Nominal and Real Wage Rigidity:
An Assessment Using Italian Microdata

by
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Abstract:

This paper uses administrative longitudinal micro-data from the Social Security Institute (INPS) to estimate the extent of nominal and real wage rigidity in Italy. Using a switching regime model of individual wage changes, which accounts for both the determinants of notional wage changes and measurement errors in individual wages, the paper sheds light on the relative importance of the two sources of rigidity. Overall, estimates show that wages in Italy are inflexible, but this is mainly due to real wage rigidity rather than downward nominal wage rigidity. Between 50 and 80% of all notional wage changes that lie below a sort of inflation-related or union-set threshold are forced to align to this level. On the other hand, only about 10% of the negative notional wage changes are transformed into wage freezes by the operation of the downward nominal wage rigidity constraint, which existing literature has mainly focused on. The implications of the estimated wage rigidity for the real side of the economy are also explored.

1. Introduction

A burgeoning literature has recently provided evidence of the existence of some downward nominal wage rigidity (henceforth, DNWR) in a number of countries using a variety of micro level data (e.g., Card & Hyslop, (1996), Kahn (1997), Mc Laughin, (1994) for the US; Christofides and Leung (1988), Crawford and Harrison (1998) and Fortin (1996) for Canada; Smith (2000) for the UK; Feher and Goette (2000) for Switzerland; Goux (1997) for France; Knoppick and Beissinger (2001) for Germany). Most previous analyses of wage rigidity in OECD countries have instead relied on time-series of macro data.

These two strands of studies have been unable to differentiate both the effects of real, downward nominal, and symmetrical rigidity from each other or from other concepts of rigidity. Yet different types of wage rigidity pose different problems to policy makers. For example, while higher inflation may overcome downward nominal rigidity, real rigidity cannot be relaxed by inflation, and the costs from symmetrical rigidities (such as menu costs and inertia) and uncertainty may be exacerbated by inflation. Using micro data researchers may be able to determine the relative importance of different types of rigidities in countries at different point in time.

Empirical research on wage rigidity in Italy has to date been scarce. Dessy (1999, and 2000) provides first descriptive evidence using survey data from the Bank of Italy's survey on household budgets (SHWI) and the European Household Panel Survey (ECHP). Devicienti (2002) uses instead administrative longitudinal micro-data from the Italian Social Security Institute (INPS) and the parametric models of Altonji and Devereux (1999) and Knoppick and Beissenger (2001).[1] These approaches allow the researcher to estimate the extent of downward nominal wage rigidity, while controlling for the determinants of the rigidity-free wage changes and the measurement error arising from the fact that broad measures of earnings, not hourly wages, are available in the data. Estimates show that the degree of downward nominal wage rigidity is medium/high – between 51% and 68% of all notional wage cuts being prevented by the existence of proportional rigidity. Similar to Knoppick and Beissenger (2001) in Germany, the estimated rigidity in Italy has shown relevant implications for the real side of the economy, in terms of excess unemployment rate in the long-run.

However, a problem of the followed approach is that it considers only the possibility that wages are nominally rigid downwardly, i.e. that there are various constraints that impede firms from implementing optimal or desired nominal wage cuts. Real wage rigidities – in the form of constraints to increase nominal wages of some inflexible amount (i.e. related to expected inflation or to such institutional features of the wage setting system as nation-wide collective bargaining) – are instead largely neglected by the previous literature. Yet both visual inspection of empirical wage change distributions and conventional wisdom suggest that in many countries of continental Europe, and most likely in Italy, real rigidities are at least as important as nominal rigidities.

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[1] A related literature has empirically investigated the existence of a negative relation between the level of *real* wages and local *un*employment rates, the so-called 'wage curve' (e.g., Layard *et al.*, 1991). Lucifora and Orrigo (1999) – using an error correction mechanism dynamic specification – do not find sufficiently robust statistical evidence for the existence of such a relationship in Italy. They point, however, to the existence of some inertia in the movements of real wages. The analysis conducted in this paper – focusing on the behaviour of nominal wages under different inflation scenarios – directly attacks the reasons for the observed behaviour of real wages.

The aim of this paper is to contribute to the existing literature estimating the degree of both nominal and real rigidity through an econometric model recently devised by Dickens and Goette (2002), which has to date only found application for the US (by the same authors) and for Germany (Bauer *et al.*, 2003).

As in Altonji and Devereux (1999) and Knoppick and Beissenger (2001), the model estimates wage rigidity while accounting for the observable determinants of the counterfactual (rigidity-free) wage-change distribution, and for measurement error in the earnings variable available in the data. Using this new approach, the paper estimates the relative importance of nominal and real wage rigidities, drawing on the INPS administrative data, 1985-1996. The estimates are then used to derive the real implications of the observed dynamics of wage changes, in terms of their costs for the long-run unemployment rate and output.

Assessing the extent and the effects of wage rigidities is the most important in a country which has been standing out for its relatively high and persistent unemployment rate throughout the eighties and the nineties – at least when compared to other EU countries. The presence of fairly strict employment legislation protection in the Italian labour market provides additional reasons for investigating the extent of wage rigidity. For, as Bewley (1999) suggests, it may be possible (and indeed this is what he finds for the US) that layoffs are a tool preferred by managers to nominal wage cuts when in the need to restore their firm competitiveness, as these cuts would have an adverse effect on employees' morale.

The paper is organised as follows. In section 2 the modelling approach is explained, section 3 provides details about the data used and the sample selection, and section 4 describes the empirical evidence on the distribution of wage changes. The main estimation results are illustrated in section 5, while section 6 explores the long-run unemployment consequences of the estimated degree of wage rigidity. Our final considerations are gathered in section 7. A description of wage-setting practises in Italy, which have important implications for both our modelling strategy and results' interpretation, has been inserted in the Appendix.

2. The model

This section describes an analytic model devised by Dickens and Goette (2002) to estimate the extent of both real and nominal rigidity in the presence of measurement error, which can be considered a development of the model proposed by Altonji and Devereux (1999) and Knoppick and Beissenger (2001). The model is described in three steps. First, we describe how the *notional* wage change is determined. Second, we describe how the *actual* wage change is derived from the notional wage. Finally we describe how the *observed* wage change differs from the *actual* wage change in the presence of measurement error in the dependent variable.

Between time period t and period $t+1$ the firm employing person i would like to increase that person's nominal wage by d^n_i percent. We will refer to d^n_i as the notional nominal wage change for person i in period t (time subscripts are suppressed throughout). We will assume that it is equal to:

(1) $d^n_i = X_i a + e_i$

where X_i are a set of individual characteristics assumed to be exogenous, a is a conforming vector of parameters, and e_i is a mean zero i.i.d. normal random variable with variance s_e^2.

In every period we assume that each individual falls into one of three groups: (i) *real regime*: those whose wages cannot be increased less than a "real rigidity threshold" (for example, the rate of inflation), (ii) *nominal regime*: those whose nominal wages cannot be decreased, and (iii) *no rigidity regime*: those whose wage change will be set to the notional wage change no matter what it is. A person belongs to the real, nominal or no rigidity regimes according to whether a dummy variable D_i takes on values 1 (real rigidity), 2 (nominal rigidity) or 3 (no rigidity). D_i is not observed and is assumed that the probability to be in each of the three groups is given by:

(2)   Prob(real regime)= Prob(D_i=1) = p_r,
(3)   Prob(nominal regime) = Prob(D_i=2) = p_n
(4)   Prob(no rigidity)= Prob(D_i=3) = $1 - p_r - p_n$.

Each individual's actual wage change is then given by

(5) $d_i^a = \begin{cases} r_i & if \quad D_i = 1, \ and \quad d_i^n \le r_i \\ 0 & if \quad D_i = 2, \ and \quad d_i^n \le 0 \\ d_i^n & otherwise \end{cases}$

where r_i can be thought as the expected rate of inflation or a contractual/institutional wage change or a combination of the two at the firm employing person i. It functions as a "point of attraction" of the wage negotiations and is described by

(6) $r_i = X_i b + e_{ri}$

where b is a conforming vector of coefficients to be estimated and e_{ri} is an i.i.d. mean zero normal random variable with variance s_r^2.

The actual wage change is not always observed because of reporting errors, recording errors, or because the quantity being measured does not exactly match the concept of the wage in the model (for example, the model describes the behaviour of base wages but the data are earned income divided by hours worked, where earned income sometimes included bonuses and overtime payments).

We assume that wage levels can be recorded (a) accurately (i.e., with no measurement error), (b) with measurement error in year t, (c) with measurement error in year $t+1$, or (d) with measurement error in both periods. For simplicity, we assume that the probability m of being affected by measurement error in any one period is the same, and is uncorrelated over time. How any given (actual) wage change is affected by measurement is unobservable, and can be described by a discrete random variable H, as follows:

(5)   Prob(d_i^a correctly measured)= Prob(H_i=1) = $(1-m)^2$
(6)   Prob(d_i^a incorrectly measured in either period 1 or 2)= Prob(H_i=2) = $2m(1-m)$
(7)   Prob(d_i^a incorrectly measured in both periods)= Prob(H_i=3) = m^2

Measurement error is represented by a normally distributed additive random variable, e_m, with zero mean and standard deviation s_m. It is assumed that the distribution of e_m is the same in both t and $t+1$. Therefore, the *observed* nominal wage change will be given by:

$$(10) \qquad d_i = \begin{cases} d_i^a & \text{if} & H = 1 \\ d_i^a + e_m & \text{if} & H = 2 \\ d_i^a + 2 e_m & & \text{otherwise} \end{cases}.$$

It should be noted that the model specified in (1)-(10) can be easily extended to allow for (i) a more complicated (and/or realistic) measurement error process, (ii) observable characteristics to affect the probability of being in the various rigidity regime via latent-variable indicators versions of equations (2)-(4), and (iii) a general covariance structure for the error terms entering the model's equations. Indeed, the model devised by Dickens and Goette allows for precisely these types of extensions, and we have here presented a simple stripped-down version of it. On the one hand, the simplifications are required to keep the computational burden at a reasonable level; on the other they are made necessary by the lack in our data of suitable information to separately identify the effects that observable worker and firm heterogeneity have on (i) the notional wage-change in (1), (ii) the regime membership in (2)-(4), (iii) the real-threshold in (5), and (iv) the measurement process in (5)-(7). Our choice has then been that of using the few observable attributes available in the data (see section 3) to identify the notional wage change distribution in (1), while assuming for simplicity that the other model's parameters (measurement error and rigidity regime membership) are constant across individuals (but not over time). We are however able to take a more flexible stand with regards to the determinants of the real rigidity threshold in (6): as will be illustrated later in the paper, we assume that the real-rigidity threshold r is constant across all individuals only in our benchmark model, while allow for heterogeneity in such a threshold at an individual level in two alternative specifications. In one of them, we make use of individual-specific extra-sample information from nation-wide union wage settlements as an alternative identification strategy of the real rigidity constraints operating in Italy during the analysed time period.

2.1 ML Estimation and measures of wage rigidity
    Individuals in this model have their wages generated by one of three processes: real rigidity, nominal rigidity or no constraints. Those who could be subject to real or nominal rigidity can be in one of two states: constrained or unconstrained. In addition, each person's wage is either recorded correctly in both periods, one period, or neither period. Table 1A (in appendix) illustrates the 15 possible regimes that may generate a wage change observation. Any observed nominal wage change could be generated by any of the regimes except that negative wage changes would never be observed if the worker was subject to nominal rigidity and the wage was correctly recorded in both periods.
    Observed nominal wage increases are consistent with any regime except NC0 (nominal constrained with no error). Observed nominal wage declines can be generated by any regime except NC0 and NU0 (nominal unconstrained with no error). While an observed wage change of zero could be generated by any of several regimes, the

conditional probability of observing a zero change is zero in any regime except NC0. Thus we have a switching model that is a mixture of known and unknown regimes, and the likelihood function for our model is:

$$(11) \quad L = \prod_{i=1}^{N} \sum_{\substack{j \in R \\ j \neq NC0 \\ j \neq NU0}} I(d_i \neq 0)P(j \mid d_i)L(d_i) + I(d_i > 0)P(NU0 \mid d_i)L(d_i) + I(d_i = 0)P(NC0)$$

where N is the number of observations, R is the set of regimes, $P(j|d_i)$ is the probability of person i being in regime j given the observed (log) wage change (d_i), $I(.)$ is the indicator function which is equal to 1 if the condition in parenthesis is true and zero otherwise, and $L(d_i)$ is the unconditional likelihood of d_i. Specifying how the data and parameters affect P and L yields the likelihood of the data given the parameters. The appendix provides the expressions for the various elements in (11).

Ultimately we want to estimate not the parameters of the model, but the extent of rigidity. There is a number of different measures that the literature on wage rigidity has considered (e.g., Knoppick and Beissenger, 2002). On the one hand, it is interesting to know how many individuals are actually affected by the two types of rigidity. For this purpose, as (5) shows, it is not enough to consider the probability of being in one rigidity-regime, as that regime is actually binding for any given employee only if his/her wage change lies in the proper range. In particular, one can receive a wage freeze only if his/her notational wage cut is below zero *and* belongs to the nominal rigidity. Similarly, wage changes are dragged on the real-threshold only if the individual's notional wage change lies is below r and s/he belongs to the real rigidity regime. Thus, we define the % of observation affected by a regime as:

(12)   Prob(d_i affected by real rigidity) = Prob(i in real regime)*$I(d<r)$,
(13)   Prob(d affected by nominal rigidity) = Prob(i in nominal regime)*$I(d<0)$,

where, denoting with Φ the standard normal cdf, one can show that:

$I(d<r) = \Phi(-(xb+r)/\sqrt{s_e^2 + s_r^2})$, and

$I(d<0) = \Phi(-(xb/s_e))$.

Other measures of wage rigidity consider the extent to which average wage changes are made higher than average notional wage changes because of the presence of the various sources of wage rigidity. Thus, the so-called *nominal wage sweep-up* measures the extent to which the average actual wage change is higher than the expected notional wage change, as - because of the operation of downward nominal wage rigidity - some notional wage cuts are actually turned into wage freezes. Similarly, the *real wage sweep-up* measures the extent to which the average actual wage change is higher than the expected notional wage change, on account of the % of notional wage changes that

are raised at the level of the r-threshold. These two measures are computed from (1)-(6) as follows:

$$(14) \quad \text{real sweep-up} = (r-d) \cdot \text{Prob(real regime)}, \quad \text{if } d<r,$$

$$(15) \quad \text{nominal sweep-up} = -\left[xb - s_e \frac{\phi(-xb/s_e)}{\Phi(-xb/s_e)} \right] \cdot \phi(-xb/s_e) \cdot \text{Prob(nominal regime)},$$

where ϕ is the standard normal pdf.

3. Data, Definitions and Sample Selection

For the analysis of wage rigidity in Italy we use administrative data from the Italian Institute for Social Security (INPS), containing information on a sample of employees over a period of twelve years – from 1985 up to 1996. For each calendar year 1985/1996, the Social Security forms of employees born on 10 March, June, September and December of any year were selected. In this way a sequence of random samples of the population of employees is formed (sampling ratio 1:91). Each yearly sample includes approximately 100,000 employees of Italian private firms, with the exclusion of workers in agriculture and the central state administration. Using available identifiers (fiscal and social security codes), individual longitudinal data can be generated for each worker. The firm's longitudinal records are then accessed for each worker in the sample and the employer's attributes are linked to the employee, obtaining a matched employer-employee database. The data therefore include not only individuals' wage and career histories but also a certain number of characteristics of each worker and of the firm where s/he currently works and has held previous jobs. Among personal characteristics, we have information about the employee's gender, age and the geographical region where s/he was employed. We also know the employee's job qualification, institutional job ranking (*livello di inquadramento*) and the national union's contract under which the employee is hired.[2] Information about the firm where the job is held includes the firm sector of activity, dates of opening and closure and its occupational trend (number of manual and non-manual workers, along with total remuneration to the two occupational groups).

As the actual number of hours worked by an employee is not observed, hourly wages cannot be computed. The number of "paid days" of each employee in each job spells and his/her *total* remuneration (before taxes) is however known, which allows us to compute the employee's daily wage. It is the year-to-year changes in this nominal wage rate that lie at the heart of our examination of wage rigidity. This is the closest we can get to a measure of total unit labour cost in the data. Note that some of the paid days may not be worked days, since, included under this heading, are periods of paid time during which no work is done, e.g., maternity leave, sick leave, holiday. Similarly, total compensation includes also payments related to maternity-leave periods, sickness, periods of temporary unemployment (*Cassa Integrazione Guadagni*), and in a few cases also arrears payments. Unfortunately, it is not possible to separately examine the

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[2] Note that each national union's contract specifies its own (specific) institutional job ranking, as well as a whole set of economic and non-economic rules (see the appendix).

various components of total compensation. The econometric model presented in section 2 allows for measurement error in the dependent variable precisely to circumvent this limit of the data.[3]

The sample of workers whose wage changes are put under observation has been restricted so as to reflect a high labour market attachment. In particular, we focus on full-time 12-month[4] workers, aged between 15 and 64 and who are job stayers (keep a job in the same firm in both years in which the wage is compared). Descriptive statistics are collected in Appendix B, Table 1. The highest wage cut recorded in the data is about 70% (=-1.2 in log-wage change) and the maximum increase is about 250% (=+1.26 in log-wage change). However, the 1st percentile of the wage-change distribution is at only –32% and the 99th percentile at 33%. This suggests that the few cases of extremely high/low wage changes might result from misreporting of either total remuneration or worked days, or both, and call for explicit modelling of measurement error in estimation.[5]

3.1 Subsample with contract information

In the Italian labour market national union contracts are often believed to be a major driving force of the observed wage dynamics. Their actual impact remains however an empirical issue. To incorporate such considerations into our models, we have collected information on union contracts and have merged them into our original INPS sample. We have been able to recover contractual wage levels and dynamics for a total of 28 major nationwide contracts, for the years between 1990 and 1996. Unfortunately, it has been impossible to obtain contractual information for the initial part of our sample (1985-1989) and for other minor union contracts.

The 28 union's contracts, drawn from the CNEL archive[6] refer to the following sectors: metal and mechanical engineering industries, trade, tourism, constructions, textiles and clothing, food industry, wood and furniture, and services (see Table 2 for the number of employees in the sample covered by each contract).

The available contractual information includes: "minimum wages", cost of living allowance ("*scala mobile*") and *other elements* (special bonuses).[7] Minimum wages and "other elements" data are taken directly form the nationwide contracts, the cost of living allowance is supplied by Assolombarda and CISL. Each contract specifies these three wage elements, differentiated according to the contract-specific job institutional ladder. Therefore, we have merged the contractual data in our INPS data by contract and the employee's position in the contractual ladder (*livello di inquadramento*). As a result, we

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[3] Another limit of the data is that, while job changes can be precisely identified, the reasons for a job separation (layoffs or quits) cannot. Since the domain of the data source is limited to employment in the private sector, periods between employment spells also cannot be characterized in a precise way. In other words, it is not possible to distinguish between individuals' movements to unemployment, self-employment, employment in the public sector and exits from the labour force.

[4] I.e., employees with at least one paid day per each month in the year.

[5] Devicienti (2001) provides separate estimates for men and women, and also for employees with very stable job spells (working exactly 312 days = 52 weeks a year). Estimated rigidity measures were always robust to sample selection.

[6] CNEL, Consiglio Nazionale dell'Economia e del Lavoro (Economy and Labor National Council) www.cnel.it

[7] Mainly this includes a function bonus in favor of cadres, but can be received also by other occupations to compensate for special features of the job (e.g., riskness). Since 1992, after the supplanting of the "scala mobile" the other element is also made up of a fixed supplement due to the worker, whenever the effective inflation rate is higher than programmed inflation.

can then compute for each employee not only his/her total wage change between *t* and *t*+1, but also the wage change dictated by the relevant contract for his/her job position. In what follows we will refer to the difference between the worker's recorded wage level and the corresponding contractual wage as the *wage drift*.[8] If the contractual component is expected to display a high or even complete degree of rigidity, the wage drift can be thought as the pay flexible component.

Note that contractual changes are correctly computed when employees remain in the same contract and in the same job-ranking between *t* and *t*+1. Coupled with the additional requirements that they be job stayers, the resulting sub-sample represents on average about 57% of the individual wage changes observed in the INPS data.

4. Institutional Setting and Wage Changes in Italy
4.1 The Distribution of Wage Changes
The Italian pyramidal wage bargaining (whereby wage contracts can be bargained at the national, industry and firm level, with agreements struck at a higher level immediately becoming lower bounds for bargaining at lower levels) limits the scope for downward wage flexibility at the firm level. This is described in Appendix C and should be borne in mind when, say, comparing the Italian experience with the US one, where bargaining is mainly conducted at the firm level and union presence is much weaker. Employment protection is stronger too, particularly for large firms, which suggests that firms in Italy will have to find alternative ways to circumvent the labour market inflexibility (both in terms of wages and quantities), for example through cautious intertemporal smoothing of employment changes, or through the strategic use of more flexible components of wages such as benefits and overtime.

The information contained in Appendix C is also relevant for answering to a question at the center of the analysis of the rest of this paper: how can wage cuts actually occur in this institutional setting? If we were interested to downward rigidity only of the base pay – or what we can consider the institutional component of wages – we would probably observe virtually no wage cuts in a country like Italy. This is because contracted minima have always been on the rise to keep up with the period's inflation (and while exceptions to the application of nationally agreed contracts may be possible in principle, they are very rare). However, if firms can take advantage of other and more variable forms of compensation to recover some degree of flexibility, then our analysis should focus on a more comprehensive measure of labor cost. To the extent that employees can embark in local and even individual bargaining, which has the effect of topping up wages bargained at the sector/national level, some room for wage variation in both positive and negative directions is possible. In this respect, bonuses and monetary compensation deriving from profit sharing candidate themselves as the most likely sources of negative nominal wage variation from one year to the next in the face of adverse economic conditions to the firm.

The distributions of nominal wage changes in Italy do not show up the typical hints of DNWR that have been found for other European countries and the US. For example, nothing like the 'big' spikes at zero wage growth reported by some authors is perceptible in our data. For each year in the sample, Figure 1 and Table 3 illustrate the

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[8] When contract renewals occur during a given year, the corresponding contractual wage is computed as a weighted average, according to the number months of validity of each renewal during the same year.

distributions of one-year wage changes, measured in terms of log wage differences. A vertical line at zero wage growth has been drawn in Figure 1, as well as a line indicating the value of inflation for the year considered.

Five important features are noticeable in Figure 1 and Table 3. First, the distributions appear to be centered on a positive value of wage growth, which is generally close to the inflation rate registered for the year. The last two columns of Table 3 show that inflation was for example about 5.8% in 1985, while the median wage change was around 6.7% (and the median wage growth was 7.6%).[9] As a result, column 5 reports that more than half of the employees in 1985 (about 57%) saw their real wages increase, perhaps reflecting a period of productivity growth. Inflation in subsequent years was not very different, reaching its highest value in 1989 at about 6.5% and its minimum at the end of the period, in 1996, when prices grew on average by 4%. The central location of the distributions depicted in Figure 1 in general follows the behavior of inflation over time, though the two do not always move in the same direction in the short run. In particular a compression of real wages can be detected during the years 1991-1994 when the median wage change is pushed below the level of inflation by the economic slowdown that characterized those years (see Table 3) and the season of wage moderation that followed the bargaining agreements of 1992/3. In fact, while before 1991 median wage growth always exceeds inflation by at least 1 percentage point, the two become almost indistinguishable thereafter.

A second distinctive feature of the wage change distribution is that numerous negative changes co-exist with a majority of wage increases, resulting in distributions that – though fairly skewed to the right in some years – look generally and surprisingly more symmetric than one would expect. As reported in Table 3, in 1985 about 8% of wage changes were wage cuts (column 2), with a median drop of almost 4% (column 8). In contrast, 89% of employees experiencing changes in their annual pay saw their nominal wage increase (column 6). The proportion of wage cuts reaches its highest value in 1992, at the heart of the period of economic slowdown. Correspondingly, the proportion of wage increases fall (at 82%) and the median raise dropped at only 5.7%.

The third characteristic of the distributions of nominal wage changes is the low percentage of employees whose wage was unaltered over two consecutive years, column 3. In fact, on average about 3% of the sample experienced zero wage growth. This result contrasts to what has been reported by the empirical studies, as for most countries spikes at zero are clearly visible in each year[10].

Forth, there is little evidence of the sort of symmetric rigidity implied by menu cost effects, and in fact no drops in the heights of the bars to the right of zero wage-growth can be observed in Figure 1. If anything, such manifestations are more evident to the left of zero, which point to the presence of a slight degree of asymmetric rigidities in the form of workers' resistance to wage cuts (DNWR).

Finally, real wages have increased the most in 1986 and in 1990, which is due to the renewals of many nationwide contracts taking place in those years. As column 5 shows, the percentage of workers with real wage rises visibly increased as a result of the renegotiation, and then steadily declined in the subsequent years. Overall, about 39% of all employees experienced real wage cuts during the sample period, and on average this

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[9] Mean wage growth is always higher than the median, and in 1985 was at 8.7%.
[10] For instance, Card & Hyslop (1996) report on average about 15% of wage freezes for the US; Smith (2000) finds a spike at zero of about 9% for British household survey data; Feher and Goette (2000) use Swiss data across adjacent years.

is the result of 12% of nominal wage cuts or freezes and 27% of nominal wages that fail to keep up with inflation (see the last row of columns 2-5).

Our preliminary descriptive would therefore suggest that Italian wages are reasonably flexible, both in nominal and in real terms. In fact, nominal wage cuts do occur, nominal wage freezes are very rare, and nominal wage raise below the year's inflation rate are even more frequent. Real wages, according to this descriptive evidence, would appear to be less rigid than nominal wages. Whether this initial conclusion can be regarded as realistic description of the Italian labour market is the aim of the rest of the paper, and particularly of the econometric estimates presented in Section 4. Before doing that, we will take a closer look at wage changes, inflation and contractual wage changes.

In Figure 2, we have distinguished observed wage changes according to whether they tend to be close to the year's inflation, and whether they are any close to a sort of wage raise dictated by collective bargaining.

As for inflation, % wage changes are classified according to whether (i) $\Delta w_{it}/w_i <$ $\text{inflation}_t - 0.005$, (ii) $\text{inflation}_t - 0.005 < \Delta w_{it}/w_i < \text{inflation}_t + 0.005$, and (iii) $\Delta w_{it}/w_i > \text{inflation}_t + 0.005$.

To approximate the % wage change dictated by collective bargaining, we have computed the modal wage change by industry/category cells. In practice, for each 2-digit industry we computed the quintiles of the wage distribution, and formed industry/quintile cells of employees. Within each cell, the modal absolute change is thought to approximate the "typical" absolute wage rise granted by the institutional arrangements stipulated by each national contract (which has broadly a 2-digit industry domain of application) to each category of employees (here approximated by the quintile of the wage distribution). The absolute wage change between t and t+1 so identified is then confronted to the individual's own starting wage in t, therefore obtaining a proxy of the proportional wage rise deriving from the collective bargaining for each employee, $\Delta w^m_i/w_i$, where w_i is the wage of the individual i at time t and Δw^m_i is the modal wage change between t and t+1 computed in the industry/quintile cell to which i belong. Wage changes are then classified according to whether (i) $\Delta w_{it}/w_i <$ $(\Delta w^m_i/w_i) - 0.005$, (ii) $(\Delta w^m_i/w_i) - 0.005 < \Delta w_{it}/w_i < (\Delta w^m_i/w_i) + 0.005$, and (iii) $\Delta w_{it}/w_i > (\Delta w^m_i/w_i) + 0.005$.

Then, wage rises in Figure 2 are distinguished among 9 classes: below/equal/above inflation and below/equal/above modal change, with the exact class width being that defined above. We already know from Table 1 that wage cuts are at around 10%, while wage freezes are only on average 3%. When we restrict our attention to positive wage changes, Figure 2 shows that %Δw_{it} that are below the individual's specific modal change, $\Delta w^m_i/w_i$, are at around 20%. Those with wage changes "at the modal change" are around 15% and, finally, those above modal change at around 50%. Our simple descriptive devise to approximate "institutional" wage changes enables us to partly revise our previous story. The wage raises granted by the institutions (national contracts) seem to represent a binding constraint for the wage rise of a relevant number of employees (about 20%). This is consistent with our model's view that, for those individuals belonging to a sort of rigidity regime, nominal wages cannot increase less than a real-rigidity threshold (here represented by the institutional constraint). On the other hand, half nominal wage rises seem to be higher than institutional wage rises, pointing to the empirical relevance of the topping-up role of the flexible components of

wages (wage drift) as a devise firms use for implementing desired wage adjustments. Also note that, over time, we observe less wage change at the modal change and more above-modal wage rises (see Figure 2). This can be interpreted, to some extent, as evidence of a decreasing relevance of national contracts (and floor/ceiling effects relating to them), particularly as a result of the wage bargaining reforms occurred in the second half of the 1990's (see Appendix C). That this tendency is not particularly strong, on the other hand, is to be attributed to the slow assimilation of the reform's clauses in the period's contract renewals. These considerations are further explored below using the evidences emerging from our sub-sample containing contractual wage information.

4.2 The Dynamics of Contractual vs Observed Wages over the period 1990-96

The wage drift, the % difference between recorded and contractual wage, is a measure of the national contracts' weight on total pay. It is positive by definition[11] and it is strictly related to the firm's dimension and hierarchical position on the contractual ladder. Table 4 shows that employees generally receive wage supplements over and above the contractual pay, with an average wage drift of about 24%. As expected, managers' supplemental pay is even higher (about 37% on average), a bit lower for white-collars (almost 28%) and smallest for blue collars, who still earn an additional 21% over the contractual wage. Note also that, while the wage drift has remained relatively stable over time – or slightly decreasing – for the white-collars and blue-collars, it has increased for managers. As Table 5 illustrates, wage drifts tend to be greater for larger firms, with differences across sectors reflecting the different incidence of firm/individual level bargaining. In particular, integrative contracting appears to be less dependent of firm size in the metal and mechanical engineering and in the textiles contracts, while the opposite holds true for food product and beverage, tourism and wholesale and retail, and construction.

In table 6 we present the changes between *t* and *t*+1 of both the contractual wage and the recorded wage, for the years between 1990 and 1996. It can be seen that there are cases in which the difference between the observed wage change and the contractual wage change is negative. This occurs mainly where the topping-up components are relatively high, so that they can be reduced in response to cyclical factors/ idiosyncratic shocks. On average, however, recorded wage changes are higher than contractual ones in all sectors. During 1990-91, with an inflation rate of 6.3%, average contractual wages increased by 10%, while recorded wages grew by 11%. The renewals in many sectors during this period were characterized by a certain stasis in integrative contracting[12], implying that wage changes are attributed principally to the contractual renewals. In 1992 there were no significant contractual renewals. As the *scala mobile* no longer applied, contractual wage dynamics slowed down considerably (at 5.5%), followed by recorded salary (at 5.9%), not far from the period inflation (at 5.3%).

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[11] In the data however we observe a small number of cases (6%) with a negative wage drift. This is mainly the result of temporary derogations to the relevant nationwide contracts due to "cassa integrazione guadagni" (redundancy payments) or maternity leave.

[12] Clauses aimed at governing the cycles and duration of industrial within-firm contracts having economic contents were quite frequent. This to contain wage/salary increases. The food-stuffs workers' contract allowed only one production bonus for the entire duration of the nationwide contract. The public and private metal and mechanical engineering, the food-stuffs and textiles industries established a date before which no kind of collective economic improvement at firm level was allowed.

The period between 1993 and 1994 witnesses an effective inflation trend that considerably exceeds programmed inflation (also due to the concomitant devaluation of the Lira). In this period the dramatic economic situation (recession) persuades the parties to remain anchored to a fairly low inflation target (that was generally perceived to be difficult to achieve). As a result, the stipulated contracts envisaged wage increases inferior to the effective increase in prices. In some sectors the recorded wage dynamics recuperated the purchasing power losses occurred at the national contractual level (Table 6). On average, contractual wages increased by 3.1%, recorded wages by 5.9%, against a programmed inflation rate of 3.5% and an effective inflation rate of 4%.

In 1994 and 1995 the first contract renewals following the new bargaining system established by protocol of the 23rd of July 1993 occurred.[13] The first installments of the renewal increases were made payable generally beginning from January 1995. The 94-95 period, on the whole, continues the season of wage moderation, with contractual wages (+3.7%) higher than programmed inflation (2.5%) but fairly below effective inflation (at 5.2%). Recorded wages however display a more vivid dynamics, at 5.8%, thereby recuperating 0.6% on effective inflation. In 1995/96 recorded and contractual wage dynamics is very close to that of the previous biennium; however, with effective inflation down to 3.9% (now very close to programmed inflation[14])

The dramatic economic situation (recession) persuades the parties to remain anchored to a fairly low inflation target (that was generally perceived to be difficult to achieve). The contracts stipulated envisage wage increases inferior to the effective increase in prices. Inflation, first contained by the economic crisis, in 1995 gains new momentum from an improvement in the economic picture. During this phase contractual remuneration increases, on average, less than effective inflation and de facto wages partially recuperate the purchasing power lost at national contract level. During the biennium of 1995-96 de facto retribution increases more than contractual wages. Effective inflation reaches rates close to that of programmed inflation, employees on average manage to recover some of the purchasing power lost in the previous years, as a result of a 1.8% (=5.2-3.4) rise in the wage drift.

5. Estimation results

Taken at their face value, the results discussed in the previous section would suggest that the structure of nominal wage changes is compatible with a labor market characterized by a fairly high degree of flexibility, as it would appear that there are no big constraints for firms to reduce the wages they pay if they so need do. And while the distributions are generally centered on or around the inflation rate, there are many wage changes that occur at levels much higher or much smaller than inflation, giving rise to a high degree of variability in wage movements.

However, this description may be a surprising one for Italy, traditionally included in the list of countries with rigid labor market institutions. The possibility that our simple

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[13] Between the end of 1993 and the beginning of 1994 various national collective contracts regarding the private sector expired. The renewals, which began in 1994, took place, for the greater part, during the second half of that year and concerned workers employed in the commercial and services departments of private metal and engineering companies, small public or private construction firms and small and medium-sized cooperative, transport and o companies.

[14] On the whole the substantial stability of the average contractual index against inflation is the outcome of opposing tendencies within the various sectors. The flexion in the manufacturing sector is countered by a certain stability in the tourist and wholesale trade.

descriptive evidence is unable to reveal the "true" – and much higher – degree of wage rigidity is investigated in the following section. The econometric approach described in section 2 is employed, with the aim of estimating the extent of "frictions" in the labor markets, controlling for (1) various observable determinants of the underlying rigidity-free wage changes, and (2) the presence of measurement errors in the available data.

One key question we attempt to address with the econometric model is whether the relatively high proportion of wage cuts revealed by the preliminary data inspection is real or reflects instead errors in measured wages. In fact, daily wages are computed by dividing total remuneration by the number of paid days of the employee (which do not necessarily coincide with worked days). In particular, in our sample spurious wage changes may result from variation in the amount of work supplied or recorded (overtime, hours worked, paid days during maternity-leaves, periods of unemployment benefits such as CIG, strategic mis-reporting of paid days by firms[15]) or variation in total remuneration (which may also vary under the above circumstances, as well as on account of fringe benefits, arrays payments, and traditional measurement error). The econometric methodology applied below aims at circumventing our inability to observe these wage components separately in the data and therefore to isolate true and spurious changes. The same methodology has been followed for studying nominal wage rigidity in Germany (Knoppik and Beissenger, 2001), the US (Altonji and Devereux, 1999) and Switzerland (Fehr and Goette, 2000), who have all shown the importance of controlling for measurement error in estimating the true degree of nominal wage rigidity.

The second key issue taken on board in the paper is to provide an estimate of the relative importance of nominal and real rigidity in Italy. If many observations are concentrated around the inflation rate, how far is this the result of inflexible wage bargaining arrangements that dictate a sort of common "institutional wage growth" regardless of the (notional) wage changes desired by firms? And is this a constraint operating over and above that preventing nominal wage cuts, on which traditionally research has focus on? The possibility of distinguishing between these two types of rigidities appears to be particularly important for European countries as opposed to Anglo-Saxon ones, given the well-known differences in their labour market institutions.

5.1. Benchmark estimates
Our benchmark estimates are obtained from the estimation of the model described in section 2 on our full 1985-96 sample, with no use of external contractual information. In particular, the model is asked to identify the real rigidity threshold and the notional wage changes distribution. In other words, both the real threshold r and the notional wage distribution in (1) are estimated within the model, along with the other relevant parameters. In this case, r is mainly interpreted as an "expected rate of inflation" which is common – i.e. has the same value – for each employee /firm. The possibility of variation in the real rigidity threshold at the contract-specific job-ranking level is instead taken on board in section 5.2.

As for the notional wage change, we have allowed variability according to the employees and firms observed heterogeneity. The X vector in (1) includes the employee's age, age squared, gender, occupation dummies for white collars and managers (base category: blue collars), dummies for firms that between t and $t+1$ have increased or reduced their total employment (base: no employment change), dummies

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[15] That Italian firms – particularly in the south of the country – might find it convenient to underreport the actual number of days worked by the employee has been suggested by Contini *et al.* (2000).

for the age of the firm, regional dummies (base category: North West), and the log of the firm total employment and its square. Similar variables have also been used by the existing papers on downward nominal wage rigidity, and differences mainly arise from the data availability (e.g., most papers enter education as an explanatory variable, but the INPS data do not contain it).

As we have no particular interest in the estimated coefficients of the X variables (our focus being on the estimates of rigidity), we will not report our full ML results for the separate sets of estimates for each of the 11 (t, t+1)-couples of years. In the interest of brevity, the effects of the X variables entered in (1) are instead described with reference to a simple OLS wage-change regression for our 12-year pooled sample (see Table 7). The different specifications we have experimented with have never resulted in noticeable changes in our ML rigidity estimates. The joint effect of the X variables on each year-specific mean notional wage change is instead of interest and is reported in the tables showing our rigidity estimates (Table 8-10).

As Table 7 shows, the impact of observed heterogeneity on wage changes is generally highly significant and of the expected sign (and this also holds true for separate regressions by year). Individual's age is found to have a negative impact on wage changes, consistently with the "classic" profile of wage levels with respect to age, which is found to be increasing at decreasing rates. Age squared is here intended to capture the presence of higher order polynomials in age. White collars and managers tend to have a higher wage growth than blue collars. Female employees have a lower wage growth than male's, but tend to reduce the distance with their male counterpart as they grow older and acquire labour market experience, as shown by the interaction between the dummy for female and age. Expanding firms often grant wage increases, as reflected by a positive coefficient of the dummy "growing", the opposite occurs for "shrinking" firms. Those working in large firms too seem to obtain bigger wage increases than in smaller firms. There is also some evidence that employees in firms aged less than 5 years manage to get larger wage raises than those working in the reference category (firms aged 5-10 years); the opposite is true for firms existing since more than 20 years. Those working in the South or Centre of the country receive on average smaller wage increases than those in the North West (the reference category), while the opposite occurs for those working in the North East (which has over the years assumed the role of the most dynamic region of the country).

As expected, nominal wages are highly responsive to inflation: when this grows, wages grow too and workers get protected by various institutional arrangements[16] – Consistently with a typical Phillips-curve argument, the rate of unemployment has a negative coefficient, indicating that when there are many unemployed wages tend to decline. The difference between current and lagged unemployment (a proxy for the deviation of current unemployment from its equilibrium level) has a negative coefficient, as it is generally found in the literature. A negative time trend is supported by the data, capturing - in a crude way as it is - the effect of the various institutional changes that occurred in the labour market over the time period considered, notably the slow but constant phasing out of the *scala mobile*, as described in the Appendix.

We now turn to our benchmark rigidity results in Table 8. The estimates are produced separately for each adjacent years, with about 40,000 observation per year.

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[16] such as the *scala mobile* – as well as by re-negotiations aimed at maintaining unaltered the real purchasing power of their wages.

Column 3 shows the mean wage change observed in the data, while column 4 and 5 provides the estimated moments of the notional wage distribution, the standard deviation (s_1 in (1)) and the mean ($= X'\hat{a}$), respectively. The estimated real threshold r is shown in column 6. In terms of the notation of equation (4), the vector $X'b$ is specified as a constant only. In principle other variables could be entered in the specification of r in (4), although it is difficult to think of exclusion restriction that could lead us to separately identify the notional wage change distribution from the real threshold. For this reason, our benchmark model is kept simple, and only a common constant r is estimated for each observation-year. Around the common r, individual variability in the real threshold is allowed by the error term entering in (6), whose estimate of the standard deviation s_r is shown in column 7.

The estimated moments of the measurement error process are instead reported in column 8 and 9. Column 8 gives the probability that observed wage change has been correctly reported, i.e. that there is no measurement error in either period 1 or period 2 (equation 5). The standard deviation s_m of the additive measurement-error term is reported in Column 9.

From column 10 to 15, Table 8 presents the rigidity measures implied by the models parameters. Column 10 and 13 give, respectively, the probability the individual falls in the real rigidity regime (equation 2) and the probability of belonging to the nominal regime (equation 3). As shown by (5), individuals who belong to the real rigidity have their wage increased by r anytime that their notional wage change is less or equal than r. Similarly, individuals who fall in the nominal rigidity have their notional wage cut transformed into a wage freeze.

Column 11 gives the probability that an observation is actually affected by the real rigidity regime (equation 12), which occur when the individual is in the rigidity regime and her notional wage change lies in the region where the real rigidity may be binding, i.e. when $\Delta w^* < r$. Similarly, column 14 computes the probability that an observation is actually affected by the nominal rigidity regime (equation 13), i.e. that the individual is in the nominal regime and her notional wage change is negative.

Finally, as some of the notional wage changes are modified by one of the two rigidity thresholds – the notional wage change being increased to r (for those affected by the real regime) or to 0 (for those affected by the nominal regime) – one can compute the % wage sweep-up due to the r-threshold (column 12) and the sweep-up attributed to the 0-treshold (column 15). These correspond to equation (14) and (15), respectively.

On average (see the last but one row of Table 8), there are about 43,000 wage change observations that can be used annually to produce the various rigidity estimates. Over the whole sample period, observed mean wage change is equal to about 7%, while the mean notional wage change is only 5%. This is an initial indication of the presence of wage rigidity, as some underlying rigidity-free wage changes are pushed up by either the nominal wage threshold (i.e., at 0 wage growth) or by the real wage threshold (at r % wage growth). The standard deviation of the error term entering the notional wage equation (1) is, on average, estimated at 0.73.

As for the real rigidity threshold, the model delivers an average value of 5.1%, which is very close to the average price inflation over the same period, at 5.3%. However, at an individual level, there is a fairly high variability as for the exact value at which the

threshold operates, as the standard deviation of the error term entering the equation for r (4) is estimated at an average value of 0.028. This is consistent with both the individual/firm variability of r when this is interpreted as expected inflation, and with the variability of r due to differentiated wage increases within union's contracts, when r is instead interpreted as an institutional constraint arising from collective wage bargaining.

When turning attention to the estimated measures of wage rigidity, we find a strong prevalence of real rigidities over nominal rigidities. The probability that a notional wage change to the left of r is increased to up to r is, on average about 60%, indicating that the r-threshold is a strong attractor of wage increases for those changes that would otherwise be less than r. On the other hand, negative notional wage changes are turned into a wage freeze (i.e. pushed up to 0% wage growth) only in less than 10% of the cases.

This result can be contrasted with the conclusions reached by previous research on the extent of downward nominal wage rigidity. For example, Knoppick and Beissenger (2001) for Germany and Devicienti (2002) for Italy find that a high fraction (between 50 and 80%) of all notional wage cuts are prevented by the nominal wage constraints, but do not take into account the possibility of notional wage changes that are pushed up beyond the 0% growth point. If, in Italy as in Germany, real rigidities in the form of binding thresholds at positive wage growth are in place, a focus on nominal wage rigidities alone might be misleading. And this is important from a policy perspective too as, while downward nominal wage rigidities can be overcome by sufficiently high inflation targets, the same does not hold with regard to real wage rigidity. More decentralised and flexible wage arrangements are generally thought to be more effective in relaxing the real rigidity constraints.

The other two measures of rigidities shown in Table 8 – the probability that an observations is actually affected by real or nominal wage rigidity, and the wage sweep-up attributed to the two types of rigidities – confirm the predominance of real rigidities over nominal wage rigidities. On average, almost 33% of the observations has been affected by real rigidity over the sample period, i.e. these observations have had their notional wage change in the region to the left of the estimated r while belonging to the real rigidity regime. On the other hand, only 10% of the observations has been affected by nominal rigidity over the sample period, having both notional wage cuts and a binding 0-treshold.

As for the wage sweep-ups, on average observed wage changes are 2.8% point higher than if there were no real rigidities in the system, and only about 0.2% point higher due to the presence of downward nominal wage rigidity. Overall, wage rigidity implies that the notional wage distribution is "deformed" around the 0 and the r wage growth point (i.e. a mass of concentration is built up from below on those cut points) in such way that average observed wage change are about 3% point higher than in the absence of constraints to wage adjustments.

Finally, we discuss the role of measurement error. As shown column 8 of Table 8, most observations, around 96%, is correctly measured. A remaining 4% is instead affected by measurement error in one or both of the years over which the wage change is computed. This can be seen as to some extent consistent with the administrative nature of the data, and with the often-held belief that for this type of data earnings are generally correctly reported. Indeed, a comparison of the min and max wage-change values displayed in Table 1, part (a), with the percentiles reported in part (b) seem to

confirm such a view. However observed wages changes in few cases are determined not only by re-negotiations but also by mis-reported work effort, by wage components that refer to past work and non-work related payments, as well as by traditional measurement error. All these causes of spurious wage changes cannot be controlled for in the data, and can be treated only after assuming a process for measurement error. According to the model's estimates, only a small minority of the observations are incorrectly reported, but the additive random variable reflecting measurement error has a large estimated standard deviation (s_m), on average equal to 0.33.

5.2. Alternative estimates: ML estimates using external information about the real rigidity threshold and the notional wage change.

Two additional sets of estimates are also provided below, in which we make use of external information as an alternative identifying strategy for both the real rigidity threshold and the notional wage change. In the first set of additional estimates (Table 9), the real rigidity threshold is identified by using the modal wage change by industry/category cells (similarly to what we have done when producing Figure 2). In practice, for each 2-digit industry we compute the quintiles of the wage distribution, and form industry/quintile cells of employees. Within each cell, the modal absolute change is thought to approximate the "typical" absolute wage rise granted by the institutional arrangements stipulated by each national contract (which has broadly a 2-digit industry domain of application) to each category of employees (here approximated by the quintile of the wage distribution). The absolute wage change between t and $t+1$ so identified is then confronted to the individual's own starting wage in t, therefore obtaining a proxy of the proportional wage rise deriving from the collective bargaining for each employee. Note that this implies that the real rigidity threshold for employee i is given by:

(6') $r_i = \Delta w^m_i / w_i + e_{ri}$

where w_i is the wage of the individual i at time t and Δw^m_i is the modal wage change between t and $t+1$ computed in the industry/quintile cell to which i belongs. Note that (6') differs from (6) in that $X = \Delta w^m_i / w_i$ and b is forced to be equal to 1. Also, unlike our benchmark estimates, r_i is now allowed to be potentially different for different employees.

As for the notional wage change in (1), our first alternative set of estimates has introduced a sort of macro wage rule as a main determinant of the underlying notional wage change. Between t and $t+1$, the process driving the notional wage change is specified as follows:

(1') d^n_i = inflation + long-run productivity + δ*log (unempl/NAIRU) + X_i'a + e_i

The role of the macro-based rule in (1') is to take into account that, whatever the empirical relevance of real rigidities linked to price indexation mechanisms, consumer price inflation and other macro variables would have a sizable impact upon the notional wage changes. Actually, it seems fair to assume that, even in framework with no real rigidity, the wages distribution ought to be shifted up by a prices' increase. Similarly,

one would expect that the presence of unemployment in excess of a "natural" rate level would trigger wage declines. So we simply implemented a rule based upon the assumption of a long-run Phillips curve, dictating that wage growth is equal to the sum of price inflation, long run productivity growth and a balancing term expressed as the ratio between current unemployment and the natural rate, as assumed in (1'). Individuals' heterogeneity is accounted for by only a couple of observable characteristics: age and age squared. It seems fair to assume that other characteristics observable in our data are relevant in shaping the notional wage changes distribution, as for instance business cycle factors and evolving human capital premia might be caught by industry and occupational dummies interacted with yearly dummies. However, we kept at a minimum the amount of individuals' heterogeneity captured by those observable characteristics which might be also related to the industry level collective bargaining and the real thresholds implied by it. So much of the individuals' heterogeneity is left to the random component. In (1') X_i'a therefore includes only age and age squared, with no constant term.

Note that, in order to implement such a rule, we need to select a value for the parameter δ and a value for the NAIRU. We resorted for both to the empirical Phillips curve which is embedded into the Bank of Italy econometric model[17]. As such, that equation has a δ parameter which is equal to 0.015. This value is however affected by the presence of the rigidities we are examining. Actually, the usual macro measure of the presence of real rigidities is precisely the inverse of the δ parameter. In order to adjust for this, we therefore arbitrarily multiplied that estimate by a factor of 4, fixing δ at 0.06, a value yet quite low according to the international standards of similar Phillips curve specifications[18]. The NAIRU has been correspondingly adjusted and fixed at 8.5%. Given the arbitrariness of the procedure we also experimented with other values for δ, with no significant changes in our results.[19]

In our second set of alternative of estimates, we still make use of external information to identify the real rigidity threshold rather than estimate it within the model as in our benchmark estimates. But this time the wage changes dictated by the national contracts have been used directly, using information from the nation-wide wage-settlements data described in section 3. While this second strategy allows us to get closer to a notion of real rigidity arising from institutional observed constraints, we are unable to use such external information for our entire sample. Indeed, the available information on union's wage-settlements could only be recovered for the 1990-1995

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[17] For a general description of the model's properties see Galli et al. (1990) and Terlizzese (1994). Fabiani et al. (1997) specifically focus upon the wage determination equation embedded in it. Actually we resorted to a simplified version of the estimated equation, removing further shift factors like the presence of strikes or the degree of capacity utilization, so that wage growth is regressed only upon a constant, some dynamics of actual and expected price inflation and the unemployment rate.

[18] See Coe-Gagliardi, 1985.

[19] More importantly, in another experiment we allowed for some heterogeneity in the macrobase- rule as we considered, besides the nationally driven rule above stated, a local adjustment factor obtained by considering also the ratio between between the local and the national unemployment rate again using the .06 parameter as a measure of the impact which such a difference should imply (in the absence of real rigidities and differences in the natural rate across areas) for the evolution of the regional wage differentials.

subperiod, while by proxying national contracts the way we have illustrated above we are able to cover the entire 1985-1995 sample.

Look now at the results in Table 9. Here the external information used is the macroeconomic rule (1') for the notional wage distribution, and the proxy for the wage rises dictated by national contracts for the real rigidity threshold in (2). The first three columns are the same in both Table 4 and 5, as the same sample is used in both sets of estimates. Looking at average estimates over the sample period, last but one row in the table, one gets broadly the same conclusions than with our benchmark estimates. Once again, real rigidities prevail according to the three measures computed (probability of being in the regime, probability of being actually affected by the given type of rigidity, and sweep-up associated to the type of rigidity). Over the 1985-1996 sample period, the probability of being in the real rigidity regime is at 0.53 (as opposed to 0.60 of Table 8), while the probability of being in the nominal regime is at 0.13 (compared to 0.10 ofTable 10 presents the estimation results using information on nationwide wage contracts, available for the years 1990-96 only. To compute the wage associated to contractual renewals, employees are further to be in the same union contract and the same position in the contractual ladder between t and $t+1$, besides to being in the same firm. Coupled with the circumstance that only 28 national contracts could be covered, the above sample selection rules imply that, on average, there are about 25,000 wage change observations per year. These restrictions do not significantly alter the wage change distribution. In fact, when focusing on the period 1990-96, both our full sample and the restricted subsample display a mean wage change of 6% (compare the last row of Table 8 and the last row in Table 10). The mean notional wage change is, on average, equal to 0.04, again indistinguishable from the mean notional wage change obtained with the benchmark estimates for the 1990-96 period.

Generally speaking, the results of Table 10 are very much in line with those of the benchmark model, when looking in both cases at the 1990-96 sub-period. The estimated value of real rigidity threshold is, on average, almost 4% in Table 10, which correspond to both the average rate of inflation and average contractual wage growth. The probability of being in the real regime is 58% against 55% found in the benchmark model, and 49% found in Table 9. On average almost 29% of the observations have been affected by real rigidity, compared to 30% obtained in Table 8 and 27% in Table 9. The sweep-up attributed to the real threshold is at 2.0% against the benchmark value of 2.4% (and 1.9% of Table 9). And in all cases the sweep-up attributed to nominal rigidity is, on average, at 0.02.

Our final remark concerns the trend displayed by the estimated real rigidity measures over time, given the institutional changes in the Italian bargaining system occurred throughout the entire time period considered discussed in the appendix. In particular, following the 1992/3 agreements that definitely abolished the *scala mobile* and established a two level (national and more "rigid" the first; at the firm level and more flexible, the second) bargaining system, our prior was to find a reduced amount of real rigidity over time, conceivably coupled to an increase in downward nominal wage rigidity. Our estimates, unfortunately, display too a high year-to-year variability to robustly confirm our expectation. On the other hand, one might argue that, to see the effect of the bargaining system established in 1993, and that was incorporated in the contract renewals only starting in 1995, data stretching at least a few years beyond our

observation period are needed. While this remains in our future research agenda, we content ourselves with noting that it is nonetheless true that real rigidities are, on average, less pervasive in the 1985-90 sub-period compared to the second half of the nineties.

6. Long-run unemployment consequences of the estimated rigidity

In this section we briefly explore the effect of the estimated wage rigidity on the long-run unemployment rate. According to a standard accelerationist Phillips curve, inflation will accelerate or decelerate depending on whether unemployment is below or above the *natural rate*, while any existing rate of inflation will continue if unemployment is at the natural rate. The natural rate is thus the minimum, and only, sustainable rate of unemployment, but the inflation rate is left as a choice variable for policymakers. Since complete price stability has attractive features, many commentators who accept the natural rate hypothesis believe the central bank should target zero inflation. Akerlof *et al.* (1996) question the standard version of the natural rate model and each of these implications. They investigate the consequences of accounting for DNWR in a model that otherwise resembles a standard natural rate model and show that there is no natural unemployment rate. Rather, the rate of unemployment that is consistent with steady inflation itself depends on the inflation rate. In the long run, a moderate steady rate of inflation permits maximum employment and output in the simulated version of their model. Maintenance of zero inflation, instead, measurably increases the sustainable unemployment rate and correspondingly reduces the level of output.

Central to their argument, is a modified version of the Phillips curve, which they write as follows:

$$(16) \qquad \pi_t = \pi_t^e + a(u^{LS} - u_t) + s_t$$

where π_t^e denotes the expected rate of inflation, u_t is the rate of unemployment in t, u^{LS} is the lowest sustainable rate of unemployment and s_t is a term reflecting the effect of DNWR on the standard accelerationist Phillips curve. In particular, s_t is interpreted as a shift in expected unit labour costs arising from wage rigidity in the face of firms' idiosyncratic shocks, and enters linearly in (16) the same as a shift in labour costs arising from any other reasons different than wage rigidity. In the definition of Akerlof *et al.* (see also Knoppick and Beissenger, 2001), s_t is the *real wage wedge* relative to the level of the real wage (RWW), which measures the wedge (and therefore the cost) introduced by wage rigidity between the expected aggregate actual and notional real wage levels. It can be easily shown that, in turn, the RWW is equal to the aggregate sweep up.[20] In the long run, when $\pi_t = \pi_t^e$, equation (16) implies that the unemployment rate with non-accelerating inflation, the so-called NAIRU, is written as:

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[20] In fact, RWW$= E\left[\dfrac{1}{N}\sum_t\sum_i w_{it}^a - \dfrac{1}{N}\sum_t\sum_i w_{it}^*\right] = \dfrac{1}{N}\left[\sum_t\sum_i E w_{it}^a - \sum_t\sum_i E w_{it}^*\right] =$

$\dfrac{1}{N}\left[\sum_t\sum_i E(w_{it}^a - w_{it-1}^a) - E(w_{it}^* - w_{it-1}^*)\right] =$ aggregate sweep-up

$$(17) \qquad u^{NAIRU} = u^{LS} + \frac{1}{a} s_t$$

The NAIRU can be larger than the lowest sustainable rate of unemployment if the relative real wage wedge s is positive. Wage rigidity – by creating a wedge between the actual and notional real wage – can indeed create an excess long-run unemployment (u^{NAIRU}- u^{LS}) given by $(1/a)$ s_t.

To approximate s_t when the economy is in steady state, we simply take our average (over the whole sample period) value of the aggregate sweep-up (nominal + real) in Table 9, which is equal to 0.3. The only missing information to compute the excess long-run unemployment in (17) is an estimate of a. The values reported for Germany (Knoppik and Beissenger, 2001) and the US (Stiglitz, 1999) range from about $a=0.1$ to about $a=0.5$, while regarding $a=0.4$ as the most reasonable value. For Italy values of a between 0.04 and 0.05 seem appropriate (e.g. Golinelli, 1998). In this case, the estimated aggregate sweep-up implies an *excess* long-run unemployment of between 6%-7.5% (compared to an average 1985-96 unemployment rate of about 10.4%).

More difficult is trying to compute long-run unemployment rate with a hypothetical 0 level of steady state inflation, as we do not have any reliable way of extrapolating our rigidity estimates to such an environment. And in fact we do not attempt at doing it. However, we note that even at relatively low levels of inflation (4% is the lowest in our sample), the estimated aggregate sweep-up remains fairly high (at 0.16 for 1995/96 in the benchmark model), thereby implying a significant excess long-run unemployment, though lower (at 3% when $a= 0.05$) than with inflation at its 1985-96 average. Therefore, as inflation is reduced, wage rigidity might entail a lower long-run unemployment if the aggregate (nominal + real) sweep-up declines too. This is at variance wit the results of Knoppick and Beissenger (2001), who show that, as steady inflation is reduced towards zero, the long-run excess unemployment raises monotonically. This occurs because they focus on downward nominal rigidity only, and because a positive inflation (that "greases the wheels of the economy" when DNWR is in place) has a beneficial impact on long-run unemployment. In our model, however, both nominal and real wage rigidities are considered, and while the constraints posed by the former can be eased by inflation, this is not necessarily the case with real rigidity. Reversing the argument, the reduction of the inflation target is not necessarily dangerous if real rigidity is at least as important as nominal rigidity, because the loss in terms of reduced grease effect can be well compensated by the benefits of lower real rigidity.[21] EU central bankers have therefore less reasons to fear extremely low inflation targets, but should keep encouraging the so-often invoked EU labour markets reforms that can impact on real rigidities.[22]

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[21] At the limit, with steady-state inflation at 0%, the real and nominal rigidity thresholds coincide, and the distinction between the two sources of rigidity vanishes.

[22] Note that to provide indications for an optimal rate of inflation both its beneficial "grease" effects on the face of DNWR and its "sand" costs should be considered (see Groshen and Scheitwer, 1999, for an estimate of the optimal rate of inflation in the US).

7. Concluding remarks

This paper has provided estimates of nominal and real wage rigidity in Italy using administrative longitudinal micro-data from the Social Security Institute (INPS). The econometric methodology is based on a switching-regime model of individual wage changes, which accounts for both the determinants of notional wage changes, measurement errors in individual wages, and allows the researcher to distinguish between nominal and real wage rigidities and to account for their relative importance. Overall, estimates have shown that wages in Italy are inflexible, but this is mainly due to real wage rigidity rather than downward nominal wage rigidity. Between 50 and 80% of all notional wage changes that lie below a sort of inflation-related or union-set threshold are forced to align to this level. On the other hand, only about 10% of the negative notional wage changes are transformed into wage freezes by the operation of the downward nominal wage rigidity constraint, which existing literature has mainly focused on. The results have been shown to be broadly robust to alternative ways to identify the notional wage change distribution and the real rigidity threshold, based on both macro rules for determining the rigidity-free wage change and contractual wage information for isolating raises dictated by nation-wide bargaining.

Over time, there are indications that real rigidities have become less important, while the opposite seems to be true with respect to the constraints posed nominal wage rigidity. This is in light with the various labour market reforms that Italy experienced during the first half of the nineties, particularly after the abolition of the automatic price-indexation clause (*scala mobile*).

The estimated models were then used to compute various implications of the extent of wage rigidity, particularly in terms of its costs for the long-run unemployment rate. The combination of both nominal and real wage rigidity is shown to entail that such costs have been serious in Italy from the mid eighties through the mid nineties, with between 6 and 7.5% of excess unemployment due to the combination of the two sources of rigidity. In terms of policy implications, the paper has suggested that, in countries where real rigidities still prevail over nominal rigidities, resistance to very low inflation targets might be miss-placed, and efforts should instead concentrate on introducing further elements of flexibility in the labour market, for example by promoting more decentralised wage bargaining mechanisms and a normative setting more favourable to the development of profit-sharing variable components of total compensation.

While the plausibility of our conclusions in the Italian case is reassuring of the methodological approach and of the various identifying assumptions made, doubts remain which call for future research efforts. First, while estimates based on our benchmark and our two alternative estimates with external information on both the notional wage change distribution and the real-wage threshold generally produce the same qualitative results, estimates still display large year-to-year variability. Future research could focus on better identification strategies for the notional wage change distribution (which is still "too" arbitrary and little differentiated across observations), the measurement error process (affecting too few observations and with high variability over time) may be made responsive to cyclical and contractual factors. Second, attention should also be devoted to the alternative ways – besides to wage cuts – that firms have to reduce labour costs. For instance, work and training contracts (CFL) or other atypical contracts are cheaper and more flexible than standard contracts, implying that firms covering turnover with this kind of contract can achieve a reduction in their average labour costs. In this respect, reforms now in the 2003 Italian government agenda

(claiming of making the labour market "the most flexible in Europe"), and mainly based on making employment more flexible in terms of contract duration, might only partly offset the costs of inflexible wage arrangements.

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Appendix A: Model's estimation

Dicken and Goette (2002) describe the general method for writing out the likelihood function in equation (11) in terms of parameters and observables for their general model. Fourteen of the fifteen regimes in Table A1will have the same form. The *L* function in (11) will be a univariate normal density function where mean and variance will depend on the regime. The *P* function will be the integral of the negative orthant of a four or five variate normal density, the random error terms entering in (1), (6), (10) and in the latent- index-function versions of (2)-(4) and (5)-(7). The means and the covariance matrix of the random variables, as well as the normalizing constant, will be regime dependent. For the general model, estimation requires evaluation multivariate normal distribution functions, which will need to be approximated by simulation (using, for example, the GHK algorithm). However, if it is assumed that the covariance matrix is block diagonal, the multivariate integrals can be written as the product of the integral of a bivariate and a trivariate normal or two bivariates. These can be approximated using conventional analytic techniques.

The general version of the model proposed by Dickens and Goette has 8xK coefficients of X (where K is the number of X variables) plus a covariance matrix with 36 elements. However, not all of these parameters are identified. The variances of the error terms in the latent-index versions of (2)-(4) and (5)-(7) will have to be normalized to one. The number of parameters is still very large, and many of them are "nuisance parameters" which are of no intrinsic interest. Also, estimating the model allowing for a general covariance structure is likely to tax the identifying information in the data and will require the use of much less accurate approximations to the integrals of the multivariate normal distributions. Feasibility will therefore impose further restrictions on the covariance matrix of the error terms. First, they assume that the random variables determining the wage and the wage setting regime are uncorrelated with the random variables determining the error regime. This entails that one can use analytic approximations to the normal integrals in the *P* functions. They also assume that the random part of the measurement errors are uncorrelated with all other random variables in the model. They further assume only the notional wage change is allowed to depend on the observable differences between individuals/firms. In practice, after imposing these restrictions, they up with the model version we have presented in section 2.

Table A1
Designations for 15 Regimes Generating Observed Wage Changes

Recording error	Wage Setting Regime				
	Unconstrained	Real Rigidity		Nominal Rigidity	
		Constrained	Unconstrained	Constrained	Unconstrained
No error	U0	RC0	RU0	NC0	NU0
One period in error	U1	RC1	RU1	NC1	NU1
Both periods in error	U2	RC2	RU2	NC2	NU2

Cannot generate negative observed nominal wage changes.

APPENDIX B: TABLES AND FIGURES

Table 1: Descriptive Statistics for the 1985-1996 Pooled Sample

(a) sample means

variable	Obs	Mean	Std. Dev.	Min	Max
ln(wage change)	462307	.056	.095	-1.20	1.26
ln(firm size)	461644	5	2.917	0	11.65
ln(firm size) squared	461644	33.55	35.1	0	135.68
worker's age	462307	0.037	0.01	0.015	0.063
age squared	462307	1.507	0.777	0.225	3.97
growing firm	462307	0.415	0.493	0	1
shrinking firm	462307	0.405	0.491	0	1
energy, gas, water	461861	0.036	0.187	0	1
mining and chemical	461861	0.095	0.294	0	1
metal products	461861	0.258	0.437	0	1
commerce	461861	0.165	0.371	0	1
transports and commun.s	461861	0.074	0.262	0	1
banking and insurance	461861	0.114	0.318	0	1
north East	462162	0.234	0.424	0	1
center	462162	0.187	0.389	0	1
south	462162	0.163	0.369	0	1
female	462301	0.275	0.446	0	1
femaleage	462301	0.009	0.016	0	0.063
manager	462065	0.009	0.096	0	1
apprentice	462065	0.013	0.112	0	1
white-collar	462065	0.387	0.487	0	1
white collar age	462065	0.014	0.019	0	0.063
inflation	462307	0.052	0.008	0.039	0.064
lagged inflation	462307	0.056	0.0124	0.04	0.091
unemployment rate	462307	10.40	1.21	8.6	11.6
firm's age: < 1 year	461857	0.033	0.177	0	1
" 1-5 years	461857	0.116	0.32	0	1
" 10-20 years	461857	0.387	0.487	0	1
" > 20 years	461857	0.322	0.467	0	1

(b) Percentiles of the wage-change distribution

1%	5%	10%	25%	50%	75%	90%	95%	99%
-.223	-.067	-.024	.019	.050	.095	.149	.193	.325

Table 2: Number of employees covered by each national contract, by year

Contracts

	1990	1991	1992	1993	1994	1995	Total
Clothing	553	608	600	623	614	611	3,609
Clothing: small and medium firms	240	266	296	331	331	323	1,787
Clothing: crafts	798	825	821	924	940	926	5,234
Food product and beverage	737	909	890	1,049	1,065	1,015	5,665
Insurance	311	304	335	390	380	362	2,082
Footwear	269	250	239	295	315	308	1,676
Pulp, paper, paper products	274	288	332	355	344	334	1,927
Baked clay	230	272	263	293	137	244	1,439
Wholesale and retail trade	3,132	3,725	4,036	4,765	4,845	4,713	25,216
Cooperative Wholesale and retail trade	182	202	212	233	244	239	1,312
Leather	405	349	333	297	273	244	1,901
Construction	1,013	1,158	1,209	1,282	1,175	991	6,828
Construction: small and medium firm	121	136	144	173	143	134	851
Cooperative construction	118	139	126	131	108	92	714
Construction: crafts	326	386	373	452	412	380	2,329
Toys	98	97	113	131	136	157	732
Wood and product of wood	528	561	621	725	707	667	3,809
Wood and product of wood: crafts	283	355	356	400	404	395	2,193
Metal and mechanical engineering	6,007	6,674	6,776	7,291	7,152	7,068	40,968
Public metal and mechanical engineering	734	891	664	798	741	696	4,524
Metal and mechanical engineering: small and medium firms	1,019	1,182	1,313	1,505	1,519	1,572	8,11
Metal and mechanical engineering: plant installation	1,432	1,565	1,724	1,939	1,893	1,91	10,463
Removal of house refuse and street cleaning services	29	41	41	260	254	229	854
Cleaning services	5	17	11	105	102	83	323
Transport	451	550	549	624	672	682	3,528
Business services	286	352	423	480	483	483	2,507
Textiles and textiles products	870	959	1,066	1,089	1,121	1,089	6,194
Tourism; hotels and restaurant	495	641	697	891	881	830	4,435
Total	**20,946**	**23,702**	**24,563**	**27,831**	**27,391**	**26,777**	**151,21**

Notes: subsample of employees who, between t and t+1, are in the same firm (job-stayers), same union's contract and same job-ranking.

Table 3:
Wage Changes And Inflation

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
		Real wage cuts		Real wage increase	Nominal wage increase	Number of	median	median	Median	inflation
year	$\Delta w<0$	$\Delta w=0$	$0<\Delta w<\pi$	$\Delta w>\pi$	$\Delta w>0$	Observations	wage cut	wage increase	Wage change	Rate (π)
1985	0.08	0.04	0.32	0.57	0.89	16742	-0.038	0.076	0.067	0.058
1986	0.05	0.02	0.12	0.82	0.94	22077	-0.043	0.097	0.093	0.047
1987	0.08	0.02	0.22	0.68	0.90	23669	-0.037	0.078	0.071	0.051
1988	0.06	0.02	0.26	0.67	0.92	24652	-0.037	0.090	0.084	0.063
1989	0.06	0.02	0.29	0.63	0.92	20814	-0.038	0.087	0.081	0.065
1990	0.04	0.01	0.17	0.78	0.95	20579	-0.041	0.112	0.107	0.063
1991	0.11	0.03	0.32	0.54	0.86	24595	-0.034	0.069	0.058	0.053
1992	0.15	0.03	0.31	0.51	0.82	23810	-0.034	0.057	0.048	0.046
1993	0.14	0.04	0.32	0.50	0.82	24992	-0.035	0.051	0.041	0.041
1994	0.11	0.03	0.36	0.50	0.86	26103	-0.033	0.061	0.052	0.052
1995	0.15	0.03	0.27	0.54	0.81	26552	-0.033	0.056	0.044	0.040
total	0.09	0.03	0.27	0.61	0.88	254585	-0.037	0.076	0.066	0.053

Notes: Wages changes exceeding the outside the 1st-99th percentile range have been trimmed. Then the sample has been restricted to employees working 312 days a year.

Figure 1
Wage Change Distributions, 1985-1996. All Full-Time Year-Round Workers
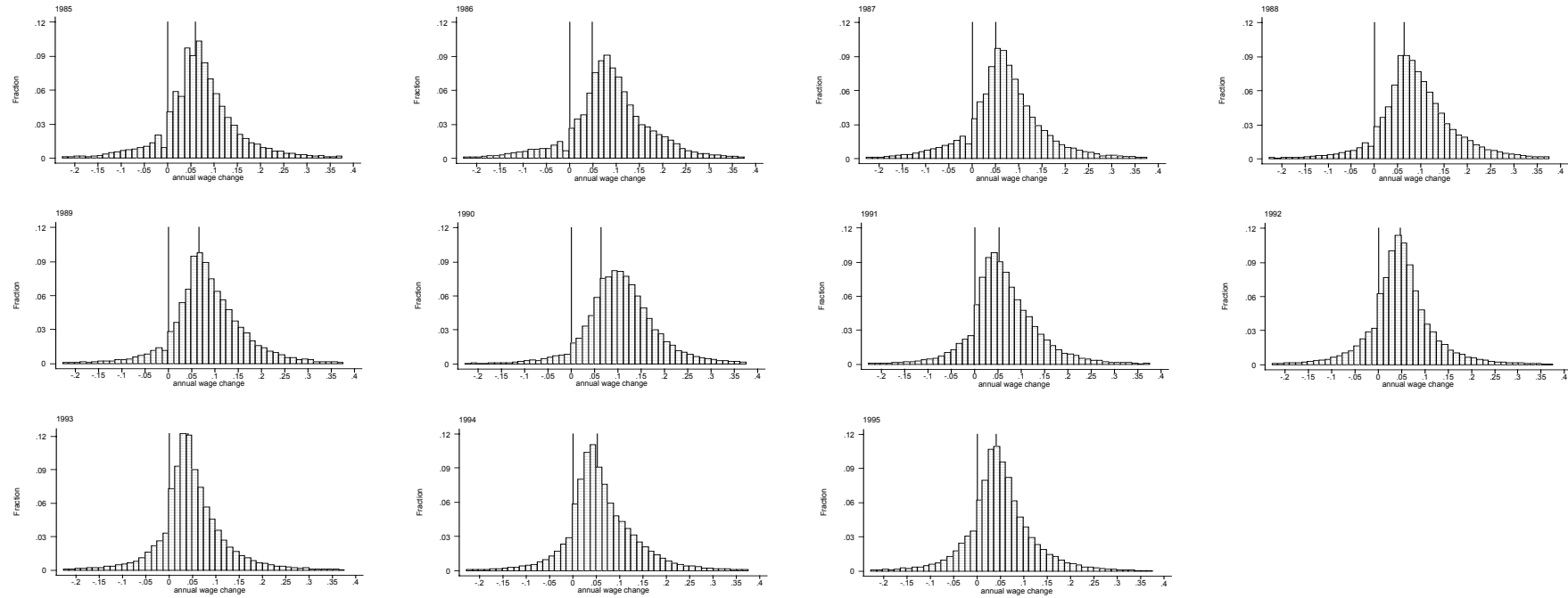
Notes: All workers sample. Two vertical bars are drawn for each distribution: one at zero wage growth, the other at the inflation rate for the year.

Figure 2: Wage raises, by inflation and institutional wage raises

(a)   Wage raises smaller than modal changes   (b)   Wage raises equal to modal changes
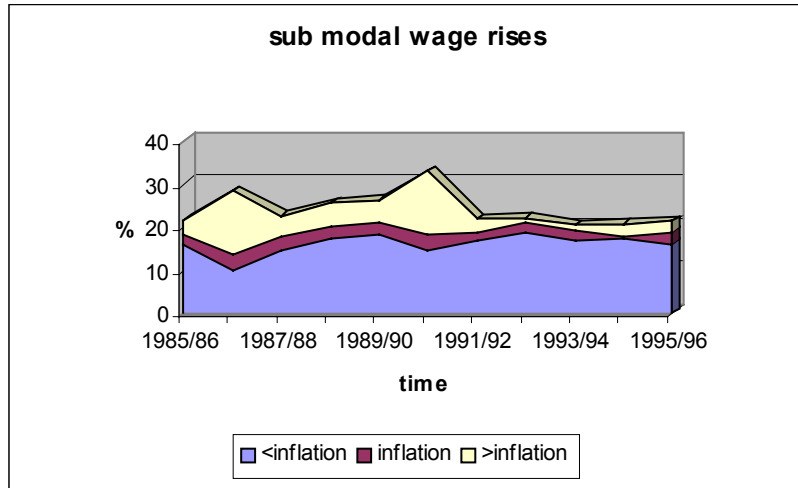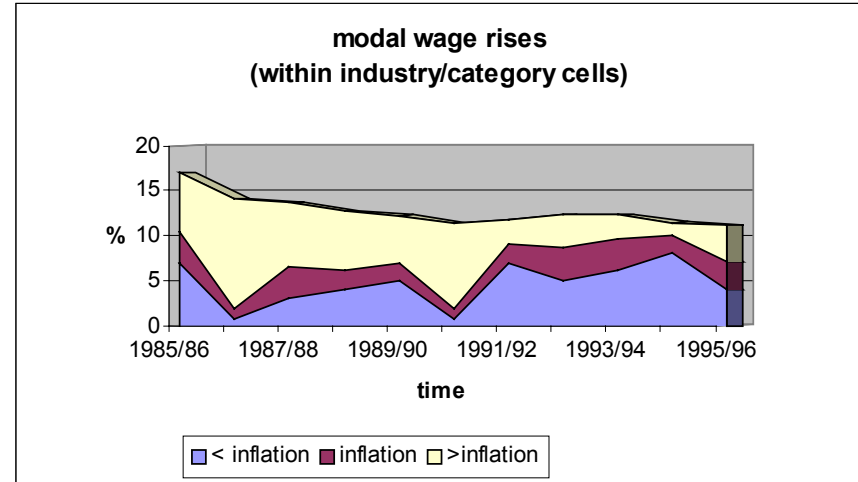
(c)   Wage raises larger than modal changes
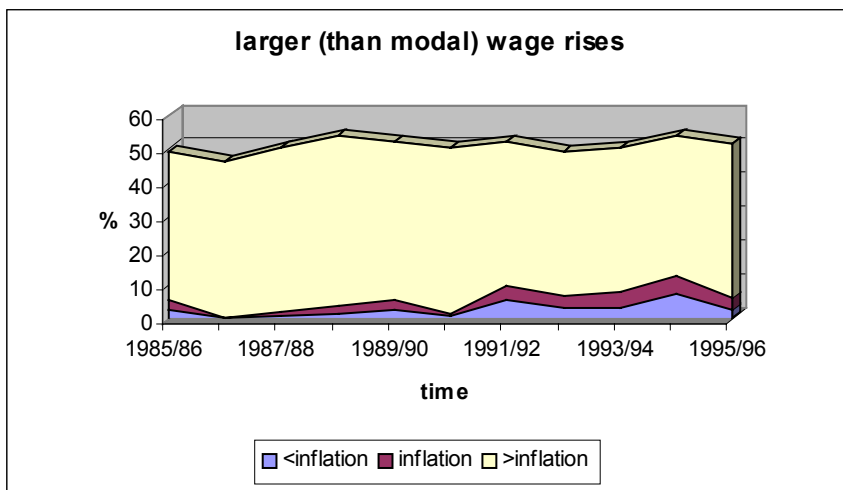
Table 4: Wage drift, by year and occupation

Anno	blue - collar	white - collar	manager	Total
1990	0.23	0.30	0.37	0.25
1991	0.22	0.30	0.35	0.25
1992	0.21	0.28	0.36	0.24
1993	0.21	0.28	0.35	0.23
1994	0.21	0.28	0.37	0.23
1995	0.21	0.28	0.40	0.24
1996	0.19	0.25	0.39	0.21

Note: subsample of employees who, between t and t+1, are in the same firm (job-stayers), same union's contract and same job- ranking (livello di inquadramento).

Table 5: Wage drift across firm dimension

contract	dimension				
	0-19	**20-49**	**50-199**	**200-499**	**>=500**
Food product and beverage	0.17	0.24	0.28	0.30	0.36
Wholesale and retail trade	0.14	0.21	0.24	0.28	0.27
Construction	0.26	0.30	0.34	0.39	0.41
Metal and mechanical enginering	0.22	0.26	0.29	0.31	0.33
Textiles and textiles products	0.22	0.22	0.24	0.25	0.25
Tourism; hotels and restaurant	0.11	0.17	0.22	0.25	0.26

Note: subsample of employees who, between t and t+1, are in the same firm (job-stayers), same union's contract and same job-ranking (livello di inquadramento).

TABLE 6: Contractual wage changes and recorded wage changes, by contract and year

Contracts	Contractual	Recorded	Contractual	Recorded	Contractual	Recorded	Contractual	Recorded	Contractual	Recorded	Contractual	Recorded
	91/90		92/91		93/92		94/93		95/94		96/95	
Food and beverage	0.085	0.11	0.013	0.086	0.066	0.050	0.046	0.057	0.026	0.047	0.027	0.042
Wholesale and retail trade	0.099	0.15	0.073	0.050	0.049	0.06	0.032	0.048	0.046	0.065	0.042	0.055
Construction	0.115	0.114	0.057	0.065	0.012	0.013	0.055	0.037	0.020	0.029	0.038	0.039
Metal and mechanical enginering	0.118	.121	0.051	0.049	0.038	0.049	0.018	0.052	0.044	0.062	0.028	0.049
Textiles	0.083	0.094	0.068	0.064	0.039	0.042	0.042	0.071	0.022	0.044	0.033	0.050
Tourism; hotels and restaurant	0.087	0.085	0.067	0.089	0.029	0.044	0.016	0.034	0.042	0.055	0.041	0.059
Total	0.100	0.11	0.055	0.59	0.041	0.53	0.031	0.509	0.037	0.058	0.034	0.052
Effective inflation	**0.063**		**0.053**		**0.046**		**0.040**		**0.052**		**0.039**	
Programmed inflation	**-**		**-**		**-**		**0.035**		**0.025**		**0.35**	

Note: subsample of employees who, between t and t+1, are in the same firm (job-stayers), same union's contract and same job- ranking (livello di inquadramento).

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Table 7
Wage Change Regression. OLS Estimates.

Rigidity type	None (simple OLS)		None (simple OLS)		None (simple OLS)	
Measurement error	No		No		No	
Sample	all workers		stable workers		all stabel men	
dip. Var. :		robust		robust		robust
ln(wage change)	Coeff.	s.e.	Coeff.	s.e.	Coeff.	s.e.
ln(firm size)	0.002	0.000	0.000	0.000	0.001	0.000
ln(firm size) squared	0.000	0.000	0.000	0.000	0.000	0.000
worker's age	-1.347	0.089	-1.460	0.116	-1.466	0.133
age squared	0.013	0.001	0.013	0.001	0.013	0.002
growing firm	0.005	0.001	0.006	0.001	0.006	0.001
shrinking firm	-0.004	0.001	-0.003	0.001	-0.003	0.001
sector1	0.016	0.002	0.012	0.001	0.011	0.001
sector2	0.005	0.001	0.005	0.001	0.004	0.001
sector3	0.003	0.000	0.003	0.001	0.003	0.001
sector5	0.004	0.000	0.000	0.000	-0.001	0.001
sector6	0.007	0.001	0.002	0.002	0.001	0.002
sector7	0.008	0.001	0.005	0.001	0.003	0.001
north East	0.002	0.000	0.000	0.000	0.000	0.000
centrer	-0.002	0.000	-0.001	0.001	-0.002	0.001
south	-0.004	0.001	-0.004	0.001	-0.005	0.001
female	-0.016	0.001	-0.019	0.001		
femaleage	0.265	0.026	0.338	0.032		
manager	0.025	0.001	0.024	0.001	0.024	0.001
apprentice	0.076	0.001	0.079	0.002	0.071	0.003
white-collar	0.031	0.001	0.026	0.001	0.026	0.001
white collar age	-0.463	0.028	-0.396	0.029	-0.404	0.035
inflation	0.730	0.080	0.519	0.089	0.564	0.106
lagged inflation	-0.089	0.065	-0.172	0.042	-0.162	0.049
unemployment rate						
level	-0.037	0.011	-0.042	0.016	-0.037	0.020
first difference	-0.011	0.000	-0.013	0.001	-0.013	0.001
lagged first differ.	0.003	0.001	0.004	0.002	0.005	0.002
firm's age						
< 1 year	0.003	0.001	0.004	0.001	0.004	0.001
1-5 years	0.001	0.001	0.001	0.001	0.001	0.001
10-20 years	-0.001	0.000	0.000	0.001	0.001	0.001
> 20 years	-0.001	0.001	-0.001	0.001	-0.001	0.001
trend	-0.002	0.000	-0.003	0.000	-0.003	0.000
constant	0.108	0.014	0.148	0.019	0.141	0.024
σ_ε	0.076		0.070		0.072	
Number of observations	461247		253882		186615	
Number of clusters	64327		41663		29455	
Log-Likelihood						
R-squared	0.074		0.090		0.087	

Notes: Asymptotic standard errors are robust to the presence of repeated observations within firms and on the same employee. sector1: "energy, gas, water"; sector2: "mining and chemical industries"; sector3: "metal products"; sector4 (omitted category): "grocery and textile"; sector5 "commerce"; sector6 "transports and communications"; sector7: "banking and insurance"

Table 8: ML benchmark estimates

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
year	No. of observations	Mean observed wage change	Standard deviation notional (s_e)	Mean notional $(X'\hat{a})$	Mean real threshold (r)	Standard deviation real threshold (s_r)	% exactly measured $(1-m)^2$	Standard deviation meas. Error (s_m)	Probability real rigidity (p_r)	% obs affected by real threshold	% wage sweeps attributed to the real threshold	Probability nominal rigidity (p_n)	% obs affected by nominal threshold	% wage sweeps attributed to the nominal threshold
85/86	35650	0.07	0.073	0.034	0.055	0.026	0.958	0.283	0.64	0.37	0.032	0.108	0.039	0.003
86/87	44403	0.086	0.091	0.045	0.07	0.03	0.975	0.321	0.66	0.384	0.04	0.071	0.025	0.002
87/88	44167	0.069	0.07	0.034	0.055	0.026	0.966	0.277	0.6	0.347	0.031	0.086	0.031	0.002
88/89	43057	0.098	0.093	0.047	0.063	0.063	0.977	0.48	0.735	0.406	0.041	0.065	0.022	0.002
89/90	40066	0.084	0.091	0.054	0.059	0.028	0.976	0.552	0.679	0.353	0.03	0.07	0.021	0.001
90/91	39610	0.103	0.109	0.046	0.083	0.044	0.985	0.514	0.838	0.514	0.06	0.036	0.013	0.001
91/92	43229	0.062	0.067	0.046	0.037	0.02	0.956	0.249	0.496	0.225	0.014	0.127	0.035	0.002
92/93	42951	0.046	0.051	0.024	0.039	0.02	0.96	0.253	0.502	0.29	0.02	0.106	0.040	.002
93/94	47737	0.045	0.046	0.029	0.031	0.015	0.949	0.222	0.48	0.243	0.014	0.14	0.047	0.002
94/95	46497	0.059	0.061	0.042	0.032	0.016	0.961	0.241	0.512	0.232	0.014	0.122	0.037	0.002
95/96	44351	0.048	0.046	0.031	0.035	0.018	0.958	0.238	0.435	0.225	0.014	0.113	0.037	0.002
Average 1985-96	42883	0.070	0.073	0.039	0.051	0.028	0.966	0.330	0.598	0.326	0.028	0.095	0.032	0.002
Average 1990-96	44229	0.067	0.071	0.040	0.047	0.024	0.965	0.339	0.585	0.310	0.025	0.100	0.032	0.002

Notes: *estimation on sample of employees who, between t and t+1, are in the same firm (job-stayers), with no external information*

Table 9: ML estimates with external info

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
year	No, of observations	Mean observed wage change	Standard deviation notional (s_e)	Mean notional ($X'\hat{a}$)	Mean real threshold (r)	Standard deviation real threshold (s_r)	% exactly measured $(1-m)^2$	Standard deviation meas, Error (s_m)	Probability real rigidity (p_r)	% obs affected by real threshold	% wage sweeps attributed to the real threshold	Probability nominal rigidity (p_n)	% obs affected by nominal threshold	% wage sweeps attributed to the nominal threshold
85/86	35650	0.07	0.073	0.053	0.06	0.021	0.93	0.229	0.497	0.264	0.017	0.186	0.043	0.002
86/87	44403	0.086	0.043	0.043	0.09	0.046	0.82	0.157	0.824	0.603	0.048	0.176	0.028	0.001
87/88	44167	0.069	0.088	0.041	0.063	0.025	0.94	0.237	0.547	0.324	0.027	0.107	0.034	0.002
88/89	43057	0.098	0.096	0.056	0.078	0.031	0.96	0.417	0.659	0.383	0.036	0.087	0.025	0.001
89/90	40066	0.084	0.082	0.074	0.074	0.022	0.96	0.483	0.459	0.229	0.017	0.125	0.023	0.001
90/91	39610	0.103	0.076	0.085	0.105	0.029	0.96	0.357	0.505	0.295	0.024	0.12	0.016	0.001
91/92	43229	0.062	0.069	0.052	0.051	0.019	0.947	0.223	0.427	0.208	0.013	0.156	0.035	0.001
92/93	42951	0.046	0.062	0.04	0.044	0.014	0.939	0.215	0.332	0.174	0.009	0.155	0.041	0.002
93/94	47737	0.045	0.071	0.024	0.038	0.019	0.949	0.222	0.505	0.291	0.019	0.137	0.051	0.002
94/95	46497	0.059	0.072	0.042	0.047	0.021	0.946	0.212	0.529	0.274	0.019	0.133	0.037	0.002
95/96	44351	0.048	0.079	0.018	0.042	0.023	0.966	0.255	0.553	0.34	0.027	0.093	0.039	0.002
Average 1985-96	42883	0.07	0.074	0.048	0.063	0.025	0.938	0.273	0.531	0.308	0.023	0.134	0.034	0.002
Average 1990-96	44229	0.060	0.072	0.042	0.055	0.021	0.952	0.252	0.485	0.275	0.020	0.128	0.037	0.002

Notes: *estimation on sample of employees who, between t and t+1, are in the same firm (job-stayers),.The real rigidity thresholds is identified by modal wage change by industry/category cells*

Table 10: ML Estimates with contract data

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
year	No, of observations	Mean observed wage change	Standard deviation notional (s_e)	Mean notional $(X'\hat{a})$	Mean real threshold (r)	Standard deviation real threshold (s_r)	% exactly measured $(1-m)^2$	Standard deviation meas, Error (s_m)	Probability real rigidity (p_r)	% obs affected by real threshold	% wage sweeps attributed to the real threshold	Probability nominal rigidity (p_n)	% obs affected by nominal threshold	% wage sweeps attributed to the nominal threshold
90/91	20623	0.107	0.089	0.08	0.076	0.045	0.939	0.255	0.883	0.429	0.035	0.055	0.01	0.0005
91/92	23350	0.054	0.062	0.053	0.044	0.019	0.925	0.198	0.407	0.210	0.012	0.172	0.044	0.0017
92/93	24204	0.047	0.079	0.019	0.034	0.023	0.958	0.245	0.624	0.355	0.026	0.096	0.039	0.002
93/94	27498	0.045	0.062	0.031	0.026	0.016	0.922	0.197	0.5	0.235	0.012	0.167	0.051	0.002
94/95	27052	0.052	0.075	0.03	0.03	0.016	0.95	0.243	0.58	0.291	0.018	0.114	0.039	0.002
95/96	26399	0.047	0.067	0.03	0.029	0.016	0.94	0.215	0.504	0.246	0.014	0.12	0.038	0.002
Average 1990-96	25155	0.059	0.072	0.041	0.040	0.023	0.939	0.226	0.583	0.294	0.020	0.121	0.037	0.002

Notes: estimation on a subsample of employees who, between t and t+1, are in the same firm (job-stayers), same union's contract and same job-ranking (*livello di inquadramento*), 3(a): The real-threshold r is obtained from the union's contractual data as: $(w^c(t+1) - w^c(t)) / w(t)$, where $w^c(t)$ is the contractual wage of the employee in year t,

APPENDIX C: Wage Setting Practices in Italy

Italy's wage setting process has been and still is dominated by industry wide national unions' wage contracts. These are formally binding only for the firms belonging to the employers' associations who have signed them. However, both the courts (in case of worker-firm disputes) and the law (which subordinates some firms' benefits to the use of those contracts and computes employers' social security contributions as a % to be applied to the maximum between actual earnings and those fixed by national contracts) somehow extend their actual coverage. Therefore the non-covered sector may be identified with the "hidden" economy, estimated to be around the 15% of total employment in 1998 by ISTAT (the national statistical office).[23]

Firms' level bargaining is quite widespread in at least the largest firms, which are however a minority in Italy's landscape. The contracts there signed top up national wages and, particularly in the periods of stronger unions' power (since the mid '60s to the beginning of the '80s), "anticipated" the issues subsequently generalised through industry wide contracts. Wage rises dictated at the firm level through unions' bargaining are quite egalitarian (within the firm itself).

An opposite nature have the autonomous firms' wage policies. Both these and individual worker-firm bargaining had been quite compressed during the period of stronger unions' power. However, since the mid '80s these components have acquired some role. Presently, these components represent between 5 and 10% of average earnings, another 10% being dictated by firms' level contracts.

The Italian pyramidal wage bargaining (whereby wage contracts can be bargained at the national, industry and firm level, with agreements struck at a higher level immediately becoming lower bounds for bargaining at lower levels) limits the scope for downward wage flexibility at the firm level. This has to be borne in mind when, say, comparing the Italian experience with that of the US, where instead bargaining is mainly conducted at the firm level. Employment protection is stronger too, particularly for large firms, which suggests that firms in Italy will have to find alternative ways to circumvent the labour market inflexibility (both in terms of wages and quantities), for example through cautious intertemporal smoothing of wage and employment changes, or through the strategic use of more flexible components of wages such as benefits and overtime.

As far as nominal adjustment to price inflation is concerned, important changes have taken place during the '90s. Up to 1992 nominal wages were indexed to prices through an automatic mechanism known as *scala mobile* whose rules were uniform across sectors. Actually, given the relevance of such an automatic mechanism, the above mentioned predominance of industry wide bargaining may be questioned. From the end of WWII to 1975 price inflation triggered each quarter wage rises differentiated across sectors and job categories[24]. The adjustment was asymmetric, as it operated only in case of price rises, and was meant to safeguard a given minimum threshold real wage (differentiated across sectors and job categories)[25]. Over time, as real wages were rising

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[23] To a large extent, and particularly in the less developed and high unemployment *Mezzogiorno*, the hidden economy features pertain not only to the avoidance of the tax and social security contributions burden but also to the use of sub-standard wages and working relations rules.

[24] Up to the end of the '60s the wage rises were also differentiated across regions as the national contracts themselves, while agreed upon at the national level, provided for wage categories differentiated across regions (the so called gabbie salariali).

[25] On average the actual safeguard against price rises (defined as the % increase in nominal wages triggered by a .01% price rise) was around 50% in mid '70s.

the actual safeguard granted by the mechanism declined and upward adjustments of the threshold wage levels were agreed upon several times at national level. In 1975 one of these periodical re-adjustments took place. On top of incorporating the large real wage rises contracted for during the previous years, the agreement profoundly changed the general rules: the quarterly wage rises were made uniform across sectors and job categories lifting up the fixed amount wage rises granted to the lowest paid sectors and job categories. This increased the average degree of safeguard against price inflation (which peaked at around 100% in 1978-1979) and imparted a strong egalitarian bias to the overall mechanism (low paid workers were automatically gaining ground in case of price inflation).

The scala mobile quite soon came under attack for its inflationary bias. The high degree of safeguard provided for was a source of real wage resistance against terms of trade shocks (particularly the oil prices' hikes experienced in 1974 and 1979) and indirect taxes rises. The quarterly timing speeded up the inflationary spiral. The egalitarian bias was affecting wage differentials and restricting the role for autonomous firms' and unions' decisions as the scala mobile automatisms were responsible for most of the wage dynamics.

In 1986 – the first year available in the sample used below for the empirical analysis is 1985 – the mechanism was partially reformed. Its timing became half-yearly. Both the average safeguard granted for and the egalitarian bias were reduced: a 100% safeguard was granted to a minimum uniform wage threshold, with a 25% safeguard granted to the difference between the nationally contracted for wage (differentiated across industries and broad job categories) and that common minimum threshold.[26] On average the safeguard against price rises declined to around 60%.

In 1992 the scala mobile was finally dismantled. The formal agreements signed up in July 1992 and July 1993 depicted a new bargaining system[27], in which national contracts, to be agreed upon every two years (against the 3 years of the previous set up[28]), are supposed to be guided by the price inflation expected (and targeted by the Government) for the future, while firms' level bargaining is supposed to be geared by profit sharing considerations. Past inflation triggers automatic wage rises only in case no agreement is reached, and the safeguard granted is at most 50%. The difference between actual and targeted inflation is not automatically recovered: it has to be taken into account when a new bargaining deal starts[29].

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[26] No automatic safeguard was granted for the topping up of wages bargained for at the firm or at the individual level.

[27] The 23rd of July 1993 protocol modified the bargaining recognizing two contracting levels: one nationwide and per sector, the second in-firm or local according to existing practice within the various production sectors; nationwide, in-firm or local contracts were to have four-year durations and the bargaining apparati were to address the issue of nationwide retribution every two years to safeguard the purchasing power of wages/salaries in consideration of the effective inflation rate for the preceding two-year period, whenever programmed inflation figures proved faulty.

[28] In the current set up national contracts deal with more regulatory aspects every 4 years.

[29] In such a case, however, unions and employers' associations have also to consider the reasons for such a discrepancy, in particular taking into account whether it was caused by terms of trade shocks against which employees are not anymore automatically insured.