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The wage to age relation in Italy: preliminary results on some new findings

Elena Giarda[1]

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[1] Address for correspondence: Elena Giarda, PROMETEIA - ASSOCIAZIONE PER LE PREVISIONI ECONOMETRICHE, Via Marconi 43, 40122 Bologna, Italy, elena.giarda@prometeia.it

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Abstract

The growth of individual wages over time is related to the individual's age. Also, the initial wage of individuals entering the labour force is growing over time due to increasing productivity of the economic system. The wage of any individual at any point in time is thus a function of the time she entered the labour market and of her age and seniority in the job. The relationship of wage to age can be studied using micro data of individual earnings over time. Such is the case with data drawn from the National Institute of Social Security (INPS) administrative archives, covering wage evolution for employees of the private sector in the period from 1985 to 1999.

The paper starts with a review of previous studies that have used similar data for different periods and different coverage, providing, in the first sections, a replica of empirical results that show the complex relationship between real individual wages, age profiles of the individuals and age cohorts. It then analyses the assumption, implicitly adopted by all studies so far, that the age profile is constant over different cohorts of individuals. It is shown that it is more sensible to assume that in face of the higher initial wages produced by the advancement of economy-wide productivity, the individual career factor is becoming less important in determining the wage response to age in the central part of the working life of private sector employees. Empirical analysis confirms that younger generations of workers benefit from higher starting wages but are faced with prospects of lower growth rates of future earnings.

The paper also finds that the strong constant term in the individual wage equations estimated in previous studies can better be substituted, in the specification of the model, by the dynamics of industry "contractual wages" or of average industry-wide national account wages. This result, to be evaluated with care because of the obvious interdependence of aggregate wage indicators and individual wages, indicates that individual wages over time can be expressed as differential wages with respect to contractual wages.

The two empirical findings of the paper will possibly allow, in future research, to integrate the changing age profile of individual wages in the explanation and forecast of the dynamics of average industry wages.

Introduction

The goal of this paper is to analyse the dynamics of individual wages in the private sector in Italy using data drawn from the National Institute of Social Security (INPS) administrative archives, covering the period between 1985 and 1999.

Existing studies on this subject have stressed the strong effect of ageing on individual wages, as it is related to the individual's career in the life cycle in the labour market. Effects of ageing on the level of individual wages are relevant for many households' and firms' decisions, as well as for welfare policies.

The availability of individual data over time (panel data), together with a variety of control variables, allows to study the wage-age relation for separate segments of the labour force, considering sex, regional effects, industrial sector, firm location and job position. Developing upon previous studies, the paper investigates two issues that are rarely treated. Most studies have provided evidence that entrance wages are increasing over time under the implicit assumption that the age profile of individual wages in Italy has remained stable over time. This may or may not be the case and deserves investigation. A time-varying wage to age profile is very important in all problems that require forecasting of future wages, such is the case for simulation of the relationship between wage profiles and pension benefits.

A second relevant issue is the relation between individual wages and contractual[2] or industry average wages. Individual careers affect the level of the economy average wages. It is also true that individual wages are affected by trends in the economy average wages and in wages determined by collective bargaining processes ("contractual wages"). So it is useful to investigate to what extent the dynamics of individual wages is affected by external events such as collective bargaining decisions.

The paper initially utilizes standard econometric techniques for the analysis of individual longitudinal data. It also develops preliminary estimates to test the changing relation of individual wages to age, a section of the research that is under revision for a more systematic treatment of the evolutionary character of the wage-age relation. It also suggests a possibly innovative way to treat the time effect that substitutes the system of time dummies with a measure of the dynamics of contractual wages, a procedure that potentially may be useful to connect micro data with economy-wide data.

Section 1 provides some description of the sample data (the WHIP, Work Histories Italian Panel) which contains work histories of a sample of individuals over the period 1985-1999, drawn from the INPS administrative archives. It provides some descriptive relations with the basic variables to be subsequently used in the analysis, such as age, sex, industry-wide wages, etc.

[2] By "contractual wages" we mean wage levels determined by collective bargaining.

Section 2 reviews the main approaches and results presented in the literature focusing on works by Lucifora-Rappelli (1995) and Brugiavini-Peracchi (2003), following the path-breaking paper by Mincer. These works concentrate mainly on the wage to age relationship and consider different sets of control variables, the years of labour market experience and some controls (such as sex, occupational category, sector, region of employment, etc.).

Section 3 provides estimates of the models with the objective to replicate the results by Lucifora-Reppelli and Brugiavini-Peracchi. Analogies and diversities of results are presented and briefly discussed.

Section 4 provides estimates of the changing structure of the age to wage relationship and also suggests how to deal with the time effects by use of economy-wide wage dynamics.

The main findings of the paper (Section 5) are that the age gradient, i.e. the wage increase related to ageing, is much smaller for late entrants in the labour market than it used to be for earlier entrants: younger generations have less to hope from getting older than elder generations. Furthermore, the industry contractual wage is an important variable in explaining the dynamics of individual wages: they are close to being unit-elastic with respect to industry contractual wages. Furthermore, this different specification of the wage equation does not result in different wage-age profiles relatively to those previously estimated.

1. The data and some descriptive statistics

The WHIP[3] (Work Histories Italian Panel) dataset contains work histories of a sample of individuals over the period 1985-1999, drawn from the INPS (Italian National Institute of Social Security) administrative archives. The sample is constructed by selecting, among all the workers registered at the INPS, those born on two specific days of each year. Each year contains between 55 000 and 70 000 observations on workers and their individual and job characteristics. For each individual, data are provided on age and sex, annual wages, number of weeks and days worked in the year, job position and qualification, sector of activity, job location, firm dimension, part time or full time work, type of work contract. The data source guarantees a high degree of accuracy, as it is used by INPS to compute social security benefits. Wages are yearly wages, net of social security contributions payable by the employer, but gross of income tax and social security contributions payable by the employee. A drawback of the data is the lack of information on overall seniority (also gained outside the INPS archive), on education level and family characteristics. Also there is no information on the motivations of a worker leaving the archive. The dataset allows to follow individual career paths and therefore to observe mobility among firms and job changes. Individuals can have more than an employment spell in the same year, depending, on the one hand, on whether

[3] Data were made available by LABORatorio Riccardo Revelli, http://www.labor-torino.it/. The data were drawn from two different INPS archives, the "O1M" and the "DM10".

[5] The term "Industry" includes Extraction, Manufacturing and Energy sectors and excludes Building and Construction. This definition will be held throughout the paper. Analysis might be extended to other sectors (such as Services, and Building and Construction) in a future version of the paper.

they have moved into a new job within the year or whether they have had two part-time jobs or, on the other, on the precision and speed with which INPS registers the job movers into the archives.

1.1 Cleaning-up the sample

The original sample contains 117 785 individuals (41 347 females and 76 438 males, with a percentage composition of 35 and 65% respectively) working in all branches of the private sector, for a total of 937 152 observations over the period 1985-1999.

For the purposes of the analysis, the paper concentrates on industry workers[5] divided in three sectors (extraction, manufacturing and energy), selecting workers aged between 18 and 65 and with at least 5 consecutive years of work in the sample: the resulting individuals are in number of 39 209 (33% of the original data-set), among which 12 253 females (31% of the total) and 26 956 males (69% of the total). Table 1 shows the percentage composition of the workers in the sub-sample by age group in 1985 and 1999.

TABLE 1

Simple descriptive statistics are depicted in Table 2: they show the extreme variability of annual wages for each year of the sample and their dynamics.

TABLE 2

1.2 Relation with industry-wide wage data

To evaluate the properties of the sample, it is useful to compare the average value of the annual wage rates from the sample with the annual average wage rate resulting from National Accounts (industry sector only).

FIGURE 1

At first inspection of Figure 1 we observe a persistent lower level of sample real wages compared with national accounts'. This is imputable to the fact that sample average wage also includes part-time wages and wages earned on a fraction of the year and therefore it is likely to produce an underestimate of annual wages. Dynamics is similar, except an acceleration of sample wages relative to national accounts starting from 1995. Of course definite conclusions cannot be drawn on the basis of these data, because changes in the dynamics can be the reflection of a variation of the sample composition (less part-time workers, less non-full year employment spells etc.) Further inspection is needed, for instance selecting a sub-sample of full-time workers with no employment gaps over the fifteen years, or by computing annualised wages from daily wages[6].

[6] Even though the latter method has the drawback of not reflecting effective wages, but imputed wages.

1.3 Relations with control variables

It is useful, before entering the phase of econometric estimation, to present some descriptive statistics of wages in relation to some of the explanatory variables that will be used in the model of next sections. The sample provides information on the number of days and weeks worked by employees in the year. Therefore it is possible to compute daily and weekly earnings, by-passing the problem of comparing wages which refer to employment of different type and duration within the year. We shall consider age, sex, job qualification, sector of activity, area of work and firm dimension. Therefore, in line with the procedures to be used in the next sections, we compute daily and weekly earnings.

Table 3 presents average daily real wages of women and men for the entire 15-year period. As expected, a constant lower level of female earnings with respect to males' is observable. Percentage differentials of women's earnings with respect to men's range from -21.6% in 1992 to -27.3% in 1996. Also depicted is average wage by age class for men and women together.

TABLE 3

Table 4 depicts daily real wages by job qualification and sector of activity: the energy sector seems to be the one providing higher wages. This is as expected in a country like Italy where public utilities historically have been public-owned until the recent wave of privatisations, guaranteeing higher wages through collective national bargaining. Also as expected are the wage differentials between job qualifications.

TABLE 4

In Table 5, decomposition by location of work and firm dimension reflects a well-known characteristic of the Italian labour market: higher wages for those working in the North of the country and in larger firms.

TABLE 5

2. Individual wages, age and productivity

Individual wages differ in different areas of the country, in different sectors of activity and in firms of different size. They also vary according to sex and job positions. Individual wages tend to grow as the individual grows older: they grow both in nominal terms and also in real terms. There are, however, two fundamental questions that can be addressed when individual data are utilized, the first being the relation of wages to ageing and the second being the relation of wages to productivity. The two issues will be taken up briefly in sequence as an introduction to the empirical estimates directed first to reproduce the results obtained in previous studies and then to test a model of the dynamics of individual wages that includes some more general assumptions on the wage-age relation and on the productivity nexus.

The relation between wages and age

The issue of the relation of real wages to age has been studied in several researches by authors such as Lucifora-Rappelli (1995) and Brugiavini-Peracchi (2003). In both studies - based upon micro-data of the INPS archive, respectively for years 1974 to 1988 and for years 1974 to 1997 - the relation of individual wages to age comes out very strong: L&R estimate a polynomial in age of degree 2, whereas B&P estimate a polynomial in age of degree 3.

The wage to age relation shows a positive coefficient on the linear term of age and negative coefficients on higher degree age coefficients (second degree always negative, third degree positive but small). Both studies raise the question whether the wage to age relation shows some declining segment as the worker gets old and approaches retirement age. Their results show that annual real wages tend to decline after 50 years of age or so, whereas (according at least to B&P) annualised monthly wages tend to present a stable or slightly increasing relation to age. Both studies maintain a time invariant relation of individual wages to age. It is thus interesting to investigate whether such invariance is truly effective.

FIGURE 2

Figure 2 depicts the annual wage profiles, from 1985 to 1999, of individuals aged 20, 30 and 40 in 1985, who have worked uninterruptedly and full time for 15 years. For comparison, the graph also presents the industry average wage. Inspection of the graph confirms some traditional findings but also suggests some new line of research. It suggests that, contrary to assumptions adopted in most studies on the dynamics of individual careers, the slope of the wage to age profile may not be time-invariant: the upward slope of the age profile seems to change over time as we move from elder to younger generations of wage earners. We take from this evidence the inducement to statistically test the invariance over time of the wage to age profile.

The productivity issue

Age and individual careers are important factors affecting the dynamics of individual wages. They may be taken as an explanation of the increasing average wage that is observed in industry-wide statistics. Productivity comes into this process if individual wages related to age are a consequence of increasing labour productivity and if, as it is the case, the average age of the working force increases over time because of demographic factors. Average industry wages tend to increase over time also because of general productivity gains in the economy.

Individual wages are thus affected by the macro economic environment and models where age is the only factor considered in explaining the dynamics of individual wages may over-weight the effect of individual factors.

How to deal with macro factors is not easy. One possibility is to make individual wages dependent upon some macro variable such as the average industry wage or industry

contractual wages[7]. There is, of course, a strong statistical correlation between any couple of wage indicators. Figure 1 showed the average individual real wage in the sample for the period 1985-1999 and the average industry wage in real terms, the simple correlation coefficient between the two being 80.9%.

There is the issue that the average industry wage is not independent of changes in the age structure of the labour force, in the sense that average industry wage may increase because of both productivity increases and ageing of the working population.

So, there exists a complex nexus between productivity, ageing and dynamics of individual and aggregate real wages. This paper does not provide a full-fledged analysis of this issue, but it attempts to estimate the effects of ageing on individual wages, taking into account that their dynamics is very much affected by changes in the macro environment, leaving for further research the analysis of interdependence of the various factors.

3. Review and comparison with previous studies

In order to show the relation of estimates obtainable using the new data sample with previous results, we begin by replicating the analysis of the two studies we have referred to in previous sections.

The Lucifora-Reppelli (1995) study presents estimates with different econometric techniques, ranging from a simple pooled model to fixed effects panel model and to random effects panel model, whereas the B&P study presents estimates based on a fixed effect panel model.

In the estimation of the L&R-type model, we use as dependent variable the natural log of daily wages in real terms[8] for workers aged between 18 and 65 with at least 5 consecutive years of contribution; the data refer to the industry sector as previously defined.

For the cohort model, the explanatory variables are: a second degree polynomial in age and dummy variables for sex (females), job position (blue collars, white collars, senior staff & managers), firm size (firms with 0 to 19, 200 and more employees), location (Centre, South & Islands), sector of activity (manufacturing, energy)[9]. Cohorts refer to workers born within the same five-year periods, with the exception of elder and younger individuals who have been selected on the basis of wider intervals: from 1925 to 1935 for the old, from 1936 to 1940 and so on for central cohorts and from 1971 to 1981 for the young. The time-dummy model excludes the cohort variables and includes time dummies for each year, using year 1985 as reference, and the same dummies of sex, job position, firm size, location and sector of activity. The results of the estimation of the two models (cohort and time) are summarised in Table 6. The age coefficients have the same signs as in the L&R paper: positive the one

[7] As reported previously, by "contractual wages" we mean wage levels determined by collective bargaining.

[8] As a deflator of nominal wages we used the earnings conversion coefficients provided by INPS and utilised to compute social security benefits ("Coefficiente di rivalutazione quota A").

[9] The reference dummies are: males, apprentices, firms with 20 to 199 employees, North, extraction sector, and cohort 1.

related to age and negative the one related to age squared. The cohort dummies are all positive and showing an increasing pattern: younger cohorts face better prospects than elder ones in terms of the level of entry wages. Higher job qualification, bigger firm dimension and northern location give a positive contribution to the wage level. Also confirmed is the gender gap: women are faced with worse entry wage prospects than men. In the time-dummy model, the same conclusions hold for the qualitative dummies. Instead we observe a different evolution in the weight of time in determining wages. Along the time spell considered by L&R, time seems to gain importance year by year. The same trend is confirmed in the years from 1986 to 1991, if we exclude the two non-significant dummies associated with 1986 and 1988. Starting from 1992 until 1995 there seems to be an inversion of the trend, with coefficients becoming smaller, even though always positive: real wages keep increasing over time, but with smaller increments. In the last three years of the sample, again we see increasing coefficients.

TABLE 6

Three representative age profiles resulting from the estimates of the two different models are depicted in Figure 3. From the cohort-model we have selected the young (those belonging to cohort 9) and the old (those belonging to cohort 1), and from the time-model the year 1985. It is interesting to note the different shape of the profiles obtained from the two models: the cohort-profiles show an ever increasing pattern as the individuals get older, whilst along the time-related profile individuals reach a peak in their wage level around 50 years of age, to then face a downward sloping wage curve.

FIGURE 3

The more recent Brugiavini-Peracchi (2003) paper estimates the wage to age relation in a fixed effects model where the dependent variable is the natural log of real wages in three different definitions: annual earnings, full-year earnings (which exclude the first and the last year of work) and annualised monthly earnings (annual earnings divided by the fraction of months worked during the year). Explanatory variables are a polynomial of degree 3 of age and the imputed years of contribution estimated by cohorts on the basis of information derived from the Bank of Italy's *Survey on households' income and wealth*, taking into account years of schooling, sex and job qualifications.

For the time being, pending reconstruction of this latter variable, the estimation is performed only on the age polynomial. The estimated coefficients are reported in Table 7 and the resulting age profile is shown in Figure 4.

TABLE 7

With respect to the age profiles shown in Figure 2 of the B&P paper (p. 93), the estimates on the new data set show a relatively flatter curve that lies in-between their annualised monthly and full-year estimates.

FIGURE 4

4. A wage to age profile changing over time

Taking into account the results of previous studies and the observations derived from inspection of the sample data, a fuller model of the wage equation can be constructed[10]. We start from the traditional Mincer-type wage equation, where the natural log of individual daily earnings is regressed on a second degree age polynomial and the set of control variables already described in Sections 2 and 3 (cohort, sex, job position, firm size, firm location and sector of activity).

In addition to this traditional specification, we add a set of variables defined as "multiplicative age-cohort dummies", that is cohort dummy variables times wage earners' age (variable $agedco_i = age*dco_i$). In the estimation we take the elder generation of wage earners (those born between 1925 and 1935, cohort 1) as the reference cohort; thus the constant term of the regression is the parameter that enters the estimation of the age profile for this cohort. The cohort dummies (variables dco_i) measure the effect of the different time of entrance in the labour force, thus generating different values of the constant term for each generation of wage earners. The estimated model is thus the following, for i = 1,...,9:

$$\ln w_i = a_0 + a_1 age + a_2 age^2 + b_2 dco_2 + \ldots + b_9 dco_9 + c_2 agedco_2 + \ldots + c_9 agedco_9 + otherdummies + \varepsilon_i$$

Taken together, the cohort and the multiplicative dummies provide measures of both the cohort effect and the different response of wages to ageing in the different cohorts. If the empirical observations we have referred to in Section 2 are correct, we expect the sign of the multiplicative dummies to be negative and progressively increasing in absolute value for younger cohorts.

The OLS estimates of the parameters of the new wage equation are reported in Table 8. Most if not all the coefficients are statistically significant. The signs of the control variables are all in line with expectations, wages being higher for males, for higher job positions, in bigger firms, in the energy sector and in northern locations. The R-squared is 0.454 for males and 0.252 for females.

TABLE 8

The age coefficients are statistically significant, as well as the cohort variables, more so for males than for females. As for the multiplicative dummies, the results of the separate equations for males and females show that their coefficients are, according to expectations, all negative and progressively increasing (in absolute value) as we move from elder to younger generations of wage earners. The pattern of the coefficients shows a regular increase in the absolute values of the coefficients both for male and female workers. All the 16 coefficients are coherent in sign with the hypothesis under test and are all statistically significant (except cohort 2 for females).

[10] In addition to the techniques presented in this section, we also intend to run *spline* regressions of wages on age and control variables.

The wage to age profiles for elder generations of workers (born between 1925 and 1935), intermediate (born between 1951 and 1955) and younger (born between 1971 and 1981) are represented in Figure 5 and Figure 6 for men and women respectively. The profiles show that the entrance wage is higher for younger cohorts. They also show that the evidence for a declining gradient of the age to wage profile is well established: the initial positive slope of the age profile is higher and ever increasing for cohort 1, it is smaller for cohort 5 beginning to bend downward after about 30 years of work, it is smaller for cohort 9 beginning to bend downward after about 15 years of work. Numbers have been derived by solving the following equation by cohort *i*:

$$\ln w_i = a_0 + a_1 age + a_2 age^2 + b_i dco_i + c_i agedco_i + otherdummies \qquad i = 1,\ldots,9$$

or equivalently, with a clearer identification of the constant term and the coefficient associated with the variable *age*:

$$\ln w_i = (a_0 + b_i dco_i) + (a_1 + c_i dco_i) age + a_2 age^2 + otherdummies \qquad i = 1,\ldots,9$$

where *w* is daily real wages, a_0 is the constant term, b_i is the coefficient associated with the cohort dummy dco_i, c_i is the coefficient associated with the multiplicative age dummy $agedco_i$, *otherdummies* are the sex, job qualification, sector of activity, firm dimension and location dummies.

For the cohorts of males under analysis, the age-profile[11] is as follows:

Cohort 1: $\ln w_1 = 1.1779 + 0.091 age - 0.0007 age^2$

Cohort 5: $\ln w_5 = 2.5388 + 0.0656 age - 0.0007 age^2$

Cohort 9: $\ln w_9 = 3.0836 + 0.0471 age - 0.0007 age^2$

FIGURE 5 & FIGURE 6

Estimation of the fixed effect model referring to individuals (instead of cohorts) produces results (Table 9) that are in line with those reported in the previous table. Specifically the signs of the age coefficients and of the multiplicative dummies are consistent: positive the coefficient of degree-1 age, negative the one of age squared and all negative and increasing in absolute value those associated with the multiplicative dummies.

TABLE 9

4.1 A model with aggregate "contractual wages"

All the results presented in the above sections show that an important component in the determination of the level of individual wages is the constant term. An interesting question to address is whether the constant term incorporates effects other than age: are individual earnings affected by the macro-economic environment? If so, how can this be taken into

[11] We exclude the set of other dummies which, being invariant to the cohort, do not change the relative wage-age profiles.

account? In previous studies (L&R), the model has been estimated with time dummies in the attempt to evaluate the effects of specific macroeconomic events taking place in any single year of the sample under examination. We suggest the inclusion, in the estimation of our model, of the index number of real contractual wages of the industry sector as an indicator of aggregate trends in the economy. The intent is to introduce some realism in a model where, otherwise, the level of individual wages would be explained mainly by a constant term. We had considered to include the industry-wide average wages, but then decided to extend the model to include the level of contractual wages: the industry wage indicator is likely to be highly dependent upon the changing age composition of the labour force, therefore it would not be an appropriate exogenous variable to use in the regression. Of course it is not obviously true that contractual wages do not include factors related to the ageing of the work force, but it seemed to us that interdependence would be smaller with the contractual wages index than with average national accounts industry wages.

The model is a fixed effect model with the log of daily real earnings regressed on the same regressors of the previous section (a degree-2 polynomial of age with cohort and multiplicative age dummies and dummy variables of sex, job qualification, sector of activity, firm dimension and location) with the addition of the log of the industry sector real contractual earnings index, ln *cw*. The model to be estimated for cohorts i = 1,...,9, becomes the following:

$$\ln w_i = a_0 + a_1 age + a_2 age^2 + a_3 \ln cw + b_2 dco_2 + \ldots + b_9 dco_9 + c_2 agedco_2 + \ldots + c_9 agedco_9 + otherdummies + \varepsilon_i$$

For simplicity Table 10 presents results only for men (similar conclusions hold for women as well).

TABLE 10

The coefficient associated with the contractual wage index is highly significant[12] and the elasticity between the index and wages is slightly above one (1.059). To be noticed is the variation in size of the constant term: from 1.178 in the model presented in Table 8 to -3.006 of our new model. The constant term is now very close to zero (bear in mind we are dealing with logarithms!). Also the new variable causes a reduction (in absolute terms) in the age coefficients, but it does not significantly affect the relative age profiles (see Figure 7). With respect to the previous model, the same conclusions on the multiplicative dummies hold too. The estimated age-profiles of the graph are obtained from the equation by cohort *i*:

$$\ln w_i = (a_0 + b_i dco_i) + (a_1 + c_i dco_i) age + a_2 age^2 + a_3 \ln cw + otherdummies \qquad i = 2,\ldots,9$$

where, as before, *w* is daily real wages, a_0 is the constant term, dco_i is the dummy associated with cohort *i* with its coefficient b_i, c_i is the coefficient associated with the

[12] Results are to be treated with caution. We are aware that inference may not be reliable because of the introduction, in a regression with individual data, of a variable (contractual wages) characterised by a higher level of aggregation, as suggested by Moulton (1986 and 1990). We wish to take this problem into account in a future version of the paper.

multiplicative age dummy *agedco*$_i$, *cw* is real contractual wages, *otherdummies* are the sex, job qualification, sector of activity, firm dimension and location dummies.

For the cohorts of males under analysis, the age-profile[13] is computed as follows:

Cohort 1: $\ln w_1 = -3.006 + 0.067age - 0.00053age^2$

Cohort 5: $\ln w_5 = -2.063 + 0.050age - 0.00053age^2$

Cohort 9: $\ln w_9 = -1.722 + 0.040age - 0.00053age^2$

From these equations we can derive evidence of what previously stated: an increase of the constant term, together with a reduction in its intensity. Thus younger cohorts are getting a higher entry wage than elder ones, but the marginal increment of their earnings is getting smaller. In addition, the gradient of wages to age (represented by the age coefficient a_1) shows a tendency to reduction (from 0.067 for cohort 1 to 0.040 for cohort 9).

FIGURE 7

Though some caution is required in interpreting the results because of the two-way causality links between aggregate wage indicators and individual wages, the economics of the results is clear: individual wages are close to be unity-elastic with respect to contractual wages. Age, with its changing effects over time, generates wage differentials with respect to the industry average rate that are negative in the early years of the working life and positive as the worker gets older.

5. Conclusions and further research

The paper confirms many of the results of previous studies which used longitudinal data on individual wage-age profiles over time. Specifically, it confirms that individual wages in real terms grow with age but tend to decline after a certain age. The paper shows however that, at least with reference to the Italian labour market, the wage to age profile, so far considered to be invariant over time, shows a marked tendency towards slopes with smaller gradients for younger cohorts and also for a progressive shortening of the positive segment of the age profile with a positive slope. The present value of future earnings for younger generations of workers is negatively affected by an expectation of a flattening wage-age profile.

The paper also suggests that an economically more meaningful individual wage equation can be constructed if individual wages are studied in relation with the dynamics of some industry-wide wage indicator, such as the index of contractual wages. By inserting this index in the wage equation, the "unexplainable" high value of the constant term estimated in most of wage-age equations of previous studies drops almost to zero.

[13] As before, we exclude the set of other dummies which, being invariant to the cohort, do not change the relative wage-age profiles. For computational reasons (being a two-variable equation), also excluded are contractual wages.

These two results also suggest that it may be possible to integrate the changing age profile of individual wages into the estimation and forecast of aggregate industry average wage. One may expect that average industry wage will be affected by the declining importance of age in determining individual wages. If the new entrants in the labour force must expect a less generous age-related wage dynamics, the average wage will have the tendency not to grow as much as it would have happened, had the wage-age profile been constant over time with cohort dummies showing higher entry wages due to productivity gains. The bleak outcome for future wages receives further evidence when considering that the rate of growth of the entrance wage is slowing down, as it is shown by the small increase of the intercept of the wage-age profile (see Figure 7) moving from cohort 5 to cohort 9, as compared with the increase of the intercept moving from cohort 1 to cohort 5.

In terms of future research, we wish to extend the analysis to 2001, by using the CLAP dataset (Campione Longitudinale degli Attivi e dei Pensionati – Longitudinal dataset of the active population and pensioners) made available by the Italian Ministry of Labour and Social Policies and drawn from the INPS archives as the WHIP sample.

In addition to the estimation techniques presented in the paper, we also intend to run *spline* regressions of wages on age and control variables. Also, being aware that inference of the model with contractual wages may not be reliable because of the introduction, in a regression with individual data, of a variable (contractual wages) characterised by a higher level of aggregation, we intend to tackle the problem following the work by Moulton (1986 and 1990).

Finally, the wage to age relation can be studied in disaggregated models at the regional level and with the introduction of other macroeconomic shocks, such as unemployment.

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APPENDIX 1: GRAPHS

Figure 1. Sample and national accounts real wages

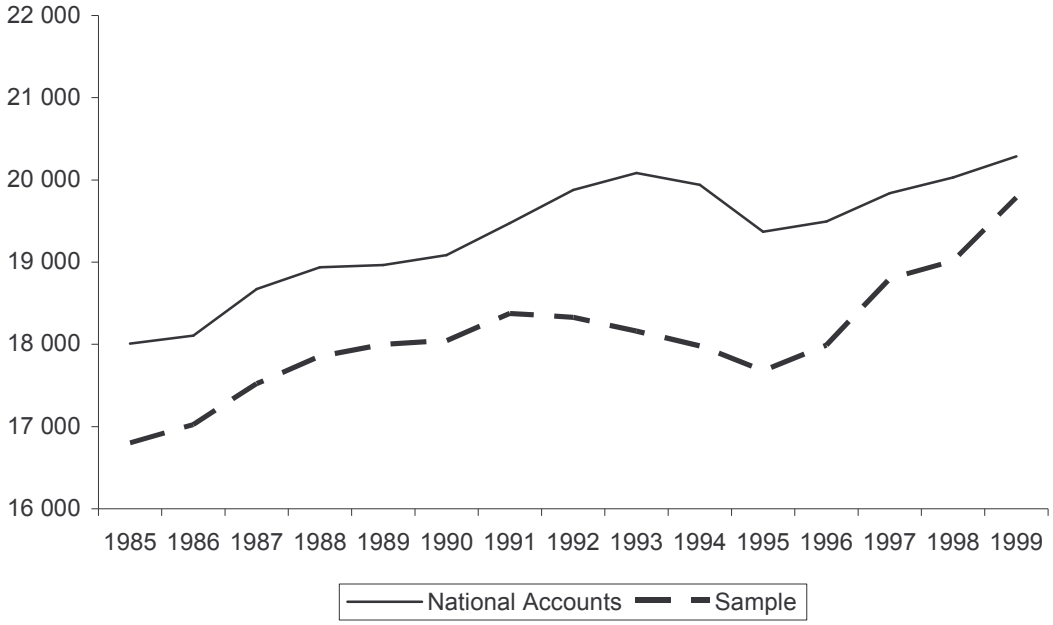


Figure 2. Nominal wages
(industry workers with 15 consecutive years of full-time work)

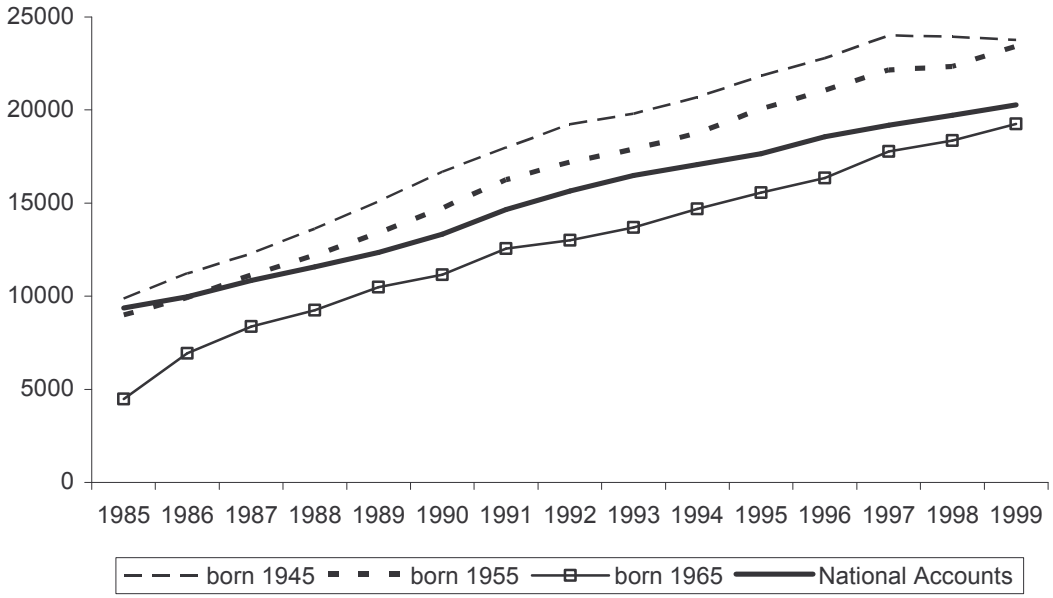


Figure 3. Estimates of the L&R-type model: wage-age profiles

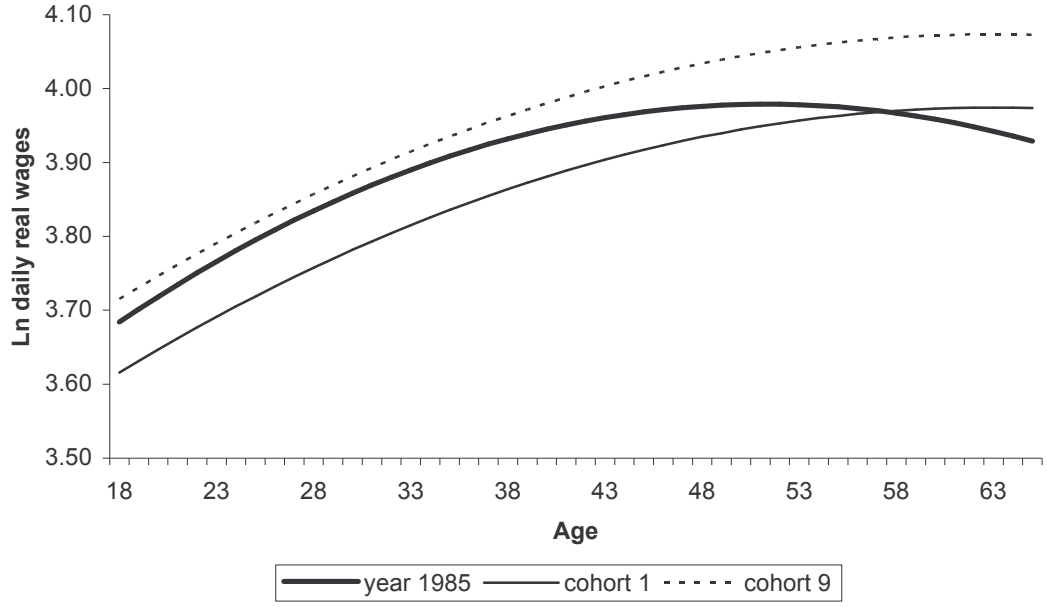


Figure 4. Estimates of the B&P-type model: wage-age profiles

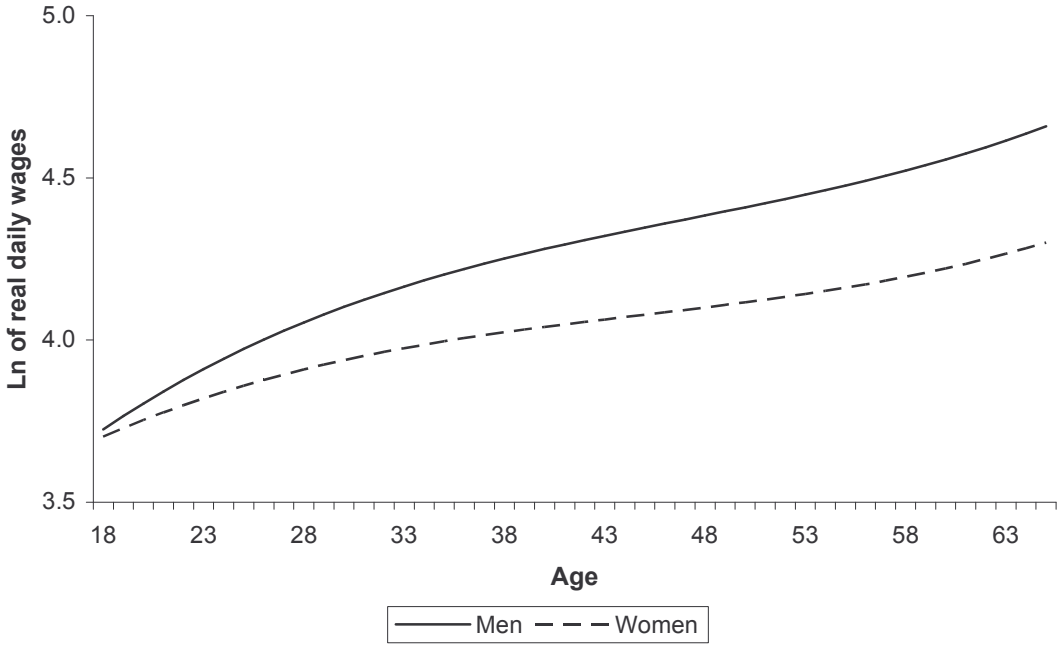


Figure 5. Estimates with multiplicative dummies: women

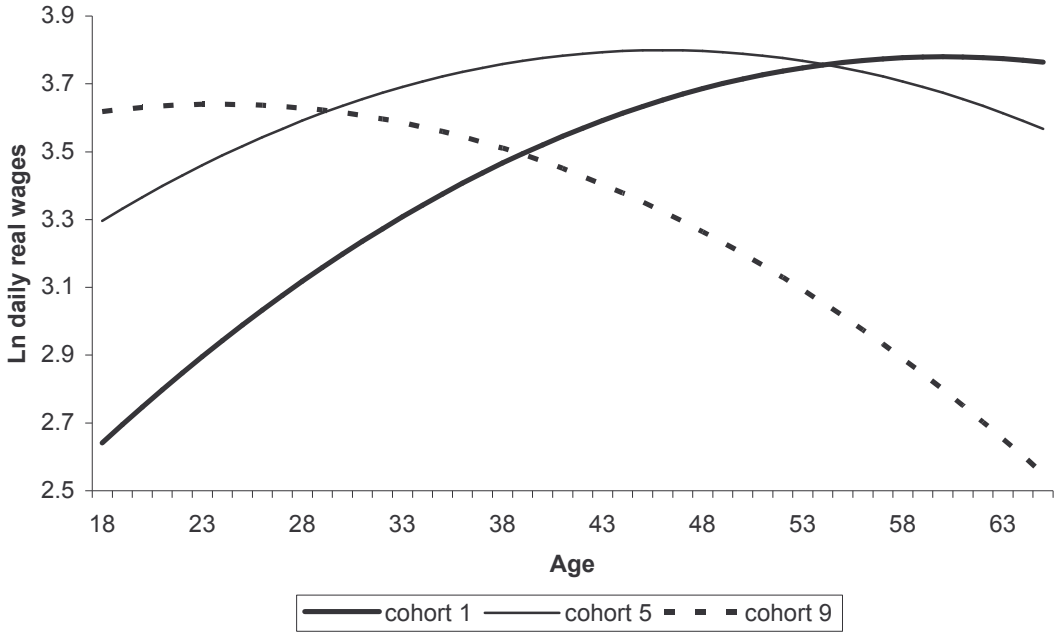


Figure 6. Estimates with multiplicative dummies: men

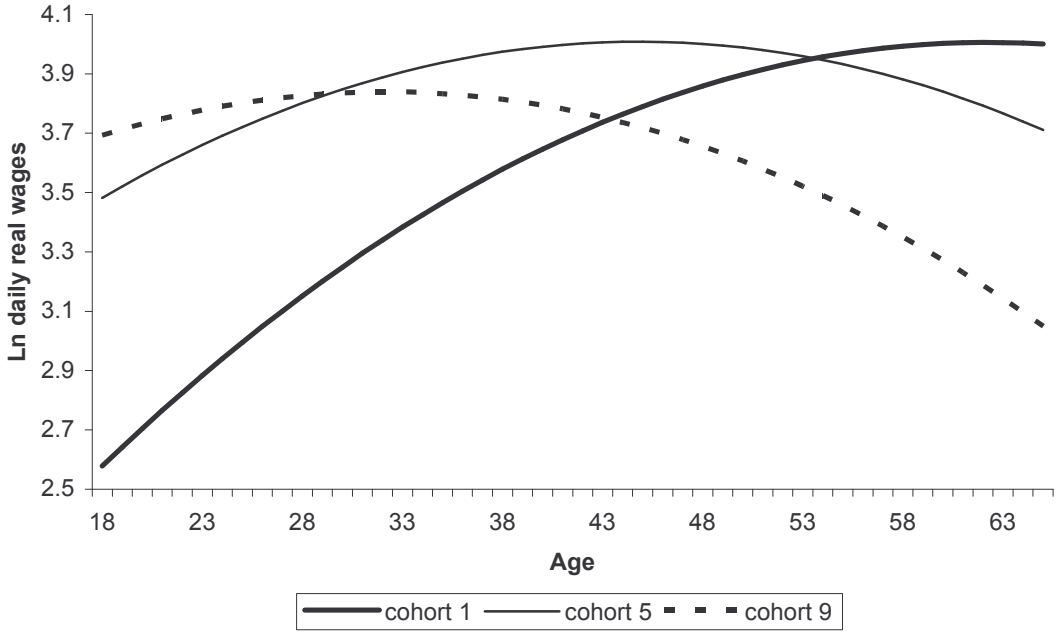
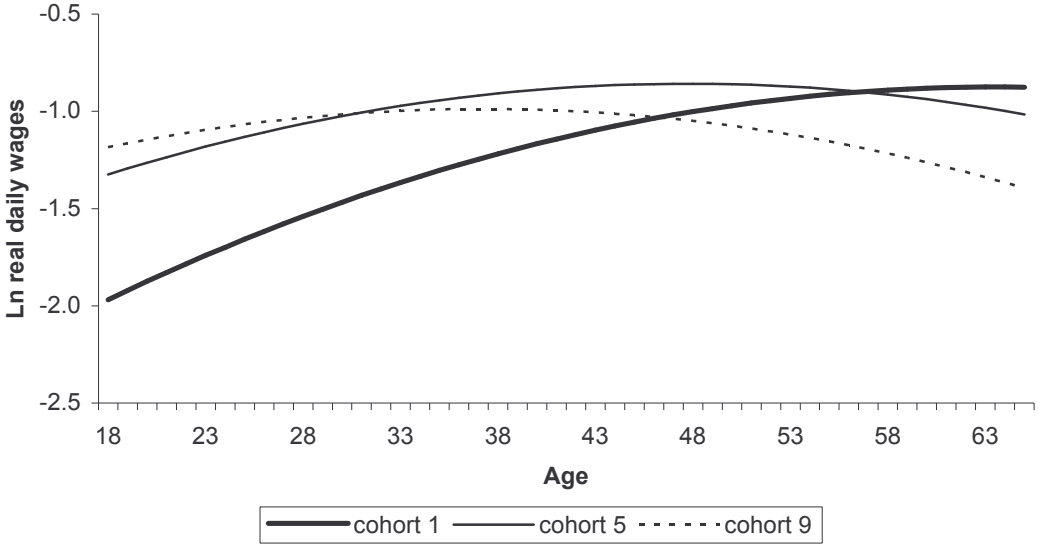


Figure 7. Estimates with multiplicative dummies and the inclusion of the contractual wage index: males



APPENDIX 2: TABLES

Table 1. Percentage age composition in 1985 and 1999

	1985			1999		
Age class	*Women*	*Men*	*Total*	*Women*	*Men*	*Total*
18-25	32.98	19.93	23.74	21.76	16.89	18.57
26-30	16.76	13.88	14.72	20.63	16.2	17.73
31-35	13.42	13	13.12	18.31	17.15	17.55
36-40	11.98	13.72	13.21	13	14.18	13.77
41-45	9.58	11.83	11.18	9.98	11.47	10.95
46-50	7.81	11.7	10.56	8.17	10.97	10
51-55	5.27	9.59	8.33	5.52	8.36	7.38
56-60	1.64	5.43	4.32	2.18	3.55	3.08
> 61	0.54	0.93	0.82	0.46	1.24	0.97

Table 2. Nominal and real sample wages

	Nominal wages			Real wages		
Year	Mean	Median	*Annual growth rates*	Mean	Median	*Annual growth rates*
1985	8 741	8 394		16 801	16 133	
1986	9 380	8 912	*7.30*	17 024	16 175	*1.33*
1987	10 180	9 608	*8.53*	17 519	16 535	*2.91*
1988	10 927	10 269	*7.34*	17 854	16 780	*1.91*
1989	11 728	10 947	*7.34*	18 003	16 803	*0.83*
1990	12 600	11 621	*7.43*	18 043	16 641	*0.22*
1991	13 824	12 747	*9.72*	18 373	16 941	*1.83*
1992	14 431	13 247	*4.39*	18 327	16 823	*-0.25*
1993	14 909	13 661	*3.32*	18 159	16 639	*-0.92*
1994	15 396	14 254	*3.26*	17 982	16 648	*-0.98*
1995	16 117	14 838	*4.69*	17 681	16 277	*-1.68*
1996	17 134	15 580	*6.31*	17 991	16 359	*1.75*
1997	18 185	16 644	*6.13*	18 803	17 209	*4.52*
1998	18 712	17 110	*2.90*	19 012	17 384	*1.11*
1999	19 786	17 989	*5.74*	19 786	17 989	*4.08*

Table 3. Daily real wages

				Age class								
	Women	Men	Total	18-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65
1985	52.94	68.84	64.36	50.15	60.07	65.21	70.73	72.40	70.53	73.04	81.88	82.85
1986	53.51	69.56	64.92	50.23	59.55	65.00	71.58	74.14	73.18	72.99	77.55	89.73
1987	54.48	70.91	66.07	49.93	60.33	66.83	70.98	76.97	76.48	76.74	76.60	85.09
1988	54.13	70.78	65.79	48.98	58.55	66.96	71.71	76.11	77.47	77.19	76.72	80.13
1989	58.47	76.03	70.67	52.03	67.36	68.84	77.06	78.72	86.72	79.89	81.93	92.87
1990	57.92	78.14	71.95	52.26	64.00	70.75	78.25	84.20	86.84	85.39	85.53	93.56
1991	59.53	76.93	71.61	52.37	62.44	71.13	75.04	81.07	84.45	88.64	96.79	92.94
1992	59.67	76.08	71.08	51.97	62.10	71.40	74.39	80.92	86.11	83.81	85.82	101.50
1993	58.83	75.25	70.24	51.90	61.17	69.42	73.65	78.78	86.20	84.32	81.32	86.27
1994	58.12	75.15	69.96	49.94	60.34	66.90	76.32	78.89	83.92	88.70	86.04	83.83
1995	56.81	72.52	67.64	48.49	60.16	68.09	71.75	75.45	79.15	87.36	80.55	79.11
1996	55.97	76.94	70.45	49.33	58.76	73.82	73.89	84.08	81.02	83.26	79.21	83.23
1997	59.16	75.80	70.66	50.76	59.58	66.93	76.08	78.26	82.16	91.48	83.15	86.92
1998	60.72	78.39	73.00	52.54	62.87	68.24	75.46	82.14	83.07	89.41	85.11	82.17
1999	64.28	88.12	80.91	53.12	61.90	74.64	84.55	88.26	97.33	100.79	102.16	91.49

Table 4. Daily real wages by job qualification and sector of activity

	Extraction	Manufacturing	Energy	All
Apprentice	42.53	37.83	-	37.84
Blue collar	71.49	60.45	97.74	61.37
White collar	77.41	85.47	110.31	87.19
White collar (senior)	133.20	153.99	219.30	160.42
Manager	190.11	212.42	205.17	211.85
All	75.77	68.25	107.56	

Table 5. Daily real wages by firm dimension and area of work

	Firm location					
Firm dimension	North-West	North-East	Centre	South	Isles	All
0-9	54.59	52.99	51.55	53.27	51.10	53.21
10-19	60.03	54.61	55.88	53.90	54.61	56.75
20-199	72.07	66.15	62.67	60.30	61.34	67.32
200-999	83.42	76.56	79.03	75.99	86.73	80.57
>=1000	86.54	80.96	93.91	76.20	92.56	87.37
All	73.93	64.74	71.28	61.26	62.21	

Table 6. Estimated coeffs. of the L&R-type model: ln real daily wages

Cohort dummies			Time dummies			
	Coef.	*P>|t|*		*Coef.*	*P>|t|*	
age	0.02234	0.000	age	0.02732	0.000	
age2	-0.00018	0.000	age2	-0.00027	0.000	
females	-0.19421	0.000	females	-0.19372	0.000	
d_bluecollar	0.19558	0.000	d_bluecollar	0.18758	0.000	
d_whitecollar	0.48241	0.000	d_whitecollar	0.47372	0.000	
d_manager	1.20659	0.000	d_manager	1.20341	0.000	
d_dim1	-0.09162	0.000	d_dim1	-0.09287	0.000	
d_dim3	0.09386	0.000	d_dim3	0.09558	0.000	
area2	-0.02858	0.000	area2	-0.02832	0.000	
area3	-0.06734	0.000	area3	-0.06718	0.000	
dco2	0.03087	0.000	d1986	0.00350	0.256	(*)
dco3	0.06046	0.000	d1987	-0.01287	0.000	
dco4	0.07850	0.000	d1988	-0.00036	0.908	(*)
dco5	0.08522	0.000	d1989	0.03492	0.000	
dco6	0.09439	0.000	d1990	0.04678	0.000	
dco7	0.09111	0.000	d1991	0.05155	0.000	
dco8	0.08540	0.000	d1992	0.05092	0.000	
dco9	0.09924	0.000	d1993	0.04736	0.000	
d_sect1	0.02691	0.000	d1994	0.03653	0.000	
d_sect3	0.21782	0.000	d1995	0.00493	0.109	(*)
const	3.27127	0.000	d1996	-0.00628	0.043	
			d1997	0.01771	0.000	
			d1998	0.02351	0.000	
			d1999	0.06446	0.000	
			d_sect1	0.02738	0.000	
			d_sect3	0.21840	0.000	
			const	3.27863	0.000	
Number of obs	359816		Number of obs	359816		
F(21,359794)	14084.66		F(27,359788)	10942.08		
Prob > F	0.0000		Prob > F	0.0000		
R-squared	0.4391		R-squared	0.4416		
(*) Significance level below 95%.						

Table 7. Estimated coeffs. of the B&P-type model: ln real daily wages

Males			Females		
N. of obs.	250878		N. of obs.	108938	
N. of groups	26956		N. of groups	12253	
R-sq within	0.0848		R-sq within	0.0261	
	Coef.	*t stat.*		*Coef.*	*t stat.*
age	0.0894	37.70	age	0.0631	15.10
age2	-0.0016	-25.05	age2	-0.0012	-10.45
age3	1.15E-05	20.13	age3	9.25E-06	8.59
const	2.5765	93.86	const	2.9144	62.30

Table 8. Estimated coeffs. of the cohort fixed effects multiplicative model for ln daily real wages

	Females		Males	
	Number of obs	108938	Number of obs	250878
	F(28,108909)	1309.07	F(28,250849)	7446.76
	Prob > F	0.0000	Prob > F	0.0000
	R-squared	0.2518	R-squared	0.4539
	Coef.	*P>|t|*	*Coef.*	*P>|t|*
age	0.0772	0.000	0.0910	0.000
age2	-0.0006	0.000	-0.0007	0.000
dco2	0.1617	0.267 (*)	0.5912	0.000
dco3	0.6035	0.000	0.8546	0.000
dco4	0.8749	0.000	1.1210	0.000
dco5	0.9812	0.000	1.3609	0.000
dco6	1.2024	0.000	1.5052	0.000
dco7	1.4212	0.000	1.6163	0.000
dco8	1.6023	0.000	1.7847	0.000
dco9	1.8165	0.000	1.9057	0.000
agedco2	-0.0022	0.405 (*)	-0.0100	0.000
agedco3	-0.0104	0.000	-0.0145	0.000
agedco4	-0.0160	0.000	-0.0197	0.000
agedco5	-0.0181	0.000	-0.0254	0.000
agedco6	-0.0237	0.000	-0.0290	0.000
agedco7	-0.0305	0.000	-0.0325	0.000
agedco8	-0.0372	0.000	-0.0391	0.000
agedco9	-0.0466	0.000	-0.0439	0.000
d_bluecollar	0.1957	0.000	0.2083	0.000
d_whitecollar	0.4488	0.000	0.5097	0.000
d_manager	1.1953	0.000	1.2161	0.000
d_dim1	-0.0872	0.000	-0.1228	0.000
d_dim2	-0.0198	0.000	-0.0204	0.000
d_dim3	0.1000	0.000	0.0639	0.000
area2	-0.0360	0.000	-0.0253	0.000
area3	-0.0419	0.000	-0.0791	0.000
d_sect1	0.0507	0.031	0.0267	0.000
d_sect3	0.1864	0.000	0.2154	0.000
const	1.4598	0.000	1.1779	0.000

(*) Significance level below 95%

Table 9. Estimated coeffs. of the individual fixed effects multiplicative model for ln daily real wages

	Females			**Males**	
	Number of groups	108938		Number of groups	250878
	Number of obs	12253		Number of obs	26956
	F(20, 96665)	186.03		F(20,223902)	1260.06
	Prob > F	0.0000		Prob > F	0.0000
	R-sq within	0.0371		R-sq within	0.103
	Coef.	*P*>|*t*|		*Coef.*	*P*>|*t*|
age	0.11030	0.000		0.10181	0.000
age2	-0.00082	0.000		-0.00075	0.000
agedco2	-0.01494	0.000		-0.00989	0.000
agedco3	-0.02343	0.000		-0.01708	0.000
agedco4	-0.03185	0.000		-0.02402	0.000
agedco5	-0.03515	0.000		-0.03000	0.000
agedco6	-0.04203	0.000		-0.03300	0.000
agedco7	-0.05203	0.000		-0.03795	0.000
agedco8	-0.05684	0.000		-0.04047	0.000
agedco9	-0.06314	0.000		-0.04067	0.000
d_bluecollar	0.18592	0.000		0.16344	0.000
d_whitecollar	0.22877	0.000		0.26203	0.000
d_manager	0.52068	0.000		0.48529	0.000
d_dim1	-0.02087	0.000		-0.03101	0.000
d_dim2	-0.01333	0.000		-0.00221	0.289 (*)
d_dim3	-0.00473	0.277 (*)		-0.01214	0.000
area2	-0.01983	0.212 (*)		-0.03163	0.000
area3	-0.06423	0.001		-0.03048	0.000
d_sect1	-0.05445	0.497 (*)		0.02620	0.072 (**)
d_sect3	0.09617	0.096 (**)		0.12656	0.000
const	2.40619	0.000		2.30296	0.000

(*) Significance level below 95%
(**) 90% significance level

Table 10. Estimates of ln real daily wages with contractual wages index: males

Number of obs	250878	
F(29, 250848)	7227.71	
Prob > F	0.0000	
R-squared	0.4552	
	Coef.	*P*>|*t*|
age	0.06716	0.000
age2	-0.00053	0.000
ln_contr_wage	1.05941	0.000
agedco2	-0.00747	0.000
agedco3	-0.00974	0.000
agedco4	-0.01297	0.000
agedco5	-0.01666	0.000
agedco6	-0.01820	0.000
agedco7	-0.01961	0.000
agedco8	-0.02417	0.000
agedco9	-0.02774	0.000
dco2	0.45338	0.000
dco3	0.60597	0.000
dco4	0.78136	0.000
dco5	0.94310	0.000
dco6	1.01547	0.000
dco7	1.06475	0.000
dco8	1.18289	0.000
dco9	1.28420	0.000
d_bluecollar	0.20885	0.000
d_whitecollar	0.51002	0.000
d_manager	1.21744	0.000
d_dim1	-0.11942	0.000
d_dim2	-0.01663	0.000
d_dim3	0.06733	0.000
area2	-0.02529	0.000
area3	-0.07923	0.000
d_sect1	0.02641	0.000
d_sect3	0.21558	0.000
const	-3.00598	0.000