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ABSTRACT

Does Delayed Retirement Affect Youth Employment? Evidence from Italian Local Labour Markets*

Pension reforms that raise minimum retirement age increase the pool of senior individuals aged 50+ who are not eligible to retire from the labour market. Using data from Italian provinces and regions and an instrumental variable strategy, we estimate the effects of local changes in the supply of workers aged between 50 and minimum retirement age on youth, prime age and senior employment. Results based on provincial data from 2004 to 2015, a period characterized by declining real GDP, indicate that adding one thousand additional senior individuals to the local labour supply reduces employment in the age group 16-34 by 189 units. Estimates based on longer regional data covering the period 1996 to 2015, that includes also a period of growing real GDP, show smaller negative effects for young workers, suggesting that the employment costs of pension reforms may be lower when the economy is growing.

JEL Classification: J26, H55, J21, J14, J11

Keywords: pension reforms, lump of labour, youth employment, local labour markets

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Introduction

During the past twenty years, youth employment in Italy has declined substantially. Data from the Labour Force Survey indicate that the number of employees aged 16 to 24 fell from 1.8 million in 1996 to 0.9 million in 2015. During the same period, employment in the age group 25 to 34 fell from 5.7 to 4 million. As shown in Figure 1, this decline started well before the 2008 recession but accelerated substantially afterwards. Conversely, the employment of individuals aged 50 to 70 increased substantially during the same period, from 3.8 to 7.3 million.[1]

A natural economic candidate to explain the observed increase of senior employment is the sequence of national pension reforms that took place in Italy from 1996 to 2011, which raised the minimum retirement age of (male) employees from 52 in 1996 to above 65 in 2015. Following these reforms, the share of individuals aged 50 to 70 who report to be retired from work declined from 40 percent in 1996 to 27.6 percent in 2015. By forcing senior workers to retire later, these reforms have affected senior labour supply and employment, with potentially negative consequences on youth employment.

Did youth employment suffer? The view that higher senior employment reduces the number of jobs available to the young has been forcefully opposed by professional economists, who have criticized the so-called "lump of labour fallacy" (see for instance Gruber and Wise, 2010 and the contributions therein). The fallacy is to assume that the total number of jobs is given. If they are, higher senior employment must imply lower youth employment. However, output and the total number of jobs are not given in a modern economy.

In spite of the policy relevance, empirical research on the causal effects of changes in retirement age on youth employment and unemployment is relatively scarce and with contrasting results. On the one hand, the country papers in Gruber and Wise, 2010, show that greater labour participation of older persons is associated with greater youth employment. On the other hand, Vestad, 2013, finds for Norway that a young worker replaces an additional early retiree, and Boeri and co-authors, 2016, find for Italy that five additional older workers locked in employment generate the loss of employment by one young worker.[2]

Perhaps one reason why there are so few academic contributions is that the identification of causal

[1] These data do not consider the discontinuity in the Labour Force Survey that occurred in 2004.
[2] Additional contributions include Munnell and Wu, 2012, for the United States; Bovini and Paradisi, 2017, for Italy and Kondo, 2016, for Japan.

effects - from pension reforms to youth employment - is complicated by the fact that policies changing minimum retirement age affect entire countries. Therefore, it is difficult to disentangle the consequences of these policies from those of concurring macroeconomic shocks, including technical progress affecting the level and composition of employment.

In this paper, we do not address the "lump of labour fallacy" hypothesis. More modestly, we study how national changes in minimum retirement age have affected the *local* labour supply and the *local* employment of young and senior individuals, using the fact that, while the treatment is national, the intensity of the treatment differs across local areas because of differences in the age structure.[3] Our empirical analysis focuses on Italy, an interesting laboratory because of the sequence of reforms raising minimum retirement age that occurred in the past twenty years.

We measure the intensity of the treatment with the changes in the local pool of senior workers older than 50 but younger than minimum retirement age. Define this pool as *PT*. By delaying retirement, pension reforms change the composition of the senior population (aged 50 to 70) and increase *PT*. We show that, when local firms can freely hire young labour but cannot dismiss senior labour because of protective employment protection legislation, a higher *PT* increases senior employment and the average age of senior employees but has ambiguous effects on youth employment, even though current output is not given. Therefore, the question whether pension reforms reduce local youth employment is ultimately an empirical one.

We estimate the causal effect of a local increase in *PT* on local youth, prime-age and senior employment and unemployment using a shift-share instrumental variable strategy à-la Card, 2007. This strategy is required to dispel simultaneity concerns arising from the fact that pension reforms that affect employment opportunities may trigger migration flows from a local area to another, thereby affecting local population and labour supply.

On the one hand, our results based on data for 102 Italian provinces and covering the years from 2004 to 2015 indicate that adding one thousand additional senior individuals to the local supply because of an exogenous increase in minimum retirement age reduces – in our preferred specification - employment for the age groups 16 to 34 and 35 to 49 by 189 and 86 units respectively, and increases

[3] Card, 1992, and Acemoglu and Robinson, 2007, use a similar empirical research design. National labour markets consist of local labour markets and migration of labour across localities is far from perfect. In the case of Italy, numerous studies have documented that population and labour mobility is limited – see for instance Ciani et al, 2017.

senior (age 50 to 70) employment by 149 units. Overall, aggregate local employment falls.

On the other hand, our estimates based on more aggregated data for the 20 Italian regions and covering the longer period 1996 to 2015[4] show smaller but still negative effects for age groups 16 to 34 and 35 to 49, equal in our preferred specification to 68 and 28 fewer units respectively, and larger positive effects for senior workers, equal to 304 additional units. In this case, aggregate local employment increases.

For Italy, the period 1996 to 2015 can be broadly divided into two sub-periods: 1996 to 2007, with positive GDP and total employment growth, and the period 2008 to 2015, with negative GDP growth and declining total employment. Our results suggest that pension reforms raising retirement age reduce youth employment in both sub-periods. The size of these negative effects, however, is sensitive to the prevailing economic conditions and is larger when the economy is in dire straits.

The paper is organised as follows. Section 1 briefly reviews pension reforms in Italy and their impact on minimum retirement age, and shows how these reforms have affected the supply of older workers in Italy. Section 2 introduces a theoretical framework that illustrates how these changes can affect youth employment. Section 3 presents the empirical specification and Section 4 illustrates the data. We show the baseline empirical findings in Section 5 and several extensions and sensitivities in Section 6. Conclusions follow.

2. Pension reforms in Italy

In this Section, we briefly describe how the Italian social security reforms implemented between 1992 and 2015 changed retirement eligibility rules and minimum retirement age.[5] Before 1992, the minimum age for *old-age* pension for men was 60 for employees in the private sector and for the self-employed, and 65 for public sector employees – conditional on having paid social security contributions for at least 15 years. Early retirement with a *seniority* pension was however possible at any age for workers who had paid social security contributions for at least 35 years.

Motivated mainly by the need to contain pension expenditure in a rapidly ageing society, the first social security reform in 1992 introduced a progressive increase in the requirements for eligibility to *old age* pensions, that were to reach age 65 by 2001. In 1995, a second major reform tightened the eligibility

[4] Province-level Labour Force Survey data are not available before 2004.

[5] See Brugiavini and Peracchi, 2010, Angelini et al, 2009, and Bottazzi et al, 2011, among others for further details on the pension reforms occurring during our sample period.

requirements for *seniority* pensions, which were to raise gradually from 1996 to 2008 and reach either 40 years of paid contributions independently of age, or 57 years of age and 35 years of paid contributions.[6] This reform also prescribed tighter eligibility requirements for the self-employed.

After only three years, pension eligibility rules changed again with a reform that accelerated the transition period and increased minimum retirement age to 58 years for the self-employed, starting in from 2001. An additional reform took place in 2005, when Welfare Minister Roberto Maroni modified again the eligibility requirements for *seniority* pensions, introducing a sharp 3-year increase in minimum eligibility age (the so-called "*scalone*"), from 57 to 60 years for public and private employees, and from 58 to 61 for the self-employed, starting from year 2008. However, in 2007, the new left-wing government led by Romano Prodi postponed the proposed three - year increase to 2011, introducing instead a gradual adjustment in the requirements, starting from 2008. For this reason, no worker has actually retired under the requirements prescribed by the "Maroni" reform. In addition, under the "Prodi bis" regime, eligibility to *seniority* pensions was made conditional to achieving a further threshold, defined as the sum of age and years of contributions – that also varied by year of retirement and sector.[7]

By abolishing seniority pensions starting in 2012, the Monti - Fornero reform further increased minimum retirement age, from 60 to 66 years for males and from 60 to 62 for females in the private sector.[8] For males, an additional quarter of a year was added to these new thresholds from 2013 to 2015. Since the gender retirement gap was expected to close in a few years, the minimum retirement age of females increased by an additional year and three quarters between 2013 and 2015 (see Moscarola, Fornero and Strom, 2015).[9]

[6] By introducing eligibility requirements for *seniority* pensions, this reform abolished the so-called "baby-pensions", which allowed public employees with at least 20 years of paid contributions to retire independently of age. This requirement was set as low as 14 years, 6 months and 1 day for married women with children and employed in the public sector.

[7] Pension reforms in Italy have also modified pension benefits. The major change occurred in 1995, before the start of our sample period, with the transition from a system based on defined benefits to a system relying on defined contributions. Another important change occurred within our sample period, when in 2007 the second Prodi government ("Prodi bis") reduced the coefficients used to transform accumulated contributions into pension benefits for workers retiring from 2010 onwards.

[8] Minimum age for females employed in the public sector also increased from 60 to 66 in 2012.

[9] The Monti - Fornero reform also applied a defined contributions formula to all workers and further increased the minimum number of year of social security contributions required to retire before minimum retirement age (just above 41 for females and just above 42 for males).

Table 1 illustrates the changes in minimum retirement age for male and female employees in the private sector and for the self-employed during the twenty years from 1996 to 2015. During this period, minimum age increased by more than ten years, from 52 to 66.25 years for male employees and from 52 to 63.75 for female employees. For the self-employed, it increased from 56 to 66.25 years for males and from 52 to 63.75 years for females.

To illustrate the effects of an increase in minimum retirement age on the composition of the senior population aged 50 to 70, define this population as $P^O = \sum_{a=50}^{70} P_a^O$, where the subscript *a* is for age, and let *MRA* be the minimum retirement age prescribed by law. Then $P^O = \sum_{a=50}^{MRA-1} P_a^O + \sum_{a=MRA}^{70} P_a^O$, where $PT = \sum_{a=50}^{MRA-1} P_a^O$ is the pool of senior individuals aged 50+ who are not eligible to retire because they are younger than *MRA* and $NPT = \sum_{a=MRA}^{70} P_a^O$ is the group eligible to retire. Pension reforms that raise minimum retirement age increase *PT* and reduce *NPT*, thereby altering the composition of the population aged 50 to 70.

Since eligibility requirements vary by gender, sector and type of employment, in this paper we define gender-specific *MRA* as the minimum among the available requirements in each year of the sample. Therefore, the value of *MRA* in 2012 was 66 for males and 62 for females. Because of the sharp increase in minimum retirement age, the ratio of *PT* to the population aged 50 to 70 increased over the sample period from less than 20 percent to close to 80 percent, as illustrated by Figure 2.

In local labour markets, the pool *PT* depends both on *MRA*, which is set at the national level, and on the age structure of the local population. Because of limited labour and population mobility and of differences in the composition of local population by age, the impact of national changes in *MRA* on local *PT* varies across local areas. Therefore, while the treatment (higher *MRA*) is common across localities, the intensity of the treatment varies locally.

In this paper, we identify local labour market either with provinces or with regions. In Italy, provinces are administrative areas that consist of several municipalities. Usually, several provinces together form a region. At present, there are 107 provinces in Italy, and 20 regions. Figure 3 shows how the ratio of local *PT* to the local population aged 50 to 70 varies across provinces in 2015. Dark blue areas have higher ratios and pale blue areas have low ratios. The former prevail in the less developed South and the latter are more frequent in the rest of the country.

Figure 4 shows the percentage change in *PT* between 2004 and 2015, by province. The dark blue areas are characterized by relatively high percent changes (above 136 percent) and the light blue areas by relatively low changes (below 100 percent). While dark blue areas are more frequent in the North, they are also present in Central and Southern Italy.

3. A simple theoretical framework

Consider a local economy where firms produce goods and services by operating a Cobb Douglas technology with two types of workers, the young N_y and the old N_o. The technology used by firm *i* producing good *i* is

$$Y_i = \left(e_{yi}N_{yi}\right)^{\alpha}\left(e_{oi}N_{oi}\right)^{1-\alpha} \tag{1}$$

where Y_i is output, $\alpha < 1$ and e_{zi}, $z = y, o$ are efficiency parameters. Product markets are imperfectly competitive and the demand for good *i* is given by

$$Y_i = Y\left(\frac{P_i}{P}\right)^{-\sigma_i} \tag{2}$$

where Y is aggregate demand and $\sigma_i > 1$ the elasticity of demand (in absolute value) with respect to the relative price. In countries such as Italy, strict employment protection regulation makes terminating the employment relation of older workers very costly. Following Boeri et al, 2016, we capture this institutional feature in a rather extreme way by assuming that local firms cannot dismiss older employees, at least in the short run. Thus, senior employment evolves according to the following simple law of motion

$$N_{oi,t} = (1 - \delta_i + \omega_i)N_{oi,t-1} \tag{3}$$

where δ_i is the percentage of older workers who retire in each period and ω_i is the rate of change due to demographic factors. In this setup, pension reforms raising minimum retirement age and the pool *PT* increase N_o by reducing δ_i ($\frac{\partial \delta_i}{\partial PT} < 0$).

Local firms select youth employment by maximizing profits $\Pi_i = P_i Y_i - w_y N_{yi} - w_o N_{oi} - c_i$, where $w_j, j = y, o$ are wages and *c* are idiosyncratic fixed costs. Wage determination in Italy is characterised by a centralised structure, with wages responding mainly to the economic conditions prevailing in the industrialised North of the country rather than to local conditions (see for instance Brunello et al, 2001; Manacorda and Petrongolo, 2006).[10] We capture this institutional feature by assuming that wages are set at the national level, and that local firms take wages as given when setting employment.

Profit maximization with respect to youth employment yields

$$N_{yi} = \alpha(1-\frac{1}{\sigma_i})Y_i^{1-\frac{1}{\sigma_i}}\left(\frac{w_y}{P}\right)^{-1} Y^{\frac{1}{\sigma_i}} \qquad (4)$$

From total differentiation of Equation (4) with respect to local *PT* we obtain

$$\frac{\partial N_{yi}}{\partial PT} = \left\{\frac{(1-\frac{1}{\sigma_i})}{1-\alpha(1-\frac{1}{\sigma_i})}\right\} N_{yi}\left[(1-\alpha)(\frac{1}{N_{oi}}\frac{\partial N_{oi}}{\partial PT} + \frac{1}{e_{oi}}\frac{\partial e_{oi}}{\partial PT}) + \alpha\frac{1}{e_{yi}}\frac{\partial e_{yi}}{\partial PT}\right] \qquad (5)$$

The ratio within braces is positive. The sign of the expression within brackets on the right hand side of (5) depends instead on the sign of three components. Given our assumptions, the first component $\frac{\partial N_o}{\partial PT}$ has positive sign. The second component $\frac{\partial e_{oi}}{\partial PT}$ has negative sign if the productivity of older workers decline with age.[11] The sign of the last component $\frac{\partial e_{yi}}{\partial PT}$ is unclear, but could be negative if the interaction with a higher number of older workers has negative spill-over effects on the young.

Given wages and aggregate output, the effects of an increase in local *PT* on local youth employment pass through three channels: a) the reduction in the turnover rate δ and the increase in senior

[10] Since the early 90s, wage determination in Italy has taken place at two complementary levels. The backbone consists of multi-year contracts negotiated at the central level by sectorial employer associations and trade unions set both industry, that define both specific wage floors and employment rules. Local agreements that redistribute productivity gains occur mainly in large firms and can add to the national floors without undoing them. See Rosolia, 2015.

[11] The studies examining the relationship between age and *individual* productivity are relatively few. Skirbekk, 2004, reviews this literature and concludes that productivity follows an inverted U-shaped profile, with significant decreases taking place from around age 50. See also Bertoni et al, 2015, and Van Ours, 2009.

employment, which rises youth employment because output increases; b) the potential reduction in e_{oi} and output, that occurs if the increase in the average working age of senior workers driven by higher minimum retirement age reduces their efficiency and productivity at work; c) the effect on e_{yi} and output.

Profits when youth employment is chosen optimally can be expressed as

$$\Pi_i = [1-\alpha(1-\frac{1}{\sigma_i})]PY_i^{1-\frac{1}{\sigma_i}}Y^{\frac{1}{\sigma_i}} - w_o N_{oi} - c_i \tag{6}$$

In the presence of very high separation costs for older workers and of centrally set wages, an increase in *PT* that keeps these workers longer in their jobs is likely to raise costs, reduce profits below zero and force some firms to exit the market, with employment losses for both young and senior workers. On the other hand, higher costs due to the retention of older workers could be passed through into higher prices and encourage new firms to enter the market by hiring younger workers. The overall effect on firm turnover, defined as the ratio of the sum of firm entries and exits to the initial stock of firms, is unclear.

We have focused so far on the employment effects of local changes in *PT*. But *PT* changes also nationally, and this could also affect local employment for at least two reasons. First, wages will change. In particular, w_o is likely to fall as the supply of older workers increases, and w_y could increase if the aggregate demand for youth labour rises. Second, additional time in employment for older workers across the country could increase their expected income and aggregate expenditure *Y*, with positive spill-over effects on local output and employment – see Equation (4) above.

4. The Empirical Specification

We investigate the effects of local changes in *PT* on employment and unemployment by age group by estimating the following linear model on provincial data

$$N_{pt}^Q = \alpha + \theta PT_{pt} + \gamma_T + \gamma_P + \delta X^Q{}_{pt-\tau} + \varepsilon_{pt} \tag{7}$$

where *N* is employment (in thousand individuals); the superscript *Q* indicates the age group (very young: 16-24, young: 25-34, prime age: 35-49 and senior: 50-70); γ_T is for time dummies and γ_P is for province dummies; *PT* is also measured in thousand individuals and X is a vector of province by time controls that includes the local real GDP and age specific population, percentage with high school or higher degree, percentage of males, average age, and percentage of employees in the industrial sector and in the public sector.

We use lagged rather than current values of *X* to attenuate endogeneity concerns and to avoid including "bad controls", or variables that are affected by current *PT*. We control for lagged rather than current real *GDP* because the question we are addressing – whether pension reforms affect youth employment – is unconditional on the current level of output (see Banks et al, 2010). Finally, ε is an error term, that we allow to be clustered by province.[12]

Province dummies capture all time invariant differences across local labour markets. Macroeconomic effects on local employment and unemployment are controlled by time dummies. In the baseline specification, the dependent variable is the level of employment. However, we also estimate a specification where both the dependent variable and *PT* are divided by the national population aged 16 to 70.[13] As an additional sensitivity, we allow for the possibility that local responses to aggregate shocks vary by province by estimating a specification that includes among the controls the interactions of province dummies with the lagged national real GDP.

Our variable of interest is *PT*, and the relevant parameter is θ, or the marginal increase in the number of employed workers in age group *Q* induced by a marginal increase in the pool of senior individuals *PT*. Ordinary least squares estimates of Equation (7) rely on standard "Difference in Differences" identification assumptions. In particular, we assume that the trend in employment for age group *Q* - observed in areas where changes in the size of *PT* due to changes in *MRA* are relatively small - corresponds to the counterfactual change that areas with a larger *PT* would have experienced if the age structure of the two areas had been the same.

If the variation in *PT* induced by changes in *MRA* were the same across local areas, it would be impossible to distinguish the effects of national and local changes in *PT*. This is not the case, however, as shown by Figure 4. Even conditional on time and province dummies, there may be unobservable concurring local employment shocks - the timing of which is correlated with changes in *MRA* - that affect both local employment and local *PT*. This is likely because the variation in *PT* relies on the

[12] Real GDP at the province level is only available until 2013. We simulate the values for 2014 and 2015 by applying to 2013 regional annual growth rates.

[13] We use the national rather than the local population because the latter is likely to be endogenous.

within-province variation in the age structure of the senior population over time, and there could be shocks affecting both this demographic component and local employment. For instance, employment shocks could trigger migration across localities. In this case, the OLS estimates of parameter θ in Equation (7) are inconsistent.

We address this threat by using instrumental variables (IV). We generate a shift-share instrument à-la Card, 2007, by applying the *MRA* in place in any given year to the provincial population aged 50 to 70 as it is in the Population Census in 1991 – well before 2004, when our observation period begins. We call our instrument *PT1991*. By using the exogenous variation in *PT1991*, we break the simultaneity between *PT* and the error term which could be due to unobservable provincial shocks, but retain the first-stage relationship that is given by the persistence in the age structure of the population within provinces and over time and by the changes in retirement age due to pension reforms.

If the error term ε in (7) is serially correlated, this could affect the consistency of our IV estimates because the instrument could to be correlated with lags of the endogenous variable *PT*. We address this threat by estimating the following dynamic model, that includes the lagged outcome as an additional control

$$N^{Q}_{pt} = \alpha + \beta N^{Q}_{pt-1} + \theta PT_{pt} + \gamma_T + \gamma_P + \delta X^{Q}{}_{pt-\tau} + v_{pt} \qquad (8)$$

In Equation (8), the lagged dependent variable is endogenous due to the presence of the province fixed effects (Nickell, 1981). To address this bias, we implement the Arellano-Bond, 1991, GMM estimator, that uses employment lags of order two and higher as instruments. If the random error *v* is not seriously correlated, these instruments are valid. We test for second order serial correlation and also report the Hansen over-identification test for instrument validity.[14]

As emphasized in the introduction, finding that a higher value of local *PT* reduces local youth employment is not sufficient to establish that the "lump of labour fallacy" holds. The key reason is that changes in *MRA* increase the pool *PT* both at the national and at the local level, and that national increases affect both national and local employment. To clarify this point further, it is useful to write a stripped down version of Equation (7), that considers youth employment as the dependent variable and

[14] In general, we include only the first lag of the dependent variable on the right hand side of equation (8), and use all other available lags to generate internal instruments. However, in some specifications – in order to pass both tests, we include also additional lags of the dependent variable on the right-hand side or use only a limited set of lags to generate internal instruments. Details are provided when commenting the results.

adds a spill-over effect as follows:

$$N_{pt}^{Y} = \alpha + \theta PT_{pt} + \lambda PT_{-pt} + \omega_{pt} \tag{9}$$

where *p* is for the province and *"–p"* is for all the other provinces in the country. In this model, θ is the marginal effect of a change in the local pool of senior workers, *PT,* on local youth employment, and λ is the marginal spill-over effect from other provinces. Since aggregate *PT* is equal to $PT_{pt} + PT_{-pt}$, equation (9) can be re-written as:

$$N_{pt}^{Y} = \alpha + (\theta - \lambda)PT_{pt} + \lambda PT_{t} + \omega_{pt} \tag{10}$$

When equation (10) is estimated using unrestricted time dummies, as we do, the parameter (θ-λ) is identified by the province by time variation of local PT but the parameter λ cannot be separately estimated. To illustrate the implications of this, it is useful to aggregate (10) over the *K* provinces. We obtain $N_{t}^{Y} = Z\alpha + [(\theta - \lambda) + K\lambda]PT_{t} + \omega_{t}$. The overall marginal effect of *PT* on youth employment is $[(\theta - \lambda) + K\lambda]$, but our empirical strategy can only estimate (θ-λ).

5. The Data

Our data are drawn from the Italian Labour Force Survey (LFS). The LFS is a quarterly survey on labour market conditions covering a representative sample of almost 77,000 households and 175,000 individuals per quarter. We use the second quarter of waves 2004 to 2015, because information about the province of residence is available in the LFS only from 2004.[15] We aggregate data by province and wave, using sampling weights to reproduce national aggregates. Due to changing boundaries over the sampling period, we use the definition of provinces in 2004 and reclassify our data accordingly. Since re-classification is virtually impossible for the neighbouring Provinces of Bari and Foggia, we treat them as a single province and end up with 102 provinces.

Data on local real GDP are from Eurostat, and data on the provincial age structure in 1991 – used to construct our instrument *PT1991* – are drawn from the 1991 ISTAT Population Census. Descriptive statistics for the relevant variable are reported in Table 3.

[15] Additionally, the survey was substantially changed in 2004 with the transition to a quarterly continuous survey.

6. Results

Our baseline estimates are shown in Table 4.[16] For each age group, we report the marginal effect of local *PT* on local employment, using both OLS and IV. In the first row, we consider a parsimonious specification that excludes the vector of controls X; in the second and third row, we add the variables in vector X lagged either once or twice. In the fourth row, we add to the vector X lagged once the interactions of province dummies with lagged aggregate GDP. Finally, in row five we consider a dynamic employment equation with lagged X. For the last specification, we only present the estimates obtained using the Arellano-Bond, 1991, GMM estimator and instrumenting *PT* with *PT1991*.

For the static models in rows (1) to (4), we find that the first stage F - test for instrument relevance ranges between 574 to 867, well above the critical value of 10, suggesting that the instrument *PT1991* is not weak. For the dynamic model in row (5), we always fail to reject the null hypothesis that the over-identifying restrictions are valid (Hansen J test) and that the error term in the dynamic equation is not serially correlated (Arellano-Bond AR(2) test).[17]

Starting from the most parsimonious specification in row (1) and focusing on the IV estimates, we find that adding one thousand individuals to the local pool *PT* of senior individuals who cannot retire because of lack of eligibility reduces local employment for the youngest group and for the group aged 25 to 34 by 52 and 235 units respectively. We also detect no statistically significant effect for prime age workers aged 35 to 49, and a positive effect equal to 210 units for senior workers aged 50 to 70.

Adding to the regressions the vector X lagged either once or twice has almost no effect on the very young (16-24) but reduces sensibly the absolute value of the marginal effect for young workers aged 25 to 34 (from 235 units to the range 140 to 186 units). On the other hand, the marginal effect for prime age workers becomes negative and statistically significant (in the range between 77 to 86 units) and the

[16] Table A.1 in the Appendix reports the results of weighted IV estimates, with weights given by the number of observations in each province by year cell.

[17] The p-values of the J-test and the AR(2) test for the four groups are respectively equal to:

- 0.09 and 0.37 for those aged 16-24
- 0.11 and 0.59 for those aged 25-34
- 0.07 and 0.83 for those aged 35-49
- 0.16 and 0.61 for those aged 50+.

For age groups 16-24 and 35-49, we can only pass both tests by including as controls the first two lags of the dependent variable. For the former group we also limit the lags used as internal instrument to the 5th. Using the weak identification diagnostics proposed by Bazzi and Clemens, 2013, we fail to detect weak instrument problems. Further details are available from the authors.

effect on senior workers declines in absolute value, from 210 to the range 149 to 184 units.

When compared to the specification in row (2), the inclusion of province dummies interacted with aggregate GDP (lagged once) reduces the absolute value of the estimated effects for the very young (41 units), the young (101 units) and the senior (140 units), but leaves unaltered the effect estimated for prime age workers (86 units). Finally, the estimates based on the dynamic specification in row (5) are broadly similar to those in row (2), with the exception of prime age workers. For this group, the marginal impact of *PT* is not significantly different from zero. Overall, and independently of the selected specification, the results in this table suggest that the increase in local senior employment induced by higher local *PT* is not sufficient to compensate for the reduction of local youth and prime-age employment.

Table 5 presents our estimates of the effects of local changes in *PT* on unemployment gross of inactivity.[18] Focusing on the findings in rows (2) to (5), we estimate that a one thousand increase in local *PT* causes a 30 to 72 units and a 14 to 62 units increase in the unemployed among the very young (16-24) and the young (25-34), a 22 to 80 units increase in unemployed prime-age (35-49) workers and a 0 to 51 decline in the number of unemployed seniors (50-70). As for employment, the decline in the unemployment of older workers following an increase in *PT* is not sufficient to compensate for the increase of unemployment in the younger age groups.

Define the young employment population ratio as $\frac{N^Y}{P^Y}$. The percentage change in this ratio induced by a hundred percent increase in *PT* is given by

$$\frac{\partial \frac{N^Y}{P^Y}}{\partial \ln PT} = \frac{N^Y}{P^Y}\left(\frac{\partial \ln N^Y}{\partial \ln PT} - \frac{\partial \ln P^Y}{\partial \ln PT}\right) \qquad (11)$$

Combining the estimates in rows (2) and (4) of Tables 4 and 5 and evaluating semi-elasticities at mean

[18] The p-values of the J-test and the AR(2) test for the four groups are respectively equal to:

- 0.12 and 0.08 for those aged 16-24
- 0.38 and 0.19 for those aged 25-34
- 0.07 and 0.90 for those aged 35-49
- 0.06 and 0.11 for those aged 50+.

For the age group 16-24, we can only pass both tests by including as controls the first two lags of the dependent variable. For the age group 35 to 49, we need to include the first three lags and to limit the lags used as internal instrument to the 5th. As above, we always fail to detect weak identification issues (see Bazzi and Clemens, 2013).

sample values, the estimated percentage change in the employment population ratio ranges between -6.7 and -8.5 percentage points for the very young (16-24), between -6.8 and -11 percentage points for the young (25-34), between -5.2 and -5.3 percentage points for prime age individuals (35-49) and between 5.4 and 6.5 percentage points for senior workers (50-70).

As shown in Section 2, senior population P^O is the sum of *PT* and *NPT*. Focusing on the IV estimates of the specification in the second row of Tables 4 and 5, we obtain that $\frac{\partial P^O}{\partial PT} = 0.098$.[19] Therefore, $\frac{\partial NPT}{\partial PT} = -0.902$. An increase in *PT* alters the composition of the senior local population by increasing the share of those too young to retire and by reducing the share of those eligible for retirement. This compositional change produces an increase in senior employment and a (small) decline in senior unemployment and inactivity.

7. Extensions and sensitivities

In these section we consider several sensitivities of our baseline results. Since the qualitative results in rows (2) to (5) of Tables 4 and 5 are similar, we focus only on specification (2), that becomes our baseline specification.

7.1 Changes in the definitions of the dependent variable

In our baseline model the dependent variable is in levels, as in Boeri et al, 2016, and Bovini and Paradisi, 2017. An alternative is to use the ratio of employment over population, and regress this ratio on the ratio of *PT* to population. Kalwij et al, 2010, divide youth employment by the working age population. We divide age specific employment and *PT* by the national population aged 16 to 70. We use the national rather than local population because the former can be reasonably considered as exogenous. Using our baseline specification, we find that results - reported in the first row on Table 6 - are very similar to those in the second row of Table 4.

We have considered so far the effects of *PT* on total employment. Rows (2) to (4) of Table 6 considers narrower definitions of employment: in the private sector only, without the self-employed and full time only. Results are broadly in line with those in Table 4, second row.

[19] Notice that $\frac{\partial N^O}{\partial PT} + \frac{\partial U^O}{\partial PT} = \frac{\partial P^O}{\partial PT}$ (0.149-0.051 =0.098), where U^O is unemployment plus inactivity.

7.2 Two Alternative Definitions of PT

Our definition of the pool of senior individuals who cannot retire include also the inactive, many of whom could be permanently disengaged from the labour market. For this group, changes in eligibility conditions for retirement are unlikely to affect labour supply decisions. We replicate our estimates after excluding the inactive from the definition of *PT* and present our results in row (5) of Table 6. Results are qualitatively similar to those in Table 4, but larger in absolute value. In particular, a one thousand increase in *PT* is estimated to reduce employment by 105 units for the very young, by 295 units for the young, by 194 units for prime age workers and to increase it by 332 units for senior workers.

We have defined *PT* as $PT = \sum_{a=50}^{MRA-1} P_a^O$. This definition relies on the implicit assumption that individuals younger than minimum retirement age cannot retire. Yet Italian retirement rules do allow individuals to go before minimum age provided that they have paid social security contributions for the prescribed minimum number of years. Let this number by *SSC*. As shown in Table A.2 in the Appendix, this number has increased steadily from 1996 to 2015. Assuming that individuals start working after finishing school, we define *MSC* as the age when school ends plus *SSC* and redefine *PT* as $PT = \sum_{a=50}^{\min(MSC-1, MRA-1)} P_a^O$. Results of the estimates based on this definition are reported in the last row of Table 6 and are very similar to those in row (5) of the same table.

7.3 Heterogeneous Effects: Gender and Area

We ask whether the effects reported in Table 4 vary across macro areas and gender. We focus on employment, distinguish between the industrialised North and Centre of the country and the less developed South and use the baseline specification in row (2) of Table 4. The instrumental variable estimates are reported in Table 7 for each of the four age groups. We find that the negative effects of *PT* on youth and prime – age employment are larger in absolute value in the South. In that area, and in striking contrast with the Centre-North, the change in the composition of the senior population due to the local increase in *PT* does not alter senior employment. Therefore, the overall employment loss is much larger in the South than in the Centre-North.

There is also evidence that senior female employment benefits less than male employment from the increase in local *PT*, and that youth and prime age female employment decline more. In particular, we estimate that a one thousand increase in local *PT* increases senior employment by 246 units for males and by 85 units for females, and reduces youth employment in the age group 25 - 34 by 94 units for males and by 186 units for females.

7.4 Estimates based on the years 1996 to 2015

We have found that local increases in *PT* raise senior employment but reduce youth and prime-age employment. Our results are based on a sample period, 2004-2015, characterized by a relative poor economic performance, as documented by Figure 5. The figure plots the evolution of Italian real GDP in the past twenty years. While GDP grew more or less continuously from 1996 to 2007, it declined rather sharply from the onset of the 2008 Recession to the end of the sample period.

The question arises whether the negative impact of pension reforms on youth employment is affected by the selection of a time period characterized by declining GDP and total employment. To address this question, we consider the longer time period 1996 – 2015, which includes the interval 1996 to 2007, when both GDP and total employment show positive growth. Unfortunately, since the disaggregation at the province level is not available before 2004, we are forced to use regions as local areas.

As in the case of provinces, we collapse individual Labour Force data at the regional level using sampling weights, and estimate our baseline specification by instrumenting current *PT* with *PT1991*.[20] Since there are only 20 regions in Italy, and we wish to cluster standard errors by region, we account for the small number of clusters using wild bootstrap techniques for inference (see Cameron, Gelbach and Miller, 2008).[21]

The IV estimates for both employment and unemployment are reported in Table 8.[22] Comparing Tables 8 and 4 (second row), our qualitative results are virtually unchanged. The quantitative effects for the very young (16-24) are also similar. For the other age groups, however, that are noteworthy differences. For the young (25-34), we estimate that a one thousand increase in local *PT* reduces employment by 7 units, much less than with provincial data covering the shorter period 2004 to 2015. For the prime-aged (35-49), the estimated decline is 28 individuals, smaller than the effect reported in Table 4. Finally, the estimated increase for senior workers is 304 units, larger than the one estimated in

[20] Results from the other specifications are qualitatively similar and available from the authors upon request.
[21] The vector X includes the same controls used for provincial data, with the exception of the share of immigrants, that is not available for the late 1990s.
[22] Not reported here, the first stage F statistics for instrument relevance - obtained by wild bootstrap - are always way above the critical value of 10.

Table 4. For the unemployed or inactive, we find that an increase in local *PT* has negative rather than positive effects on youth (25-34) unemployment and much larger negative effects on senior unemployment than those found using provincial data and a shorter time period.

A potential concern is that the observed differences between Table 4 and 8 are due not to the sample period but to the definition of local labour markets (regions rather than provinces). Yet when we consider regions and the shorter time interval from 2004 to 2015, the estimated effects are much more similar to those shown in Table 4, especially for young and prime-aged individuals.[23]

We tentatively conclude that, while the direction of the effect of a higher local *PT* on local youth employment does not vary across different sample periods, the size of the negative effect reported in Table 4 is partly due to the specific sample period, characterized by declining GDP and stagnant employment.[24] In a growing economy, these effects are likely to be significantly smaller.[25]

7.5 Spill-over effects

We have regressed local employment on local *PT*. Yet, local employment could also be affected by changes of *PT* in neighbouring areas. We investigate whether local spill-overs are present by using two alternative measures of neighbouring areas: a) provinces that share their border with the selected province; b) provinces where the main city is located less than 100 kilometres from the main city of the selected province.[26]

We augment the specification used in the second row of Table 4 with the value of *PT* for the neighbouring area, which we instrument with the corresponding value of *PT1991*. Results reported in Table 9 show that, conditional on the local *PT*, the value of *PT* in neighbouring areas has small and often not statistically significant effects on local employment.

7.6 Firm turnover

Changes in local *PT* could affect firm turnover by facilitating firm entry and / or exit. We define gross

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[23] Using the shorter time period, regional data and the baseline specification, the estimated employment effects for the four age groups are equal to -0.068 for the very young, -0.109 for the young, -0.089 for the prime aged and 0.245 for senior workers.

[24] While total employment in Italy increased from 19.7 to 21.7 million between 1996 and 2003, it was equal to 22.2 in 2004 and to 22.3 million in 2015.

[25] We recognize that the individuals affected by pension reforms in the late nineties were younger than those affected in the late 2000s and early 2010s and that this difference could also affect our results.

[26] We use the Stata code "geodist", which computes geodetic distances, i.e. the length of the shortest curve between two points along the surface of a mathematical model of the earth.

turnover as annual entries plus exits over the stock of firms in the previous period, and net turnover as entries minus exits over the previous stock. Data on firms are from the *MovImprese* database of the *Camere di Commercio*, that contains population-level data on firm entries and exits by province and year. Due to a change in the definition of firm exit, data can only be used from 2006 onwards. We regress gross and net turnover on *PT* (measured in million units) and the controls used in Table 4 (row 2). Results shown in Table 10 indicate that an increase in *PT* raise both gross and net turnover. The estimated effect, however, is very small.

Conclusions

We have studied the effects of changes in minimum retirement age that modify the local labour supply of senior workers on youth employment in Italy. Our treatment variable is the size of the local pool of senior individuals who are aged above 50 but below minimum retirement age. Pension reforms that tighten eligibility conditions have increased minimum retirement age, thereby raising the local pool of those who cannot retire because they are younger than minimum age, and altering the composition of the local senior population.

By means of simple model, we have shown that, when employment protection makes it difficult to dismiss senior workers, a larger local pool increases their employment. Average age at work also increases, and this could affect negatively the productivity of older workers. The productivity of younger workers could also change, although it is not clear in which direction. When output is allowed to vary, these effects influence youth employment, with an ambiguous net effect. Furthermore, when wages are set nationally and cannot be adjusted locally and senior employment cannot be displaced because of the very high adjustment costs, a larger local pool could drive some local firms out of the market and induce other firms to rise their relative prices, thereby attracting new firms that typically employ young workers. Overall, firm turnover could either raise or fall.

We have estimated the causal effect of a local increase in the pool of senior workers who are too young to retire on the local employment and unemployment of four age groups, the very young, the young, the prime aged and the seniors, using a shift-share instrumental variable strategy à-la Card, 2007. We have found that – in our preferred specification - raising the local pool by one thousand additional senior individuals reduces youth and prime-age employment by 189 and 86 individuals respectively, and increases senior employment by 149 individuals. Our estimated effects for youth employment are similar to those found by Boeri et al, 2016, using Italian firm data and considering only the last pension reform (Monti-Fornero).

We have argued that the size of the negative effects on youth employment could depend on the selected sample period, that is characterised by declining real GDP and stagnant total employment. Using longer regional data that cover the period 1996 to 2015, we have shown that the effects on youth (16 to 34) and prime-age (35-49) employment are indeed negative but smaller, equal to 68 and 28 fewer employees, and that the effects on senior workers are larger and equal to 304 employees. They suggest that the employment costs of pension reforms that delay the retirement of older workers may be lower when these reforms are implemented in a growing economy.

Our empirical approach has both pluses and minuses. The clear plus is that it helps identifying local employment effects. The minus is that by means of this approach we can only retrieve part of the overall effect of changes in the aggregate supply of older workers on aggregate youth employment. Clearly, a test of the "lump of labour" hypothesis require stronger assumptions that can discriminate this effect from concurring macroeconomic effects.

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TABLES AND FIGURES

Table 1. Minimum retirement age in the private sector, by year and gender.

Year	Male employees private sector	Male self-employed	Female employees private sector	Female self-employed
1996	52	56	52	52
1997	52	56	52	52
1998	53	57	53	53
1999	53	57	53	53
2000	54	57	54	54
2001	55	58	55	55
2002	55	58	55	55
2003	56	58	56	56
2004	57	58	57	57
2005	57	58	57	57
2006	57	58	57	57
2007	57	58	57	57
2008	58	59	58	58
2009	59	60	59	59
2010	59	60	59	59
2011	60	61	60	60
2012	66	66	62	62
2013	66.25	66.25	62.25	62.25
2014	66.25	66.25	63.75	63.75
2015	66.25	66.25	63.75	63.75

Source: national legislation.

Table 2. Population, employment and unemployment in the age group 50-70 and PT. By year

Year	Average population aged 50 to 70 (PO)	PT	Population aged 50-70 minus PT	Employment age 50-70	Unemployment and inactivity age 50-70
2004	141,684	58,592	83,093	49,377	92,307
2005	143,422	59,209	84,212	51,524	91,898
2006	144,104	58,449	85,655	53,556	90,547
2007	145,505	58,844	86,661	55,710	89,795
2008	147,603	67,450	80,153	57,822	89,781
2009	149,126	75,828	73,298	59,241	89,885
2010	148,817	75,664	73,153	56,582	92,235
2011	151,216	84,752	66,464	62,443	88,773
2012	151,622	113,568	38,054	61,588	90,034
2013	154,320	115,634	38,686	63,670	90,650
2014	158,112	121,781	36,330	67,726	90,385
2015	161,080	123,721	37,359	71,751	89,329

Table 3**.** Descriptive statistics. Province-by-year variables. Observations: 1,122

	Mean	Std. Dev.
# Employees/1,000 – age 16-24	11.24	12.18
# Employees/1,000 – age 25-34	48.49	57.75
# Employees/1,000 – age 35-49	103.56	124.59
# Employees/1,000 – age 50-70	60.14	70.71
# Unemployed and Inactive/1,000 – age 16-24	42.08	51.33
# Unemployed and Inactive/1,000 – age 25-34	25.67	35.92
# Unemployed and Inactive/1,000 – age 35-49	35.00	47.44
# Unemployed and Inactive/1,000 – age 50-70	90.30	99.63
Total population/1,000 – age 16-24	53.32	61.87
Total population/1,000 – age 25-34	74.17	85.59
Total population/1,000 – age 35-49	138.57	161.29
Total population/1,000 – age 50-70	150.44	168.34
PT/1,000	86.81	103.83
PT/1,000 - narrower definition (1)	53.48	64.73
PT/1,000 - narrower definition (2)	61.34	74.59
IV1991/1,000	77.58	93.15
Wave	2010	3.16

Notes: 102 provinces observed for 11 years (2005-2015). Source: ISTAT Labour Force Survey

Table 4. Marginal effects of a higher pool of potential senior workers (PT) on total employment by age group. OLS, IV and Arellano Bond estimates. Static model and dynamic model. Provincial data 2004-2015.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Age group	16-24	16-24	25-34	25-34	35-49	35-49	50-70	50-70
Estimation method	OLS	IV	OLS	IV	OLS	IV	OLS	IV
(1) Without X	-0.053***	-0.052***	-0.224***	-0.235***	0.005	0.009	0.215***	0.210***
	(0.007)	(0.007)	(0.033)	(0.034)	(0.041)	(0.040)	(0.027)	(0.023)
(2) With lagged X	-0.050***	-0.049***	-0.133***	-0.140***	-0.082***	-0.086***	0.162***	0.149***
	(0.005)	(0.005)	(0.014)	(0.017)	(0.025)	(0.027)	(0.027)	(0.029)
(3) With X lagged twice	-0.052***	-0.051***	-0.177***	-0.186***	-0.070***	-0.077***	0.204***	0.184***
	(0.005)	(0.005)	(0.014)	(0.018)	(0.025)	(0.028)	(0.028)	(0.030)
(4) With lagged X and province	-0.044***	-0.041***	-0.085***	-0.101***	-0.094***	-0.086***	0.168***	0.140***
dummies * lagged GDP interactions	(0.011)	(0.011)	(0.019)	(0.023)	(0.034)	(0.038)	(0.031)	(0.031)
(5) With lagged N and lagged X	-	-0.041***	-	-0.125***	-	0.015	-	0.120***
(Arellano Bond GMM estimates)		(0.011)		(0.018)		(0.034)		(0.015)

Notes: number of observations: 1,122 in rows (1), (2) and (4), 1,020 in rows (3) and (5). Row 5: Arellano Bond estimates. All models include province and wave dummies. The vector X includes the firs lag of provincial GDP per capita; the percentage of employees in the industry sector and in the public sector by province and age group; total population by province and age group; the percentage of workers with high school or higher degree by province and age group; the percentage of males by province and age group; average age by province and age group; the share of immigrants by province and age group. Standard errors are clustered by province. ***: p<.01; **: p<.05; *:p<.01.

Table 5. Marginal effects of a higher pool of potential senior workers (PT) on unemployment and inactivity by age group. OLS, IV and Arellano Bond estimates. Static model and dynamic model. Provincial data 2004-2015.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Age group	16-24	16-24	25-34	25-34	35-49	35-49	50-70	50-70
Estimation method	OLS	IV	OLS	IV	OLS	IV	OLS	IV
(1) Without X	0.084***	0.087***	0.047***	0.047***	0.081***	0.083***	-0.040	-0.064
	(0.021)	(0.019)	(0.009)	(0.007)	(0.010)	(0.011)	(0.070)	(0.067)
(2) With lagged X	0.055***	0.053***	0.060***	0.062***	0.076***	0.080***	-0.042	-0.051
	(0.010)	(0.010)	(0.017)	(0.014)	(0.013)	(0.014)	(0.043)	(0.043)
(3) With X lagged twice	0.054***	0.053***	0.055***	0.054***	0.070***	0.077***	-0.027	-0.046
	(0.016)	(0.014)	(0.021)	(0.015)	(0.010)	(0.011)	(0.051)	(0.05)
(4) With lagged X and province dummies * lagged GDP interactions	0.035***	0.030***	0.027	0.029	0.076***	0.079***	-0.020	-0.026
	(0.012)	(0.012)	(0.020)	(0.015)	(0.029)	(0.029)	(0.037)	(0.039)
(5) With lagged N and lagged X (Arellano Bond GMM estimates)	-	0.072***	-	0.003	-	0.018	-	0.010
		(0.017)		(0.025)		(0.032)		(0.047)

Notes: number of observations: 1,122 in rows (1), (2) and (4), 1,020 in rows (3) and (5). Row 5: Arellano Bond estimates. All models include province and wave dummies. The vector X includes the first lag of provincial GDP per capita; the percentage of employees in the industry sector and in the public sector by province and age group; total population by province and age group; the percentage of workers with high school or higher degree by province and age group; the percentage of males by province and age group; average age by province and age group; the share of immigrants by province and age group. Standard errors are clustered by province. ***: p<.01; **: p<.05; *: p<.01.

Table 6. Marginal effects of a higher pool of potential senior workers (PT) on employment by age group. OLS and IV estimates of the static model with lagged X. Sensitivities. Provincial data 2004-2015.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Age group	16-24	16-24	25-34	25-34	35-49	35-49	50-70	50-70
Estimation method	OLS	IV	OLS	IV	OLS	IV	OLS	IV
(1) Employment / total population	-0.051***	-0.050***	-0.137***	-0.145***	-0.078***	-0.081***	0.166***	0.155***
	(0.005)	(0.005)	(0.014)	(0.017)	(0.025)	(0.026)	(0.026)	(0.029)
(2) Private sector employment	-0.046***	-0.045***	-0.109***	-0.116***	-0.057***	-0.060***	0.088***	0.079***
	(0.006)	(0.006)	(0.019)	(0.021)	(0.020)	(0.022)	(0.021)	(0.022)
(3) Net of self-employment	-0.042***	-0.040***	-0.101***	-0.110***	-0.029***	-0.034***	0.129***	0.120***
	(0.006)	(0.006)	(0.013)	(0.015)	(0.024)	(0.024)	(0.020)	(0.023)
(4) Full time employment	-0.036***	-0.034***	-0.109***	-0.117***	-0.033	-0.037*	0.126***	0.117***
	(0.006)	(0.006)	(0.011)	(0.016)	(0.022)	(0.021)	(0.021)	(0.024)
(5) Narrower definition of PT (1)	-0.098***	-0.105***	-0.243***	-0.295***	-0.130***	-0.194***	0.489***	0.332***
	(0.010)	(0.015)	(0.038)	(0.047)	(0.060)	(0.060)	(0.026)	(0.055)
(6) Narrower definition of PT (2)	-0.082***	-0.087***	-0.214***	-0.251***	-0.138***	-0.164***	0.342***	0.292***
	(0.010)	(0.009)	(0.030)	(0.032)	(0.041)	(0.046)	(0.043)	(0.057)

Notes: number of observations: 1,122. All models include province and wave dummies. The vector X includes the first lag of provincial GDP per capita; the percentage of employees in the industry sector and in the public sector by province and age group; total population by province and age group; the percentage of workers with high school or higher degree by province and age group; the percentage of males by province and age group; average age by province and age group; the share of immigrants by province and age group. Standard errors are clustered by province. ***: p<.01; **: p<.05; *: p<.01.

Table 7. Marginal effects of a higher pool of potential senior workers (PT) on employment by age group. IV estimates of the static model with lagged X. Heterogeneities. Provincial data 2004-2015.

	(2)	(4)	(6)	(8)
Age group	16-24	25-34	35-49	50-70
North and Centre	-0.040***	-0.134***	-0.070***	0.192***
	(0.007)	(0.023)	(0.038)	(0.031)
South	-0.061***	-0.155***	-0.113***	-0.011
	(0.003)	(0.013)	(0.025)	(0.016)
Males	-0.032***	-0.094***	0.034	0.246***
	(0.007)	(0.017)	(0.036)	(0.038)
Females	-0.058***	-0.186***	-0.147***	0.085***
	(0.007)	(0.026)	(0.041)	(0.026)

Notes: number of observations: 1,122. All models include province and wave dummies. The vector X includes the first lag of provincial GDP per capita; the percentage of employees in the industry sector and in the public sector by province and age group; total population by province and age group; the percentage of workers with high school or higher degree by province and age group; the percentage of males by province and age group; average age by province and age group; the share of immigrants by province and age group. Standard errors are clustered by province. ***: p<.01; **: p<.05; *: p<.01.

Table 8. Marginal effects of a higher pool of potential senior workers (PT) on total employment by age group. IV estimates. Static model and dynamic model. Baseline specification with lagged X. Regional data 1996-2015

	(2)	(4)	(6)	(8)
Age group	16-24	25-34	35-49	50-70
Employment	-0.061***	-0.008	-0.028	0.304***
	[0.000]	[0.870]	[0.357]	[0.002]
Unemployment	0.071***	-0.038	0.031	-0.269***
	[0.000]	[0.131]	[0.193]	[0.006]

Notes: number of observations: 361. All models include region and wave dummies. The vector X includes the 1-year lagged values of regional GDP per capita; the percentage of employees in the industry sector and in the public sector by region and age group; total population by region and age group; the percentage of workers with high school or higher degree by region and age group; the percentage of males by region and age group; average age by region and age group. Wild bootstrap p-values within brackets. ***: p<.01; **: p<.05; *:p<.01.

Table 9. Marginal effects of a higher pool of potential senior workers (PT) on employment by age group. IV estimates of the static model with lagged X. Spill-over effects. Provincial data 2004-2015.

Age group	(1) 16-24	(2) 25-34	(3) 35-49	(4) 50-70
Panel A				
Provincial PT	-0.049***	-0.140***	-0.086***	0.149***
	(0.005)	(0.017)	(0.027)	(0.029)
PT of neighbouring provinces *1000	0.000	0.000	0.000	0.000*
	(0.000)	(0.000)	(0.000)	(0.000)
Panel B				
Provincial PT	-0.049***	-0.140***	-0.086***	0.149***
	(0.005)	(0.017)	(0.027)	(0.029)
PT of provinces whose capital is distant at most 100 km from the provincial capital *1000	-0.017	-0.046*	0.031	0.050*
	(0.011)	(0.025)	(0.029)	(0.030)

Notes: number of observations: 1,020. All models include province and wave dummies. The vector X includes the first lag of provincial GDP per capita; the percentage of employees in the industry sector and in the public sector by province; the stock of firms by province; the percentage of workers with high school or higher degree by province; the percentage of males by province; average age by province; the share of immigrants by province. Standard errors are clustered by province. ***: p<.01; **: p<.05; *: p<.01.

Table 10. Marginal effects of a higher pool of potential senior workers (PT) on gross and net firm turnover. IV estimates of the static model with lagged X. Provincial data 2004-2015.

Age group	(1) OLS	(2) IV
Gross turnover	0.039**	0.033*
	(0.017)	(0.018)
Net turnover	0.031**	0.032**
	(0.013)	(0.013)

Notes: number of observations: 1,122. *PT* is measured in million individuals. All specifications include province and wave dummies. The vector X includes the first lag of provincial GDP per capita; the percentage of employees in the industry sector and in the public sector by province and age group; total population by province and age group; the percentage of workers with high school or higher degree by province and age group; the percentage of males by province and age group; average age by province and age group. Standard errors are clustered by province. ***: p<.01; **: p<.05; *: p<.01.

Figure 1. Employment by age group. Italy 1996 to 2015

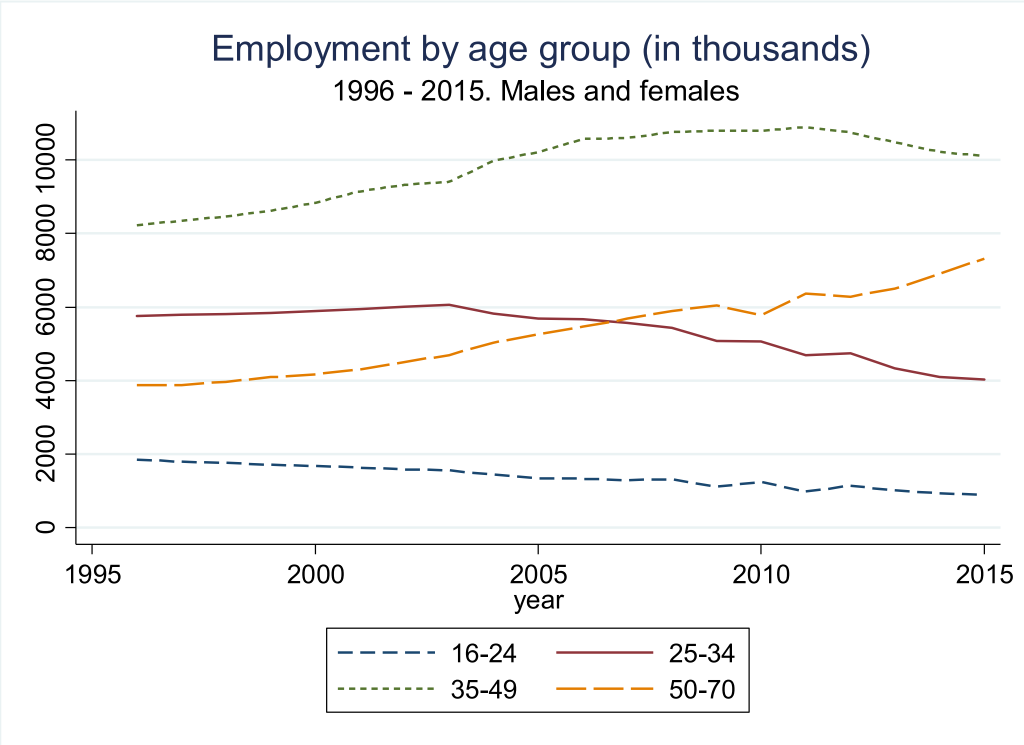
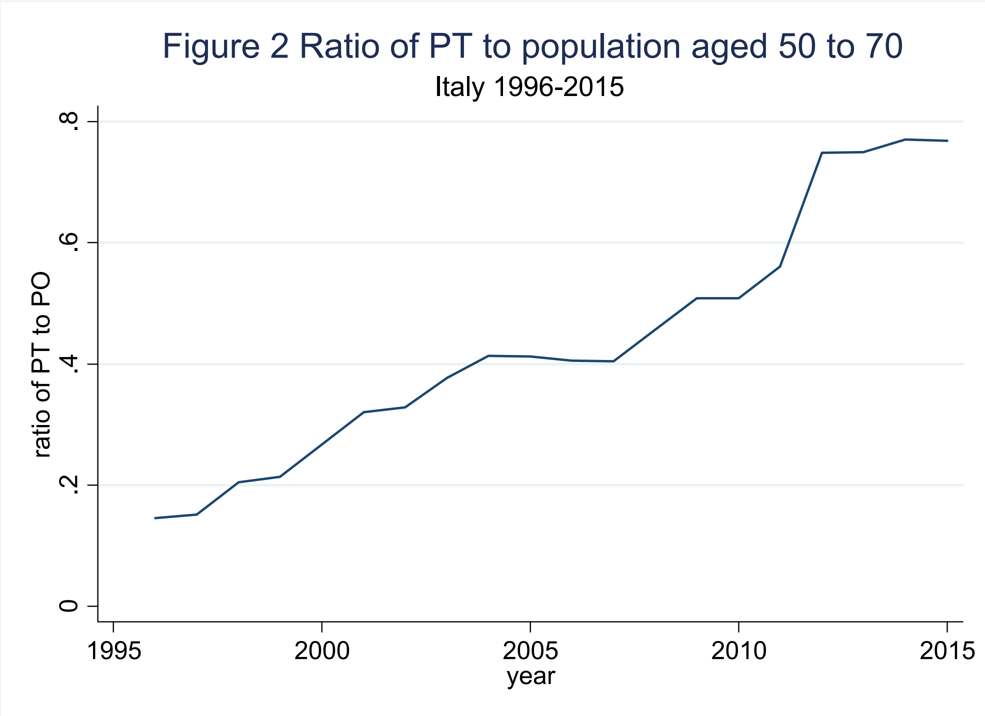
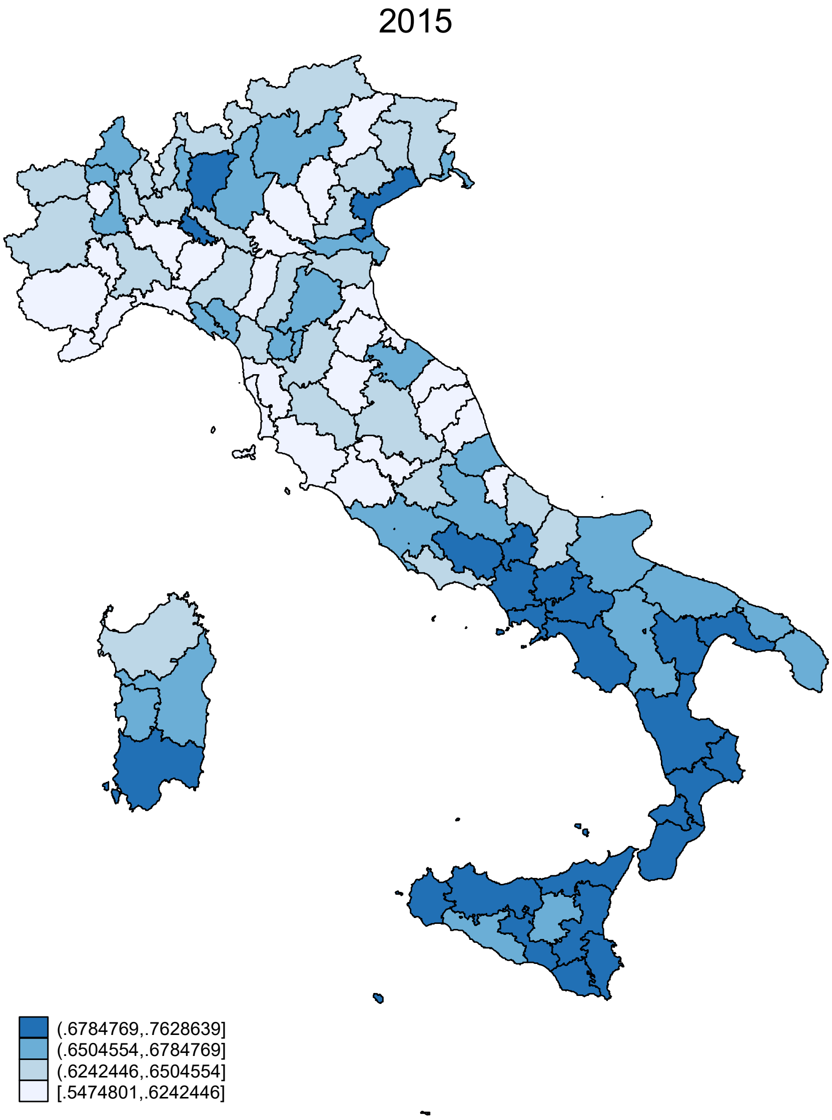


Figure 2. The ratio of national PT to the population aged 50 to 70



Source: Italian labour force survey.

Figure 3. The ratio of local PT to population aged 50 to 70 by province in year 2015.



Source: Italian Labour Force Survey.

Figure 4. The change of PT between 2004 and 2015 by province.

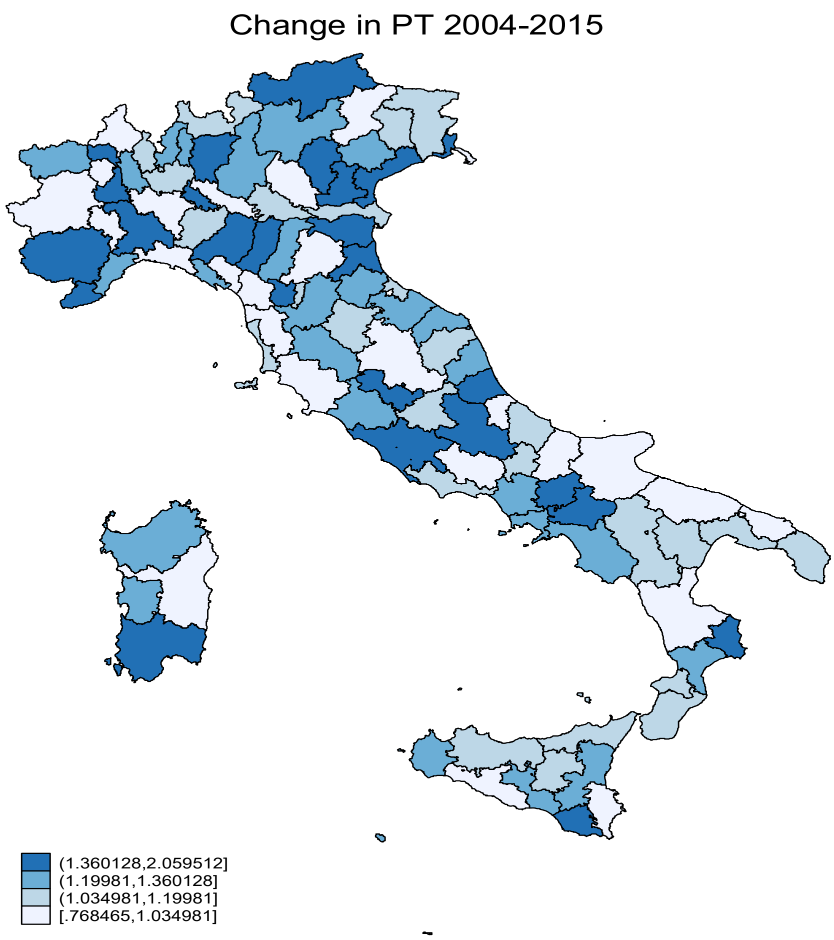
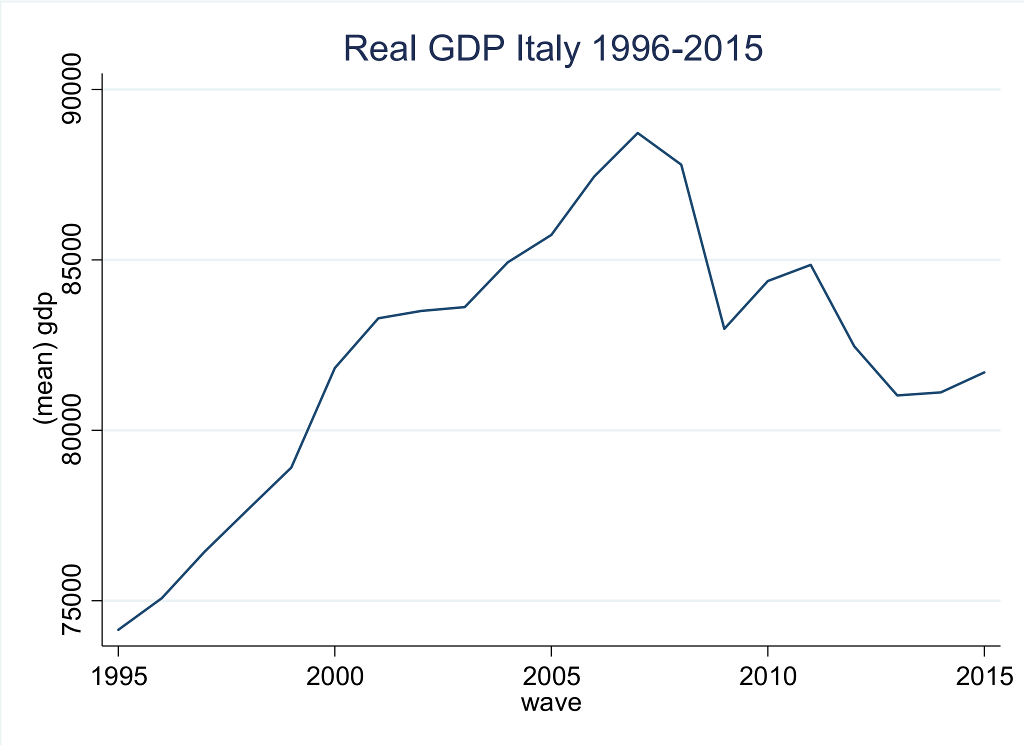


Figure 5. Italian Real GDP 1996-2015



Appendix

Table A1**.** Marginal effects of a higher pool of potential senior workers (PT) on employment and unemployment by age group. IV estimates of the static model with lagged X. Weighted estimates. With lagged values of X. Province data 2004-2015.

	(1)	(2)	(3)	(4)
Age group	16-24	25-34	35-49	50-70
Employment	-0.047***	-0.122***	-0.072***	0.141***
	(0.006)	(0.021)	(0.032)	(0.030)
Unemployment	0.061***	0.062***	0.072***	-0.048
	(0.008)	(0.014)	(0.021)	(0.039)

Notes: number of observations: 1,122. All models include province and wave dummies. The vector X includes the 1-year lagged values of provincial GDP per capita; the percentage of employees in the industry sector and in the public sector by province and age group; total population by province and age group; the percentage of workers with high school or higher degree by province and age group; the percentage of males by province and age group; average age by province and age group; the share of immigrants by province and age group. Standard errors are clustered by province. ***: p<.01; **: p<.05; *: p<.01.

Table A2. Years of social security contributions required to retire before minimum retirement age. By sector and gender.

Year	Male employees	Male self-employed	Female employees	Female self-employed
1996	36	40	36	40
1997	36	40	36	40
1998	36	40	36	40
1999	37	40	37	40
2000	37	40	37	40
2001	37	40	37	40
2002	37	40	37	40
2003	37	40	37	40
2004	38	40	38	40
2005	38	40	38	40
2006	39	40	39	40
2007	39	40	39	40
2008	40	40	40	40
2009	40	40	40	40
2010	40	40	40	40
2011	40	40	40	40
2012	42.08	42.08	41.08	41.08
2013	42.41	42.41	41.41	41.41
2014	42.5	42.5	41.5	41.5
2015	42.5	42.5	41.5	41.5

Source: national legislation.