Local Labor Market Heterogeneity in Italy: Estimates and Simulations Using Responses to Labor Demand Shocks*

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Emanuele Ciani[ab†], Francesco David[c] and Guido de Blasio[a]

[a] Bank of Italy, Structural Economic Analysis Directorate, Via Nazionale 91, 00184 Roma, Italy

[b] Centre for the Analysis of Public Policies, University of Modena and Reggio Emilia, viale Berengario 51, 41121 Modena, Italy

[c] Bank of Italy, Regional Economic Research Division, Palermo Branch, via Camillo Benso Conte di Cavour, 131/A, 90133 Palermo, Italy

Abstract

Using different sources of data from Italian local labor markets (LLMs) between 1971 and 2011, the paper documents a number of stylized facts: a) the local differences in private employment to population rates are highly persistent; b) population shows a limited reaction to labor demand shocks, in line with the high rigidity of nominal wages and pro-cyclical variations in rents, which absorb the gains (losses) from higher (lower) employment rate; c) labor demand shocks are quite persistent and unevenly distributed, affecting those areas that were already lagging behind and boosting those that were more advanced; d) shocks are also amplified by the non-linearity of the employment adjustment, which reacts more to negative shocks than to positive ones. The estimated reactions to the shocks are then used to perform policy-motivated simulations. We find that allowing greater population reactions seems to be a superior policy option. If Italy had experienced the population reactivity of the US, local disparities would have significantly reduced, as much as what would have happened with a sizable intervention in lagging behind areas.

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† Corresponding author: emanuele.ciani@bancaditalia.it, Tel.: +39 0647924601

1. Introduction

Aggregate nation-wide trends in employment are often the result of heterogeneous local dynamics. For instance, Census data from the Italian Local Labor Markets (LLMs) show that the interquartile range in the local private employment to population ratio increased by almost 6 percentage points between 1971 and 2001, with only a slight decrease during the last available decade (2001-11). One of the main reasons is that areas characterized by a different economic structure tend to be hit by different labor demand shocks. Those specialized in sectors with worse performance will be more likely to show a decline in their relative employment with respect to the rest of the country, while those specialized in expanding sectors are likely to climb the ladder.

Nevertheless, the difference between the local and the aggregate employment and population dynamics depends on the reallocation of factors and the adjustment of local prices (see, for instance, Blanchard and Katz, 1992). Migration plays an important role, because the local unemployment toll may be alleviated if those who lose a job move elsewhere. With perfect mobility, individuals should move from declining to expanding LLMs in order to gain from better chances of getting a job. In other terms, population movement should be sufficient to avoid an increase in the geographical heterogeneity of the employment over population ratio. Mobility is also highly influenced by changes in relative wages and house prices. Take, for instance, an area where local labor demand is declining with respect to the overall nation-wide trend. This relative negative shock might be counterbalanced if wages can be reduced (or if their overtime increase can be contained with respect to other areas), thereby increasing the local comparative advantage. On the same line, a decrease in house prices may counterbalance the loss in the attractiveness of the area.

Italian LLMs seem to display a quite strong persistence in the private employment over population rate (Figure 1a; see also Bertola and Ichino, 1995). Although data constraints limit the analysis to private employment, it is interesting to notice (Table 1) that the autocorrelation is quite stronger than the one for the US estimated by Amior and Manning (2015). This high persistence may be due to two related mechanisms. On the one hand, Figure 1b shows that changes in overall employment are generally associated with small population reactions, so that the adjustment in the private employment over population ratio is quite limited. This implies that variation in employment tend to have lasting effects on the local economies. On the other hand, the labor demand shocks causing the changes in

employment may reduce the heterogeneity only if they tend to revert the economic fortunes of each area. Differently, they may increase it if they tend to be persistent and positively associated with initial employment levels, so that lagging-behind areas tend to be hit by negative shocks.

[Figure 1 about here]

[Table 1 about here]

In this work we inspect both sides by looking at the dynamics of private employment and working age population in Italian LLMs, using decadal changes observed in the Italian Censuses between 1971 and 2011. We focus on the labor demand side, analyzing the impact of local labor demand shocks on employment and working age population. Following Bartik (1991) and Blanchard and Katz (1992) we measure these shocks by applying nation-wide growth in each sector to the sectoral composition in the LLM at the beginning of the period. We first provide evidence about the limited population mobility, which may also be amplified by the limited elasticity of wages to local labor demand shocks, in contrast to house prices that seem to be positively related. We then show that labor demand shocks have been quite persistent, negatively affecting areas that were already lagging-behind and boosting those that were more advanced. Finally, we perform some simulations using predictions from our estimates to understand whether increasing population reactivity would have significantly reduced the increase in the employment rate dispersion. We compare it with a public policy that, keeping the same population reaction, boosted the local economies which started from a lower private employment rate. We find that granting greater population reactions would be a step in the right direction, as the alternative policy option would entail sizable fiscal transfers.

The paper contributes to the literature analyzing the reactivity of LLMs to local labor demand shocks. Our approach takes inspiration from Bartik (1991) and Blanchard and Katz (1992), who analyzed how the employment and population adjusts dynamically to a shock in labor demand.[2] However, our exercise is closer to Amior and Manning (2015), who try to

[2] A non-exhaustive list of other papers in this stream of literature includes Decressin and Fatás (1995), who compare European adjustments to the US ones, finding that migration plays a less relevant role in the former; Bound and Holzer (2000), who study the role of mobility across different groups of the population in the US during the 80s; Dao et al (2014), who extend the Blanchard and Katz's analysis to a longer period and to European regions; Beyer and Smets (2015), who reassess the adjustment of regional labor market in Europe and in the US.

explain the strong persistence of the local employment to population rate in the US commuting zones. Similarly to us, the authors focus on decadal long adjustments in population using Bartik shocks as a source of exogenous variation, but they estimate a dynamic model where adjustments also depends on the initial level of the employment rate and not only on employment growth. Their findings suggest that the main driver over the long run is the high autocorrelation of the local labor demand shocks. Population mobility appears to be quite large, although it is not sufficient to absorb shocks within a decade. For Italy we find that, instead, the low population elasticity plays a very important role, although we also find that the distribution and persistence of shocks contribute to the diverging economic fortunes of the LLMs.[3] Amior and Manning also conclude that both wages and house prices increase with employment growth, while our results suggest a small wage elasticity opposed to a positive relation with house prices. Another closely related paper is Détang-Dessendre et al (2016), who focus on French local labor markets. Using a variation of Bartik shocks as an instrument for employment growth, they study whether an increase in local employment leads only to adjustments in the employment and activity rate or is also absorbed through immigration and commuting.[4] Their results, that refer to periods ranging from 5 to 9 years, suggest that the flexibility of French local labor markets is not far from the one in the US, differently from what we find for Italy. Differently from us, the authors do not analyze responses in wages and house prices, although they focus also on labor force participation and commuting, which we do not analyze. Finally, we also follow Notowidigdo (2011) and study the non-linearity of the employment and population elasticity to the shocks. This is useful to understand whether the population reaction is more important in upturns than in downturns. While he finds a convex reaction of employment and population to labor demand shocks in the US, we find that in Italy the relation is at most concave for employment and definitely quite linear and flat for population.

Our findings confirm results from a large literature that highlights the limited mobility of population in Italy. Several papers analyzes the responsiveness of population and

[3] Interestingly, in more recent years also the US exhibited declining migration rates (Molloy et al, 2011), in particular during downturns. Dao et al (2014) suggest that the population response has been decreasing since the nineties, while Autor et al (2013) show that it has not been sufficient to compensate the job-loss in areas specialized in sectors affected by the exposure to trade with China. This is questioned by Monras (2015), who argue that during downturns shocks are mostly absorbed by reduced in-migration rates, rather than out-migration.

[4] Partridge et al (2009) perform a similar exercise for the US.

migration to regional changes in employment (or unemployment), wages and social transfers. Decressin and Fatás (1995) use a framework similar to Blanchard and Katz (1992) and find that the regional migration response to employment changes is very limited in Italy compared to other countries, although they do not instrument employment using a proxy of demand shocks. Faini et al (1997) discussed that the puzzling evidence of increasing unemployment North-South differentials and decreasing migrations. Bentivogli and Pagano (1999) estimate the relation between labor mobility, unemployment and income (and its variance) in Europe and in the US, suggesting that the elasticities are stronger in the latter. Brunello et al (2001) showed that migration from the South to the rest of the country shrunk in the 80s and 90s because of reducing wage differentials and increasing transfers, although only part of the divide could have been absorbed if migration had been as it was during the 70s. We contribute to this literature in several respects. First of all, we are the first to analyze the response of the population to labor demand shocks at the LLM level over a long period of time (1971-2011).[5] We believe that the LLM is a more interesting unit of spatial analysis than regions, because it is designed to represent an approximately self-contained area in terms of commuting. Furthermore, once we account for the strong differences between the South and the Centre-North, around 2/3 of the remaining variance of the time-demeaned private employment to population rate at the LLM level is within regions. Secondly, even if we use a simplified empirical specification that does not account for dynamics, we directly focus on a the reactivity of employment, population, house prices and wages to a plausibly exogenous proxy of labor demand shocks, while previous papers generally looked at the relation between the different outcomes using their lagged values as instruments. We also study non-linearities of the local labor market adjustments to demand shocks, which have not been discussed in any of the previous papers for Italy. Finally, we make use of the estimated reactions to shocks to simulate and compare two hypothetical policy options.

The paper is structured as follows. Section 2 briefly illustrates the empirical framework. Sections 3 to 5 discuss the results. Section 6 proposes some policy-motivated simulations. Section 7 concludes, highlighting the links between our estimates and the previous literature.

[5] Fasani (2011) studies the impact of labor demand shocks at the provincial level on the deportation of undocumented immigrants. Although the two topics are related, his research question is far from ours.

2. Empirical framework and data

Our main aim is to analyze how local economies react to labor demand shocks, in particular whether the population movement is sufficient to compensate the change in private employment. For the measure of the shocks we follow the approach proposed by Bartik (1991) and used, among others, by Blanchard and Katz (1992), Notowidigdo (2011) and Amior and Manning (2015). We use nation-wide variations in single industries and we apply them to each LLM industry-mix (as measured at the beginning of each Census period). We define E_{ikt} as the private employment in LLM i ($i=1,\dots,n$), in industry k ($k=1,\dots,K$) at time t ($t=1971,1981,\dots,2011$). Then, we obtain a measure of the predicted growth in private employment by multiplying the industry-mix at time $t-1$ for the change in each single industry employment in the rest of the country (indexed as $-i$):

$$\Delta\theta_{it} = \sum_{k=1}^{K} \omega_{ikt-1} \left(\frac{E_{-ikt} - E_{-ikt-1}}{E_{-ikt-1}} \right) \qquad (1)$$

where $\omega_{ikt} = E_{ikt}/E_{it}$ is the share of industry k in total employment in LLM i at time t. E_{-ikt} refers to total national employment minus the employment in LLM i. The idea underlying our measure of the local shocks is that each LLM is small enough so that nation-wide changes are exogenous to it. In other words, the beginning of the period industry mix interacted with the employment growth in the single industries is assumed to be unrelated with other changes occurring at the local level that may affect employment and population. The industries k are defined using the A The plausibility of this assumption is checked in Section 3.1, where we analyze the LLMs highly specialized in a particular industry and that, at the same time, represent a substantial share of the workers in that industry at the national level.

To analyze the impact of the labor demand shocks on the local economies we study how the shocks relate to the growth in different outcomes, $\Delta y_{it} = (y_{it} - y_{it-1})/y_{it-1}$, by running the regression:

$$\Delta y_{it} = \beta_y \times \Delta\theta_{it} + \gamma_t + \Delta\varepsilon_{it} \qquad (2)$$

where γ_t are decade fixed effects. We mainly focus on private employment and population reactions, but we also present evidence about the reactivity of wages and house prices in order to understand the sources of the rigidity of Italian LLMs.

In order to understand whether population reaction is sufficient to compensate the private employment growth due to the demand shock, we compare the coefficient β_{pop} withβ_E. If the former is smaller than the latter, it means that the growth (contraction) in population is smaller than the one in employment, and therefore the employment rate increases (decreases). Notice that β_{pop}/β_E is exactly the 2SLS regression of population growth on employment growth, with the latter instrumented by the shock.

Given that the regressions are similar to using first differences, we are implicitly accounting for LLMs specific effects that are constant over time. Due to the presence of significant outliers and long tails, we always censor all variables (shocks and growth in the outcomes) at the 5th and 95th percentiles. We do this separately by decade, to avoid ending up with only one decade being strongly censored. To check whether results are driven by censoring, we also analyze whether our main result about population reactivity changes when we only censor at the 1st and 99th percentiles.

All the main data come from the Censuses conducted every decade from 1971 to 2011.[6] Our unit of analysis is the Local Labor Market (LLM), which has been defined by the National Statistical Office (ISTAT) as a relatively self-contained area in terms of commuting for working reasons. We use the definition based on the "commuting-to-work" data from the 2001 census, which identifies 686 LLMs, but we also check whether results are significantly different using an older definition, based on the 1981 Census commuting matrix.[7] The Service and Manufacturing Census have been subject to several changes across time, both with respect to the unit of analysis and the range of activities covered. Nevertheless, ISTAT provides a fully harmonized set of data at the LLM level for the decades from 1971 to 2001, in which elementary data have been corrected in order to keep the analysis consistent with the definitions from year 1971. Differently, there is currently no available harmonized dataset for 2011. Given that major changes occurred between 2001 and 2011, in particular with respect to the classification of economic activity, we keep the analysis of the last decade separate.

[6] Data at the local level have been extracted from ISTAT database "Atlante statistico dei comuni", February 2014 edition, available at http://www.istat.it/it/archivio/113712 (last access: 03/06/2015).

[7] The map was recently revised using the new method that was implemented with the 2011 Census. At the moment of writing, the data at the local level that have been used in this paper are not available for this new definition.

Employment is defined as the number of labor units for each local unit (plant) of a private enterprise in manufacturing or services. It excludes the public sector, apart from those public companies (such as railways and mail services) that produce goods or services that are sold on the market. Between 1971 and 2001 Industries are defined at the three digit economic activity ATECO 1991 code, corresponding to Eurostat's NACE rev. 1. In this period of time Istat provides us with comparable data across the waves. Minor industries with zero national employment in at least one decade cannot be employed for calculating variations, and therefore we aggregated them with the closest industry at the third digit level. We end up with 174 industries, for which we can always calculate Bartik shocks as the leave-one-out employment growth is always different from zero. From 2001 to 2011 the ATECO code has been revised twice, in 2002 and 2007. The changes do not allow to map each three digit code of the 1991 classification (still in use in 2001) to those of the 2007 one (in use in 2011). However, we reaggregated the 1991, 2002 and 2007 classifications so that they match 1:1 with each other. This is done through an algorithm, which is described in more details in the Data Appendix. Unfortunately, census data do not consider agriculture. However, in the period under analysis, the agricultural share of employment declined all over Italy.

We limit the analysis to private employment for two main reasons. First of all, the census for employment in public institutions is available only from 1981, and it changed quite substantially in 1991, with a large extension in the coverage of sectors and type of units. Given that the last decade (2001-11) has to be analyzed separately for the reasons mentioned above, this would limit the possibility to inspect persistence and the dynamics in the longer run. Secondly, public employment may be used also to counteract unemployment and as a mean to transfer resources to poorer areas. This implies that its dynamics, and its effects on the local economy, need to be inspected separately from private employment. We defer to Auricchio et al (2016), who develop an analysis of the impact of public employment on local economies using the available data for Italy.

Population refers to the number of resident individuals. Notice that commuting implies that the number of resident individual differs from that of individuals working in the

LLM. Nevertheless, the definition of LLM should minimize this difference. We focus on working age individuals, between 15 and 64.[8]

Unfortunately, the Census does neither collect any information on wages nor on house prices. In order to study their reactivity to labor demand shocks, we use three additional data sources. For the private sector wages, we use a dataset on the universe of private firms provided by the National Social Insurance Institute (INPS), which is available from 1990. The two main limitations of using this dataset are that (i) it does not include income for self-employed, who are instead part of the private employment units collected by the census data, and (ii) data refer to the municipality where the firm is registered and therefore we cannot distinguish different plants. Nevertheless, to the best of our knowledge this is the only source that allows us to calculate wages at the LLM level for the years 1991 and 2001. Instead of using the average wage at the LLM level, we calculated LLM effects in each year by netting out sectoral composition, in order to avoid decadal growth to reflect compositional changes. In some years for some smaller LLMs we have less than 5 firms for which we are able to use info on wages, and therefore we exclude 45 LLMs from the analysis; see the data Appendix for more details on the treatment of wage data. For house prices we use two sources of data: *Il Consulente immobiliare* (an industry-related review published by Il Sole 24 Ore media group), which collects data on prices in the main Italian cities since 1965, and the *Osservatorio del mercato immobiliare* (OMI; run by an agency of the Ministry of Finance), which has a deeper geographical coverage (virtually all Italian municipalities) starting in 2003. More information on both datasets can be found in the data Appendix.

In Table 2 we describe some sample statistics about the growth in the outcomes and the shocks between 1971 and 2001. The distribution of employment growth is slightly skewed towards negative values, as the median is smaller than the average. Population is more stable, with a more symmetric distribution. Differences across LLMs in the levels of the outcome variables are also due to the presence of some urban LLMs that have higher population and employment. The ratio between employment and population is quite heterogeneous, as expected given the strong geographical differences that characterizes Italy (see, for instance, Accetturo et al, 2009 and references therein).

[8] We cannot restrict employment to this particular age class. However, for the decades that we consider this seems to be a minor concern, given that few individuals worked after reaching age 65.

The distribution of shocks is presented graphically in Figure 2, which displays their time-demeaned values by decade. It is quite symmetric in the middle one (1981-1991). Differently, it is skewed towards the left in 1971-1981, while it is more dispersed in the last decade.

[Table 2 approximately here]

[Figure 2 approximately here]

Employment is responsive to shocks. Table 3 column 1, shows that a 1% shock increases employment by around 0.5%. Nevertheless, this result is quite far from estimates from other countries. For instance, estimates from the US usually estimate an elasticity equal to one (see, for instance, Amior and Manning, 2015) or greater (Notowidigdo, 2011). The limited elasticity of Italian employment to labor demand shocks is in line with previous evidence (de Blasio and Menon, 2011) which suggest a very limited multiplier for tradable sector shocks on local economies. The reaction of employment may be different for negative and positive shocks. Hence in Section 4 we further inspect the non-linearities and the comparison with the US.

3. Limited mobility

3.1 Low population reaction to private employment

The second column of Table 3 shows a simple linear regression of the variation of population with respect to the growth in private employment. As discussed with reference to Figure 1, this relation is quite limited, although obviously positive. In order to focus only on working age population growth induced by labor demand shocks, in the third column we use as explanatory variable the Bartik shock $\Delta\theta_{it}$. The elasticity is around 0.2, less than half the elasticity of private employment with respect to the shock. This implies that the population reaction compensates only around half of the variation in private employment induced by labor demand shocks. This is captured by the 2SLS regression in the fourth column, and it implies that the private employment to population rate increases by 0.5 percent after a labor demand shock by 1 percent.

[Table 3 approximately here]

One possible comparison is with the responses estimated for the US by Amior and Manning (2015), who also focused on decadal changes in employment and (working age)

population in commuting zones, using data from 1950 to 2010.[9] To be precise, they estimate a dynamic specification where population responds not only to contemporary shocks but also to the lagged employment over population rate. When they estimate a specification similar to ours, also instrumented by Bartik shocks, they obtain a coefficient of 0.82 (idem, pg. 17), much larger than our estimates. Differently, their preferred estimates for the dynamic equation are an elasticity of population to contemporaneous growth of 0.66 and to the lagged employment rate of 0.44. Both lead to a non-negligible adjustment of population to present and past shocks. Given the shortness of our series (3 decades as opposed to 6 in their data), we prefer to focus on the estimate of the contemporaneous effect. Nevertheless, if we estimate a similar specification as theirs we obtain a population elasticity to contemporaneous growth of 0.12 and to the lagged employment rate of 0.16, much lower than what they observe for the US.[10]

Another useful comparison is with the French results from Détang-Dessendre et al (2016). The authors use Census data for changes during four periods of different length, 1982-1990, 1990-1999, 1999-2006 and 2006-2011. Their main specification analyzes the impact of employment growth on all margins of adjustment, both internal (employment and activity rate) and external (population and net commuting changes). Employment growth is instrumented using a variation of Bartik shocks, called "Regress-M", where predicted changes are based on a regression using sectoral distribution at the beginning of the period and at the beginning of the two previous periods. Their estimates of (working-age) population elasticity to employment growth range from 0.5 to 0.7 in rural areas and from 0.6 to 0.8 in urban ones, which are closer to the results for the US, while our estimates are consistently below 0.5.

Results may be quite different by area. The South of the country, which includes also the two main islands (Sicily and Sardinia), displays lower productivity and has been characterized, particularly during the seventies, by stronger migratory movements towards the Centre-North. However, the cost of living is lower in the South, so that the nominal wage

[9] Also Beaudry et al (2014) study decadal changes, but their specification for population changes is derived from a structural model and aims at assessing changes in utility level. Therefore it includes as explanatory variables changes in the employment rate, in house prices and wages, which make it hardly comparable to ours.

[10] Similarly to them, we instrument the contemporaneous growth in employment using the Bartik shock, and the lagged employment rate using the lagged Bartik shock. Instruments are strong, with an F larger then 10, in both first stages.

could be smaller while preserving the same purchasing power (see: Boeri et al, 2014). The first two columns of Table 4 show that indeed the population reactivity is larger in the South. However, in both cases the adjustment is not sufficient to compensate the growth (or contraction) of private employment.

[Table 4 approximately here]

Interestingly, the changes in the reactivity over the decades seem to reflect the aggregate migration trends. As discussed by Mocetti and Porello (2010), gross migration was stronger in the seventies, decreased substantially in the eighties, and finally showed an upsurge at the end of the nineties. The estimated reactions of population to private employment variation, in the last three columns of Table 4, display a similar pattern.

[Table 5 approximately here]

Table 5 shows results for the most recent decade, 2001-2011. The reaction of private employment to the shock itself is stronger. This is actually in line with a trend in the estimates of this elasticity that is observed also in the 1971-2001 sample, where it grows from 0.36 in the first decade to 0.62 in 1991-2001.[11] The reaction of population to private employment changes, estimated using 2SLS, is small and surprisingly negative. This may be due to strong differences in the North-South behavior. When we split by area the elasticity of private employment to shocks is quite similar in the two areas, but the reaction of working age population to private employment is now negligible and not statistically significant in both.

Our analysis is based on the assumption that the shock is exogenous, which implies that the national dynamics in the employment of specific industries is unrelated to the dynamics in the single LLM. This assumption may be problematic if some LLMs are specialized in a particular industry *k* and, at the same time, they represent the majority of the workers in that industry at the national level. Focusing on the 1971-2001 sample, we analyze two variables to understand whether this is an important concern. For each LLM in a given decade, we take the maximum share ω_{ikt-1} across sectors and the maximum fraction over national employment $f_{ikt-1} = E_{ikt-1}/(\sum_{j=1}^{N} E_{jkt-1})$ across sectors. Sample statistics are

[11] One possible concern is that this is due to the LLM definition, which is closer to the recent period. However, running estimates using the oldest LLM definition (the 1981 ones) leads to a similar growth in the elasticity of private employment to the shocks, from 0.35 in the first decade to 0.66 in 1991-2001.

reported in Table 2. The average and median values are relatively small. Nevertheless, at the top of the distribution we start observing LLMs who have large fractions of workers employed in a specific industry (more than 31% after the 95th percentile). At the same time, there are also some LLMs whose employment in a specific industry represents a sizable fraction of the total (more than 15% after the 95th percentile). This may not be a problem if these are small industries that do not have particular influence on the total employment of these LLMs. Given that the shocks are a combination of the two, we are particularly worried if there are LLMs who have specific sectors for which both ω_{ikt-1} and f_{ikt-1} assume strong values. We therefore build two additional indicators for LLM that have such cases. The first is a dummy for LLMs who have industries in which both ω_{ikt-1} and f_{ikt-1} are larger than the 95th percentile of the distribution reported in Table 2 (respectively, 0.31 and 0.15). These are very few cases, whose exclusion does not affect the final results (results available on request). Secondly, given that the 95th percentile for the shares ω_{ikt-1} is particularly large, we define a second dummy for LLMs who have industries in which both ω_{ikt-1} and f_{ikt-1} are larger than 0.15. They represent a small proportion of cases, around 1.6%. Their exclusion leads to similar conclusions of the main results, as shown by the first column of Table 6.

[Table 6 approximately here]

The limited reaction of population seems to be a result which is robust also to further sensitivity checks. The second column of Table 6 shows that adding LLM fixed effects, that capture linear LLM-specific time trends, drives down the estimates to almost zero. Limiting the censoring to the 1st to 99th percentiles, instead of 5th-95th, also leads to smaller estimates of the population reaction (third column). Finally, using the LLM definition of 1981 leads to very similar results.

3.2 Wage and house prices

One possible reason for the limited mobility of population is that the gains or losses from labor demand shocks may be lower than in other countries if local wages display a small reactivity. This has already been shown by several papers who focused on the reactivity of local wages to local unemployment (Bodo and Sestito, 1994; Faini, 1995; Casavola et al 1995; Lucifora and Origo, 1999) and on the role of collective bargaining in generating downward wage rigidities (Devicienti et al, 2007). These studies use different sources of data on wages, generally taken from National Accounts or from INPS, and relate them to the regional or provincial unemployment rate, sometimes instrumenting the latter with its lags.

Differently, from them, we focus on the elasticity of wage to shocks in labor demand, as measured by Bartik shocks, and our spatial units are the LLMs.

The first column in Table 7 relates the growth in local wages to the labor demand shocks. Pooled regressions show that a 1% demand shock lead to a change in wages by approximately 0.3%, which is one fourth smaller than the related growth in employment. This result seems to be driven by the North-South heterogeneity. The elasticity shrinks to 0.16 and 0.14 for the Centre-North and South, respectively, when we estimate it separately (compared to an elasticity of private employment to shocks by 0.29 and 0.43 respectively). In the second column we also show that the reactivity of wages to shocks is hardly significant, both economically and statistically, when we look at the last decade, also considering the much larger elasticity of employment itself as measured in Table 6. This confirms the hypothesis that local wages are quite rigid with respect to local labor demand shocks.

[Table 7 approximately here]

Simple models of spatial equilibrium (see Moretti, 2011, for a survey) suggest that another crucial variable in assessing who gains or loses from changes in labor demand depends also on the changes in house prices, which absorb a large fraction of household income. Cannari et al (2000) use the time-series about population transfers of residence from the South to the North between 1986 and 1992 to estimate the elasticity of migration to differentials in house prices. Their results suggest that increased house prices in the Centre-North have limited the mobility from the South, thereby mitigating the potential reduction in regional disparities. Here we focus on the reaction of house prices to labor demand shocks. Results are shown in the last two columns of Table 7. For the period 1971-2001 we have to limit the analysis to the municipalities that are administrative center of a province, and we use data from *Il Consulente immobiliare*. At the level of these municipalities, employment is not always diverse enough to guarantee variability at the three-digit level of the ATECO code. Thus for this regression only we build the shock using the variability at the 2-digit level The results display a positive elasticity of house prices to labor demand shocks, which is close to one. The reactivity seems to be smaller in the Centre-North than in the South, but the reduction in sample size leads to very imprecise estimates. If we consider the average labor income as the product of the employment rate and wage, we can use the two elasticities to calculate the one for average labor income. The elasticity of employment rate to shocks between 1971 and 2001 is 0.389 (not shown in the table). Therefore the percent change in average labor income with respect to a 1% shock in labor demand is $(1 + 0.389) \times$

$(1 + 0.273) - 1 = 0.768$, which basically implies that the increase in house prices completely absorbs the gains from the shock.

For the last decade, even if limited to a smaller period of time, we can instead observe the variation of house prices at the LLM level. The elasticity with respect to labor demand shocks is even stronger, and equal to 1.591, which rescaled over a decade (assuming a constant percent increase each year) would be 1.787. In this decade, given that wages do not seem to react to the shocks, this result implies that the real wage actually decreases, and this is in line with the limited change in population, which is even negative according to the pooled estimates. The difference between the two areas is also quite strong, with a much stronger elasticity of house prices in the Centre North. This is in line with evidence from Mocetti and Porello (2010), who suggest that the migration from South to North has decreased quite significantly in the first decade of the new century, and that approximately one third of this contraction can be attributed to the increase in house prices in the Centre North.

As a comparison, it is again useful to compare the results with those from Amior and Manning (2016) for the US. The authors only report estimates from their dynamic specification, which as discussed in Section 3.1 also includes the lagged employment rate as an explanatory variable. Nevertheless, in their results both wages and housing costs (measured as either rents or prices) respond positively and significantly to employment growth, in line with the elasticity of population. This is quite different from our conclusions that Italian LLM display (local) wage rigidity combined with house price reactivity. It is also interesting to note that also Amior and Manning's estimates indicate that house prices tend to overshoot, displaying an elasticity with respect to current employment growth well above one. The authors suggest that, in the short term, this may be due to a change in the agents' beliefs about future increases in asset prices.

4. Non-linearities

As migration tends to be pro-cyclical (see, for instance, Molloy et al, 2011), one important issue is whether the adjustment of labor demand shocks to economic downturns differs from the way they adjust to upturns. Notowidigdo (2011) runs regressions of decadal changes in employment, population wages and house prices for US Metropolitan Statistical Area on labor demand shocks measured with a similar approach as us. His estimates display a convex relation between both outcomes and shocks in labor demand: employment and

population are less reactive to negative shocks than to positive ones. In the US context, where wages are more likely to adjust to changes in labor demand, the author argues that the result is driven by a concavity in housing supply: house prices decrease after a negative shock is stronger than the increase after positive ones. This provides an incentive not to move for workers affected by negative shocks, because part of their nominal wage decrease is compensated by a cut in the housing costs. This mechanism, together with mobility costs, implies a resilience to a decline in labor demand. Differently, the author suggests that housing supply is more elastic for expansions, and therefore the increase in house prices does not fully compensate the increase in wages.

Our results for employment and population are shown in Table 8. In the upper panel, we use pooled estimates over 1971-2001 using the value of the shocks. There is no evidence of a convexity, and actually the responses of employment and of the employment rate seem to show a small concavity. One concern is that Notowidigdo (2011) calculates the shocks by interacting the industry-mix with the changes in the relative national share of each single industry. This implies that shocks can be interpreted as a deviation from the nation-wide average shock, so that they do not capture aggregate trends. While this is algebraically irrelevant in a linear specification and when only a single decade is used, pooled estimates of a quadratic specification with year fixed effects are different if shocks are measured as deviations from the average trend over the decade. In the latter case the non-linearity is not with respect to the zero, but with respect to the average trend. In line with this interpretation, a negative shock would be a predicted decline with respect to the average trend, while a positive shock would be an increase.

[Table 8 approximately here]

If we follow this interpretation (bottom panel), which is closer to Notowidigdo (2011), the employment response that we estimate is concave.[12] Compared to a one s.d. positive shock, which triggers a rise in employment of 2.1%, a negative shock of the same magnitude decreases employment by 3.9%. The population reaction is quite different. It is less marked than that referring to employment and roughly symmetric. According to our estimates, a one s.d. positive (negative) shock will increase (decrease) population by 1%. The

[12] The concavity is still statistically significant, even if only at the 10 per cent level, if we cluster at the level of provinces (which are 110 in total) instead of clustering at the LLM level.

magnitudes estimated for the US is an increase of population by 9.7% with a one s.d. positive shock and a decrease by 2.9% with a negative shock of the same size. The last column takes a look at the employment to population rate, which jointly captures the dynamic responses of employment and population. The asymmetric shape is confirmed. The employment to population ratio decreases by around 2.7% with a one s.d. negative shock and increases by 0.7% with a positive innovation of the same magnitude. Given the estimated concavity, the differences in responses are even larger for stronger shocks.

The difference with the results from Notowidigdo (2011) is likely to be explained by the presence of significant frictions to labor reallocation in the Italian context. First of all, centralized wage bargaining can create downward real rigidities that limit the adjustment of wages, in line with what we showed in Section 3.2 and with results from previous literature. If we estimate the equations for wage growth using a quadratic specification, the quadratic term is small in both decades (1991-2001 and 2001-11) and not statistically significant. Secondly, population mobility is smaller than the US one. Finally, Notowidigdo (2011) finds that the house prices reaction is concave, so that they react more to downturns than to upturns. Differently, if we estimate a quadratic for the house prices in the 2001-11, for which we have more variability and observations, the term on the quadratic is actually positive, indicating a convexity rather than a concavity. Although it is hardly statistically significant, this suggests that the mechanism favoring population mobility to expanding areas, highlighted by Notowidigdo for the US, is not operative in Italy. This is in line with the conclusion that the increase in prices in those areas that performed relatively better actually limited labor mobility from declining LLMs.

5. The autocorrelation and distribution of the shocks

With limited population adjustment, demand shocks do not necessarily lead to an increase in the geographical dispersion of the private employment over population rate. This depends on their distribution. If they are negatively correlated with the initial levels, they will tend to increase the dispersion, while the opposite is true if positive shocks are more likely to hit areas that are already lagging behind.

[Figure 3 approximately here]

Figure 3a shows that shocks tend to be positively correlated with the private employment over population rate at the beginning of the decade. This correlation is non-

negligible. If we run a regression of shocks over the rate, including year fixed effects, we obtain a coefficient of .116 (s.e. 0.008). This implies that one s.d. decrease in the time-demeaned private employment over population rate (around 13 percentage points) leads to a (time-demeaned) shock which is smaller by almost one third of a s.d.[13]

Another side of the same issue is that shocks, as discussed by Amior and Manning (2015) for the US, tend to be persistent over time, hitting repeatedly the same areas. Figure 3b shows that this is the case for Italy as well. The ACF of the time demeaned shock (calculated as in Table 1) is around 0.26 for one lag, and actually increases to 0.43 for two lags. Interestingly, this persistence is lower than the one estimated by Amior and Manning (2015) for the US, who report an ACF around .8 for one lag and .6 for two lags in the lag of the time demeaned Bartik shock. This suggests that, for Italy, a more important role is likely to be played by the low mobility, rather than by the high persistence of the shocks.

6. Simulations

In order to understand how much of the increase in the heterogeneity across LLMs in the private employment to population rate is due to low population mobility and to the distribution and persistence of shocks, we perform some simulations. This section aims to provide suggestions, grounded on empirical basis, for policy makers interested in fighting LLM heterogeneities.

First of all, we start from the actual changes in private employment and we use them to predict the growth in working age population. The prediction is generated multiplying the growth in private employment by the coefficient estimated by 2SLS. We also ignore changes in population captured by time dummies. Figure 4a shows that the prediction accounts for around half of the overall increase in the employment rate interquartile range between 1971 and 2001, and it also tracks quite well the dynamics in each decade. We then perform a simple experiment, in which we increase to 0.8 the population elasticity, which is close to the US estimates from Amior and Manning (2015, see section 3.1 for a discussion). As can be expected, this is sufficient to avoid almost all the increase in heterogeneity across the decades, as population changes absorb the changes in private employment.

[13] The result is very similar if we censor the shock only at the 1st and 99th percentiles.

We then try to understand the role of the distribution of shocks by simulating a massive intervention by the Government which, in each decade, increases by one s.d. (measured in the actual decade distribution of private employment growth) the growth in private employment for those LLM which, at the beginning of the decade, were in the bottom 25^{th} percentile of the employment to population rate. In all the decades these LLMs are mostly from the South of Italy, with few exceptions. As can be seen from Figure 4a, this intervention would have a similar effect on heterogeneity as the increase in population mobility. Note, however, that the intervention implies a quite substantial boost at the local level, as the standard deviation of private employment is 23 per cent in the first decade and around 12 in the following two. The cost at the aggregate level is less relevant, because the LLMs that receive the positive shock are generally smaller and start, by construction, from places with fewer workers. Adding up all the LLMs that receive the intervention in each decade, this implies a boost of 93,000 workers in the decade 1971-1981, and of 72,000 and 69,000 in the following two. Nevertheless, while the first possibility might be achieved through a less stringent regulation, this second policy option is likely to entail important fiscal resources (from national or EU sources). Apart from the size of the intervention, the main issue is that transfers have been generally found to be ineffective in increasing local employment and production in Italy. Most of the recent evaluations of place-based policies estimated zero impact on employment, both in the case of country specific schemes (Accetturo and de Blasio, 2012; Andini and de Blasio, 2016) and in the case of European structural funds (Ciani and de Blasio, 2015; see also the results for Italy in Becker et al, 2013). In other cases, where the estimated impact of transfers on employment is positive, it is temporary, and therefore only endless transfers might raise the economic conditions of a given area (Barone et al, 2016). An increase in local public employment is also unlikely to be sufficient, as there is evidence that it crowds-out private jobs (Auricchio et al, 2016).

[Figure 4 approximately here]

One concern in these simulations is that they take, as source of variation, the actual growth in private employment. This may actually be endogenous, as it probably reflects also the contemporaneous growth in population. As a robustness check, we perform a similar simulation, but starting from the labor demand shocks $\Delta\theta_{it}$. We use them to first predict the growth in private employment from the first stage regressions of Table 3 (neglecting year dummies). We then predict population changes as before, and we calculate the employment rate accordingly. As before, in the higher mobility scenario we increase this reaction to 0.8.

In the public intervention scenario we now increase the shock by one s.d. of the shock itself in those LLMs that were in the bottom quartile of the private employment rate distribution at the beginning of the decade.[14] The basic predictions (Figure 4b) are quite similar to the ones we obtained before, although the overall increase in the interquartile range of the private employment rate is smaller. In this case, though, the public intervention is less effective, most likely because it operates on the predicted shocks, rather than on the actual changes. Labor mobility is still quite effective.

7. Discussion and conclusions

We have analyzed the responsiveness of local labor markets to decadal shocks in labor demand. Our results highlight that the population reaction is quite limited and not sufficient to compensate private employment growth. As a result, increases in employment due to demand shocks have lasting effects on the private employment over population rate. Furthermore, shocks tend to be quite persistent over time and positively correlated with the initial level of the employment rate.

Our results are in line with a large empirical literature that provides evidence of frictions that hinder the ability of local areas to reap the benefits of a positive shock and, at the same time, prevent the necessary price adjustments that would offset a negative one. According to the IMF (2011), Italy's wage setting system is an obstacle for job creation, because the system implies that wages are hampered to react to local labor market conditions. Several authors (Bodo and Sestito, 1994; Lucifora and Origo, 1999; Brunello et al, 2001) provided evidence of a low reactivity of wages to local unemployment, in particular for Southern regions, which are characterized by lower productivity. This can be explained by the presence of national collective bargaining. Indeed, we show new evidence about the limited elasticity of local wages to local labor demand shocks. Once we distinguish by macroarea, all estimated elasticities are smaller than 0.2 and hardly statistically significant, contrary to the positive elasticity of private employment to shocks. Shocks that decrease local labor demand are therefore likely to have a small impact on wages, limiting the adjustment

[14] Given that private employment is simply a prediction from the shock, nothing would change if we would have done this directly on the predicted growth in employment.

that may offset the impact on employment. Wage flexibility may also help reallocation from declining to expanding sectors within each LLM.

The real estate market might have also played a role in explaining the limited mobility, as the housing price differential between richer and poorer areas has constantly increased from the mid-80's onwards (Cannari et al, 2000), due to the rigidity of housing supply. Our results using different sources of data suggest that house prices react quite swiftly to changing labor demand conditions. As their variation is larger than the change in wages, this implies that the gains from increased employment in areas hit by positive shocks are partially compensated by a decrease in real wages due to increased housing costs. This limits population mobility towards expanding areas. On the opposite, house prices decrease more than wages in areas hit by negative shocks, thereby absorbing part of the losses due to decreased employment.

Other factors, not studied in the present paper, may more generally contribute to explain the limited population mobility. As highlighted by Saraceno (1994) and Alesina and Ichino (2009), an important role is played by the "familism" that characterizes the welfare system. The family network in Italy offers most of the support for higher education, unemployment, child and elderly care. As a result, spatial proximity to the family discriminates the access to a wide range of basic social services. Migration opportunity costs are therefore likely to be very high in comparison with the US, where the family network is weaker, or other European countries characterized by a stronger welfare state. A reduced propensity to move to other areas can also be explained by the dynastic nature of professional occupations, such as pharmaceutical sellers (see: Mocetti, 2016). Labor mobility can also be discouraged by public transfers, which are overwhelmingly devoted to areas experiencing economic difficulties. The magnitude of these transfers, which includes both national and EU money, has been substantial (see, for instance, Banca d'Italia, 2008). Brunello et al (2001) suggest that public money has a prominent role in keeping within country migration at a low level. Alesina et al (1999) argue that public employment has acted as additional redistributive devise in favor of declining places.

Our estimates suggest that the combination of low population mobility and unequal persistent shocks contributed to the increase in the geographical heterogeneity of the private employment rate across the country. By means of some simulations, we showed that the growth in the employment rate dispersion between 1971 and 2001 would have been quite smaller if the population reactivity to private employment growth would have been similar to

the one observed in the US. Similar results could have been obtained by a large scale public intervention that had boosted private employment in lagging-behind area. However, it seems quite unlikely that the Government would have been able to implement a local intervention effective enough to generate the simulated increase in private employment. This suggests that policies that would favor population mobility could be quite successful in limiting the geographical heterogeneity. These may include both interventions aimed at increasing the supply of housing, in particular in expanding areas, and reforms that make welfare and employment interventions to be person-based, rather than place-based (see also Glaeser, 2007). Furthermore, wage flexibility allowing for more geographical variation may help absorbing local shocks and allowing reallocation within the LLMs.

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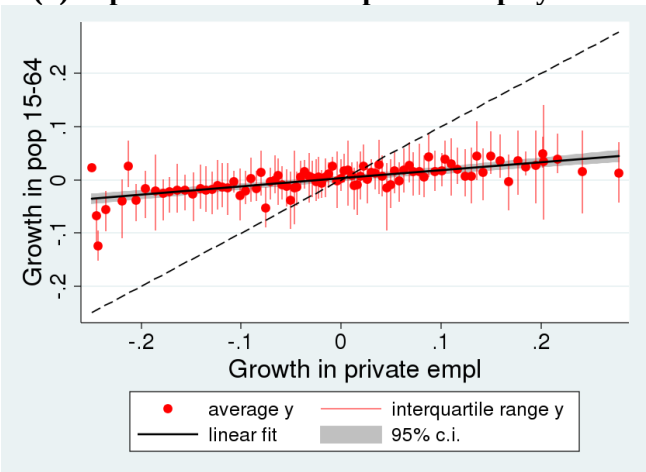
Figures

Figure 1 Heterogeneity and persistence in employment and population, Italy, 1971-2001

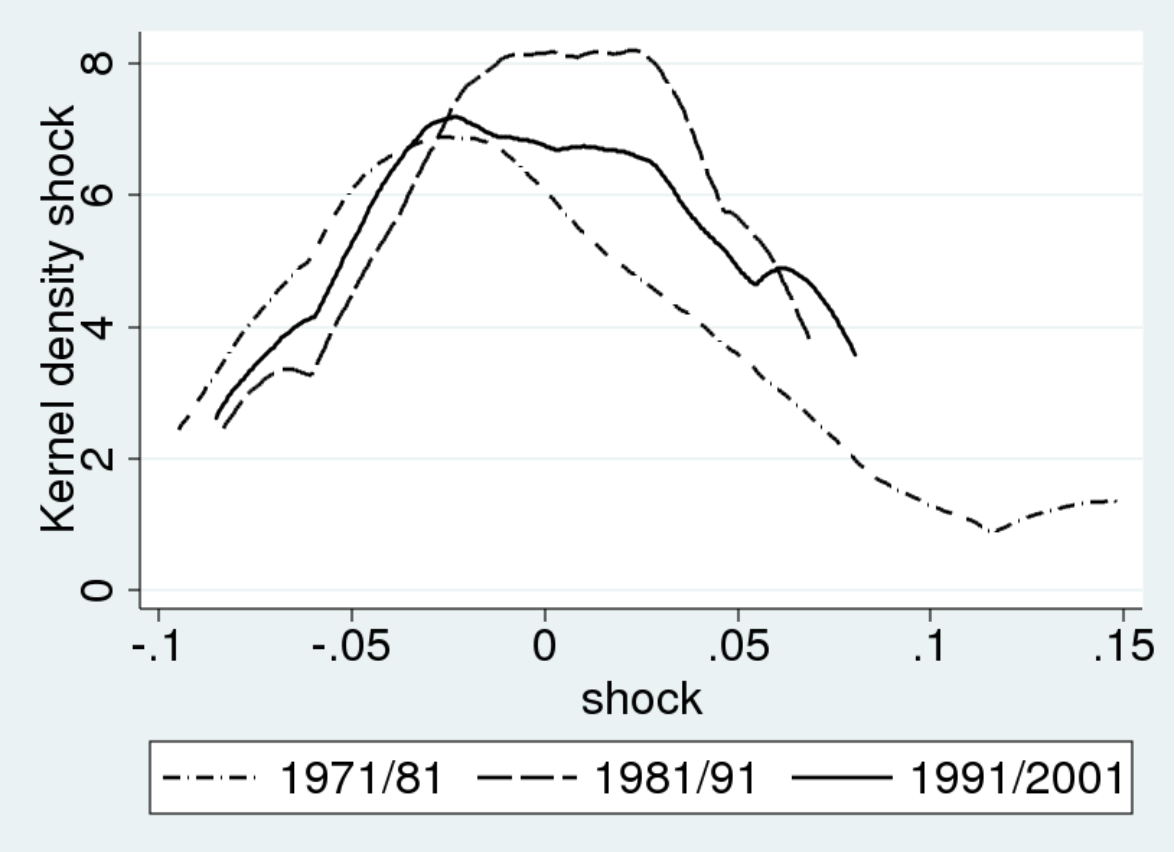
(a) Persistence of the private employment to population rate

(b) Population reaction to private employment



Notes: In figure (a) the unit of observation is the LLM over time and data are extracted from censuses 1971 and 2001. Figure (b) pools time-demeaned growth rates and shocks in the three decades. Each point represents a percentile of the distribution of time-demeaned growth in private employment (limited to the 5^{th}-95^{th} overall distribution).

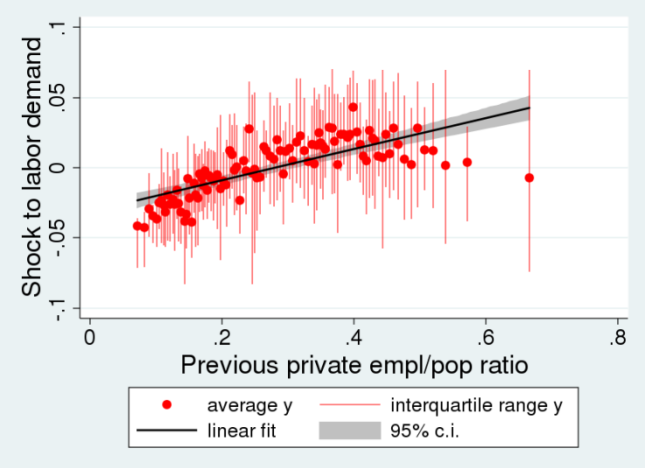
Figure 2 The distribution of shocks, by decade, Italy, 1971-2001



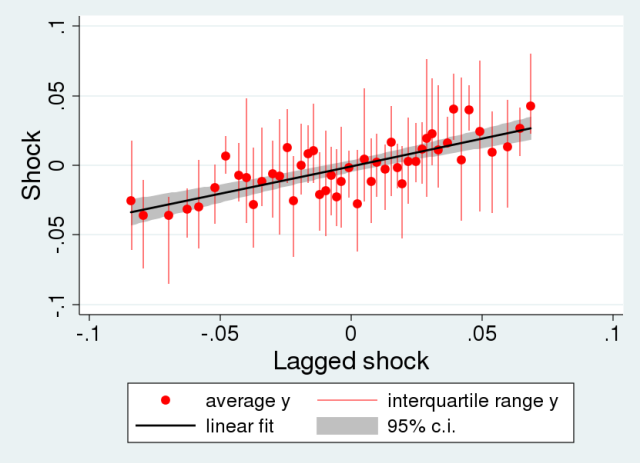
Notes: The graphs show densities estimated with a kernel density estimator (Epachnikov kernel, Silverman's rule-of-thumb bandwidth). The unit of observation is the LLM over time and data are extracted from censuses 1971, 1981, 1991, 2001. Shocks are time-demeaned predicted growth rates and have been calculated by applying to each LLM industry-mix at time *t-1* the nation-wide changes in employment for every single industry (defined using the ATECO 1991 code, 3 digit level). Shocks have been censored at the 5th and 95th percentiles (in each decade).

Figure 3 Persistence and distribution of the local labor demand shocks, Italy, 1971-2001

(a) Distribution of the labor demand shocks by previous employment rate



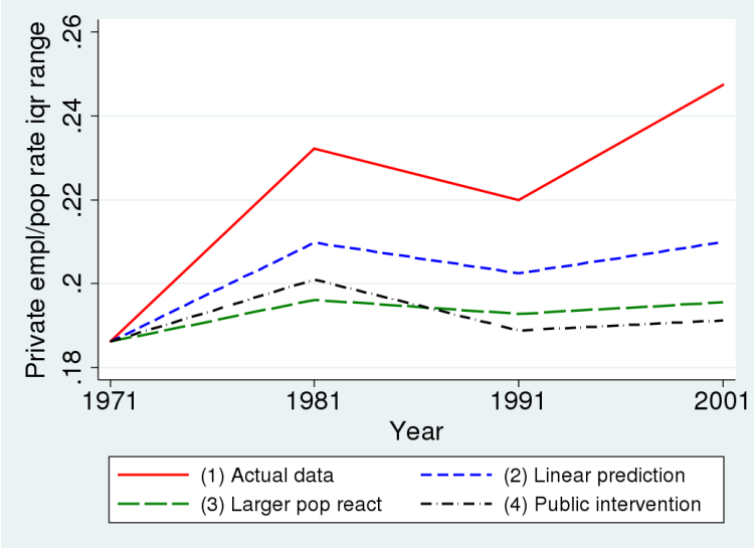
(b) Persistence of the labor demand shocks



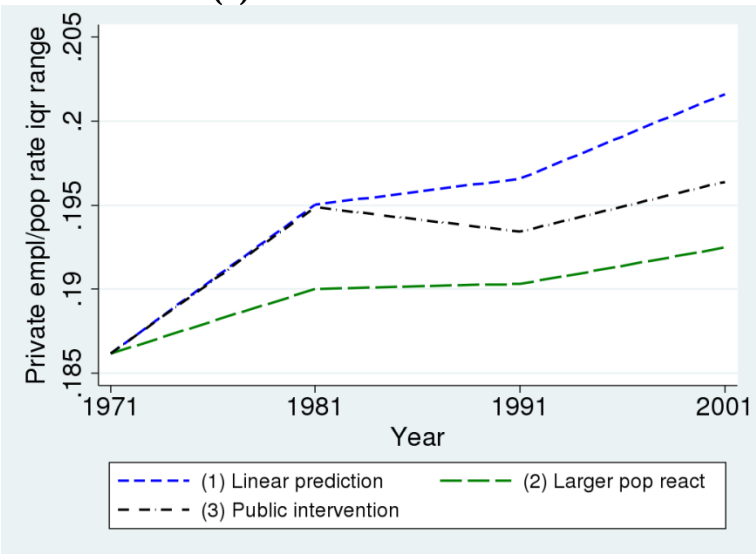
Notes: Figures (a) and (b) pool time-demeaned shocks in the three decades. Each point in (a) represents a percentile of the distribution of the previous decade private employment over population rate, while in (b) a percentile of time-demeaned lagged shocks.

Figure 4 Simulations of the evolution in the dispersion of the private employment over population rate in different scenario

(a) Simulation with actual private employment changes



(b) Simulation with shocks



Notes: The figures describe the evolution of the interquartile range in the private employment over population rate, as predicted by the different models from the actual distribution of shocks (not censored). The actual rate in 1971 is taken as initial value. In (a) the predictions are obtained calculating the population reaction to the actual change in private employment, neglecting the additional time fixed effects. In the larger population reaction the elasticity of population to private employment is imposed to be 0.8. In the public intervention scenario, in each decade those LLMs starting from the bottom quartile of the employment rate (at the beginning of the decade) receive a boost to their employment variation equal to one s.d. of the variation across all LLMs in that decade. In (b) the private employment change is predicted starting from the shocks, by using the coefficients from Table 3, column (1), and neglecting time fixed effects. The public intervention scenario is calculated as before, but the boost is applied to the shock.

Tables

Table 1 Autocorrelation function of the employment rate

Lag	Italy, Local Labor Markets, 1971-2001, only private employment	US, Commuting Zones, 1950-2010, total employment
1	.94	.84
2	.885	.78
3	.881	.71

Note: The ACF refers to the time-demeaned log employment rate. It is estimated as the ratio of the covariance with the specific lag to the product of the current and lagged standard deviation. The US ACF is from Amior and Manning (2015)

Table 2 Descriptive statistics, pooled 1971-2001 sample

	mean	median	sd	5th percentile	95th percentile	min	max
Growth in employment	0.1290	0.0820	0.2181	-0.1573	0.5767	-0.2381	0.8535
Growth in pop 15-64	0.0141	0.0128	0.0740	-0.1170	0.1457	-0.1434	0.1674
Growth in empl/pop rate	0.1131	0.0744	0.1968	-0.1512	0.5186	-0.1877	0.7385
Shock	0.0598	0.0414	0.0900	-0.0631	0.2254	-0.0840	0.3138
Industry with maximum share of local employment	0.1585	0.1384	0.0806	0.0729	0.3126	0.0347	0.7578
Industry with maximum ratio local emp / total empl	0.0360	0.0107	0.0815	0.0010	0.1471	0.0002	0.9812
Presence of an industry max share and ratio over 95th percentile	0.0034	0.0000	0.0582	0.0000	0.0000	0.0000	1.0000
Presence of an industry with max share and ratio over .15	0.0160	0.0000	0.1256	0.0000	0.0000	0.0000	1.0000
Employment	20,231	5,522	66,407	887	67,459	309	1,241,088
Population 15-64	55,521	21,610	155,590	4,671	172,688	1,857	2,482,070
Empl/population rate	0.3059	0.2977	0.1364	0.1152	0.5283	0.0666	0.8908
South	0.4738	0.0000	0.4994	0.0000	1.0000	0.0000	1.0000
Observations	2058						

Note: The unit of observation is the LLM over time and data are extracted from censuses 1971, 1981, 1991, 2001. Shocks are predicted growth rates and have been calculated by applying to each LLM industry-mix at time *t-1* the nation-wide changes in employment for every single industry (defined using the ATECO 1991 code, 3 digit level). All shocks and growth rates have been censored at the 5th and 95th percentiles. For each year and LLM observation, the maximum share is max $\omega_{ikt-1}=E_{ikt-1}/(\sum_{s=1}^{K} E_{ist-1})$, calculated across industries. The maximum ratio of local employment over total employment is instead max $f_{ikt-1} = E_{ikt-1}/(\sum_{j=1}^{N} E_{jkt-1})$, calculated across industries for each year and LLM observation. The "presence of an industry …" are dummies for the presence of an industry with both ω_{ikt-1} and f_{ikt-1} are larger than the 95th percentile of the distribution (respectively, 0.31 and 0.15) or larger than 0.15.

Table 3 Population elasticity to employment, 1971-2001

	Growth in:				
	Private sector employment	Population 15-64	Population 15-64	Population 15-64	Employment/population rate
	OLS	OLS	OLS	2SLS	2SLS
Shock (predicted growth)	0.4533***		0.2083***		
	(0.0872)		(0.0351)		
Growth in private employment		0.1454***		0.4594***	0.5131***
		(0.0100)		(0.0878)	(0.0903)
Observations	2058	2058	2058	2058	2058
First stage F				27.0	27.0

Note: * p<.10 ** p<.05 *** p<.01. The unit of observation is the LLM over time. See Table 2 for variables definition and data source. The regressions include a constant and year fixed effects. Standard errors clustered for LLM in parentheses. All shocks and growth rates have been censored at the 5th and 95th percentiles.

Table 4 Population elasticity to employment, by decade (1971-2001) and area (2SLS regression)

	Growth in population 15-64				
	Centre-North	South and Islands	1971-81	1981-91	1991-2001
Growth in private employment	0.4493***	0.5962***	0.6587***	0.2531*	0.3710***
	(0.1018)	(0.1790)	(0.2390)	(0.1311)	(0.0741)
Observations	1083	975	686	686	686
First stage F	17.1	13.2	6.2	13.5	41.8

Note: * p<.10 ** p<.05 *** p<.01. The unit of observation is the LLM over time. See Table 2 for variables definition and data source. The regressions include a constant and, in the last two columns, year fixed effects. Standard errors clustered for LLM in parentheses.

Table 5 Population elasticity to employment, 2001-2011

	Growth in:					
	Italy		Centre-North		South and Islands	
	Private sector employment	Population 15-64	Private sector employment	Population 15-64	Private sector employment	Population 15-64
	OLS	2SLS	OLS	2SLS	OLS	2SLS
Shock (predicted growth)	0.8484***		0.7826***		0.9325***	
	(0.0697)		(0.0939)		(0.1270)	
Growth in private employment		-0.1079**		-0.0132		0.0487
		(0.0481)		(0.0621)		(0.0685)
First stage F		148		69		54
Observations	686	686	361	361	325	325

Note: * p<.10 ** p<.05 *** p<.01. The unit of observation is the LLM over time. See Table 2 for variables definition; the sources of data are the population and firms censuses. The regressions include a constant and year fixed effects. Standard errors clustered for LLM in parentheses. All shocks and growth rates have been censored at the 5th and 95th percentiles.

Table 6 Sensitivity analysis for the estimate of the population elasticity to employment, 1971-2001 (2SLS regression)

	No extremes	With LLM fixed effects	Censoring at 1st-99th	LLM definition 1981
Growth in private employment	0.4912***	0.0737**	0.3450***	0.4773***
	(0.0957)	(0.0314)	(0.0717)	(0.0797)
Observations	2025	2058	2058	2865
First stage F	24.6	53.5	25.9	34.2

Note: * p<.10 ** p<.05 *** p<.01. The unit of observation is the LLM over time. The regressions include a constant and year fixed effects. Standard errors clustered for LLM in parentheses. See Table 3 for other info.

Table 7 Wage and house price elasticity to local labor demand shocks, by decade and area (OLS regression)

	Wage growth 1991-2001	Wage growth 2001-2011	House prices growth 1971-2001	House prices growth 2003-2011
			Pooled	
Shock	0.2728***	-0.0322	0.782**	1.5929***
	(0.0690)	(0.0458)	(0.395)	(0.1509)
Observations	645	645.	309	686
			Centre-North	
Shock	0.1633*	0.0637	0.282	1.7898***
	(0.0898)	(0.0542)	(0.504)	(0.2062)
Observations	360	360	201	361
			South and Islands	
Shock	0.1378	0.0977	0.558	0.5831*
	(0.1348)	(0.0950)	(0.634)	(0.3104)
Observations	285	285	108	325
Unit of observation	LLM	LLM	Provincial central city	LLM

Note: * p<.10 ** p<.05 *** p<.01. Wages are LLM wage effects calculated separately for 1991-2001-2011 on data from INPS and they refer to employees in private firms. In some years for some smaller LLMs we have less than 5 firms for which we are able to use info on wages, and therefore we exclude 45 LLMs from the analysis; see the data Appendix for more details on the treatment of wage data. House prices for 1971-2001 are from *Il Consulente Immobiliare*, while those for 2003-2011 are from *OMI*. See the Data Appendix for more details. Standard errors are clustered at the unit of observation level.

Table 8 The effects of a shock in local labor demand. Quadratic polynomial, 1971-2001

	Growth in:		
	Private sector employment	Population 15-64	Private employment over population rate
	Labor demand shock (predicted employment growth)		
shock	0.5845***	0.1768***	0.4059***
	(0.0824)	(0.0408)	(0.0779)
shock × shock	-0.6904	0.1657	-0.9119**
	(0.4208)	(0.1280)	(0.3840)
Effect of a -σ shock	-0.0372	-0.0099	-0.0274
Effect of a +σ shock	0.0324	0.0111	0.0209
Test for symmetric effects (p-value)	0.1014	0.1957	0.0178
	Labor demand shock (predicted employment growth) – time demeaned		
shock	0.5048***	0.2054***	0.2850***
	(0.0853)	(0.0370)	(0.0741)
shock × shock	-2.6583**	0.1464	-2.7052**
	(1.3261)	(0.4622)	(1.1790)
Effect of a -σ shock	-0.0395	-0.0117	-0.0266
Effect of a +σ shock	0.0206	0.0128	0.0074
Test for symmetric effects (p-value)	0.0454	0.7514	0.0221
Observations	2058	2058	2058

Note: * p<.10 ** p<.05 *** p<.01. The unit of observation is the LLM over time. See Table 2 for variables definition and data source. The regressions include a constant and year fixed effects. Standard errors clustered for LLM in parentheses. P-values for marginal effects statistical significance in brackets. σ is one s.e. deviation of the shock in the whole sample (approximately 5%).

Data appendix

Census data: reclassification of ATECO 1991-2002-2007

This section is largely drawn from Auricchio et al (2016). In 1991 and 2001 the ISTAT economic activity classification was ATECO 1991, later changed to the ATECO 2002. In 2007 ISTAT, following Eurostat requirement, released a new ATECO 2007 that implements a quite radical change. The ISTAT release for the 1991 and 2001 Census data are classified using the ATECO 1991 at the 5-digit level, while the 2011 Census data are distributed with the ATECO 2007 classification, still at the 5-digit level. There is no official transition matrix from ATECO 1991 to ATECO 2007. There are, however, two different transition matrices, one from ATECO 1991 to ATECO 2002 and the other from ATECO 2002 to ATECO 2007 (both available on the ISTAT web site). Since for our purpose we can work with a less detailed classification, we approximated the 3-digit level classification in both matrices. Nevertheless, even at this level the two transition matrices are not bijective. To solve this issue we use a re-aggregation procedure to build an univocal relationship. We started with the second and more critical transition matrix. We first removed those multiple correspondences that, at a close inspection, resulted to be less relevant. We then aggregated the 3-digit ATECO 2002 codes so that each ATECO 2007 was mapped into only one ATECO 2002 code. We then applied the same aggregation of the 3-digit ATECO 2002 codes to the 1991-2002 matrix. In very few cases this was not sufficient to have each ATECO 1991 code to be mapped to a single ATECO 2002 (re-aggregated) code. After careful inspection, these were marginal cases. Hence we corrected them by choosing the most relevant mapping. The do-file aggregating the codes is available with the replication material.

LLM wage effects

INPS, the National Social Insurance Institute, collects information from each private firm operating in Italy about the average number of employees and their average monthly wage. By means of a research agreement, we have access to a dataset containing this information at the firm level from 1991 to 2013. We cannot distinguish different plants. Although some firms have multiple social insurance positions, these are due to administrative reasons (such as distinguishing employees covered by different national contracts) and not to the presence of different plants. This implies a possible measurement error, because the geo-reference for this data refers to the municipality in which the firm is registered, and therefore we miss the other plants. However, there are currently no microdata on wages at the plant level from which to obtain better estimates. INPS data are provided separately for blue collars, white collars, directors and apprentices. We consider only blue collars and white collars.

Using the fiscal code, we first merge the INPS to an administrative registry of all firms and enterprises (*Registro delle imprese*, maintained by the Chamber of Commerce) in order to recover the municipality in which the company is based. We match it with the last available address. Although this is far from perfect, few firms move their location over years. Furthermore, the administrative registry is maintained mainly to provide current legal information, and historical data are at the moment not fully reliable.

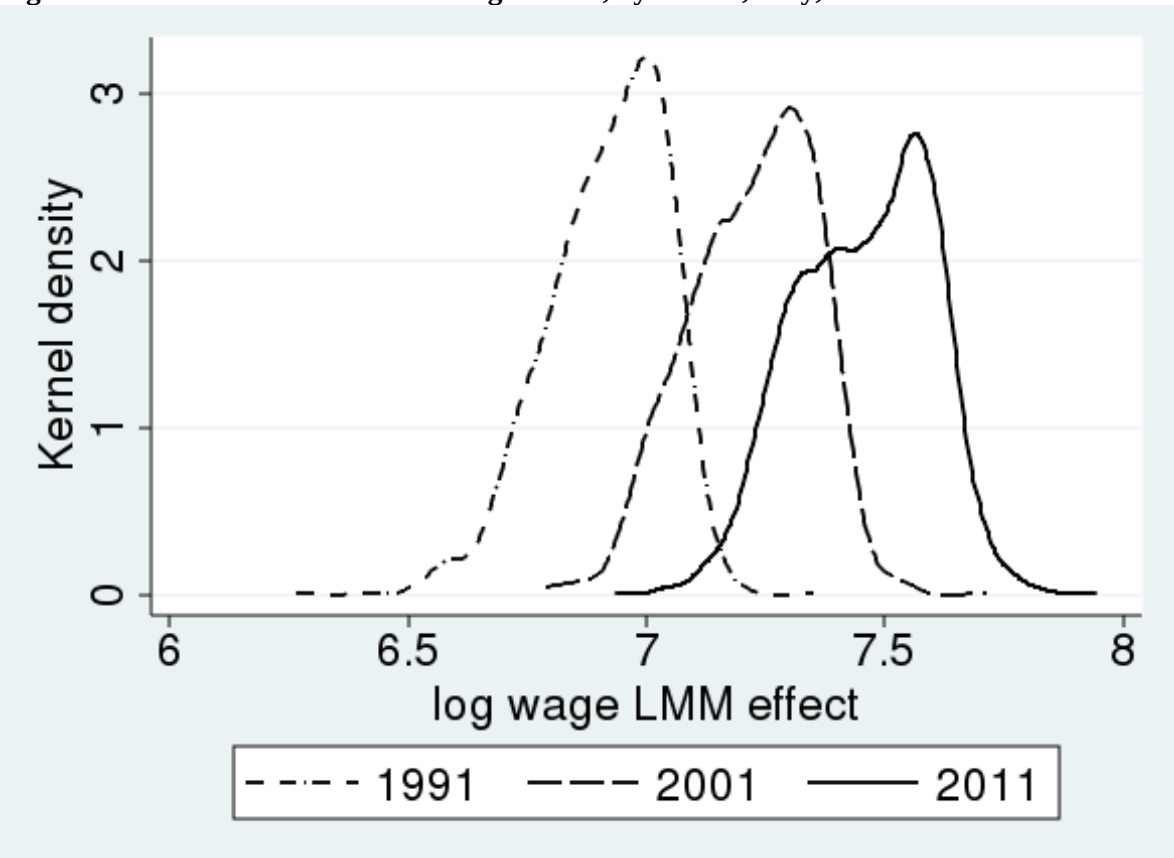
In matching the two archives we first lose a significant fraction (38.8 per cent) of records that belong to employers who are not firms but individuals, for which INPS does not provide us the fiscal code due to privacy concerns. Nevertheless, these firms are on average much smaller, with 1.8 employees (blue or white collars) against 10.2 for the other firms, so that they represent only 10.0 per cent of the employees observed in the dataset. We further lose another 12.8 per cent of observations from firms whose fiscal code, probably misreported in one of the two sources, cannot be found in the *Registro delle imprese*.

Using the information on municipality we identify the 2001 LLM. We focus only on 1991, 2001 and 2011. To avoid extremely unreliable estimates, we dropped data pertaining to LLM which, in any of

the three years, included less than 5 firms, independently from their size. Separately by category (blue and white collars) and year (1991, 2001, 2011) we estimate Poisson regressions for the average wage, including a full set of dummies for the ATECO code (at the 2 digits level, lower levels would lead to too few firms for many sectors) and for the LLM. Estimates are obtained weighting each firm by the number of employees (in the relevant category). Finally, we obtain an average sectoral composition by calculating, separately for each employment category, the pooled (over the three years) weighted (by employment) averages of the sectoral dummies. We also obtain the average share of blue-collars in a similar way. We then predict the LLM wage fixed effects in each year and category using the previous Poisson regressions applied to this sectoral composition. Finally, we recover the LLM wage fixed effect in each year weighting each category by its share (fixed over time and across LLMs).

The distribution of wages is shown in figure A1. They are not deflated, but given the presence of time fixed effects in all regressions this would make no difference.

Figure A1 The distribution of LLM wage effects, by decade, Italy, 1991-2011



Notes: The graphs show densities estimated with a kernel density estimator (Epachnikov kernel, Silverman's rule-of-thumb bandwidth). The unit of observation is the LLM over time.

House prices

For the period 2003-2011, house prices at the local level are based on data released by the *Osservatorio del mercato immobiliare* (OMI) from 2003 onwards. These data are built on two reports per year from approximately 8,100 Italian municipalities, divided into nearly 31,000 homogeneous zones that are identified on the basis of socio-economic and urban characteristics. The main sources are private real estate agencies, with a specific collaboration agreement, who have to collect data about at least 5 transactions. When they cannot, subjective assessment from the agents is also allowed. Residually, also administrative data on the transactions are considered. For each zone and type of

building (flats, villas and cottages) a minimum and maximum price are given. First of all the average for each building and zone is taken as the mid-point and then the price is further averaged across different buildings (with equal weights that do not vary across different municipalities). Secondly, the average price at the municipality level is calculated by weighting the different zones with municipality-specific weights calculated by Cannari and Faiella (2008) trough information collected in the Bank of Italy surveys of Household Income and Wealth of Italian families (SHIW). Finally, we calculated the average house price at the LLM level by weighting each municipality by the number of buildings used as a residence from the 2001 Census data.

For the 1971-2001 period we resort to data from *Il Consulente immobiliare* (CI), an industry-related review published by Il Sole 24 Ore media group. Since 1965, CI collects information from market operators on average house prices. The sample of municipalities surveyed has changed in time, but from 1970 onward it includes all the Italian cities that are administrative center of a province. Data are provided by CI twice a year and are divided into two property categories (new and recently built) and three locations (centre, semi-centre and outskirts). Following Zollino et al. (2008), we firstly averaged the prices of new and recently built houses, then we calculated the average city price weighting the price of each location with SHIW weights.