) \cdot \left\{\sigma + (\alpha+\beta)\rho + \alpha\theta\right\} \tag{7}$$

$$\frac{d\log \hat{w}_c}{dS_c} = \left(\frac{-1}{\Delta \cdot S_c}\right) \cdot \left\{(1-\mu)\sigma - (1-\alpha-\beta)\rho - (1-\alpha-\mu\beta)\theta\right\} \tag{8}$$

$$\frac{d\log w_c}{dS_c} = \left(\frac{-1}{\Delta \cdot S_c}\right) \cdot \left\{(1-\mu)\sigma - (1-\alpha-\beta)\rho + \alpha(1-\mu)\theta\right\} \tag{9}$$

where Δ is a negative constant.

To fix ideas, let us start by considering the case when agglomeration has similar effects on the utility, that is, suppose that $\theta \cong 0$. In this case, the skilled and the unskilled have the same preferences, and the impact of agglomeration on wages will exactly be the same (see expressions 8 and 9). In principle, agglomeration can generate both disamenities (such as pollution; in this case ρ tends to be negative) and amenities (in this case ρ tends to be positive) on residents' utility. However, it is not always possible to establish which effects will prevail, as claimed by the following Remark.

Remark 1. Provided that firms always benefit from agglomeration (i.e., $\sigma > 0$), one can identify whether amenities or disamenties will prevail only in the following two cases:

Case (i). When an increase in agglomeration generates a higher local rent and lower (or equal) wages, then urban amenities must prevail over disamenities.

Case (ii). When an increase in agglomeration generates a lower (or equal) local rent and higher wages, then urban disamenities must prevail over amenities.

By contrast,

Case (iii). When an increase in agglomeration generates both higher local rent and wages, it *cannot* be identified whether urban amenities or disamenities will prevail.

This Remark can be illustrated by referring to Figure 1, where we plot the isocost of a typical firm (the decreasing line denoted by $\overline{C}$) and the iso-utility curve (the increasing line $\overline{U}$) of a typical resident in the wage-rent space.[5] Starting from point H, suppose that city size increases. Given our assumptions about the positive effect of agglomeration on productivity[6], the new isocost $\overline{C}'$ will be located north-east of point H. By contrast, because of the intrinsically ambiguous effect of city size on utility, an increase in agglomeration can either shift the iso-utility north-west (when amenities prevail, as for $\overline{U}'$ in Figure 1) or south-east (when disamenities prevail, as for $\overline{U}''$). The mere observation that agglomeration has increased both rents and wages (as it happens in point A' and point B') is *not* sufficient to assess whether amenities or disamenities prevail. This occurrence corresponds to Case (iii) in Remark 1. By contrast, a point such as A where rents - but not wages - have gone up is unambiguously associated with a positive effect of agglomeration on utility: see Case (i). On the other hand, a point such as B in Figure 1 is unambiguously associated with dominating disamenities, which corresponds to Case (ii).

When we are able to determine whether amenities or disamenities prevail, the hypothesis that agglomeration has differentiated effects on utility across education classes has additional empirical implications. When the more educated evaluate more the consumption possibilities associated with city size (formally, when $\theta > 0$), then the following holds:

Remark 2. When $\theta > 0$, equations (8) and (9) imply that $\frac{d \log w_c}{dS_c} > \frac{d \log \hat{w}_c}{dS_c}$. Thus, the impact of city size on unskilled wages will be *larger* than the effect on skilled wages.

The intuition for Remark 2 is quite straightforward. Under the Cobb-Douglas technology used here, agglomeration has the *same* impact on skilled and unskilled productivity[7], but it unequally affects the utility of individuals. In particular, since the more educated have a preference bias toward city size, they will be ready to accept some wage discount and pay high rents to live in a larger city. By contrast, since the less educated are relatively less keen to live in larger towns, high rents must be (at least in part) compensated by higher wages.

In conclusion, the model above offers a straightforward way to test whether city size is such that amenities prevail over disamenities. When amenities prevail, bigger cities will be associated with higher

[5] With θ=0, the graph applies to both types of workers.
[6] The assumption that agglomeration favors productivity rules out the possibility that, when agglomeration increases, the isocost $\overline{C}$ will shift south-west of H, where it may hold that $\Delta r < 0$ and $\Delta w < 0$.
[7] The general validity of Remark 2 must be qualified. Under the Cobb-Douglas production function we adopt here, agglomeration has an equiproportional impact on the productivity of skilled and unskilled workers. Thus, as pointed out in Glaeser (2008, p.84), here the relative productivity of skilled and unskilled workers can only depend on the local composition of the labor force. However, with more general production functions, it might also occur that agglomeration affects skilled productivity disproportionately more relative to unskilled productivity. If this was the case, big cities might drive an increase in skilled wages relatively larger than the increase in unskilled wages, contrary to what *Remark* 2 predicts. This theoretical possibility is rejected by the evidence we present below.

rents. Moreover, according to Remark 2, city size is expected to produce larger wage increases among the less educated.

The model provides implications that can be tested with different degrees of depth. First, we have to gather evidence about the welfare effects of agglomeration on rents and wages. If we find that agglomeration generates both higher wages and higher rents, we cannot conclude whether amenities or disamenities dominate in cities. However, if we find – as we do below – that amenities dominate, then we can go on and test whether there is an education bias in the evaluation of city size.

III. Empirical Results

III.1 Data

Our main data source is the Survey of Household Income and Wealth (SHIW). This survey is conduced every two years by the Bank of Italy on a representative sample of about 8,000 households.[8] The SHIW collects detailed information on Italian households. For each member of the family, it gathers data on demographic features and economic behavior including wage, age, sex, marital status, work status, schooling, work history, and employer's branch of activity. Moreover, at the household level, the survey collects data on dwellings, including both the main family's house of residence and other property owned. For each dwelling, the SHIW collects several characteristics: rent, surface, location, year of construction, and additional information such as number of bathrooms and presence of a heating system. In the estimation below, we pool data from four waves (1993, 1995, 1998, and 2000).

The details of the variables used in the paper are reported in the Appendix 2. The dataset includes 27,754 dwelling's observations and 23,244 wage and salary worker's observations (the sample is restricted to workers of age between 15 and 65). Table 1 shows mean and standard deviation for the main variables. The average dwelling in our sample is large just over 100 squared meters and is 50 years old. In 35% of the cases it is endowed with more than one bathroom; in 80% of the cases the dwelling has an heating system. Within the city, 57% of the dwellings are located in the centre or in the area between the town centre and outskirts. The average worker's job experience is 22 years, and in 55% of the cases the educational attainment is equal or higher than high school diploma. Almost 40% of our sample is composed of females.

An important feature of the SHIW is the fact that the *standard* information on demographic and economic aspects, which are recorded regularly in every wave and are similar to those collected by other surveys such as the American PSID or CPS, are supplemented by special sections. These sections gather subjective data on aspects (such as individual expectations or cultural preferences) that are somewhat unusual in conventional economic surveys.[9] Below, we exploit the 1995 special section on *job satisfaction* and the 1993 special section on the *local quality of life*.

[8] See Bank of Italy (various years) for details. SHIW micro-data are publicly available at www.bancaditalia.it. However, for confidentiality reasons city codes are made available only to the staff of the Bank of Italy.

[9] The special sections are considered to be quite demanding for the respondents and very expensive for the Bank of Italy. This explains why special sections are not recurrent and are usually posed only to a subset of the respondents.

Dwellings (workers) are distributed over 380 (377) cities. The measure for city size is (the log of the) number of residing population as recorded by the Italian Statistical Institute, ISTAT. In addition, we also make use of a series of dummies, one for each of the following categories: Villages (up to 5,000 inhabitants); Large Villages (from 5,000 to 20,000 inhabitants); Small MAs (from 20,000 to 50,000 inhabitants); Midsize MAs (from 50,000 to 200,000 inhabitants); and Large MAs (more than 200,000 inhabitants). The 27,754 dwellings of our sample are distributed over the city size range as follows: 10% are located in Villages; 16% in Large Villages; 30% in Small MAs; 30% in Midsize MAs and 15% in Large MAs. For the IV estimation, we use the ISTAT (log of) total city land as instrument for the city size. Appendix 3 reports the names of the cities included in the sample for the two largest groups of Midsize and Large MAs. All regressions are based on appropriate weighted data.[10]

III.2 Results for Local Prices

By looking at the relation between city size, on the one hand, and rents and wages, on the other, the model developed in Section II may allow us to assess whether agglomeration is good or bad for residents' utility. Moreover, it allows us to test whether the impact on welfare differs across education groups. We now turn to the empirical evidence.

III.2.1 Rents

We start by considering the urban rent premium. Column 1 of Table 2 reports least-square results from a specification in which house rents (log of annual rents) are regressed on city size, controlling for nothing else than time dummies. This regression suggests that raw differences in house rents are quite pronounced: the coefficient on city size is equal to .07 and it is highly significant (s.e. = .01).

Heterogeneity in house characteristics across cities might be driving the observed differences.[11] To control for observable house features, Column 2 includes a number of standard regressors (see, e.g., Berger et al. 2008, and Gyourko et al. 1999): the surface area and the age of the dwelling, and dummies for the presence of two or more bathrooms and heating system. The regression also contains a set of dummies for the location of the dwelling within the city. The SHIW classifies location by six categories: isolated area, countryside; town outskirts, between outskirts and town center, town center, other, hamlet. A dummy for properties located in the south of Italy is also added.[12] Finally, we include a dummy for imputed rents.[13] The

[10] Our coefficient estimates however are not sensitive to weighting or not weighting the data.
[11] The advantage of our empirical approach is that by using micro-data we control for worker and house characteristics. For instance, Tabuchi and Yoshida (2000) use area averages and cannot disentangle the extent to which higher rents and wages depend on houses and workers of superior quality.
[12] As well known, the south of Italy differs from the center-northern territories in a number of respects: the south is generally poorer and less endowed with infrastructures. The south has also lower quality of local institutions, local public services, and property right protection. To make sure that city size dummies are not just picking up differences between center-north and south of Italy, we control for the southern location of the dwellings.
[13] The interviewed can be either the property owner or the tenant. In the first case, the SHIW collects the rent the owner charges (or, if the dwelling is not rented or it is the family residence, her best estimate for the rent she could charge). In the second case, the tenant reports the actual rent. The fraction of hypothetical rents in our sample is 77% (see Table 1).

effects of these variables on rents (not reported in the table) are as expected: rents are higher for larger and newer houses and for dwellings endowed with more than one bathroom and heating system. Location dummies enter with high significance: compared with dwellings located in the countryside, rents for the houses in the town center are 29 percent higher. The dummy for Southern locations is associated with a 30% discount on rents. As for the coefficients of interest, we find that the differences in rents across cities of different size are increased by the additional controls added. The coefficient on city size is now equal to .10 and remains highly significant.

Column 3 provides a robustness check concerning the way of measuring city size. We replace the continuous variable log of residing population with a series of dummy (Large Villages, Small MAs, Midsize MAs, Large MAs; with Villages representing the omitted category) to check for the presence of non-linearities. We find that the positive effect on rents found for Large MAs is almost twice as much as the impact found for Small and Midsize MAs. As an additional check, we also substitute the size of the city with the size of the local labor market area, which is a functional region related to its local labor market defined in terms of commuting conditions (OECD, 2002). Results (not reported, but available by the authors) were remarkably similar to those shown.[14]

Unobservable characteristics of the house and the neighborhood might bias these estimates. For instance, larger cities might display higher housing quality even after controlling for surface, age, bathrooms and heating; or might have suburbs of superior quality. To give a first evaluation of this issue, we use the subjective evaluations available in the SHIW, which refer respectively to the quality of the house and the area where the house is located.[15] The two subjective measures are clearly correlated with the observable characteristics of the houses, which represent our standard controls. This implies that their inclusion will reduce the coefficients on the observables. However, the two individual ratings are also likely to be correlated with unobservable house and location characteristics. Thus, their inclusion can provide a robustness check for the effect of city size with respect to unobservable features.[16] Column 4 describes the results we obtain by adding both the two subjective ratings. As expected, the two ratings are highly significant and their inclusion reduces the estimated effects of the observables (the explanatory power of the regression rises from 50% to 56%). Magnitude and significance of the coefficient on city size, however, remains undisputed.

On the one hand, hypothetical rents might reflect the interviewees' inaccurate knowledge of the housing market. On the other hand, actual rents reflect contractual arrangements that have been agreed years before. The latter effect seems to dominate, as we find that imputed rents are generally higher than actual rents.

[14] Since the emphasis of this paper is on local amenities, and many of them (such as public services) are provided by the municipality authority, we believe that the city represents a more sensible level of aggregation than the local labor market area, which includes a number of municipalities.

[15] In the first case, the interviewed has to answer to the question "How do you rate this dwelling" by picking one of the following answers: luxury, upscale, mid-range, modest, low-income, very-low income. In the second case, the question is "How do you rate the area in which this dwelling is located?" and the potential answers are recorded respectively as: upscale, run-down, neither upscale or run-down, other.

[16] The inclusion of subjective house ratings reduces the rent sample to 27,728 observations. As we checked, this reduction is not relevant for the results obtained before.

We also control for potential confounding factors at the local level: localization economies and human capital. While the focus of this paper is on urbanization economies, agglomeration effects can be due to the concentration of an industry rather than the size of a city itself (Rosenthal and Strange, 2004). To check that city size is not capturing the effect of industry concentration, we include a variable describing the degree of industrial agglomeration-like exhibited by each city. This variable, calculated by Cannari and Signorini (2000), has been used in the localization literature in de Blasio and Di Addario (2005).[17] Similarly, agglomeration effects can reflect the concentration of human capital at the local level (see: Moretti, 2004 and Dalmazzo and de Blasio, 2007a and 2007b for an application to Italy). Consequently, wages and rents would be increasing in local human capital, and the effect of agglomeration overestimated. To check for the role of human capital we also include the average years of schooling at the city level. Column 5 describes the results we obtain by adding both the additional controls. On the one hand, the measure for localization does not enter significantly. On the other hand, the measure for local human capital enters with a substantial magnitude and high significance. More importantly, after adding the two controls, the coefficients for city size decreases only moderately to .09.

Subsequently, we consider spatial fixed effects at increasingly finer partitions of the Italian territory. As suggested by Ciccone (2002), the introduction of increasing detailed spatial fixed affects allows us to control for spatially correlated omitted variables. Thus, Columns 6 and 7 re-run the baseline regression of Column 2 by using, respectively, 5 macro-regions, and 20 regions. Remarkably, the positive effect of city size persists.

So far, our results suggest that there is a positive correlation between city size and rents. This correlation seems to be robust. It survives after controlling for dwelling observable and unobservable characteristics; it does not depend on the way city size is measured; it is not due to localization economies or human capital; it is not driven by spatially correlated omitted variables. Still, one cannot be sure that this correlation can be interpreted as a causal relation running from city size to rents. There might still be some omitted determinants of rents that might be correlated with the size of the city: for example, a productivity shock might have a simultaneous impact on the size of the municipality and the prices of its real estate market. This problem can be tackled when one has an instrument for the city size. Such an instrument must account for the observed variation in city size, but it must not be correlated with the residual of the rents equation. Ciccone (2002) proposes “city land area” as an instrument for city population. The validity of this instrument relies on the fact that the city borders reflect historically predetermined administrative criteria rather than areas’ economic conditions. Thus, city’s area in itself should not be a determinant of current conditions, while being positively correlated to the level of population living there. Note that the plausibility

[17] Note, however, that in the Italian case the industrial clusters (so called *distretti industriali*) are basically a non-urban phenomenon, as they are concentrated in the small and midsize cities of the centre and north-east areas (in our sample, the correlation between city size and localization is as low as 0.15).

of this argument is particularly appealing in the case of Italy, where the borders of the municipalities reflect historical determinants that is some cases can be traced back to the middle age. As matter of fact, only 13% of the 380 cities included in our sample changed the extension of their area over the period 1860-1991. For those that experienced a change in the size of their territory, the average increase was equal to 3.6%. In Column 8, we present the IV estimation results that we obtain by using (the log of) city land as an instrument. They suggest that the omitted variable bias is not what drives our results. The point estimate for city size decreases modestly from .10 of the benchmark specification of Column 2 to .09, and remains statistically significant.

III.2.2 Wages

Glaeser and Maré (2001) found that workers in cities earn a substantial premium (33%) over their non-urban counterparts. Which is the urban premium for the Italian workers? The estimation procedure focuses on some version of the basic wage equation. Table 3 presents the results for individual log earnings (hourly wage rate) as the dependent variable. In Column 1, we start by showing that there are raw wage variations among residents of differently sized cities. The coefficient on population enters with a positive point estimate of .02 and high significance (s.e. = .00).

Next, we check whether raw differences are due to observed differences in workers' attributes. The specification in Column 2 includes the standard Mincerian set of individual characteristics: labor market experience,[18] its squared value, number of years of schooling, and two dummies for sex and marital status. Similarly to the rent-equation, the specification also includes a dummy for workers residing in the South. The results are in line with what is usually obtained in this kind of exercise.[19] We find that workers with high-school diploma and college graduates earn respectively 44% and 80% more than workers with an elementary school qualification (not reported in table). The remaining controls enter with standard signs. Wages increase up to 40 years of experience. Wages of women are 8 percent lower than men's wages. Married workers enjoy a 6 percent premium. Southern workers suffer a 11 percent wage discount. Crucially, by controlling for workers' attributes, the effect of city size on wages vanishes. This suggests that the raw urban wage differentials are entirely explained by observable differences in workers characteristics across cities of different size. Column 3 highlights that the absence of a wage premium is not due to the way we specify city size.

In Column 4 we add an additional set of individual controls, which refer to the worker's branch of activity, employer's size and job qualification.[20] In principle, it is debatable whether to include or not these

[18] The measure of work experience is calculated as the difference between worker's age at the survey date and the age when the first job was taken. Thus, this measure of experience is more accurate than the most widely used measure of seniority (*Experience = Age - Years of Schooling – 6*), which attributes "waiting unemployment" after school to work experience.

[19] For previous studies based on the SHIW, see Cannari and D'Alessio (1995) and Colussi (1997).

[20] In particular, we include dummies for industries (agriculture; manufacturing; building and construction; wholesale and retail trade, lodging and catering services; transport and communications; services of credit and insurance institutions; real estate and renting services, other professional, business activities; general government and other

controls. On the one hand, these additional controls take care of some of the unobservables. On the other hand, to the extent that the additional controls are likely to be determined simultaneously with the labor market outcome - their inclusion can lead to an underestimation of the true differences among areas (see Duranton and Monastiriotis, 2002). In Column 5, we also capture the impact of localization economies and local human capital on wages (see de Blasio and Di Addario, 2005 and Dalmazzo and de Blasio 2007a and 2007b). In Columns 6 and 7 we perform the sensitivity test for spatially correlated omitted variable. For all these experiments, we still find no impact of city size on wages.

Another concern is the extent to which our results are driven by spatial sorting. For instance, the absence of correlation between city size and earnings could be explained by the fact that workers with worse unobserved abilities are more likely to dwell in large cities. To tackle this issue, we use the confidential SHIW data on the birthplace of workers. This information is at the level of the 103 Italian Provinces that cover the country. While this is certainly not ideal, we should be able to track spatial sorting by looking at the labor market outcome for those who work where they were born (the 'stayers'), in comparison to the others (the 'movers').[21] By including an additional set of controls for movers/stayers to the specification reported in Column 2, we find that spatial sorting is not an issue (see Column 8). The average urban premium remains non-significant for both groups. Similarly, the interactions of city size with the dummy for movers does not enter significantly. To end with, Column 9 shows the IV results obtained by using (the log of) city land as instrument. Again, we fail to find any significant effect of agglomeration on wages.

Table 4 allows for interactions between city size and workers' observables. We find that higher education is not rewarded more in urban areas than elsewhere. On the contrary, the interaction terms between city size and education are negative[22]: for the college educated the interaction coefficient enters with a 5% statistical significance.[23]

In the following section we sum up all empirical results, and discuss their implications in the light of the theoretical predictions.

III.2.3 Interpretation of the Results for Local Prices

Italian urban residents pay substantial extra-rents. However, on average, they do not receive a wage premium, as commonly observed for the US or Japan.[24]

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private and public services). We also add dummies for employer's size (up to 4; from 5 to 19; from 20 to 49; from 50 to 99; from 100 to 499; 500 or more; not applicable - public-sector employee). Finally, we add dummies for the individual job qualification (blue-collar worker or similar; office worker or school teacher; junior manager cadre; manager, senior official).

[21] A similar procedure is followed by Charlot and Duranton (2004).

[22] Similarly, Di Addario and Patacchini (2008) find that returns to college in Italy are negatively correlated with the population size of the local labor market. However, as they claim, the explanation for this result is beyond the scope of their paper.

[23] Glaeser and Maré (2001) find that the urban wage premium increases with experience and interpret this result as suggesting that cities make workers more productive. We do not find cross effects between work experience and urban status.

[24] Existing evidence generally shows that large cities are associated with sizeable wage-premia, as shown for US data by, e.g., Glaeser and Maré (2001) and Ciccone and Peri (2006), and for Japanese cities by Tobuchi and Yoshida (2000).

According to the theoretical implications of the model, we can conclude that agglomeration mostly generates amenities: see Case (i) in Remark 1. In other words, a larger city size will generate a combination of rents and wages like the one in point A, in Figure 1. This evidence is consistent with the view that, in Italy, the advantages of cities largely depend on their consumption possibilities.[25]

Remark 2 from the theoretical model also suggests that, if the more educated put greater value on agglomeration amenities[26], they will be willing to accept relatively lower urban salaries. Our empirical evidence on education-specific wages substantiates this presumption. This can also explain why the more educated, being willing to accept "worse" conditions in terms of wages, are relatively more present in larger metropolitan areas. Our findings thus support the view that highly-educated individuals care more about urban amenities than their less-educated counterparts. Finally, the fact that the skilled-unskilled wage differential decreases with city size suggests that, in big Italian cities, skilled workers do not enjoy a "productivity premium" relative to the unskilled or, at least, that such a productivity premium is less relevant than the "amenity premium": on this, see Glaeser (2008).

Our results so far have been silent about the sources of urban amenities. In the next Section, we will try to identify some.

III.3 Possible Sources of Urban Amenities

Urban amenities may have to do with a variety of factors, ranging from the non-wage advantages of participating in a thick labor market to the possibility of enjoying a large variety of consumption amenities. For instance, a large labor market may affect turnover (Finney and Kohlhase, 2008), or the co-location benefits for high-power couples (Costa and Kahn, 2000). Also, as emphasized by Glaeser et al. (2001), city size seems to be relevant for many quality-of-life aspects. Clearly, the list of potential candidates for urban amenities is very long and research on this aspects is still limited. To investigate on some possible sources, we focus on subjective evaluations, provided by the SHIW survey, respectively on job satisfaction and quality of life.

In the 1995 wave of the SHIW, 2,809 employed individuals were asked the following question: "Apart from the economic aspects, how do you judge the overall satisfaction from your work?". The interviewed were required to provide a rating between 1 (lowest) and 5 (highest). Respondents were then asked to provide a finer judgment of their job satisfaction according to the following six criteria:

[25] The story is different for the US, where agglomeration seems to have predominant effects on local productivity. Rappaport (2008) shows that density is strongly correlated with several measures of amenities, and that high amenity levels are capitalized much more into higher rents than into lower wages. However, he argues that the relevance of amenities is limited by the fact there is still a positive correlation between density and wages in US cities. On the relative impact of productivity and amenity effects on wages in US metropolitan areas, see also Beeson and Eberts (1989). Albouy (2008) argues that the population size of US metropolitan areas does not seem to affect their quality-of-life: it seems that amenities from urban life are largely compensated by disamenities such as pollution and crime. Glaeser and Resseger (2009) suggest that that amenities are not likely to cause more skilled people to locate in large US metropolitan areas.

[26] To test the soundness of this "preference bias" assumption, we also regressed rents on individual education interacted with city size (results are available upon request). We found that in big cities, even after controlling for income, educated individuals tend to pay rents higher than those paid by the less educated.

environmental conditions (physical and social); dangerousness for life or health; effort required; how the job is interesting; consideration by others; concern about losing employment.

We show in Table 5 the results obtained by using job satisfaction indexes as the dependent variables. We estimate –for the overall index and for each of the six criteria of assessment– a Poisson regression model which has the same specification as the one in Table 3, Column 2. These results should be taken quite cautiously given their qualitative nature. Nonetheless, they suggest that there is a positive and significant impact of the city size on job satisfaction of high-skill individuals (Column 1). Results in Columns 2-7 show that agglomeration seem to benefit educated workers mainly through a better working environment. Those with a college degree also enjoy a higher consideration received from others. On the other hand, the interaction coefficient between college education and city size enters with a significantly negative sign when workers are asked about the risk of losing their job.

In the 1993 wave, SHIW respondents were asked to provide their own evaluation about a group of quality-of-life determinants. In particular, the household head was required to answer fifteen questions on both her/his personal and his/her family members' experience about quality of life in municipality of residence.[27] The fifteen questions on local quality of life concerned: Public Transportation, Health Services, Universities, Local Bureaucracy, Traffic Congestion, Water Quality, Nursery, Primary and Secondary School, Street Cleaning, Green Areas, Safety and Crime Control, Shopping Possibilities, Leisure Activities, Air Pollution, Noise Pollution. Respondents chose a number from 1 (lowest satisfaction) to 10 (highest satisfaction) for each feature.

Although some of these attributes, such as water quality, are not necessarily related to urban size, we estimate a single Poisson regression for each of these 15 indexes by using the same specification adopted in Column 2 of Table 3. The results, reported in Table 6, suggest a varied picture. The urban scale has a positive impact on the quality of life perceived by more educated workers when shopping possibilities (Column 11) and cultural consumption opportunities such as cinemas, theaters, and museums (Column 12) are considered. These findings are consistent with the idea that the educated are relatively more sensitive to urban consumption opportunities. Also, even though the evaluations of transportation (Column 1), health (Column 2) and schooling (Column 7) decrease with the size of the city, the deterioration perceived by the high-skilled is less intense. This might suggest that the educated have a more benevolent, or more informed, attitude toward big cities. Finally, noise pollution (Column 14) seems to bother the highly educated more than their less educated counterparts while, unsurprisingly, some other traditional urban disamenities, such as poorer street cleaning (Column 8) and higher crime levels (Column 10) do not seem to have a clear pattern across education groups.

Again, these results are only suggestive and should be taken quite cautiously. The aspects of local quality of life collected by the SHIW are only a subset of all the characteristics that can be relevant. For

[27] The question was: "On the basis of your personal experience and the experience of your family member (please, refer to actual experience and not to what you might have read on newspaper) how would you rate your municipality for the following aspects of the quality of life…".

example, the survey did not require any evaluation on aspects such as the architectural beauty of the city, which can be very relevant in the Italian case.

IV. Conclusion

Since Marshall, there is a wide consensus about the positive role of agglomeration on productivity. However, the concentration of people in cities can produce ambiguous effects on the welfare of residents. On the one hand, large urban populations generate disamenities such as traffic congestion and pollution. On the other hand, large cities allow for the provision of a wide array of consumption or job opportunities and specialized services. Further, amenities or disamenities can be evaluated differently, depending on the level of individual education.

We present a Roback model which explicitly considers the possibility that: (i) city size is a source of amenities or disamenities, and (ii) amenity evaluation is conditional to individual schooling. The model allows us to identify the cases when urban scale amenities dominate over disamenities. For the empirical analysis, we use a unique dataset on household and individual–level data for Italian cities. Our findings neatly show that urban size has, on average, a strong positive impact on rents and a negligible impact on wages. We interpret this as evidence that city size predominantly generates positive effects on residents' utility. Further, college-educated individuals seem to put more weight on urban amenities, since they pay high rents and are still willing to receive relatively lower wages to live in larger metropolitan areas.

Finally, we find that the sources of urban attractiveness, especially for the more educated, have to do both with better chances to find a satisfactory job in a large labor market, and with the wide availability of consumption amenities. In particular, the highly educated seem to benefit more from a better working environment, the consideration people have for their job, the wide array of urban shopping possibilities and cultural amenities made available by the concentration of cinemas, theaters, and museums.

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Figure 1: Agglomeration Effects on Rents and Wages

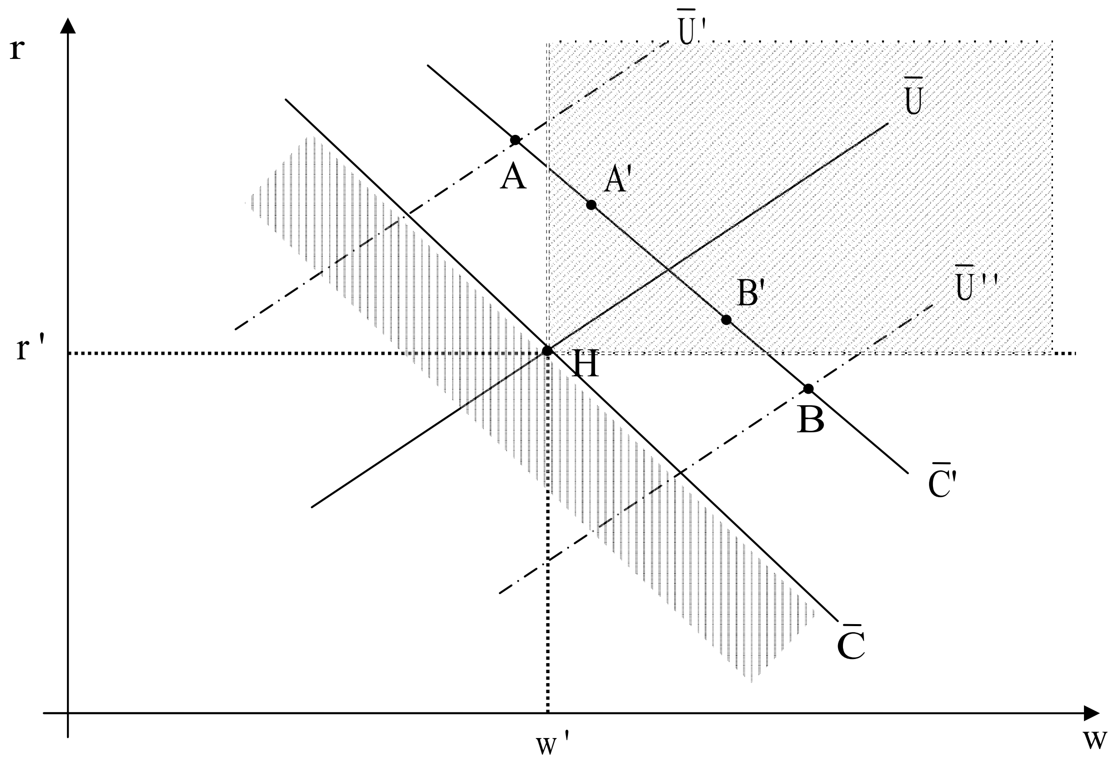


Table 1. Descriptive Statistics for the Main Variables

	Mean	Std. Dev.	Obs.
City Size	-1.772	-0.868	27,754
City Size dummies: Villages	0.101	0.302	27,754
Large Villages	0.156	0.363	27,754
Small MAs	0.298	0.457	27,754
Midsize MAs	0.297	0.458	27,754
Large MAs	0.147	0.354	27,754
(Log) Rents	8.712	0.709	27,754
Surface area (m2)	103.721	52.144	27,754
Age of the house	50.206	74.662	27,754
Bathrooms	0.350	0.484	27,754
Heating system	0.816	0.387	27,754
Imputed Rents	0.772	0.420	27,754
House location: Isolated area, countryside	0.063	0.242	27,754
Town outskirts	0.311	0.463	27,754
Between outskirts and town centre	0.322	0.467	27,754
Town Centre	0.252	0.434	27,754
Other	0.034	0.058	27,754
Hamlet	0.018	0.014	27,754
South	0.349	0.477	27,754
Localization	0.248	0.332	27,728
Local Human Capital	8.342	0.701	27,754
Educational Achievement: Elementary School	0.128	0.340	27,754
Junior High School	0.316	0.472	27,754
High School	0.425	0.492	27,754
College	0.120	0.321	27,754
City Land	0.129	0.186	27,754
(Log) Wages	2.464	0.406	23,244
Experience	22.219	11.720	23,244
Female	0.392	0.488	23,244
Married	0.669	0.471	23,244
Movers	0.222	0.416	22,719
Overall Job Satisfaction	3.564	1.078	2,809

Notes.- Source SHIW 1993-2000. The description of the variables is in the Appendix 2. Observations are weighted to population proportions. To save space, the table does not report summary statistics for the following variables: Subjective house ratings, Subjective Location Rating, Industries, Firm size, Job Qualifications, Single-item Evaluations of Job satisfaction, and Single-item Evaluations of Quality of Life.

Table 2. Effect of City Size on Rents

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
City Size	.066***	.101***		.097***	.090***	.102***	.102***	.087***
	(.012)	*(.009)*		*(.008)*	*(.010)*	*(.009)*	*(.008)*	*(.020)*
Size Dummies:								
i. Large Villages			.147***					
			(.045)					
ii. Small MAs			.280***					
			(.037)					
iii. Midsize MAs			.351***					
			(.037)					
iv. Large MAs			.595***					
			(.057)					
Localization					.054			
					(.035)			
Local Human Capital					.152***			
					(.032)			
Basic Controls	NO	YES	YES	YES	YES	YES	YES	YES
Additional Controls	NO	NO	NO	YES	NO	NO	NO	NO
Geo-Controls	NO	2	2	2	2	5	20	20
Estimation Method	LS	LS	LS	LS	LS	LS	LS	IV
R2	.08	.50	.50	.56	.50	.50	.51	.50
N. Obs.	27,754	27,754	27,754	27,728	27,754	27,754	27,754	27,754

Notes.- Source SHIW 1993-2000. The White robust standard errors reported in parentheses are corrected for the potential clustering of the residuals at the city level. Regressions include calendar year dummies. Regressions are weighted to population proportions. *** (**) [*] denotes significance at the 1% (5%) [10%] level. *Basic Controls* include: Surface area (m2), Age of the house, Dummy for two bathrooms, Dummy for heating system, Dummies for house's location, and Dummy for imputed rents. *Additional Control*s include: Dummies for subjective house rating and Dummies for subjective location rating, Household income. Column (8) reports results from IV estimation, with the (log of) City Land as instrument. See the Appendix 2 for more detailed variable definitions and sources.

Table 3. Effect of City Size on Wages

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
City Size	.023***	.002		-.001	.001	.003	.004	.002	.003
	(.004)	*(.003)*		*(.002)*	*(.003)*	*(.003)*	*(.003)*	*(.003)*	*(.005)*
Size Dummies:									
i. Large Villages			.010						
			(.019)						
ii. Small MAs			.004						
			(.017)						
iii. Midsize MAs			.013						
			(.017)						
iv. Large MAs			.025						
			(.019)						
Localization					.006				
					(.016)				
Local Human Capital					.014				
					(.014)				
Movers								.004	
								(.057)	
Pop × Movers								-.002	
								(.006)	
Basic Controls	NO	YES	YES	YES	YES	YES	YES	YES	YES
Additional Controls	NO	NO	NO	YES	NO	NO	NO	NO	NO
Geo-Controls	NO	2	2	2	2	5	20	2	2
Estimation Method	LS	LS	LS	LS	LS	LS	LS	LS	IV
R2	.03	.40	.40	.48	.40	.40	.41	.40	.40
N. Obs.	23,244	23,244	23,244	23,125	23,244	23,244	23,244	22,719	23,244

Notes.- Source SHIW 1993-2000. The White robust standard errors reported in parentheses are corrected for the potential clustering of the residuals at the city level. Regressions include calendar year dummies. Regressions are weighted to population proportions. *** (**) [*] denotes significance at the 1% (5%) [10%] level. *Basic Controls* include: Experience, Experience squared, Dummies for Education, Dummy if female, Dummy if married. *Additional Control*s include: Dummies for industries, Dummies for firm sizes, and Dummies for job qualifications. Column (8) reports results from a specification that allows for interactions between all the explanatory variables and the dummy Movers. Column (9) reports results from IV estimation, with the (log of) City Land as instrument. See the Appendix 2 for more detailed variable definitions and sources.

Table 4. Effect of City Size on Wages: Interactions of City Size and Human Capital Variables

	No Interaction	Interaction: City Size
City Size	.003	
	(.006)	
Education Dummies:		
i. Junior High School	.184***	.003
	(.024)	*(.006)*
ii. High School	.451***	-.010
	(.035)	*(.008)*
iii. College	.784***	-.021**
	(.040)	*(.009)*
Basic Controls	YES	
Additional Controls	NO	
Geo-Controls	2	
Estimation Method	LS	
R2	.40	
N. Obs.	23,244	

Notes.- Source SHIW 1993-2000. The White robust standard errors reported in parentheses are corrected for the potential clustering of the residuals at the city level. Regressions include calendar year dummies. Regressions are weighted to population proportions. *** (**) [*] denotes significance at the 1% (5%) [10%] level. The Table reports results from a specification that allows for interactions between all the explanatory variables and City Size (only City size and education variables, along with their interactions, are reported). Basic Controls include: Experience, Experience squared, Dummy if female, Dummy if married. See the Appendix 2 for more detailed variable definitions and sources.

Table 5. Effect of City Size on Job Satisfaction: Interactions of City Size and Human Capital Variables

	Overall Index		Single items											
Dependent Variables:	(1) Job satisfaction		(2) Environmental Conditions (Physical and Social)		(3) Dangerousness for Life or Health		(4) Effort Required		(5) Interestingness		(6) Consideration by Others		(7) Concern about Losing Your Employment	
	No Interaction	Interaction City Size	No Interaction	Interaction City Size	No Interaction	Interaction City Size	No Interaction	Interaction City Size	No Interaction	Interaction City Size	No Interaction	Interaction City Size	No Interaction	Interaction City Size
City Size	-.016		-.008		-.077**		-.004		-.004		.043**		.022	
	(.021)		*(.014)*		*(.030)*		*(.018)*		*(.014)*		*(.018)*		*(.031)*	
Education Dummies:														
Junior High School	.0007	-.009	.031	-.005	-.172**	.151***	-.012	.020*	-.011	-.016	.098*	-.046**	-.200***	-.005
	(.048)	*(.015)*	*(.045)*	*(.011)*	*(.068)*	*(.018)*	*(.042)*	*(.012)*	*(.037)*	*(.011)*	*(.053)*	*(.015)*	*(.064)*	*(.018)*
High School	.072	.047**	.079*	.031**	-.178**	.143***	.038	.025*	.054	-.010	.129**	-.046**	-.335***	-.010
	(.062)	*(.017)*	*(.044)*	*(.013)*	*(.088)*	*(.024)*	*(.053)*	*(.014)*	*(.044)*	*(.012)*	*(.055)*	*(.018)*	*(.091)*	*(.026)*
College	.065	.096***	.104**	.071**	-.221**	.184***	.080	.020*	.103***	-.004	.056	.058**	-.504***	-.050**
	(.067)	*(.018)*	*(.047)*	*(.015)*	*(.106)*	*(.035)*	*(.058)*	*(.014)*	*(.034)*	*(.013)*	*(.056)*	*(.023)*	*(.112)*	*(.024)*
Basic Controls	YES		YES		YES		YES		YES		YES		YES	
Additional Controls	NO		NO		NO		NO		NO		NO		NO	
Geo-Controls	2		2		2		2		2		2		2	
Estimation Method	Poisson		Poisson		Poisson		Poisson		Poisson		Poisson		Poisson	
Log Pseudolikelihood	-4792.139		-4692.821		-4559.629		-4787.444		-4826.833		-4745.463		-4600.043	
N. Obs.	2,809		2,809		2,809		2,809		2,809		2,809		2,809	

Notes.- Source: SHIW 1995. The dependent variables are the respondent's subjective evaluations (1=lowest satisfaction, 5=highest satisfaction) for overall job satisfaction and single-item criteria of job satisfaction. The White robust standard errors reported in parentheses are corrected for the potential clustering of the residuals at the city level. Regressions are weighted to population proportions. *** (**) [*] denotes significance at the 1% (5%) [10%] level. For each dependent variable, the Table reports results from a specification that allows for interactions between all the explanatory variables and City Size (only city size and education variables, along with their interactions, are reported). *Basic Controls* include: Experience, Experience squared, Dummy if female, and Dummy if married. See the Appendix 2 for more detailed variable definitions and source.

Table 6. Effect of City Size on the Quality of Life: Interactions of City Size and Human Capital Variables

	(1)		(2)		(3)		(4)		(5)		(6)	
Dependent Variables:	Public Transportation		Health Services		Local Bureaucracy		Traffic Congestion		Water Quality		Nursery	
	No Interaction	Interaction City Size	No Interaction	Interaction City Size	No Interaction	Interaction City Size	No Interaction	Interaction City Size	No Interaction	Interaction City Size	No Interaction	Interaction City Size
City Size	-.095		-.163***		-.068***		-.156***		-.023		-.007	
	(.035)		*(.020)*		*(.021)*		*(.026)*		*(.029)*		*(.016)*	
Education Dummies:												
Junior High School	.077	.014	-.079	.023	.140**	.031*	.064	.033**	.037	-.002	.078**	.012
	(.057)	*(.021)*	*(.068)*	*(.018)*	*(.063)*	*(.016)*	*(.049)*	*(.013)*	*(.060)*	*(.018)*	*(.039)*	*(.011)*
High School	-.006	.039**	-.089*	.029*	.194***	.032**	.080	.049**	.008	-.000	-.022	-.006
	(.054)	*(.017)*	*(.052)*	*(.015)*	*(.054)*	*(.014)*	*(.068)*	*(.019)*	*(.067)*	*(.022)*	*(.053)*	*(.015)*
College	-.014	.069**	.123***	.032***	.242***	.028*	.029	.015	.098	-.004	-.042	-.001
	(.056)	*(.024)*	*(.046)*	*(.015)*	*(.060)*	*(.015)*	*(.102)*	*(.030)*	*(.076)*	*(.025)*	*(.071)*	*(.020)*
Basic Controls	YES		YES		YES		YES		YES		YES	
Additional Controls	NO		NO		NO		NO		NO		NO	
Geo-Controls	2		2		2		2		2		2	
Estimation Method	Poisson		Poisson		Poisson		Poisson		Poisson		Poisson	
Log Pseudolikelihood	-12,978.144		-13,459.324		-13,171.819		-13,589.852		-14,846.591		-9,729.1897	
N. Obs.	3,716		3,716		3,716		3,716		3,716		3,716	

Notes.- Source: SHIW 1993. The dependent variables are the respondent's subjective evaluations (1=lowest satisfaction, 10=highest satisfaction) for the above Indexes of Quality of Life. The White robust standard errors reported in parentheses are corrected for the potential clustering of the residuals at the city level. Regressions are weighted to population proportions. *** (**) [*] denotes significance at the 1% (5%) [10%] level. For each dependent variable, the Table reports results from a specification that allows for interactions between all the explanatory variables and City Size (only city size and education variables, along with their interactions, are reported). *Basic Controls* include: Experience, Experience squared, Dummy if female, and Dummy if married. See the Appendix 2 for more detailed variable definitions and sources.

Table 6 (*continued*). Effect of City Size on the Quality of Life: Interactions of City Size and Human Capital Variables

Dependent Variables:	(7) Primary and Secondary School		(8) Street Cleaning		(9) Green Areas		(10) Safety and Crime Control		(11) Shopping Possibilities		(12) Leisure Activities (Cinemas, Theaters, etc.)	
	No Interaction	Interaction City Size	No Interaction	Interaction City Size	No Interaction	Interaction City Size	No Interaction	Interaction City Size	No Interaction	Interaction City Size	No Interaction	Interaction City Size
City Size	-.034**		-.033		-.082**		-.103***		.007		-.075	
	(.015)		*(.021)*		*(.039)*		*(.021)*		*(.036)*		*(.0541)*	
Education Dummies:												
Junior High School	.043	.005	-.010	.004	.096	.018	.011	.001	.057	.048**	.072	.060***
	(.035)	*(.011)*	*(.047)*	*(.012)*	*(.061)*	*(.016)*	*(.055)*	*(.014)*	*(.072)*	*(.019)*	*(.096)*	*(.026)*
High School	.010	-.001	-.012	.004	.136	.033	.075	.013	.069	.062**	.115	.090**
	(.038)	*(.012)*	*(.055)*	*(.014)*	*(.091)*	*(.029)*	*(.065)*	*(.018)*	*(.087)*	*(.023)*	*(.096)*	*(.035)*
College	.050	.024*	-.001	.011	.158	.040	.106*	.015	.098	.085**	.203*	.234***
	(.042)	*(.014)*	*(.058)*	*(.015)*	*(.113)*	*(.027)*	*(.057)*	*(.015)*	*(.095)*	*(.028)*	*(.105)*	*(.034)*
Basic Controls	YES		YES		YES		YES		YES		YES	
Additional Controls	NO		NO		NO		NO		NO		NO	
Geo-Controls	2		2		2		2		2		2	
Estimation Method	Poisson		Poisson		Poisson		Poisson		Poisson		Poisson	
Log Pseudolikelihood	-10,621.648		-13,213.174		-13,937.3		-13,334.287		-13,742.225		-13,719.883	
N. Obs.	3,716		3,716		3,716		3,716		3,716		3,716	

Notes.- Source: SHIW 1993. The dependent variables are the respondent's subjective evaluations (1=lowest satisfaction, 10=highest satisfaction) for the above Indexes of Quality of Life. The White robust standard errors reported in parentheses are corrected for the potential clustering of the residuals at the city level. Regressions are weighted to population proportions. *** (**) [*] denotes significance at the 1% (5%) [10%] level. For each dependent variable, the Table reports results from a specification that allows for interactions between all the explanatory variables and City Size (only city size and education variables, along with their interactions, are reported). *Basic Controls* include: Experience, Experience squared, Dummy if female, and Dummy if married. See the Appendix 2 for more detailed variable definitions and sources.

Table 6 (*continued*). Effect of City Size on Single Item Evaluations of Quality of Life: Interactions of City Size and Human Capital Variables

Dependent Variables:	(13) Air Pollution		(14) Noise Pollution		(15) *Universities*	
	No Interaction	Interaction: Pop	No Interaction	Interaction: Pop	No Interaction	Interaction: Pop
City Size	-.040**		-.070**		-.033	
	(.019)		*(.029)*		*(.021)*	
Education Dummies:						
Junior High School	.023	-.005	-.023	.005	-.010	.042**
	(.025)	*(.011)*	*(.020)*	*(.011)*	*(.027)*	*(.016)*
High School	.010	.001	-.050**	.031*	-.012	.045**
	(.028)	*(.012)*	*(.023)*	*(.017)*	*(.025)*	*(.018)*
College	.050	-.014	-.062**	-.054**	.001	.040*
	(.042)	*(.014)*	*(.026)*	*(.024)*	*(.028)*	*(.021)*
Basic Controls	YES		YES		YES	
Additional Controls	NO		NO		NO	
Geo-Controls	2		2		2	
Estimation Method	Poisson		Poisson		Poisson	
R2	-11,546.459		-13,778.012		-12,912.390	
N. Obs.	3,716		3,716		1,694	

Notes.- Source: SHIW 1993. The dependent variables are the respondent's subjective evaluations (1=lowest satisfaction, 10=highest satisfaction) for the above Indexes of Quality of Life. The White robust standard errors reported in parentheses are corrected for the potential clustering of the residuals at the city level. Regressions are weighted to population proportions. *** (**) [*] denotes significance at the 1% (5%) [10%] level. For each dependent variable, the Table reports results from a specification that allows for interactions between all the explanatory variables and Pop (only city size and education variables, along with their interactions, are reported). *Basic Controls* include: Experience, Experience squared, Dummy if female, and Dummy if married. See the Appendix 2 for more detailed variable definitions and sources.

Appendix 1

Derivation of Expressions (7), (8) and (9)

Taking logs and differentiating the system given by equations (2), (5) and (6) yields that:

$$\begin{bmatrix} -(1-\alpha-\beta) & -\alpha & -\beta \\ -(1-\mu) & 1 & 0 \\ -(1-\mu) & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} d\log r_c \\ d\log \hat{w}_c \\ d\log w_c \end{bmatrix} = \begin{bmatrix} -\sigma / S_c \\ -(\rho+\theta)/S_c \\ -\rho / S_c \end{bmatrix} \cdot dS_c$$

where the determinant $\Delta = -[1-\mu(\alpha+\beta)]$ is negative. Expressions (7), (8) and (9) immediately follow from the solution of this system.

Equilibrium City Size

The city size, defined as the sum of local unskilled and skilled populations, $S_c = n_c + \hat{n}_c$, is itself endogenous. The values $(n_c, \hat{n}_c)$ can be calculated following Roback (1988).

Profit maximization for firms located in area c implies that the demands for skilled labor $\hat{N}_c$, unskilled labor N_c, and land L_c are given, respectively, by:

$$\hat{N}_c = \frac{\alpha \cdot Y_c}{\hat{w}_c}, \quad N_c = \frac{\beta \cdot Y_c}{w_c}, \quad L_c = \frac{(1-\alpha-\beta)\cdot Y_c}{r_c} \qquad \text{(A1)}$$

In equilibrium, skilled labor demand $\hat{N}_c$ must be equal to its local supply $\hat{n}_c$. Also, unskilled labor demand N_c must be equal to local unskilled supply, n_c. Finally, the local supply of land, which is given and equal to $\bar{\ell}_c$, must be equal to the total demand for land, which is given by the sum of land demanded by firms (as from equation A1), plus the land demanded by the skilled workers, equal to $\hat{n}_c \cdot (1-\mu) \cdot \frac{\hat{w}_c}{r_c}$, plus the land demanded by the unskilled workers, $n_c \cdot (1-\mu) \cdot \frac{w_c}{r_c}$. Thus, the following three equations constitute a system in $\{Y_c, \hat{n}_c, n_c\}$, for any given price vector $\{r_c, \hat{w}_c, w_c\}$:

$$\hat{n}_c = \frac{\alpha \cdot Y_c}{\hat{w}_c} \qquad \text{(A2)}$$

$$n_c = \frac{\beta \cdot Y_c}{w_c} \qquad \text{(A3)}$$

$$\bar{\ell}_c = \frac{1}{r_c}\{(1-\alpha-\beta)\cdot Y_c + (1-\mu)\cdot \hat{n}_c \cdot \hat{w}_c + (1-\mu)\cdot n_c \cdot w_c\} \qquad \text{(A4)}$$

Using (A2) and (A3) to substitute $\{\hat{n}_c, n_c\}$ away in (A4), one obtains:

$$Y_c = \frac{\bar{\ell}_c \cdot r_c}{1-\mu(\alpha+\beta)} \qquad \text{(A5)}$$

which can be substituted back into (A2) and (A3) to obtain:

$$\hat{n}_c = \frac{\alpha}{\hat{w}_c}\left[\frac{\bar{\ell}_c \cdot r_c}{1-\mu(\alpha+\beta)}\right], \qquad \text{(A6)}$$

$$n_c = \frac{\beta}{w_c}\left[\frac{\bar{\ell}_c \cdot r_c}{1-\mu(\alpha+\beta)}\right]. \qquad \text{(A7)}$$

Thus, adding (A6) and (A7) side by side, and noticing that equations (5) and (6) in the text imply respectively that $w_c = \frac{r_c^{1-\mu} \cdot \nu}{\eta \cdot S_c^{\rho}}$ and $\hat{w}_c = \frac{r_c^{1-\mu} \cdot \hat{\nu}}{\eta \cdot S_c^{\rho+\theta}}$, "city size" $S_c = n_c + \hat{n}_c$ can be rewritten as:

$$S_c = \frac{\eta \cdot \bar{\ell}_c \cdot r_c(S_c)^{\mu}}{1-\mu(\alpha+\beta)}\left[\frac{\alpha}{\nu} \cdot S_c^{\rho} + \frac{\beta}{\hat{\nu}} \cdot S_c^{\rho+\theta}\right] \qquad \text{(A8)}$$

Expression (A8) implicitly characterizes the equilibrium value of city-size. Recall that, when urban amenities dominate over disamenties, the functions $r_c(S_c)$, S_c^{ρ} and $S_c^{\rho+\theta}$ are increasing in city size S_c. Thus, when a city experiments a rise in population people will find that city even more attractive, generating a self-reinforcing mechanism.

There is an interesting theoretical possibility here. Since the right-hand side of (A8) is increasing in S_c, it is quite immediate to show that (A8) has the following functional structure:

$$S_c = f(S_c) \equiv \Theta \cdot \left[a \cdot S_c^h + b \cdot S_c^g\right] \qquad \text{(A9)}$$

where (Θ, a, b, h, g) are positive constants. We argue that, since the function $f(S_c)$ is increasing in S_c, the model may deliver *multiple equilibria* in city size.

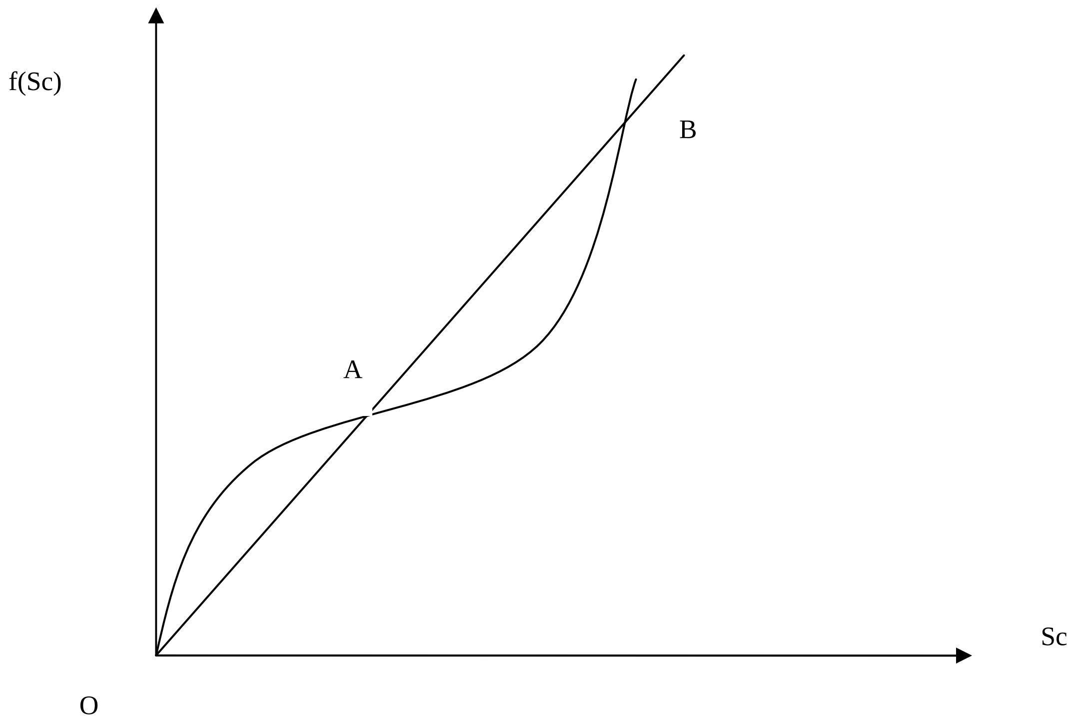
To characterize better the circumstances under which multiplicity can arise, notice first that $f(0) = 0$: the origin belongs to the function (point O in Figure A1 below), and city-size equal to zero is always a (degenerate) solution of the model. As claimed, the sign of the first derivative of the r.h.s. of (A9) is unambiguously positive, which is $f'(S_c) > 0$. On the other hand, the sign of the second derivative is as follows:

$$\text{sgn}\left(f''(S_c)\right) = \text{sgn}\left[a \cdot h \cdot (h-1) \cdot S_c^{h-2} + b \cdot g \cdot (g-1) \cdot S_c^{g-2}\right] \qquad \text{(A10)}$$

Thus, if it holds that $f''(S_c)$<0 for any $S_c \geq 0$, the function is globally *concave*, and there will be only *one* equilibrium where city-size is strictly positive. Global concavity occurs when *h* and *g* are both less than one.

By contrast, if $f''(S_c)$>0 for any $S_c \geq 0$, the function is globally *convex* and, again, there will be a *unique* equilibrium where city-size is strictly positive. Global convexity occurs when *h* and *g* are both greater than one.

However, when it holds that *h*<1 and *g*>1 (or, vice-versa, that *h*>1 and *g*<1), the function $f(S_c)$ can admit a flex-point, and it can exhibit a behaviour similar to the one illustrated in Figure A1:



Here, points O, A, B characterize different equilibrium city sizes for a *given* level of land endowment.

Although there may be multiple equilibria in city size, given technology and preferences, an equilibrium size is associated with a unique local price vector.

Appendix 2

Description of the variables

Variable	Description
Population	Resident population of the municipality (millions of inhabitants). Source: ISTAT. Population is also measured with use of a series of dummies, one for each of the following categories: Villages (up to 5,000 inhabitants); Large Villages (from 5,000 to 20,000 inhabitants); Small MAs (from 20,000 to 50,000 inhabitants); Midsize MAs (from 50,000 to 200,000 inhabitants); and Large MAs (more than 200,000 inhabitants).
Rents	Log of the annual rent. For each household, the interviewed can be either the property owner or the tenant. In the first case, the SHIW collects the rent the owner charges (or, if the dwelling is not rented or it is the family residence, her best estimate for the rent she could charge). In the second case, the tenant reports the actual rent paid. The sample is trimmed at the 1st and 99th and percentile of the distribution of rents.
Surface area (m2)	Area in square meters.
Age of the house	Calculated as the difference between the year of the survey and the year the house was constructed, which is a data available from the SHIW.
Bathrooms	Indicator variable equal to one if two or more bathrooms are available in the dwelling.
Heating system	Indicator variable equal to one if an heating system is available in the dwelling.
Imputed rents	Indicator variable equal to one if the rent is estimated by the interviewed. The interviewed can be either the property owner or the tenant. In the first case, the SHIW collects the rent the owner charges (or, if the dwelling is not rented or it is the family residence, her best estimate for the rent she could charge). In the second case, the tenant reports the actual rent.
House's location	Series of dummies for the location of the dwelling (isolated area, countryside; town outskirts; between outskirts and town center; town center; other; hamlet).
South	Indicator variable equal to one for the following Italian regions: Abruzzi, Molise, Campania, Puglia, Basilicata, Calabria, Sicilia, and Sardegna.
Localization	Variable describing for each city for the degree of industrial agglomeration-like features it exhibits. Source: Cannari and Signorini (2000).
Local Human Capital	Average years of schooling (1991) in the city where the dwelling is located or the individual resides. Source: ISTAT 1991
Wages	Log of hourly wages. Hourly wages are calculated by dividing the annual earnings (from any activity as employee, including fringe benefits, net of taxes and social security contributions) by the total amount of hours worked in a year (Average Hours Worked per Week × Months Worked × 4.3333). The sample is trimmed at the 1st and 99th and percentile of the distribution of earnings.
Educational achievement	Series of dummies for the worker's educational qualification: elementary school (5 years of schooling) ; junior high school (8 years of schooling); high school (13 years of schooling); college (18 years or more of schooling).
Experience	Calculated as the difference between worker's age at the survey date and the age at first job held, which is a data available from the SHIW.
Female	Indicator variable equal to one if the worker is a female.
Married	Indicator variable equal to one if the worker is married.
Movers	Indicator variable equal to one if a worker was born in a province different from that of residence.
Job Turnover	Number of work activities, including the temporary ones, performed in the worker's lifetime.
Job Satisfaction	Respondent's subjective evaluation (1=lowest satisfaction, 5=highest satisfaction). The question (posed only in the 1995 SHIW) was the following: "Apart from the economic aspects, how do you judge the overall satisfaction from your work?". Respondents were then asked to provide a finer judgement of their satisfaction according to the following six criteria: environmental conditions (physical and social); dangerousness for life or health; effort required; interestingness; consideration by others; concern about losing your employment.
Quality of life	Respondent's subjective evaluation (1=lowest satisfaction, 10=highest satisfaction. The question (posed only in the 1993 SHIW) was the following: "On the basis of your personal experience and the experience of your family member (please, refer to actual experience and not to what you might have read on newspaper) how would you rate your municipality for the following aspects of the quality of life: Public Transportation, Health Services, Universities, Local Bureaucracy, Traffic Congestion, Water Quality, Nursery, Primary and Secondary School, Street Cleaning, Green Areas, Safety and Crime Control, Shopping Possibilities, Leisure Activities, Air Pollution, Noise Pollution."

Appendix 3

List of Large MAs and Midsize MAs

Large MAs

Trieste; Bologna; Bari; Catania; Firenze; Genova; Taranto; Venezia; Messina; Napoli; Palermo; Padova; Verona; Roma; Milano; Torino.

Midsize MAs

Acireale; Afragola; Agrigento; Alessandria; Altamura; Ancona; Andria; Aprilia; Arezzo; Ascoli Piceno; Asti; Avellino; Aversa; Barletta; Benevento; Bergamo; Bisceglie; Bitonto; Bolzano – Bozen; Brescia; Brindisi; Busto Arsizio; Cagliari; Caltanissetta; Campobasso; Carpi; Carrara; Caserta; Casoria; Castellammare di Stabia; Catanzaro; Cava de' Tirreni; Cerignola; Cesena; Chieti; Chioggia; Cinisello Balsamo; Civitavecchia; Cologno Monzese; Como; Cosenza; Cremona; Crotone; Cuneo; Ercolano; Faenza; Fano; Ferrara; Foggia; Foligno; Forlì; Gela; Giugliano in Campania; Grosseto; Guidonia Montecelio; Imola; La Spezia; Lamezia Terme; L'Aquila; Latina; Lecce; Legnano; Livorno; Lucca; Manfredonia; Marsala; Massa; Matera; Mazara del Vallo; Modena; Modica; Molfetta; Moncalieri; Monza; Novara; Parma; Pavia; Perugia; Pesaro; Pescara; Piacenza; Pisa; Pistoia; Pordenone; Portici; Potenza; Pozzuoli; Prato; Quartu Sant'Elena; Ragusa; Ravenna; Reggio di Calabria; Reggio nell'Emilia; Rho; Rimini; Rivoli; Rovigo; Salerno; San Giorgio a Cremano; San Remo; San Severo; Sassari; Savona; Scandicci; Sesto San Giovanni; Siena; Siracusa; Teramo; Terni; Tivoli; Torre del Greco; Trani; Trapani; Trento; Treviso; Udine; Varese; Viareggio; Vicenza; Vigevano; Viterbo; Vittoria.