Wage Differentials and Temporary Jobs in Italy*

Matteo Picchio†

4th September 2006

Abstract

The focus of this paper is to analyse the wage effects of temporary jobs using the 2000 and 2002 waves of the Survey of Italian Households' Income and Wealth. Exploiting the short longitudinal dimension of the survey and taking into account of individual- and job-specific unobservable components result in an estimated wage penalty for temporary workers of about 12–13%. Furthermore, there is evidence of higher wage returns to seniority for temporary workers, generating a reduction in the wage gap by about 2.3 percentage points after one year of tenure.

Keywords: Temporary employment, wage differentials, returns to seniority, individual effects, firm effects.

JEL classification numbers: C23, J31, M51.

*This project has been financed by the Marche Polytechnic University fellowship and the 'Politique Scientifique Fédérale' (SPF) fellowship . We are also grateful for the financial support from the Belgian French Community's program 'Action de Recherchers Concertée' 03/08-302. The research project has especially benefited from the support of and the discussions with Bart Cockx. We wish to thank Muriel Dejemeppe, Riccardo Lucchetti, Stefano Staffolani, and the participants to the Doctoral Workshop in Economics, January 26-27, 2006, Louvain-La-Neuve (Belgium) and to the Cost Conference A23, May 25-26, 2006, London for their comments. All remaining errors are mine.

†Department of Economics, Marche Polytechnic University, Piazzale Martelli, 8, 60121 Ancona, Italy. E-mail: m.picchio@univpm.it. IRES and Department of Economics, Université Catholique de Louvain, Place Montesquieu, 3, B-1348 Louvain-La-Neuve, Belgium.

1 Introduction

Temporary employment in Europe has been extensively debated both by researchers and policy makers. Temporary contracts have been often introduced by policy makers as an instrument for labour market flexibility and to react to the high level of European unemployment. As a matter of fact, in recent years the share of employees with temporary contracts has risen in almost all European countries, in particular in those showing relatively high levels of employment protection.

Traditionally, the Italian standard work arrangement has been full-time, salaried, permanent, and characterized by high degree of employment protection, mostly against dismissals. In the last decade, pursuing higher level of flexibility, atypical employment forms have been growing in importance thanks to some labour market reforms that, in particular, have extended and generalized the main discipline of temporary jobs.

Although temporary contracts may provide an instrument to increase labour market flexibility and a "stepping-stone" into longer employment relationships (Booth et al., 2002), they often imply important and combined disadvantages. Firstly, temporary workers are subject to higher turnover and probability of unemployment (Dolado et al., 2002; Farber, 1999) since fixed-term contracts expire automatically at the end of the agreed period. Secondly, they seem to receive lower wages than permanent employees with the same qualifications and jobs. Recent research from Britain, France, Spain, and Germany (Blanchard and Landier, 2001; Booth et al., 2002; Brown and Sessions, 2003; Jimeno and Toharia, 1993; Hagen, 2002) has examined wages and conditions attached to fixed-term employment. In general, it has been found out that temporary workers earn significantly less than comparable permanent employees.

The purpose of this paper is the analysis of the wage effects of temporary jobs in Italy using the 2000 and 2002 waves of the Survey of Italian Households' Income and Wealth (SHIW), a representative survey conducted by the Bank of Italy every 2 years. In particular, we wish to understand whether the effects of temporary jobs are higher or lower wages and whether temporary workers receive higher wage returns to seniority than comparable permanent workers' ones.

We therefore try to provide some empirical evidence about wage differentials between temporary and permanent workers for the Italian case, since so far this subject has not been investigated. Moreover, the second contribution to this line of research is to evaluate the potential importance of job seniority in determining the magnitude of the wage gap: indeed, it could be heterogeneous and dependent on job seniority. The idea is that wage

penalties for temporary workers might be decreasing with job seniority, both because temporary workers participate in a full way to the firm life when job seniority is high and because asymmetrical information tends to disappear and the employer is able to remunerate the true workers' productivity.

Hence, we estimate a wage equation that is standard in most respects, but augmented by a dummy variable for the contract type (temporary or permanent) and its interactions with seniority and quadratic seniority.

The starting point is the estimation of the wage model via pooled ordinary least squares (POLS) and random effects (RE). The POLS and RE estimates reveal that temporary jobs generate negative effects on wages: workers having a temporary contract earn significantly less than the permanent counterpart. Furthermore, there is no evidence of particular wage returns to seniority for temporary workers.

Since it is plausible the presence of unobservables affecting both seniority and selection into the contract type, we estimate the impact of temporary contracts on wages by fixed effects (FE). Also the FE estimation results reveal a wage penalty for temporary workers and no evidence of higher or lower wage premiums to seniority for this kind of workers.

Finally, we allow for correlation with job-specific components by performing the FE estimator on the sample of workers who do not change jobs between the two observation moments (2000 and 2002). Finally, we follow a suggestion by Abowd et al. (1999) to increase the precision of this estimator by a control function approach on the complete sample.

The estimation results reveal a wage penalty for temporary workers of 12%, larger in modulus than the one obtained using POLS, RE, and FE estimators. Moreover, after controlling for individual- and job-specific effects, an higher wage return to seniority for temporary workers is detected: thus, the wage gap is reduced by about 2.3 percentage points after one year of seniority.

The paper is organized as follows. Section 2 presents the Italian institutional labour market setting, displaying the recent changes and introducing the main characteristics of temporary contracts regulations. In section 3 we summarize what the theory tells us about wage differentials between temporary and permanent workers. In section 4 we discuss the specification of the wage equation and clarify our estimation procedures. Section 5 describes the data and reports basic descriptive statistics about the selection into temporary contracts and the wage differentials between temporary and permanent workers. Section 6 displays the estimation results and contains a discussion about the main findings. Finally, section 7 reports concluding remarks.

2 The institutional setting

Traditionally, the Italian standard work arrangement has been full-time, dependent, permanent, and characterized by high degree of employment protection, mostly against dismissals. This strict regulation has been relaxed since the mid nineties. Indeed, in recent years, pursuing higher level of flexibility, atypical employment forms have been growing in importance. The major step has been the "Treu package" (Law No. 196/1997), which introduced and regulated new sorts of contracts, mainly temporary work agency employment, followed by Legislative Decree No. 368/2001 which has implemented European Council Directive No. 1999/70/EC of June 1999 on fixed-term employment.[1]

More in details, Law No. 196/1997 has legally legitimized temporary work agencies, prohibited before, and has given rise to the expansion of new temporary contract forms, including seasonal, youth work-training, and apprenticeship contracts.

Legislative Decree No. 368/2001 cancelled Law No. 230/ 1962,[2] which was previously the main discipline regulating fixed-term contracts, and has relaxed the circumstances prohibiting them; fixed-term employment has thus been extended and generalized. Indeed, before the 2001 reform fixed-term contracts were allowed only in well-defined situations such as for seasonal jobs, for replacing temporarily absent employees, and predetermined, occasional, and extraordinary services. Thus, job relationship deadlines were uniquely valid for reasons specifically indicated either by law or by collective agreements. After Legislative Decree No. 368/2001, fixed-term contracts can be stipulated whenever there are technical, productive, organizational, or substitution reasons.[3] Therefore, the employers' degrees of freedom have increased and temporary contracts can be stipulated in much more flexible circumstances. This is the main modification of fixed-term contracts regulation, while duration, wage conditions, and other formal requirements have not been touched.

As a matter of fact, the legislation is still generic about the duration of fixed-term contracts which are not bound by a maximum duration. As

[1] We do not mention in this paper the "Biagi law" (Law No. 30/2003), which is the most recent modification of temporary employment regulations, because our empirical analysis focuses on 2000 and 2002 waves.

[2] Legislative Decree No. 368/2001 cancelled also art. 8-bis of Law No. 79/1983 and art. 23 of Law No. 56/1987.

[3] However, they are not allowed to replace workers on strike, to replace workers who have been collectively dismissed during the previous year, to substitute workers whose contracts have been temporarily suspended.

regard renewals, fixed-term contracts can be renewed only once and only if the total maximum duration of the temporary job relationship is shorter than 3 years. But, if there is a while of at least 10 ten days (20 days for fixed-term contracts longer than 6 months) between the two temporary contracts, the same employee can be hired again with a fixed-term contract by the same employer. According to art. 6 of Legislative Decree No. 368/2001 fixed-term workers are entitled to the same legal and remunerative conditions as the comparable workers recruited for an indefinite duration. This principle is generic and, for instance, permanent workers could receive higher wages compensating their full participation to the firm's activity (Montanari, 2003).

Summarizing, the legal changes since the mid nineties and up to 2002 have generated the following institutional setting for temporary employment:

- Temporary contracts can be stipulated for technical, productive, organizational, or substitution reasons.
- In principle, temporary contracts are not constrained by a maximum duration; they can be renewed only once and only if the total maximum duration of the temporary job relationship is shorter than three years.
- Temporary workers are entitled to the same legal conditions as those recruited for an indefinite duration. They should also receive training that is adequate for the tasks to be undertaken.

3 Conceptual framework

There are some theoretical reasons for which we should observe a wage differential between temporary and permanent workers. According to the theory of compensating differentials, formalized by Rosen (1974), workers with the same level of competence should receive different wages if their working conditions are different. Since temporary contracts often imply important and combined disadvantages,[4] we should detect a wage premium for temporary workers to offset differences in the value of working conditions.

However, the theory of compensating differentials has not been of great value in explaining wage variation and, until now, only wage penalties have been found for temporary jobs. In recent years, several empirical studies for different European countries have been conducted on this topic. But so far,

[4]For instance, the following disadvantages have been observed: higher turnover and probability of unemployment (Dolado et al., 2002; Farber, 1999), physical constraints, repetitive and monotonous work, noise, and less opportunity to acquire new skills (Letourneux, 1998). Guadalupe (2003) finds a difference of 5 percentage points in accident probabilities.

there does not exist any empirical study investigating wage effects of temporary contracts in Italy. In Spain negative earnings differentials for temporary workers between 8.5% and 10.8% are detected by Jimeno and Toharia (1993); Blanchard and Landier (2001) find a wage penalty for temporary workers of about 20% for France; Booth et al. (2002) estimate a British negative wage gap between 6% and 10%, while Brown and Session's (2003) finding is around 12%; finally, Hagen (2002) detects a large wage penalty for German temporary workers of about 23.4% performing the Heckman's (1978) dummy endogenous variable model estimation and lower and statistically not significant wage penalties (between 5% and 10%) using several matching estimators. Table 1 collects the estimation results (and the corresponding estimators) of the wage differential between temporary and permanent workers in some European countries and United States.

Table 1: Wage differentials between temporary and permanent workers: some empirical results.

Author	Country	Estimator	Wage differential %		
			Total	Male	Female
Jimeno & Toharia (93)	Spain	OLS	-9/-11		
Segal & Sullivan (98)	USA	FE	-15/-20		
Blanchard & Landier (01)	France	POLS	-20.0		
Brown & Session (03)	Britain	DEVM/IV	-12.0		
Booth *et al.* (02a)	Britain	POLS		-15.7	-13.4
Booth *et al.* (02a)	Britain	FE		-6.7	-10.3
Hagen (02)	W. Germany	DEVM	-23.4		
Hagen (02)	W. Germany	Matching	-5/-10†		

Notes: †Statistically non significant at the 10% level.
OLS=Ordinary Least Squares; POLS=Pooled Ordinary Squares; FE=Fixed Effects; IV=Instrumental Variables; DEVM=Heckman's (1978) Dummy Endogenous Variable Model.

As a matter of fact, there are a number of reasons for negative effects on temporary workers' wage. In the dual labour market framework characterized by perfect substitution between temporary and permanent workers, difficulties in monitoring the workers, and uncertainty about product demand, Rebitzer and Taylor (1991) show that the optimal strategy for the firm may consist in hiring both permanent and temporary employees, with a lower wage for fixed-term workers. Temporary workers are indeed used by employers to regulate short-term fluctuations in product demand and the equilibrium is characterized by an excess supply of workers to permanent jobs and by a negative wage differential for temporary workers.

In the insider-outsider wage bargaining framework, Bentolila and Dolado (1994) suggest that if unions are dominated by permanent workers (the in-

siders) then the presence of fixed-term workers (the outsiders) increases the permanent workers' bargaining power. Therefore, the unions can ask for higher wages, without affecting the survival probability of permanent workers because temporary workers are the first ones to be laid off.

The specific human capital theory may provide another explanation for wage gaps that does not reflect compensating differentials. Indeed, both temporary workers and corresponding firms have lower incentives to invest in firm-specific human capital since the job match could expire in a short period. Thus, the underinvestment in specific-human capital might give rise to lower wages for temporary workers and damage their wage profiles.

Temporary jobs can also be interpreted as a screening tool used by firm to extend the legally limited probationary period. If a temporary worker performs well, the contract is renewed and converted into permanent duration. In the shirking wage efficiency framework Güell (2000) derives a wage penalty for temporary worker because there is no need to use temporary workers' wages as incentive device in reducing shirking. Indeed, firms are able to reduce temporary workers' shirking by relating the renewal of the contract and its conversion into permanent duration to the worker's performance.

Furthermore, probationary periods may give rise to a self-selective process. Indeed, as pointed out by Loh (1994), the employer posts some temporary vacancies with lower wages, promising higher wages afterwards if the worker gets the renewal of the contract. The higher the worker's ability, the higher the chances of fulfilling the productivity requirements, getting the renewal of the contract. Thus, according to the Loh's (1994) model, we should observe a positive correlation between the choice of a temporary contract and the worker's ability, a steeper wage path within the same firm for the workers who had temporary contracts and wage penalties during the probationary stage.

4 Model specification and estimation issues

In this section we introduce the wage equation we are going to estimate. The most general specification of the wage equation can be written as:

$$\ln w_{it} = \mathbf{z}'_{it}\boldsymbol{\beta} + \mathbf{x}'_{it}\boldsymbol{\delta} + c_i + \phi_{j(i)} + u_{it}, \tag{1}$$

where $\ln w_{it}$ is the real (2002 prices) net hourly wage for individual i at time t and $\mathbf{z}_{it}$ is a 5-dimensional vector collecting our variables of primary inter-

est. It contains the dummy variable for contract type, TC_{it},[5] job-seniority (computed as age minus age at which the worker has begun the current job), its square, the interaction between seniority and contract type, and its quadratic term. The K-vector $\mathbf{x}_{it}$ includes a set of further explanatory variables (including the constant and the time dummy) indicating the workers' geographical area of residence (4 dummies), gender, education (4 dummies), household position, marital status, the sector and firm size (8 and 6 dummies, respectively), 2 occupational dummies (white collar and manager, while blue collar is the reference), part-time, potential work experience (computed as age minus age at the beginning of the first job), and its quadratic term. The error term in equation (1) has been decomposed into a time-invariant individual-specific component, c_i, a job-specific component, $\phi_{j(i)}$, which is time-invariant for stayers (employees who did not change job between 2000 and 2002) and time-variant for movers,[6] and an idiosyncratic error term, u_{it}.

4.1 Estimating the wage model by pooled ordinary least squares and random effects

Now we introduce the assumptions under which the POLS and the RE estimators can be used to consistently estimate the parameter vectors in model (1). Rewrite the model as

$$\ln w_{it} = \mathbf{z}'_{it}\boldsymbol{\beta} + \mathbf{x}'_{it}\boldsymbol{\delta} + v_{it}, \tag{2}$$

where $v_{it} \equiv c_i + \phi_{j(i)} + u_{it}$ is the composite residual, given by the sum of the individual-specific effects, the job-specific effects, and the idiosyncratic error.

It is well known that a necessary condition for the consistency of the POLS and RE estimators is zero correlation between the regressors and the composite error term, v_{it}. Therefore, the following assumptions are necessary (and sufficient for the POLS estimator) for each $i = 1, \ldots, N$ and $t = 1, \ldots, T$:

$$E(\mathbf{z}'_{it}c_i) = \mathbf{0} \qquad E(\mathbf{x}'_{it}c_i) = \mathbf{0} \tag{3}$$

$$E(\mathbf{z}'_{it}\phi_{j(i)}) = \mathbf{0} \qquad E(\mathbf{x}'_{it}\phi_{j(i)}) = \mathbf{0} \tag{4}$$

$$E(\mathbf{z}'_{it}u_{it}) = \mathbf{0} \qquad E(\mathbf{x}'_{it}u_{it}) = \mathbf{0}. \tag{5}$$

[5] The dummy variable TC_{it} is equal to 1 when the employee is a temporary worker. See appendix A-2 for details about the definition and the construction of variables used in the econometric analysis.

[6] The subscript $j(i)$ refers to the specific job match between the vacancy j and the individual i. Since the time variation of the job match is given by a change in the subscript j (for instance from $j(i)$ to $h(i)$), the temporal subscript t has been omitted.

If we have correctly modelled $E(\ln w_{it}|\mathbf{z}_{it}, \mathbf{x}_{it}, c_i, \phi_{j(i)})$, assumption (5) holds. The problematic assumptions are assumptions (3) and (4), stating that there should not be any correlation between individual and job unobservables and individual and job characteristics collected into $\mathbf{z}_{it}$ and $\mathbf{x}_{it}$. These assumptions are clearly likely to fail in our framework and POLS and RE estimators are indefensible.

4.2 Within-individual estimation of the wage model

Assume now that there is no correlation between the job-specific effects, $\phi_{j(i)}$, and the explanatory variables, $[\mathbf{z}'_{it}, \mathbf{x}'_{it}]'$. Then, the general specification of the wage equation (1) can be rewritten as

$$\ln w_{it} = \mathbf{z}'_{it}\boldsymbol{\beta} + \mathbf{x}'_{it}\boldsymbol{\delta} + c_i + \eta_{it}, \tag{6}$$

where $\eta_{it} \equiv \phi_{j(i)} + u_{it}$, and it is straightforward to show the consistency of the within-individual (FE) estimator. Indeed, if there is no correlation between the job-specific effects and the wage regressors, the composite error term η_{it} is uncorrelated to the explanatory variables conditional on the individual-specific effect, c_i; then, least squares estimation of model (6) generates unbiased results.

Therefore, the FE estimator allows us to estimate the wage equation taking into account of the possible correlation between individual heterogeneity and the explanatory variables. Nevertheless, a number of wage regressors – including contract type and job tenure – are likely to be correlated with unobservable job-specific characteristics. Thus, the assumption of zero correlation between regressors and job-specific effects, which is necessary for the consistency of the FE estimator, could fail and the estimation results from the within-individual approach loose in credibility.[7]

4.3 Tackling the correlation between the job-specific component and the wage regressors

In this subsection we relax assumptions (3) and (4), so that individual- and job-specific effects are allowed to be arbitrary correlated to the wage regressors, and we show how to obtain consistent estimators of the parameter vector $[\boldsymbol{\beta}', \boldsymbol{\delta}']'$. The methodology we propose in subsections 4.3.1 and 4.3.2

[7] If we interpret the job-specific effects, for instance, as the quality of the job match between firm and employee, then the higher the quality of the job match, the higher the probability of observing a high job tenure, generating correlation between the composite error term, η_{it}, and $\mathbf{z}_{it}$.

are inspired by Light and McGarry (1998) and Abowd et al. (1999). In subsection 4.3.3 we introduce some specification tests.

4.3.1 Within-individual-job estimation of the wage model

As we will see more in details in section 5, the econometric analysis is carried out using a small panel data set with only 2 time periods. Therefore, we can distinguish two types of workers: workers who changed firm between 2000 and 2002 (the "movers") and workers who did not change firm (the "stayers"). Thus, if we restrict our analysis on the stayers and we apply the usual FE transformation[8] to the original wage equation (1), we are able to remove both the individual-specific component, c_i, and the job-specific component, $\phi_{j(i)}$. The FE transformed model is

$$\ddot{\ln w}_{it} = \ddot{\mathbf{z}}'_{it}\boldsymbol{\beta} + \ddot{\mathbf{x}}'_{it}\boldsymbol{\delta} + \ddot{u}_{it}, \quad i \in S, \tag{7}$$

where the two dots denote that the within-individual time means have been subtracted from the original realizations at date t for individual i and S is the set of stayers. Ordinary least squares applied to the time demeaned model generate unbiased results. This procedure allows any arbitrary correlation between the individual- and job-specific components, but we have to assume the exogeneity of mobility; this means that the reasons for which the worker changes job are random once we condition on the wage regressors and the fixed components. We need, as usual, the strict exogeneity of our explanatory variables conditional on the individual- and job-specific effects: $E(u_{it}|\mathbf{Z}_i, \mathbf{X}_i, c_i, \phi_{j(i)}) = 0$ for $t = 1, \ldots, T$, where $\mathbf{Z}_i$ and $\mathbf{X}_i$ are, respectively, $T \times 5$ and $T \times K$ matrices collecting individual i's observations.

Moreover, we would obtain identical estimates and inference if we applied, instead of the within-individual estimation on the stayers' subsample, the within-individual/within-job estimation using the full sample.[9] By within-individual/within-job procedure we refer to the FE estimator that exploits, instead of deviations from individual means, deviations from within-job means. Since these deviations sum to zero within-individuals, they are uncorrelated by construction with both the person-specific components, c_i, and the job-specific effects, $\phi_{j(i)}$.

[8] Abowd et al. (1999) propose to use the within-individual first differences of the data. Since T=2, FE estimation and first differencing produce identical estimates and inference (e.g., see Wooldridge, 2002, pp.284).

[9] The statistical appendix A-1 shows this basic result.

4.3.2 Within-individual estimation of the augmented wage model

The estimator we have seen in the previous subsection is inefficient (only stayers' information is exploited in the estimation) in estimating the general specification of wage equation (1). Following Abowd et al. (1999), we try to improve on the precision of our estimates reintroducing in our sample the movers and solving the problem of endogeneity by adopting another strategy.

Demeaning or first differencing the data when we use the full sample do not remove completely the job-specific component. More in details, applying the first differencing transformation to equation (1) yields

$$\Delta \ln w_{it} = \mathbf{\Delta z}'_{it}\boldsymbol{\beta} + \mathbf{\Delta x}'_{it}\boldsymbol{\delta} + \Delta\phi_{jh(i)} + \Delta u_{it}, \tag{8}$$

where

$$\Delta\phi_{jh(i)} = \phi_{j(i)} - \phi_{h(i)}$$

and the subscripts j and h indicate the firms where worker i was working during 2002 and 2000, respectively. If individual i is a stayer, $j = h$ and $\Delta\phi_{jh(i)} = 0$. If individual i is a mover, $j \neq h$ and $\Delta\phi_{jh(i)} \neq 0$. Since we are allowing our wage regressors to be arbitrary correlated to the job-specific component, then there is a problem of endogeneity due to the presence of workers who changed their job between 2000 and 2002.[10]

In order to take into account of the correlation between individual characteristics and the job-specific component, we apply a control function estimator and augment the general wage model in equation (1) by a set of interactions between observable individual and job characteristics.

Denote $\mathbf{S}$ the $NT \times P$ matrix of P interactions between individual and job characteristics and assume that, conditional on $\mathbf{S}$, individual characteristics and firm unobservables are orthogonal. Then, the within-individual estimator on the augmented wage equation

$$\ln w_{it} = \mathbf{z}'_{it}\boldsymbol{\beta} + \mathbf{x}'_{it}\boldsymbol{\delta} + \mathbf{s}'_{it}\boldsymbol{\alpha} + c_i + \phi_{j(i)} + u_{it}, \tag{9}$$

is consistent and allows us to improve on efficiency.[11]

4.3.3 Specification checks

The interesting peculiarity of the procedure presented in subsection 4.3.2 is that some specification checks are applicable. Under the null hypothe-

[10] We end up with the same conclusions and problems if we apply the time-demeaning transformation instead of first differencing.

[11] See Abowd et al. (1999) for further details about the conditional estimation method.

sis of conditional orthogonality between individual characteristics and the job-specific component, both the within-individual estimator on the stayers' subsample and the conditional within-individual estimator are consistent, with a gain in efficiency from the last one. Under the alternative only the within-individual estimator on stayers is consistent. Thus, we can use the Hausman (1978) statistic to compare the estimation results coming from these two estimators of the parameter vector $[\boldsymbol{\beta}', \boldsymbol{\delta}']'$.

Another possible specification check consists in testing the strict exogeneity of our wage regressors. As proposed by Wooldridge (2002), if $T = 2$ we can do it performing a first difference estimation of the original equation augmented by the wage regressors in levels (2002 or 2000 levels), and then computing an F-test for significance of the wage regressors in levels. The intuition behind this regression-based test for endogeneity is that the regressors in levels should not be significant as additional explanatory variables in the first differenced equation under the null of strict exogeneity. Thus, we estimate by ordinary least squares the equation

$$\Delta \ln w_{i2} = \boldsymbol{\Delta}\mathbf{z}'_{i2}\boldsymbol{\beta} + \boldsymbol{\Delta}\mathbf{x}'_{i2}\boldsymbol{\delta} + \boldsymbol{\Delta}\mathbf{s}'_{i2}\boldsymbol{\alpha} + \mathbf{z}'_{i2}\boldsymbol{\gamma} + \mathbf{x}'_{i2}\boldsymbol{\lambda} + error_{it}, \tag{10}$$

and we test the null hypothesis $\mathbf{H}_0$: $[\boldsymbol{\gamma}', \boldsymbol{\lambda}']' = \mathbf{0}$ performing the F-test for significance of $[\mathbf{z}'_{i2}, \mathbf{x}'_{i2}]'$. If the interaction terms $\mathbf{s}_{it}$ are able to capture the correlation between individual characteristics and the unobservable job-specific component, we should not reject the null hypothesis $\mathbf{H}_0$.

Finally, we will test for sample selection bias and attrition. The sample selection bias may arise because the dependent variable can only be observed when the individual participates in the labour market as employee. Attrition may occur because some observations leave the sample for reasons that may not be entirely random. Both these tests are performed on the wage equation augmented by the proxy interactions and following Wooldridge (1995 and 2002). Furthermore, in these tests the unobserved individual and firm effects are allowed to be correlated with the wage regressors and the selection rules may depend on the unobserved effects.

More in details, suppose that for each t the selection equation for individual i's labour market participation is

$$d_{it} = 1[\mathbf{F}_i\boldsymbol{\psi}_t + \varepsilon_{it} > 0], \quad \varepsilon_{it}|\mathbf{F}_i \sim N(0,1), \tag{11}$$

where $\mathbf{F}_i$ is a set of exogenous variables and $1[\cdot]$ is an indicator function which is unity if its argument is true and zero otherwise. The exogenous regressors predicting the participation in the labour market are: gender, geographical area (4 dummies), education (4 dummies), marital status, age, its square,

a dummy for husband working status, number of children in 3 age groups (0–5, 6–14, and 15–18), a time dummy, and the interactions between gender and education dummies. The regressors in all time periods enter into the selection equation at time t to allow for selection models with unobserved effects. Using a Mundlak (1978) approach, we can replace $\mathbf{F}_i$ with $(\mathbf{f}_{it}, \bar{\mathbf{f}}_i)$, where $\bar{\mathbf{f}}_i$ denotes the individual means, and, assuming that the coefficients are time-constant, we can estimate them by pooled probit. Once we have computed the inverse Mills ratios, we introduce them into the conditional FE model: the sample selection test is given by the t-statistics (using robust standard errors) on the inverse Mills ratios.

As regard attrition, in 2000 we have some employees that disappear in 2002 because they become either not-employed or self-employed or they drop out the survey. The reasons for which they leave the sample could not be random, for instance they could depend on having had a temporary contract in 2000. First, we rewrite our augmented wage equation in first differences, yielding

$$\Delta \ln w_{i2} = \mathbf{\Delta z}'_{i2}\boldsymbol{\beta} + \mathbf{\Delta x}'_{i2}\boldsymbol{\delta} + \mathbf{\Delta s}'_{i2}\boldsymbol{\alpha} + \Delta\eta_{i2}. \tag{12}$$

Considering that in our panel $T = 2$ and conditional on being an employee in 2000, we can write the selection equation into the 2002 employees' sample as follows:

$$a_{i2} = 1[\mathbf{g}_{i2}\boldsymbol{\zeta}_2 + \epsilon_{i2} > 0],\ \epsilon_{i2}|\{\mathbf{g}_{i2}, \mathbf{\Delta x}_{i2}, \mathbf{\Delta z}_{i2}, \mathbf{\Delta s}_{i2}, a_{i1} = 1\} \sim N(0,1), \tag{13}$$

where $\mathbf{g}_{i2}$ contains our wage regressors in 2000 levels (which are observed both for the employees in our panel and for the employees that drop out of the sample in 2002).

Then, it is possible to show that

$$\begin{aligned} E\ \ & (\Delta \ln w_{i2}|\mathbf{\Delta z}_{i2}, \mathbf{\Delta x}_{i2}, \mathbf{\Delta s}_{i2}, \mathbf{g}_{i2}, a_{i2} = 1) = \\ =\ \ & \mathbf{\Delta z}'_{i2}\boldsymbol{\beta} + \mathbf{\Delta x}'_{i2}\boldsymbol{\delta} + \mathbf{\Delta s}'_{i2}\boldsymbol{\alpha} + \rho_2\lambda(\mathbf{g}_{i2}\boldsymbol{\zeta}_2), \end{aligned} \tag{14}$$

where $\lambda(\mathbf{g}_{i2}\boldsymbol{\zeta}_2)$ is the inverse Mills ratio, if our wage regressors are strictly exogenous, selection does not depend on their first-differences once we have controlled for their 2000 levels, and $\Delta\eta_{i2}$ and ϵ_{i2} are jointly normal.[12] Thus, a test for attrition can be computed in two steps:

i) Estimate equation (13) using a cross section probit and compute the estimated inverse Mills ratios $\widehat{\lambda}(\mathbf{g}_{i2}\widehat{\boldsymbol{\zeta}}_2)$.

ii) Augment equation (12) by $\widehat{\lambda}_{i2}$, estimate using OLS, and test the null

[12] See e.g. Wooldridge (2002, pp.585–586) for further details.

hypothesis H_0: $\rho_2 = 0$.

5 Data and sample

The empirical analysis has been conducted using the 2000 and 2002 waves of the Survey of Italian Households' Income and Wealth (SHIW).[13] The SHIW is a nationally representative survey conducted by the Bank of Italy every two years since 1989. As the question about the contract type was introduced in 2000,[14] we cannot use for our research project previous surveys. The 2002 wave covers 8,011 households composed of 22,148 individuals and 13,536 income-earners. The households that were interviewed also in 2000 are 3,605. The 2000 wave covers 8,001 households, 22,268 individuals, and 13,814 income earners.

Since self-employed workers are deemed to be structurally different from salaried workers, they are removed from the sample. We left out individuals out of the range 15–65 years of age, we removed individuals who were not salaried workers in 2000 or 2002, and we excluded observations lying in the first and in the last percentiles of the wage and weekly working hours distributions, respectively. Finally, we excluded observations with missing values for some of the variables used in the specification of the wage model, ending up with a sample of 4,370 observations, corresponding to 2,185 employees across two time periods.

As we have seen in subsection 4.3.1, when we try to face and solve the endogeneity generated by the correlation between unobservable job-specific components and individual characteristics we will split the sample into the movers' subsample and the stayers' subsample. The latter is made up of 3,922 observations corresponding to 1,961 employees, while the movers' subsample is composed by 448 observations for 224 employees.

In subsection 4.3.3 we have introduced tests to check the presence of sample selection and attrition biases. They are performed through probit estimations of selection equations. The probit participation equation is estimated using 10,394 observations corresponding to 5,197 individuals (individuals interviewed both in 2000 and 2002 but not salaried workers in one of these two years). As regard the attrition bias test, the cross section probit selection equation is estimated using 2,706 individuals corresponding to 2,185 employees, 86 self-employed, 266 not-employed and 169 individuals who drop out the survey in 2002.

[13] The Survey and further details are available on the Web-server of the Bank of Italy (http://www.bancaditalia.it/statistiche/consultazione).

[14] Annex B1, question 1 of the SHIW questionnaire.

The variables of primary interest are:

- Contract type, TC_{it}. It is a dummy variable which is equal to 0 if the individual is a permanent worker and equal to 1 if the individual is a fixed-term worker or a worker for a temporary work agency.
- Seniority, indicating the number of years coming from the difference between age and age at which the worker has begun the job performed at the interview year.

The data allows us to distinguish between two types of temporary workers: fixed-term contracts and workers for temporary work agencies. The small sample size of workers for temporary work agencies forces us to aggregate temporary workers in a unique category.[15] The percentage of temporary contracts is given in Table 2. Over 2000–2002, the average percentage of workers with a temporary job is 6.11%.[16]

Table 2: Mean hourly wage by type of contract.

	Mean	Std.Dev
Hourly wages (€)		
Permanent	9.01	4.70
Temporary	7.92	7.43
Overall	8.94	4.91
Wage penalty (%)	-12.10	
Temporary Contract (%)	6.11	0.24
	Value	p-value
Wage difference (€)	1.09	0.019
Person-wave observations		4,370

Source: SHIW - Bank of Italy, 2000 and 2002.
Notes: Hourly wages are in constant prices (2002).

The dependent variable is the natural logarithm of the average net hourly wage (in euros and in 2002 prices), $\ln w_{it}$, computed using information provided by the SHIW on the average net monthly wage and the average weekly working hours. Table 2 displays the average hourly wage disaggregated by contract type, the wage penalty, the wage difference, and its significance. Over 2000–2002, the average hourly net wage (in 2002 prices) is equal to 9.01€ for permanent workers and 7.92€ for temporary employees. The wage difference (1.09€) is significant and the wage penalty from these raw data is about 12%.

[15]The fraction of temporary workers for temporary work agencies is 0.21% over the full sample and 3.4% over the temporary workers' subsample, corresponding to 9 observations.

[16]More detailed information on the fraction of temporary workers by year, personal, and firm characteristics is reported in the data appendix, Table A-2.

The work experience is actually a potential work experience in years. Since no information about past employment and unemployment spells is available, we can only approximate work experience using the provided information about the age at which our workers began their first job activity.

In the wage equation specification we control for working hours including a dummy variable which is equal to 1 if the worker has a part-time contract. We do not apply any particular definition of part-time based on the number of working hours: employees are simply required to self-define their contracts choosing between "part-time" or "full-time". More details about the definition and the construction of the variables used in our wage models are reported in the data appendix A-2.

Table 3 reports the job composition by individual and firm characteristics of temporary workers, permanent workers, and the complete sample. We can see that temporary workers are younger, they have a smaller job seniority and a shorter job experience. It is easier to find low educated employees among temporary workers. While about 28% of the employees lives in the South of Italy (South and Islands), if we restrict our focus on temporary workers, then we note that this percentage increases up to 53%, meaning that more than one half of the Italian temporary workers lives in the South of Italy. We can also find a large presence of temporary workers among low skill jobs: the weight of agriculture, building and construction, domestic services, and small size firms (up to 19 employees) is particularly high. Finally, we notice that it is much easier to observe a blue collar among temporary contracts (62.2% of temporary workers are blue collars) than to observe a blue collar among permanent employees (40.6% of permanent workers are blue collars).[17]

6 Wage effects of temporary contracts: estimation results

Table 4 presents estimation results of the wage model via POLS, RE, and FE. These estimation results are discussed in subsection 6.1. Table 5 shows the estimates via FE for stayers and the regression results obtained by the within-individual estimator of the wage equation augmented by 70 interactions between individual and job characteristics. Subsection 6.2 contains a discussion about the results obtained through these two procedures. The interpretation of the outcome from the specification checks is instead provided in subsection 6.3. In subsection 6.4 we perform some sensitivity analyses.

[17] Further descriptive statistics are reported in Tables A-1, A-2, and A-3.

Table 3: Job distribution by contract type, personal, and firm characteristics, 2000–2002.

	Temporary		Permanent		Total	
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
Age	36.345	10.865	41.592	9.859	41.271	10.001
Tenure	10.524	12.009	16.436	10.638	16.075	10.818
Experience	16.611	13.028	21.483	10.560	21.185	10.789
Education						
None or Elementary	0.176	0.382	0.075	0.264	0.081	0.274
Middle school	0.363	0.482	0.299	0.458	0.303	0.460
Professional school	0.064	0.245	0.086	0.280	0.084	0.278
High school	0.262	0.441	0.406	0.491	0.397	0.489
University degree or more	0.135	0.342	0.134	0.340	0.134	0.341
Area						
North-East	0.109	0.312	0.268	0.443	0.258	0.438
North-West	0.180	0.385	0.243	0.429	0.239	0.427
Centre	0.176	0.382	0.227	0.419	0.224	0.417
South	0.281	0.450	0.168	0.374	0.175	0.380
Islands	0.254	0.437	0.094	0.291	0.103	0.305
Firm size						
Up to 4	0.116	0.321	0.073	0.260	0.075	0.264
From 5 to 19	0.303	0.461	0.169	0.375	0.177	0.382
From 20 to 49	0.105	0.307	0.116	0.320	0.116	0.319
From 50 to 99	0.067	0.310	0.084	0.251	0.084	0.277
From 100 to 499	0.105	0.307	0.108	0.310	0.106	0.310
500 or more	0.056	0.231	0.127	0.334	0.123	0.329
Public Sector	0.247	0.432	0.324	0.468	0.319	0.466
Occupation						
Blue collar	0.622	0.486	0.406	0.491	0.419	0.493
White collar	0.343	0.476	0.501	0.500	0.492	0.500
Manager	0.034	0.181	0.093	0.291	0.089	0.291
Industry						
Agriculture	0.142	0.350	0.024	0.153	0.031	0.174
Industry & Mining	0.184	0.388	0.308	0.462	0.300	0.458
Building & Construction	0.079	0.270	0.047	0.212	0.049	0.216
Wholesale & Retail Trade	0.154	0.361	0.096	0.294	0.099	0.299
Transport & Communication	0.030	0.171	0.040	0.196	0.039	0.194
Credit & Insurance	0.007	0.086	0.049	0.215	0.046	0.210
Business services	0.030	0.171	0.033	0.180	0.033	0.179
Domestic services	0.060	0.238	0.034	0.182	0.036	0.186
Public administration	0.315	0.465	0.369	0.483	0.366	0.482
Female	0.502	0.501	0.402	0.490	0.408	0.492
Head of Household	0.330	0.471	0.483	0.500	0.474	0.499
Married	0.532	0.500	0.708	0.455	0.697	0.460
Part-time	0.240	0.428	0.068	0.252	0.078	0.269
Stayer	0.715	0.452	0.909	0.287	0.897	0.303
Observations	267		4,103		4,370	

Source: SHIW - Bank of Italy, 2000 and 2002.

6.1 Pooled ordinary least squares, random effects, and fixed effects estimation results

In interpreting our estimation results, we begin by comparing results obtained via POLS, RE, and FE. These results derive from the estimation of the same wage model but under different assumptions on the error structure and endogeneity. We get very similar results from POLS and RE estimates, reported in the first six columns of Table 4. Temporary contracts induce a wage penalty about 9.5% and the estimated coefficient is statistically different from zero at a 5% significance level. Furthermore, since the interaction terms between contract type and seniority are not significantly different from zero, there is not a particular wage return to seniority for temporary workers.

However, using the FE estimator, we can relax the assumption of zero correlation between the individual specific component and our wage regressors, which is instead necessary for the consistency of the POLS and the RE estimators. The estimation results from the FE estimator are displayed in the last three columns of Table 4. Note that the estimation results for some of the control variables are not reported. These variables are indeed not identified in the FE framework because either time constant (gender, geographical area of residence, and education[18]) or time-variant but growing at the same rate of the time dummy (potential experience).

The estimated coefficient associated to contract type is now larger in modulus (the coefficient is -0.116) implying a wage penalty for temporary workers of about 11%,[19] statistically different from zero at a 5% significance level (p-value=0.049). The interactions between seniority and contract type are again not significantly different from zero, even if now the correspondent estimated coefficients are larger in modulus that the ones obtained from POLS and RE estimators.

However, these results could be biased even if we control for individual heterogeneity. Indeed, if there is some correlation between our explanatory variables and the job-specific component (which has been included in the error term) the strict exogeneity requirement conditional on the individual-specific component, c_i, fails.[20]

[18] In point of fact, education is time-variant in our panel data set, as you can note from the within-individual standard deviation reported in Table A-1. More precisely, 2,068 individuals (94.65%) of our sample did not change educational qualification between 2000 and 2002. For 117 workers the education dummies are time-variant but we detected a decrease of the educational qualification due to measurement errors for 43 individuals. Thus, we preferred to consider education dummies as time-invariant removing them from the set of explanatory variables in the FE estimation.

[19] $10.952 = [\exp(-0.116) - 1] \cdot 100$.

[20] In particular, our variables of primary interest are likely to be correlated with a firm-

Table 4: POLS, RE, and FE estimates of the wage model.

	POLS			RE			FE		
Variable	Coeff	S.E.†	p-value	Coeff	S.E.†	p-value	Coeff	S.E.†	p-value
TC	-0.101	0.041	0.013	-0.101	0.041	0.014	-0.116	0.059	0.049
TC×Tenure	0.009	0.007	0.210	0.010	0.008	0.194	0.018	0.012	0.123
TC×Tenure^2/100	-0.000	0.000	0.704	-0.000	0.000	0.566	-0.000	0.000	0.206
Tenure	0.006	0.002	0.010	0.005	0.002	0.023	-0.008	0.006	0.186
Tenure^2/100	-0.000	0.000	0.449	-0.000	0.000	0.652	0.000	0.000	0.310
Experience	0.015	0.002	0.000	0.016	0.002	0.000			
Experience^2/100	-0.024	0.005	0.000	-0.026	0.005	0.000	-0.057	0.023	0.014
Area - Reference: North-East									
North-West	0.028	0.014	0.049	0.027	0.014	0.061			
Centre	-0.030	0.014	0.037	-0.032	0.015	0.027			
South	-0.049	0.019	0.011	-0.050	0.019	0.009			
Islands	-0.006	0.022	0.779	-0.010	0.022	0.654			
Education - Reference: None or Elementary									
Middle school	0.065	0.024	0.006	0.066	0.024	0.005			
Professional school	0.091	0.028	0.001	0.095	0.028	0.001			
High school	0.148	0.027	0.000	0.153	0.027	0.000			
University degree or +	0.385	0.033	0.000	0.396	0.034	0.000			
Firm size - Reference: Up to 4									
From 5 to 19	0.048	0.026	0.064	0.041	0.026	0.116	-0.026	0.043	0.547
From 20 to 49	0.098	0.027	0.000	0.078	0.027	0.004	-0.061	0.049	0.211
From 50 to 99	0.140	0.029	0.000	0.116	0.029	0.000	-0.044	0.051	0.382
From 100 to 499	0.153	0.028	0.000	0.137	0.028	0.000	-0.014	0.049	0.782
500 or more	0.200	0.028	0.000	0.183	0.028	0.000	0.019	0.051	0.709
Public Sector	0.198	0.030	0.000	0.178	0.030	0.000	0.013	0.051	0.806
Occupation - Reference: Blue collar									
White collar	0.130	0.015	0.000	0.131	0.015	0.000	0.081	0.032	0.011
Manager	0.315	0.028	0.000	0.294	0.027	0.000	0.132	0.043	0.002
Industry - Reference: Agriculture									
Industry & Mining	0.119	0.041	0.004	0.110	0.041	0.008	0.048	0.069	0.489
Building & Construct.	0.136	0.046	0.003	0.120	0.045	0.008	0.044	0.073	0.544
Wholesale & Retail Tr.	0.067	0.043	0.120	0.058	0.043	0.179	0.002	0.074	0.977
Transport & Commun.	0.139	0.047	0.003	0.122	0.047	0.009	0.044	0.077	0.564
Credit & Insurance	0.245	0.048	0.000	0.222	0.048	0.000	-0.046	0.080	0.563
Business services	0.103	0.049	0.036	0.090	0.050	0.073	0.010	0.082	0.900
Domestic services	0.052	0.051	0.310	0.058	0.052	0.262	0.055	0.084	0.511
Public administration	0.109	0.043	0.011	0.102	0.042	0.017	0.030	0.070	0.670
Female	-0.070	0.013	0.000	-0.077	0.013	0.000			
Head of Household	0.025	0.012	0.039	0.021	0.012	0.073	-0.026	0.028	0.355
Married	0.062	0.014	0.000	0.063	0.014	0.000	0.039	0.044	0.369
Part-time	0.071	0.025	0.004	0.077	0.027	0.005	0.149	0.058	0.010
2002	0.021	0.008	0.012	0.020	0.008	0.015	0.084	0.021	0.000
Constant	1.400	0.064	0.000	1.064	0.048	0.000	2.216	0.162	0.000
Observations			4,370			4,370			4,370
R^2			0.415			0.355			0.035
Adjusted R^2			0.410			0.349			0.029
F-test of joint	$F(36, 2184)$		p-value	$F(36, 2184)$		p-value	$F(26, 2184)$		p-value
significance:	64.36		0.000	62.95		0.000	2.68		0.000
White/Koenker	$F(\ 2, 2184)$		p-value	$F(\ 2, 2184)$		p-value	$F(\ 2, 2184)$		p-value
heteroskedasticity test:	9.95		0.000	6.97		0.001	15.50		0.000
Regression-based strict exogeneity tests:						$F(25, 2134)$=1.53 p-value=0.045			
						$F(\ 5, 2154)$=2.17 p-value=0.055			
Hausman tests RE vs FE:						$F(25, 2184)$=4.21 p-value=0.000			
						$F(\ 5, 2184)$=2.01 p-value=0.074			

Source: SHIW - Bank of Italy, 2000 and 2002.
Notes: †Arellano (1987) robust standard errors have been computed.

6.2 FE on stayers and conditional FE estimation results

In this subsection we present estimation results tackling the plausible endogeneity of our wage regressors after controlling for individual heterogeneity. Table 5 displays these results.

The first three columns report estimation results coming from the within-individual estimator applied to the subsample of employees who did not change their job between 2000 and 2002. The FE transformation of the stayers' dataset removes both the individual- and the job-specific components because the first one is time-invariant by definition, the second one is within-job constant. Thus, dropping the movers, we eliminate the source of possible endogeneity.[21]

The estimated coefficient for contract type is now -0.127, larger in modulus than the one obtained from the full sample. Thus, there is evidence of a wage penalty for temporary workers who undergo no job mobility of about 11.9%.[22] Note that this estimated coefficient is statistically different from zero only at a 10% significance level (p-value=0.096): the standard errors are exploding since we have eliminated observations and variations from our dataset. The temporary workers' return to one year of tenure is 1.9 percentage points higher than the permanent workers' one, but it is not significantly different from zero.

The focal point now is to understand whether the coefficients of the variables of primary interest are practically small or the insignificant t-statistics are small due to large standard errors. Thus, we reintroduce in our sample the movers and we try to capture the correlation between individual char-

or job-specific component. Indeed, we would expect that the higher the job-specific component (for instance due to a good job match between worker and firm), the higher the worker's tenure because the worker should not be willing to quit for an outside option.

[21] As it is possible to note from the first three columns of Table 5, there are no estimation results for tenure. Indeed, it is not identified because it grows at the same rate of the time dummy in the stayers' subsample. We can also note that the estimation results for the industry dummies are instead reported, even if we would expect that the industry dummies were not identified because time-invariant for the stayers. Indeed, even if it is possible that a firm changes industry (for instance, converting its plants) or that the employee moves to another industry but working for the same employer (if the employer has different activities in different branches or if the employer is a temporary work agency), this is not likely to occur. In our stayers' subsample we have 441 individuals (22.5% of the stayers' subsample, 20.2% of the total sample) characterized by time-variant industry dummies. It is well-known that even if the measurement error is not systematic, we could have a measurement error bias. In order to understand if this measurement error is able to bias the estimated coefficients of the variables of primary interest, we perform some sensitivity analyses reported in appendix A-3.

[22] $11.927 = [\exp(-0.127) - 1] \cdot 100$.

Table 5: FE on stayers and conditional FE estimates of the wage model.

	FE on Stayers			Conditional FE‡		
Variable	Coeff	S.E.†	p-value	Coeff	S.E.†	p-value
TC	-0.1271	0.0763	0.096	-0.1261	0.0605	0.037
TC×Tenure	0.0191	0.0133	0.151	0.0234	0.0122	0.055
TC×Tenure^2/100	-0.0004	0.0003	0.208	-0.0006	0.0004	0.087
Tenure				0.0054	0.0133	0.683
Tenure^2/100	0.0005	0.0003	0.102	0.0001	0.0003	0.666
Experience^2/100	-0.0710	0.0289	0.014	-0.0549	0.0253	0.030
Firm size - Reference: Up to 4						
From 5 to 19	-0.0505	0.0472	0.285	-0.0149	0.3014	0.961
From 20 to 49	-0.0681	0.0553	0.219	-0.3452	0.3299	0.295
From 50 to 99	-0.0588	0.0565	0.298	-0.4172	0.3300	0.206
From 100 to 499	-0.0273	0.0549	0.619	-0.1419	0.3411	0.677
500 or more	0.0057	0.0551	0.918	-0.2168	0.3470	0.532
Public Sector	-0.0180	0.0563	0.750	-0.3103	0.3389	0.360
Occupation - Reference: Blue collar						
White collar	0.1089	0.0326	0.001	0.0755	0.0324	0.020
Manager	0.1746	0.0415	0.000	0.1356	0.0443	0.002
Industry - Reference: Agriculture						
Industry & Mining	-0.0119	0.0719	0.869	-1.1975	0.5763	0.038
Building & Construction	-0.0294	0.0751	0.696	-0.5897	0.7391	0.425
Wholesale & Retail Trade	-0.0561	0.0782	0.473	-1.5554	0.5641	0.006
Transport & Communication	-0.0107	0.0785	0.892	-0.7554	0.6287	0.230
Credit & Insurance	-0.0854	0.0834	0.306	-0.5014	0.7242	0.489
Business services	-0.0628	0.0830	0.449	-0.3466	0.7629	0.650
Domestic services	0.0133	0.0859	0.877	-0.8951	0.7337	0.223
Public administration	-0.0226	0.0736	0.759	-0.2445	0.6182	0.693
Head of Household	-0.0292	0.0293	0.320	-0.0278	0.0267	0.299
Married	0.0020	0.0368	0.956	0.0313	0.0461	0.497
Part-time	0.1319	0.0629	0.036	0.1274	0.0554	0.022
2002	0.0608	0.0204	0.003	0.0846	0.0235	0.000
Constant	2.1807	0.1551	0.000	1.9869	0.2048	0.000
Observations			3,922			4,370
R^2			0.033			0.073
Adjusted R^2			0.027			0.052
F-test of joint		$F(25, 1960)$	p-value		$F(96, 2184)$	p-value
significance:		2.39	0.000		1.81	0.000
White/Koenker		$F(\ 2, 1960)$	p-value		$F(\ 2, 2184)$	p-value
heteroskedasticity test:		13.51	0.000		15.32	0.000
F-test of joint significance for interactions:				$F(70, 2184)$=1.46		p-value=0.008
Regression-based strict exogeneity tests:				$F(25, 2064)$=1.30		p-value=0.146
				$F(\ 5, 2084)$=1.73		p-value=0.124
Hausman tests *FE on Stayers* vs *Conditional FE*:				$F(24, 2184)$=1.46		p-value=0.070
				$F(\ 4, 2184)$=0.56		p-value=0.644
Hausman tests *Conditional FE* vs *Conditional RE*§:				$F(25, 2184)$=3.69		p-value=0.000
				$F(\ 5, 2184)$=1.89		p-value=0.093

Source: SHIW - Bank of Italy, 2000 and 2002.
Notes: †Arellano (1987) robust standard errors have been computed. ‡Within-individual estimation results of the wage model augmented by 70 interactions between individual and job characteristics. The 70 interactions are included in the wage equation but not reported in this table. Table A-5 displays their coefficients and standard errors.§This regression-based Hausman test compares estimation results obtained by FE and RE estimators of the augmented wage model using the full sample.

acteristics and job-specific components augmenting the wage model by a set of interactions between individual and job characteristics.[23] The role of the interactions is to proxy the correlation between individual characteristics and job unobservables and they should allow us to improve the precision of our estimation.

The personal characteristics used to generate the interaction terms are within-individual means of potential work experience, age (time-invariant), and job seniority (time-variant). The job characteristics used in our analysis are firm size (6 time-variant dummies) and a 9-industry classification (8 time-variant dummies).

The conditional FE estimation results of the augmented wage equation are reported in the last three columns of Table 5. The temporary workers' wage penalty is if about 11.8%[24] corresponding to an estimated coefficient of the contract type dummy equal to -12.6 and statistically different from zero at a 5% significance level. Furthermore, the coefficient of the interaction between contract type and seniority is positive and statistically different from zero at a 10% significance level,[25] meaning that there is some slight evidence for larger returns to seniority for temporary workers. An individual who accepts a temporary contract earns 11.8% lower wages than a permanent worker, *ceteris paribus*; the wage gap seems to decrease over time and within the same firm, since the temporary worker's returns to seniority are higher than the comparable permanent worker's ones. After one year of seniority, the temporary worker's wage gap is reduced by about 2.3 percentage points.

Figure 1 displays the estimated wage penalties over job seniority for temporary workers.[26] We can note that the temporary workers' wage penalty is decreasing with seniority, independently on the estimation technique, even if the unique and slight significant evidence comes from the conditional FE estimate. The conditional FE estimator also provides the steepest wage penalty path: the wage differential between temporary and permanent workers disappears after more than 5 years of temporary employment within the same firm. Even if this finding is consistent with the institutional setting, according to which there is no a maximum duration for temporary contracts, it does

[23] The set of 70 interactions between individual and job characteristics, their means, and their standard deviations are displayed in Table A-4.

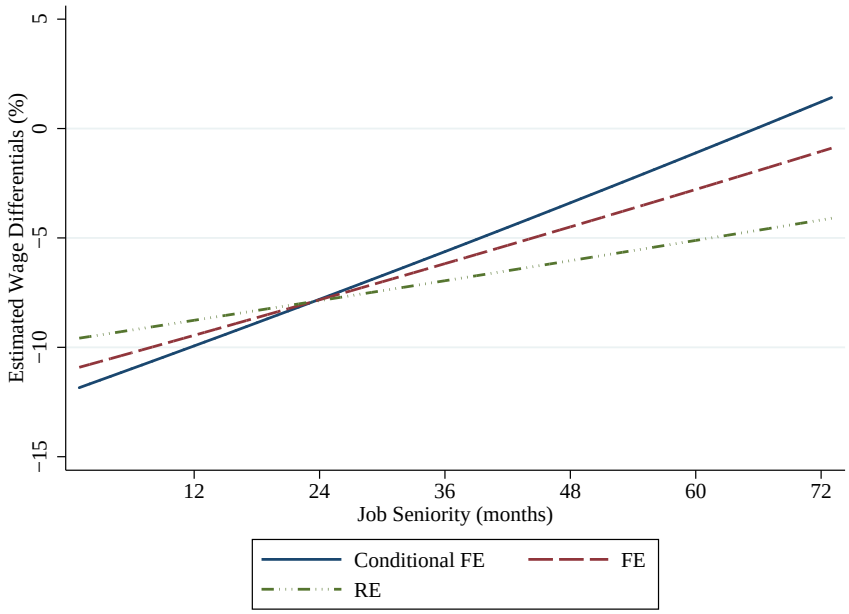
[24] $11.847 = [\exp(-0.126) - 1] \cdot 100$.

[25] The estimated coefficient of the interaction term between seniority and contract choice is equal to 0.023, p-value=0.055. The coefficient of the interaction between contract type and the square of seniority is negative, significant at a 10% level, but very small in magnitude (-0.0006).

[26] Figure 1 is based on the estimation results presented in Tables 4 and 5. It plots the wage gap (in percentage) between a temporary worker and the comparable permanent one.

not seem to be realistic (in Gagliarducci (2005) the Italian median length of temporary jobs is around 20 months). We can also note in figure 1 that, as soon as we control for unobservable components, the wage gap curve pivots and we have higher wage penalties for temporary workers and faster catching up rates when the degree of participation to the firm life increases.

Figure 1: Estimated wage differentials for temporary workers.



Thus, the empirical evidence does not support the theory of compensating differentials. Furthermore, there is a slight evidence of decreasing wage penalties within the same firm, supporting the Loh's (1994) interpretation of temporary contracts as a sorting mechanism. Firms post vacancies characterized by a probationary stage (the temporary contract) with lower wages, but promising higher wages afterwards, in order to generate a self-selection of the most skillful candidates. Our results and especially the steeper wage-tenure profile for temporary workers are consistent with the interpretation of temporary jobs as probationary periods and when the length of the probation increases, we observe a wage increase of the successful employees, generating a reduction of the wage gap. Furthermore, if we interpret temporary jobs as an on-the-job training period for new workers, our findings are in line with the ones by Barron et al. who find that a 10% increase in the worker's on-the-job training (measured in hours) raises wage growth by 1.5%.

Our results may also be explained looking at the institutional setting.

According to the non-discrimination principle,[27] temporary workers should receive the same remuneration as the comparable permanent workers; thus, we should not observe a wage gap. But the interpretation of "comparability" has been indicated by Court of Ravenna in 2002,[28] stating that it is not possible to find an absolute principle of equity treatment between temporary and permanent workers since they are characterized by a different degree of participation to the firm life. Therefore, according to the institutional setting as defined by the labour market reforms and by the 2002 judgment, we could observe wage discrimination if permanent and temporary workers have different degrees of participation to the firm life. Assuming that job seniority is able to capture this degree of participation, our results are in line with the institutional setting and when job seniority increases – higher degree of participation to the firm life – there is no longer a legal reason for the firm to discriminate and the wage gap between permanent and temporary workers disappears.

6.3 Specification checks

The estimation results commented in subsection 6.2 and obtained following the procedure proposed by Abowd et al. (1999) are credible if we believe that the 70 interactions between individual and job characteristics are able to proxy for the correlation between individual characteristics and the job-specific components. If the orthogonality condition between individual characteristics and firm unobservables conditional on the interaction matrix $\mathbf{S}$ holds, we should get estimation results that are not far away the ones we got performing the FE estimation using the subsample of stayers. Thus, we tested the null hypothesis of conditional orthogonality using a regression-based Hausman (1978) test robust to any form of serial correlation and heteroskedasticity.[29] The Hausman statistic has been computed comparing the estimated coefficients of the wage regressors which are common both to the original wage equation and to the augmented one (excluding tenure, which is not identified performing the FE procedure on stayers, and the time dummy). The Hausman statistic has been reported at the bottom of Table 5 and we note that we can not reject the null hypothesis of conditional orthogonality when we restrict our attention on the variables of primary interest; indeed, we get a p-value equal to 0.644 from the Hausman test comparing the esti-

[27] See art. 4 of Law 196/1997 and art. 6 of Legislative Decree 368/2001.

[28] See Montanari (2003) for a comment about the motivation of the judgment.

[29] See appendix A-1 for more information about the regression-based Hausman test we use to test the null hypothesis of conditional orthogonality between individual characteristics and firm unobservables.

mated coefficients associated to $\mathbf{z}_{it}$, the regressor vector collecting contract type, job seniority, their interaction, and the respective quadratic terms.

Furthermore, under the conditional orthogonality assumption we are successfully modelling $E(\ln w_{it}|\ \mathbf{z}_{it}, \mathbf{x}_{it}, \mathbf{s}_{it}, c_i, \phi_{j(i)})$, and the strict exogeneity assumption $E(u_{it}|\ \mathbf{Z}_i, \mathbf{X}_i, \mathbf{S}_i, c_i, \phi_{j(i)}) = 0$ should hold. We tested the strict exogeneity assumption using the regression-based test as described in subsection 4.3.3. The test statistic is $F(25, 2064) = 1.3$ with a p-value equal to 0.146. This means that the wage regressors in 2002 levels are not significant as additional explanatory variables in the first-differenced equation: there is no evidence of failure of the strict exogeneity assumption.[30]

If we compute the same test statistic without introducing into the wage equation the proxy interactions, we get $F(25, 2134) = 1.53$ and a p-value equal to 0.045. The strict exogeneity assumption fails and the results presented in the last three columns of Table 4 are biased, most likely because of the omission of firm unobservables. This is a further outcome supporting the assumption that the interactions between individual and job characteristics are able to capture the correlation between individual characteristics and the job-specific component.

Since we are particularly interested in the estimated coefficients associated to the type of contract, its interaction with tenure, and its quadratic term, we performed specification checks using three-degrees-of-freedom tests and their outcomes are displayed in Table 6. We can note that even if we do not

Table 6: Three-degrees-of-freedom specification tests.

Tackling the correlation between regressors and individual heterogeneity:	
Regression-based strict exogeneity tests:	$F(\ 3, 2156)$=1.83 p-value=0.140
Hausman tests *RE* vs *FE*:	$F(\ 3, 2184)$=0.69 p-value=0.558
Tackling the correlation between regressors and job-specific components:	
Regression-based strict exogeneity tests:	$F(\ 3, 2086)$=1.40 p-value=0.242
Hausman tests *FE on Stayers* vs *Conditional FE*:	$F(\ 3, 2184)$=0.70 p-value=0.550
Hausman test *Conditional FE* vs *Conditional RE*:	$F(\ 3, 2184)$=1.03 p-value=0.378

Source: SHIW - Bank of Italy, 2000 and 2002.

control for the possible correlation between individual characteristics and firm unobservables, we cannot reject the null hypothesis of strict exogeneity

[30] If we perform a strict exogeneity test with a smaller number of degrees of freedom, in order to test if the regressors of primary interest are exogenous (contract type, tenure, their interaction, and the respective quadratic terms), we get $F(5, 2084) = 1.73$ and a p-value equal to 0.124. Thus, conditional on the interactions $\mathbf{S}$, $\mathbf{z}_{i02}$ are not significant as additional explanatory variables in the first-differenced equation.

for contract type and its interaction with tenure, conditional on the full set of explanatory variables and on the individual-specific component, c_i. Thus, we can look at the regression-based Hausman test which tells us that the FE and the RE procedures result in estimated coefficients that are close to each other, meaning that the three variables are not endogenous in the wage model if we do not control for individual- and job-specific components. We end up with a similar conclusion when we compare the FE and RE estimation results of the augmented wage equation. Thus, we should conclude that the RE assumptions hold because the Hausman statistic fails to reject; we should focus on the RE estimates, since the RE estimator is the BLUE estimator when the specific components are random. But it is also true that, as soon as we perform five-degrees-of-freedom specification checks including also tenure and its square, the conclusions change (as you can see from Tables 4 and 5). Since the FE on the stayers' subsample and the conditional FE procedures are more robust than a RE approach and in order to avoid a type II error (failing to reject the RE assumptions when they are false), we draw our conclusions from the conditional FE estimates.

Finally, we tested for the presence of sample selection bias and attrition bias in the conditional FE model. There is evidence neither of attrition (the t statistic of the inverse Mills ratio is -0.76, p-value=0.45) nor of sample selection bias (the t statistic is 0.25, p-value=0.804).[31]

6.4 Sensitivity analyses

6.4.1 Controlling for weekly working hours

Recall now the most general specification of our wage equation and rewrite it splitting the K-vector of control variables as follows:

$$\begin{aligned} \ln w_{it} &= \mathbf{z}'_{it}\boldsymbol{\beta} + \mathbf{x}'_{it}\boldsymbol{\delta} + c_i + \phi_{j(i)} + u_{it} \\ &= \mathbf{z}'_{it}\boldsymbol{\beta} + \mathbf{w}'_{it}\boldsymbol{\theta} + pt_{it}\tau + c_i + \phi_{j(i)} + u_{it}. \end{aligned} \tag{15}$$

The 5-dimensional vector $\mathbf{z}_{it}$ collects our variables of primary interest, while the K-vector $\mathbf{x}_{it}$ includes a set of control variables among which pt_{it}, a dummy variable which is equal to 1 if the worker i has a part-time job at time t.

We introduced the part-time control variable because, since the fraction of part-time worker is much higher among temporary workers (as you can

[31] The probit selection equation estimates, through which the inverse Mills ratios have been estimated, are reported in Appendix A-2, Table A-7. For sake of brevity we do not report the estimation results of the auxiliary wage regressions augmented by the inverse Mills ratios; these results are available upon request from the author.

see in Table 7, displaying descriptive statistics for working hours by contract type), omitting a control for working hours may result in underestimating the wage penalty for temporary workers if there is a positive correlation between working hours and wages.

Table 7: Descriptive statistics for working hours by contract type.

	Temporary		Permanent		Total	
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
Part-time	0.240	0.428	0.068	0.252	0.078	0.269
Weekly working hours						
Overall	34.45	10.80	37.66	7.90	37.46	8.14
Part-time	24.44	11.78	23.48	6.75	23.66	7.92
Full-time	37.61	8.28	38.69	6.92	38.64	7.00
Observations	267		4,103		4,370	

Source: SHIW - Bank of Italy, 2000 and 2002.

Thus, an implicit assumption for the consistency of our estimators is that pt_{it} is not correlated to the error term, conditional on the other explanatory variables and on the individual- and job-specific components. Therefore, sufficient assumptions for consistency are:

- $E(v_{it}|\ \mathbf{PT}_i, \mathbf{Z}_i, \mathbf{W}_i) = 0$ for the POLS and RE estimators;
- $E(\eta_{it}|\ \mathbf{PT}_i, \mathbf{Z}_i, \mathbf{W}_i, c_i) = 0$ for the FE estimator;
- $E(u_{it}|\ \mathbf{PT}_i, \mathbf{Z}_i, \mathbf{W}_i, c_i, \phi_{j(i)}) = 0$ for the FE on stayers' subsample and conditional FE estimators.[32]

If the aim of inserting in the wage equation pt_{it} is to control for working hours, we may do it better by replacing pt_{it} with a more precise working hours measure. Thus, we are going to substitute weekly working hours, wh_{it},[33] for part-time, pt_{it}.

Therefore, the new wage equation is

$$\ln w_{it} = \mathbf{z}'_{it}\boldsymbol{\beta} + \mathbf{w}'_{it}\boldsymbol{\theta} + wh_{it}\pi + c_i + \phi_{j(i)} + u_{it}. \tag{16}$$

Since the weekly working hours have been employed to get the dependent variable (the average hourly wage), wh_{it} is endogenous by construction. The part-time dummy variable is likely to be negatively correlated with weekly working hours; moreover, under the assumptions for the consistency of the

[32] Actually, for the consistency of the FE estimator on stayers' subsample we need also the exogeneity of mobility.

[33] See appendix A-2 for details about the weekly working hours variable.

estimators we have so far employed, the part-time dummy is uncorrelated to the error term. This means that, without introducing further assumptions, we can use pt_{it} as valid excluded instrument for the endogenous variable wh_{it}. We should be able to improve the precision of the estimates presented so far. Furthermore, we control for weekly working hours solving its endogeneity without imposing further assumptions. We now replicate what we presented in subsections 6.1 and 6.2 using an instrumental variable approach to solve the endogeneity of wh_{it}. Thus, Table 8 is the IV counterpart of Table 4, while Table 9 is the IV counterpart of Table 5.

We can observe that controlling for weekly working hours, instrumented by the part-time dummy, always results in more precise estimates. The specification checks and the Hausman tests comparing RE and FE estimators lead to the same conclusion as in subsection 6.3[34] and, moreover, checking for sample selection and attrition biases does not result in the rejection of the null hypotheses.[35] If we look at the estimation results from the conditional FE estimator (last three columns of Table 9), we note that the coefficient of contract type is now highly significant, higher in modulus, and equal to -0.146. A worker who accepts a temporary job suffers a wage penalty of about 13.6%,[36] *ceteris paribus*. Furthermore, the estimated coefficient of the interaction between the dummy for the type of contract and job seniority is statistically different from zero at a 5% significance level. After one year of job seniority, the wage penalty for temporary workers is reduced by about 2.35 percentage points. Figure 2 shows that the wage differential disappears in more than 6 years.[37]

[34]Note that all the results of these regression-based tests are computationally equivalent to the ones we got before (see Tables 4 and 5). Indeed, we have performed these tests, firstly, premultiplying each variable for the correspondent projection matrix of exogenous instruments (to take into account the endogeneity of weekly working hours) and secondly replicating the regression-based procedures described in subsection 4.3.3.

[35]The t statistic of the inverse Mills ratio is equal to 0.09 (p-value=0.927) when we test the presence of sample selection bias, it is equal to -0.67 (p-value=0.502) when we test for attrition bias. These tests have been performed taking into account the endogeneity of weekly working hours introducing the inverse Mills ratios as further exogenous regressor into the IV procedure. The probit selection equation estimation results, through which the inverse Mills ratios have been computed, are reported in Appendix A-2, Table A-7. For sake of brevity we do not report the IV estimation results of the auxiliary wage regressions augmented by the inverse Mills ratios; these results are available upon request from the author.

[36]$13.584 = [\exp(-0.146) - 1] \cdot 100$.

[37]Figure 2 is based on the the estimation results presented in Tables 8 and 9. It plots the wage gap (in percentage) between a temporary worker and the comparable permanent one.

Table 8: IV, IV/RE, and IV/FE estimates of the wage model.

	IV			IV/RE			IV/FE		
	Coeff	S.E.†	p-value	Coeff	S.E.†	p-value	Coeff	S.E.†	p-value
TC	-0.106	0.039	0.007	-0.107	0.040	0.007	-0.125	0.051	0.015
TC×Tenure	0.009	0.007	0.171	0.011	0.007	0.148	0.017	0.010	0.096
TC×Tenure^2/100	-0.000	0.000	0.644	-0.000	0.000	0.440	-0.000	0.000	0.181
Tenure	0.005	0.002	0.010	0.004	0.002	0.039	-0.005	0.005	0.353
Tenure^2/100	-0.000	0.000	0.457	-0.000	0.000	0.798	0.000	0.000	0.579
Experience	0.015	0.002	0.000	0.017	0.002	0.000			
Experience^2/100	-0.025	0.005	0.000	-0.028	0.005	0.000	-0.046	0.021	0.026
Area - Reference: North-East									
North-West	0.029	0.014	0.032	0.027	0.014	0.047			
Centre	-0.031	0.014	0.026	-0.035	0.014	0.013			
South	-0.052	0.018	0.004	-0.056	0.018	0.002			
Islands	-0.010	0.021	0.613	-0.018	0.021	0.384			
Education - Reference: None or Elementary									
Middle school	0.065	0.022	0.004	0.066	0.022	0.003			
Professional school	0.092	0.027	0.001	0.099	0.027	0.000			
High school	0.146	0.026	0.000	0.155	0.026	0.000			
University degree or +	0.369	0.032	0.000	0.384	0.032	0.000			
Firm size - Reference: Up to 4									
From 5 to 19	0.046	0.025	0.061	0.035	0.026	0.172	-0.032	0.039	0.410
From 20 to 49	0.096	0.026	0.000	0.065	0.027	0.017	-0.062	0.044	0.158
From 50 to 99	0.136	0.028	0.000	0.098	0.028	0.000	-0.043	0.045	0.340
From 100 to 499	0.153	0.027	0.000	0.127	0.027	0.000	-0.005	0.044	0.900
500 or more	0.198	0.027	0.000	0.170	0.028	0.000	0.018	0.046	0.692
Public Sector	0.188	0.029	0.000	0.156	0.029	0.000	0.009	0.046	0.836
Occupation - Reference: Blue collar									
White collar	0.128	0.014	0.000	0.128	0.015	0.000	0.060	0.028	0.029
Manager	0.332	0.028	0.000	0.298	0.026	0.000	0.122	0.038	0.001
Industry - Reference: Agriculture									
Industry & Mining	0.112	0.039	0.004	0.096	0.039	0.013	0.026	0.056	0.640
Building & Construct.	0.129	0.044	0.003	0.104	0.043	0.015	0.042	0.062	0.495
Wholesale & Retail Tr.	0.064	0.041	0.113	0.050	0.041	0.218	-0.004	0.060	0.942
Transport & Commun.	0.134	0.045	0.003	0.108	0.044	0.014	0.049	0.064	0.450
Credit & Insurance	0.235	0.046	0.000	0.200	0.046	0.000	-0.054	0.068	0.431
Business services	0.097	0.047	0.038	0.077	0.048	0.111	0.006	0.068	0.929
Domestic services	0.041	0.049	0.403	0.045	0.050	0.360	0.025	0.069	0.713
Public administration	0.091	0.041	0.027	0.076	0.041	0.063	0.002	0.059	0.977
Female	-0.082	0.014	0.000	-0.098	0.015	0.000			
Head of Household	0.025	0.012	0.031	0.019	0.011	0.090	-0.022	0.024	0.342
Married	0.062	0.013	0.000	0.062	0.013	0.000	0.037	0.040	0.360
Weekly working hours	-0.005	0.002	0.003	-0.006	0.002	0.003	-0.016	0.005	0.001
2002	0.019	0.008	0.021	0.017	0.008	0.036	0.067	0.019	0.000
Constant	1.693	0.099	0.000	1.168	0.075	0.000	2.943	0.206	0.000
Observations			4,370			4,370			4,370
R^2			0.466			0.397			0.315
Adjusted R^2			0.461			0.392			0.311
F-test of joint	$F(36, 2184)$		p-value	$F(36, 2184)$		p-value	$F(26, 2184)$		p-value
significance:	69.70		0.000	67.39		0.000	3.79		0.000
White/Koenker	$F(\ 2, 2184)$		p-value	$F(\ 2, 2184)$		p-value	$F(\ 2, 2184)$		p-value
heteroskedasticity test:	10.40		0.000	6.34		0.002	7.28		0.001
F-test for	$F(\ 1, 2184)$		p-value	$F(\ 1, 2184)$		p-value	$F(\ 1, 2184)$		p-value
excluded instruments:	787.9		0.000	473.5		0.000	61.11		0.000
Regression-based strict exogeneity tests:						$F(25, 2134)$=1.53 p-value=0.045			
						$F(\ 5, 2154)$=2.17 p-value=0.055			
Hausman tests *RE* vs *FE*:						$F(25, 2184)$=4.21 p-value=0.000			
						$F(\ 5, 2184)$=2.01 p-value=0.074			

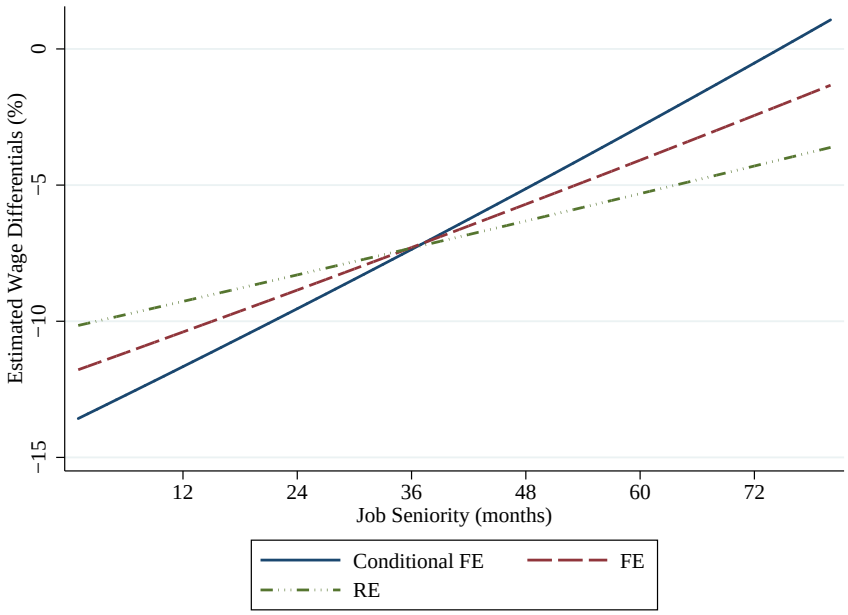
Source: SHIW - Bank of Italy, 2000 and 2002.
Notes: †Arellano (1987) robust standard errors have been computed.

Table 9: IV/FE on stayers and conditional IV/FE estimates of the wage model

	IV/FE on Stayers			Conditional IV/FE‡		
Variable	Coeff	S.E.†	p-value	Coeff	S.E.†	p-value
TC	-0.1209	0.0670	0.071	-0.1459	0.0539	0.007
TC×Tenure	0.0170	0.0118	0.149	0.0238	0.0108	0.028
TC×Tenure^2/100	-0.0004	0.0003	0.211	-0.0006	0.0003	0.052
Tenure				0.0004	0.0118	0.971
Tenure^2/100	0.0003	0.0003	0.226	0.0001	0.0002	0.702
Experience^2/100	-0.0539	0.0256	0.035	-0.0431	0.0228	0.059
Firm size - Reference: Up to 4						
From 5 to 19	-0.0607	0.0432	0.160	0.0089	0.2652	0.973
From 20 to 49	-0.0708	0.0494	0.152	-0.2371	0.2990	0.428
From 50 to 99	-0.0510	0.0500	0.308	-0.2983	0.2940	0.311
From 100 to 499	-0.0162	0.0492	0.742	-0.0871	0.2963	0.769
500 or more	0.0100	0.0499	0.841	-0.1456	0.3074	0.636
Public Sector	-0.0118	0.0502	0.813	-0.2975	0.2928	0.310
Occupation - Reference: Blue collar						
White collar	0.0849	0.0279	0.002	0.0568	0.0282	0.044
Manager	0.1582	0.0370	0.000	0.1237	0.0388	0.001
Industry - Reference: Agriculture						
Industry & Mining	-0.0180	0.0567	0.752	-1.2504	0.4754	0.009
Building & Construction	-0.0248	0.0619	0.688	-0.7364	0.6534	0.260
Wholesale & Retail Trade	-0.0491	0.0630	0.435	-1.4096	0.4735	0.003
Transport & Communication	0.0040	0.0646	0.951	-0.6678	0.5252	0.204
Credit & Insurance	-0.0844	0.0700	0.228	-0.5754	0.5973	0.335
Business services	-0.0510	0.0667	0.445	-0.4902	0.6486	0.450
Domestic services	-0.0042	0.0691	0.951	-0.8968	0.5866	0.126
Public administration	-0.0401	0.0601	0.505	-0.2360	0.5070	0.642
Head of Household	-0.0242	0.0251	0.335	-0.0330	0.0424	0.437
Married	0.0009	0.0315	0.976	0.0247	0.0229	0.281
Weekly working hours	-0.0157	0.0060	0.008	-0.0143	0.0051	0.005
2002	0.0478	0.0178	0.007	0.0654	0.0221	0.003
Constant	2.8948	0.2398	0.000	2.7208	0.2603	0.000
Observations			3,922			4,370
R^2			0.322			0.323
Adjusted R^2			0.318			0.308
F-test of joint		$F(26, 2184)$	p-value		$F(96, 2184)$	p-value
significance:		3.53	0.000		2.35	0.000
White/Koenker		$F(\ 2, 1960)$	p-value		$F(\ 2, 2184)$	p-value
heteroskedasticity test:		7.13	0.001		3.27	0.038
F-test for		$F(\ 1, 1960)$	p-value		$F(\ 1, 2184)$	p-value
excluded instruments:		37.55	0.000		59.23	0.000
F-test of joint significance for interactions:				$F(70, 2184)$=1.30		p-value=0.048
Regression-based strict exogeneity tests:				$F(25, 2064)$=1.30		p-value=0.146
				$F(\ 5, 2084)$=1.73		p-value=0.124
Hausman tests *FE on Stayers* vs *Conditional FE*:				$F(24, 2184)$=1.46		p-value=0.070
				$F(\ 4, 2184)$=0.56		p-value=0.644
Hausman tests *Conditional FE* vs *Conditional RE*§:				$F(25, 2184)$=3.69		p-value=0.000
				$F(\ 5, 2184)$=1.89		p-value=0.093

Source: SHIW - Bank of Italy, 2000 and 2002.
Notes: †Arellano (1987) robust standard errors have been computed. ‡Within-individual estimation results of the wage model augmented by 70 interactions between individual and job characteristics. The 70 interactions are included in the wage equation but not reported. Table A-6 displays their coefficients and standard errors.

Figure 2: Estimated wage differentials for temporary workers controlling for weekly working hours.



6.4.2 Heterogeneous impact of temporary jobs on wages and recent employment histories

As sensitivity analysis, we have augmented the wage equation using a set of interactions between the contract type dummy and time-invariant and time-variant wage regressors.[38] The aim is to understand whether there is any other heterogeneity due to some time-invariant and/or time-variant explanatory variables and whether our results are robust to heterogeneous responses.

We have found out that these interactions are jointly not determinant and the estimation results of the variables of primary interest are not affected.

Finally, we have tried to control for recent employment histories. A temporary job may be interpreted as a program participation and, in this framework, we could ask whether our results were sensible to the unemployment and earning dynamics[39] before the acceptance of a temporary job. Indeed,

[38] We have interacted TC_{it} with gender, education, geographical area, industry, firm size, occupational dummies, marital status, household position, time dummy, and squared experience.

[39] The earning pattern (and its importance in the program evaluation literature) was first

it is plausible to suppose some correlation between the individual's employment status and/or his (her) income level before the temporary job and the probability of ending in a temporary contract.

We would have introduced in the econometric specification of our wage equation some regressors controlling for the employees' recent histories, but the SHIW provides very little information about them. Therefore, we have included in wage equation (9) three proxy dummies for labour market history: (i) a dummy equal to one if the employee has received some unemployment benefits in the interview year, as a proxy for recent unemployment spells; (ii) a dummy equal to one if the employee had been a self employed; (iii) a dummy equal to one if the employee is performing the first job activity.

These three dummy variables are jointly not significant,[40] but doubts about their capability to control for individuals' recent histories arise. Limited by the survey, we cannot go deeply into this issue.

6.4.3 FE estimation on stayers: testing the exogeneity of mobility

In subsection 4.3.1 we argued that the FE estimator on the stayers' subsample allows us to consistently estimate our wage equation allowing for any kind of correlation between individual- and job-specific components. We have also introduced a further requirement, the exogeneity of mobility. Indeed, in order to perform this estimator, we have imposed a selection rule on the employees' full sample: we have dropped employees who changed job between 2000 and 2002. But, if this selection rule is not entirely random and it is correlated to the error term even if we condition on individual and job fixed effects, our estimation results could be biased.

The stayers' first differenced wage equation is

$$\Delta y_{i2} = \mathbf{\Delta h}'_{i2}\boldsymbol{\beta} + \Delta u_{i2}, \quad i = 1, \ldots, S, \tag{17}$$

where $\Delta y_{i2}{=}y_{i2}{-}y_{i0}$, $\Delta u_{i2}{=}u_{i2}{-}u_{i0}$, $\Delta \mathbf{h}_{i2}{=}\mathbf{h}_{i2}{-}\mathbf{h}_{i0}$, $\mathbf{h}_{it}{=}[\mathbf{z}'_{it}, \mathbf{x}'_{it}]'$, and $t = 0$ and $t = 2$ correspond to 2000 and 2002, respectively. The selection equation is

$$m_{i2} = 1[\mathbf{d}'_{i2}\boldsymbol{\theta}_2 + \xi_{i2} > 0], \quad i = 1, \ldots, N, \tag{18}$$

where $\mathbf{d}_{i2}$ contains the variables in $\mathbf{h}_{i0}$. Assume that: (i) $\mathbf{h}_{it}$ is strictly exogenous; (ii) selection does not depend on $\mathbf{\Delta h}_{i2}$ once $\mathbf{d}_{i2}$ has been controlled

noted by Ashenfelter (1978), while see, e.g., Heckman et al. (1997) for the importance of the unemployment dynamics.

[40] The p-value of the F-test is 0.888 .

for; and (iii) Δu_{i2} and ξ_{i2} are bivariate normal random variables, that is

$$\begin{pmatrix} \Delta u_{i2} \\ \xi_{i2} \end{pmatrix} \sim N \left[\mathbf{0}, \begin{pmatrix} \sigma_u^2 & \rho\sigma_u \\ \rho\sigma_u & 1 \end{pmatrix} \right], \tag{19}$$

where ρ is the correlation between the disturbances. Then, the expected hourly wage of employee i can be written as

$$\begin{aligned} E(\Delta y_{i2}|\ \boldsymbol{\Delta}\mathbf{h}_{i2}, \mathbf{d}_{i2}, m_{i2}=1) &= E(\boldsymbol{\Delta}\mathbf{h}'_{i2}\boldsymbol{\beta} + \Delta u_{i2}|\mathbf{h}_{i2}, \mathbf{d}_{i2}, m_{i2}=1) \\ &= \boldsymbol{\Delta}\mathbf{h}'_{i2}\boldsymbol{\beta} + E(\Delta u_{i2}|\mathbf{h}_{i2}, \mathbf{d}_{i2}, m_{i2}=1) \\ &= \boldsymbol{\Delta}\mathbf{h}'_{i2}\boldsymbol{\beta} + E(\Delta u_{i2}|m_{i2}=1) \text{ since } u_{it} \perp \mathbf{h}_{it} \\ &= \boldsymbol{\Delta}\mathbf{h}'_{i2}\boldsymbol{\beta} + E(\Delta u_{i2}|\xi_{i2} > -\mathbf{d}'_{i2}\boldsymbol{\theta}_2). \end{aligned} \tag{20}$$

By assumption (iii), $E(\Delta u_{i2}) = E(\Delta u_{i2}) + \rho\sigma_u[\xi_{i2} - E(\xi_{i2})]$, therefore exploiting the law of iterated expectations we can rewrite the last term of equation (20) as follows:

$$\begin{aligned} E(\Delta u_{i2}|\xi_{i2} > -\mathbf{d}'_{i2}\boldsymbol{\theta}_2) &= E\Big[E(\Delta u_{i2}|\xi_{i2})\big|\ \xi_{i2} > -\mathbf{d}'_{i2}\boldsymbol{\theta}_2\Big] \\ &= E\Big\{E(\Delta u_{i2}) + \rho\sigma_u\big[\xi_{i2} - E(\xi_{i2})\big]\big|\xi_{i2} > -\mathbf{d}'_{i2}\boldsymbol{\theta}_2\Big\} \\ &= \rho\sigma_u E(\xi_{i2}|\ \xi_{i2} > -\mathbf{d}'_{i2}\boldsymbol{\theta}_2) \\ &= \rho\sigma_u \frac{\phi(\mathbf{d}'_{i2}\boldsymbol{\theta}_2)}{\Phi(\mathbf{d}'_{i2}\boldsymbol{\theta}_2)} \\ &= \rho\sigma_u \lambda(\mathbf{d}'_{i2}\boldsymbol{\theta}_2), \end{aligned} \tag{21}$$

where $\lambda(\cdot)$ is the inverse Mills ratio and $\phi(\cdot)$ and $\Phi(\cdot)$ are the standard normal density function and the standard normal cumulative distribution function, respectively. Plugging equation (21) into equation (20) yields

$$E(\Delta y_{i2}|\ \boldsymbol{\Delta}\mathbf{h}_{i2}, \mathbf{d}_{i2}, m_{i2}=1) = \boldsymbol{\Delta}\mathbf{h}'_{i2}\boldsymbol{\beta} + \rho\sigma_u\lambda(\mathbf{d}'_{i2}\boldsymbol{\theta}_2). \tag{22}$$

Equation (22) makes clear that if mobility is exogenous we have zero correlation between the disturbances of the first differenced wage equation (17) and the disturbances of the selection equation (18), and we can consistently estimate $\boldsymbol{\beta}$ using the selected sample (the stayers' subsample). But, if ρ is different from zero, the OLS regression of Δy_{i2} on $\boldsymbol{\Delta}\mathbf{h}_{i2}$ using the stayers' subsample omits the inverse Mills ratio, leading to inconsistent estimation of $\boldsymbol{\beta}$ if there is some correlation between our wage regressors and mobility once we control for individual- and job-specific components.

In order to test the presence of selection bias, we perform the two step procedure proposed by Heckman (1976): (i) we obtain the probit estimate $\widehat{\boldsymbol{\theta}}_2$

using the full sample and we compute the inverse Mills ratios $\widehat{\lambda}_i = \lambda(\mathbf{d}'_{i2}\widehat{\boldsymbol{\theta}}_2) = \phi(\mathbf{d}'_{i2}\widehat{\boldsymbol{\theta}}_2)/\Phi(\mathbf{d}'_{i2}\widehat{\boldsymbol{\theta}}_2)$; (ii) we perform the OLS regression of Δy_{i2} on $\boldsymbol{\Delta}\mathbf{h}_{i2}$ and $\widehat{\lambda}_i$ using the stayers' subsample and we test the significance of the estimated parameter associated to $\widehat{\lambda}_i$. Indeed, under the null hypothesis of no selection bias, the estimated inverse Mills ratios should not have explanatory power in the augmented wage regression.

Table 10 displays the probit estimation results of the two step procedure for the selection bias test. We include as covariates of the selection indicator, m_{i2}, all the wage regressors in 2000 levels. Therefore, the identification of this procedure hinges on the inclusion of wage regressors in 2000 levels into the selection equation, while they are included in first-differences into the outcome equation. We find that the coefficient of the inverse Mills ratio is not significantly different from zero (t-stat=0.80, p-value=0.423) and we can not reject the null hypothesis of no selection bias when we use the subsample of stayers instead of the employee's full sample.[41] The selection rule we have imposed in order to tackle the correlation between job-specific components and individual characteristics seems not to bias the estimation results obtained via FE and displayed in the first three columns of Tables 5 and 9.

7 Concluding remarks

This paper has investigated whether the effects of temporary contracts are higher or lower wages and whether temporary workers are compensated by particular returns to seniority. According to the theory of compensating differentials we would expect to detect a risk premium for temporary workers in terms of higher wages. Nevertheless, we have seen that there are other theoretical explanations leading to wage penalties for temporary employees.

As a matter of fact, the main finding is that, after controlling both for individual-specific components and unobservable job-specific effects, a significant wage penalty for temporary workers of about 12% is detected. This wage penalty becomes highly significant and equal to 13.5% when we control for weekly working hours. Once more, the empirical evidence does not support the theory of compensating differentials.

Given that there are wage penalties for temporary workers, another finding is that temporary employees seem to be compensated by higher returns to

[41] We have repeated this test controlling for weekly working hours and implementing an IV procedure using the inverse Mills ratio as included instrument. The t-statistic associated to the coefficient of the inverse Mills ratio is 0.88, corresponding to a p-value equal to 0.379.

Table 10: Probit estimation results of the two step procedure to test selection bias.

Variable in 2000 levels	Coeff	S.E.	p-value
TC	-1.127	0.185	0.000
TC×Tenure	0.180	0.039	0.000
TC×Tenure^2/100	-0.005	0.001	0.000
Tenure^2/100	0.002	0.000	0.000
Experience^2/100	0.013	0.015	0.375
Firm size - Reference: Up to 4			
From 5 to 19	0.011	0.160	0.946
From 20 to 49	0.210	0.181	0.245
From 50 to 99	-0.018	0.192	0.925
From 100 to 499	0.039	0.187	0.834
500 or more	0.106	0.189	0.576
Public Sector	0.380	0.219	0.083
Occupation - Reference: Blue collar			
White collar	-0.044	0.102	0.669
Manager	0.066	0.179	0.714
Industry - Reference: Agriculture			
Industry & Mining	-0.381	0.278	0.171
Building & Construction	-0.354	0.325	0.276
Wholesale & Retail Trade	-0.271	0.292	0.354
Transport & Communication	-0.459	0.335	0.170
Credit & Insurance	-0.090	0.351	0.797
Business services	-0.027	0.346	0.937
Domestic services	0.003	0.343	0.992
Public administration	-0.171	0.308	0.578
Head of Household	0.115	0.099	0.249
Married	-0.193	0.099	0.052
Part-time	0.009	0.141	0.950
Constant	1.070	0.349	0.002
Observations			2,185
Censored			224
Pseudo R^2			0.219
Log-likelihood			-564.24
Test of joint significance	χ^2_{24}=316.6 p-value=0.000		

Source: SHIW - Bank of Italy, 2000 and 2002.

seniority. The estimated coefficient of the interaction term between contract type and seniority is 0.023 but statistically different from zero only at a 10% significance level (p-value=0.055). This slight evidence of decreasing wage penalties within the same firm becomes heavier when we control for weekly working hours: the estimated coefficient of the interaction is still around 0.023 but significant at the 5% level.

The empirical evidence does not support the theory of compensating differentials. Furthermore, there is a slight evidence of decreasing wage penalties within the same firm, supporting the Loh's (1994) interpretation of temporary contracts as a sorting mechanism. Firms post vacancies characterized by a probationary stage (the temporary contract) with lower wages, but promising higher wages afterwards, in order to generate a self-selection of the most skillful candidates. Furthermore, if we interpret temporary jobs as an on-the-job training period for new workers, our findings are in line with the ones by Barron et al. who find that a 10% increase in the worker's on-the-job training (measured in hours) raises wage growth by 1.5%.

Assuming that job seniority is able to capture the degree of participation to the firm life, our results may be explained by the institutional setting and when job seniority increases – higher degree of participation to the firm life – there is no longer a legal reason for the firm to discriminate and the wage gap between permanent and temporary workers disappears.

Appendix

A-1 Statistical appendix

Equivalence between FE estimation on the stayers' subsample and the within-individual/within-job procedure on the full sample.

Define $\mathbf{H} \equiv [\mathbf{Z} \vdots \mathbf{X}]$ the $NT \times D$ matrix collecting our observable wage regressors, where $D = 5 + K$ and $T = 2$. Denote $\mathbf{Y}$ the NT-vector of our dependent variable. $\mathbf{H}$ and $\mathbf{Y}$ can be partitioned according to job mobility as follows: $\mathbf{H} = [\mathbf{H}_s' \vdots \mathbf{H}_m']'$ and $\mathbf{Y} = [\mathbf{Y}_s' \vdots \mathbf{Y}_m']'$, where $\mathbf{H}_s$ is the $TS \times D$ regressors matrix for stayers, $\mathbf{H}_m$ is the $TM \times D$ regressors matrix for movers, and $\mathbf{Y}_s$ and $\mathbf{Y}_m$ are the TS- and TM-vectors of the dependent variable for stayers and for movers, respectively; in this empirical analysis $S = 1,961$ and $M = 224$. Finally, $\mathbf{Q}$ is the $T \times T$ symmetric, idempotent time-demeaning matrix with rank $T - 1$.

The FE estimator on the stayers' subsample is

$$\begin{aligned} \hat{\boldsymbol{\beta}}_{FEs} &= \Big(\sum_{i=1}^{S} \mathbf{H}_{is}' \mathbf{Q} \mathbf{H}_{is}\Big)^{-1} \Big(\sum_{i=1}^{S} \mathbf{H}_{is}' \mathbf{Q} \mathbf{Y}_{is}\Big) \\ &= \Big(\sum_{i=1}^{S} \ddot{\mathbf{H}}_{is}' \mathbf{H}_{is}\Big)^{-1} \Big(\sum_{i=1}^{S} \ddot{\mathbf{H}}_{is}' \mathbf{Y}_{is}\Big). \end{aligned} \tag{A-1}$$

Equation A-1 shows that the FE estimator can, in general, be interpreted as an instrumental variables (IV) estimator where the excluded instruments are the deviations from the individual means.

The within-individual/within-job (FEWJ) estimator can be written as

$$\hat{\boldsymbol{\beta}}_{FEWJ} = \Big(\sum_{i=1}^{S} \widetilde{\mathbf{H}}'_{is}\mathbf{H}_{is} + \sum_{j=1}^{M} \widetilde{\mathbf{H}}'_{jm}\mathbf{H}_{jm}\Big)^{-1}\Big(\sum_{i=1}^{S} \widetilde{\mathbf{H}}'_{is}\mathbf{Y}_{is} + \sum_{j=1}^{M} \widetilde{\mathbf{H}}'_{jm}\mathbf{Y}_{jm}\Big), \tag{A-2}$$

where $\widetilde{\mathbf{H}}_{is}$ is the $ST \times D$ regressors matrix containing the stayers' deviations from the within-job means, and $\widetilde{\mathbf{H}}_{im}$ is the $MT \times D$ matrix counterpart for the movers. The deviations from the within-job means for the stayer i at time t are $\widetilde{\mathbf{h}}_{its} = \mathbf{h}_{its} - \sum_{t=1}^{T} \mathbf{h}_{its}$, exactly equal to the deviations from the individual means. The deviations from the within-job means for the mover j at date t are, instead, simply equal to zero. Thus, $\widetilde{\mathbf{H}}_{is} = \ddot{\mathbf{H}}_{is}$ and $\widetilde{\mathbf{H}}_{jm} = \mathbf{0}$ for $i = 1, 2, \ldots, S$ and $j = 1, 2, \ldots, M$. Substituting into equation (A-2) yields

$$\begin{aligned}
\hat{\boldsymbol{\beta}}_{FEWJ} &= \Big(\sum_{i=1}^{S} \ddot{\mathbf{H}}'_{is}\mathbf{H}_{is} + \mathbf{0}\Big)^{-1}\Big(\sum_{i=1}^{S} \ddot{\mathbf{H}}'_{is}\mathbf{Y}_{is} + \mathbf{0}\Big) \\
&= \Big(\sum_{i=1}^{S} \ddot{\mathbf{H}}'_{is}\mathbf{H}_{is}\Big)^{-1}\Big(\sum_{i=1}^{S} \ddot{\mathbf{H}}'_{is}\mathbf{Y}_{is}\Big) \\
&= \hat{\boldsymbol{\beta}}_{FEs}
\end{aligned} \tag{A-3}$$

Therefore, fixed effects estimation on the stayers' subsample and within-individual/within-job procedure on the full sample produce identical estimates and inference in our framework. Indeed, the within-individual/within-job technique can be interpreted as an IV procedure: our wage regressors are endogenous because they are likely to be correlated with personal- and job-specific characteristics; these endogenous regressors are instrumented using the deviations from the within-job means; since, the deviations from the within-job means are equal to zero for movers and equal to the deviations from the individual means for stayers, our IV estimator gives a zero weight to movers and we get the usual FE estimator preformed on the stayers' subsample.

The within-individual/within-job (FEWJ) estimator as IV estimator of the time-demeaned model and a regression-based Hausman test.

We have seen that the FEWJ estimator and the FE estimator on the stayers' subsample produce the same results. Another equivalence that we exploit to compute a regression-based Hausman test and compare the estimated coefficients of the variables of primary interest is the following:

$$\begin{aligned}
\hat{\boldsymbol{\beta}}_{FEWJ} &= \Big(\sum_{i=1}^{S} \ddot{\mathbf{H}}'_{is}\mathbf{H}_{is}\Big)^{-1}\Big(\sum_{i=1}^{S} \ddot{\mathbf{H}}'_{is}\mathbf{Y}_{is}\Big) \\
&= \Big(\sum_{i=1}^{N} \widetilde{\mathbf{H}}'_{i}\ddot{\mathbf{H}}_{i}\Big)^{-1}\Big(\sum_{i=1}^{N} \widetilde{\mathbf{H}}'_{i}\ddot{\mathbf{Y}}_{i}\Big).
\end{aligned} \tag{A-4}$$

Indeed, since $\widetilde{\mathbf{H}}_{is} = \ddot{\mathbf{H}}_{is}$ and $\widetilde{\mathbf{H}}_{im} = \mathbf{0}$, we get

$$\begin{aligned}
\hat{\boldsymbol{\beta}}_{FEWJ} &= \Big(\sum_{i=1}^{N} \widetilde{\mathbf{H}}_i' \ddot{\mathbf{H}}_i\Big)^{-1}\Big(\sum_{i=1}^{N} \widetilde{\mathbf{H}}_i' \ddot{\mathbf{Y}}_i\Big) \\
&= \Big(\sum_{i=1}^{S} \widetilde{\mathbf{H}}_{is}' \ddot{\mathbf{H}}_{is} + \sum_{j=1}^{M} \widetilde{\mathbf{H}}_{jm}' \ddot{\mathbf{H}}_{jm}\Big)^{-1}\Big(\sum_{i=1}^{S} \widetilde{\mathbf{H}}_{is}' \ddot{\mathbf{Y}}_{is} + \sum_{j=1}^{M} \widetilde{\mathbf{H}}_{jm}' \ddot{\mathbf{Y}}_{jm}\Big) \\
&= \Big(\sum_{i=1}^{S} \ddot{\mathbf{H}}_{is}' \ddot{\mathbf{H}}_{is}\Big)^{-1}\Big(\sum_{i=1}^{S} \ddot{\mathbf{H}}_{is}' \ddot{\mathbf{Y}}_{is}\Big) \\
&= \Big(\sum_{i=1}^{S} \ddot{\mathbf{H}}_{is}' \mathbf{H}_{is}\Big)^{-1}\Big(\sum_{i=1}^{S} \ddot{\mathbf{H}}_{is}' \mathbf{Y}_{is}\Big). \qquad \text{(A-5)}
\end{aligned}$$

The FE estimator $\hat{\boldsymbol{\beta}}_{FE} = (\sum_{i=1}^{N} \ddot{\mathbf{H}}_i' \ddot{\mathbf{H}}_i)^{-1}(\sum_{i=1}^{N} \ddot{\mathbf{H}}_i' \ddot{\mathbf{Y}}_i)$ is the BLUE estimator under homoskedaticity and the presence of individual fixed constants, c_i; the FE estimator is simply the least squares estimator of the time-demeaned dataset. In this context the FEWJ estimator $\hat{\boldsymbol{\beta}}_{FEWJ} = (\sum_{i=1}^{N} \widetilde{\mathbf{H}}_i' \ddot{\mathbf{H}}_i)^{-1}\ (\sum_{i=1}^{N} \widetilde{\mathbf{H}}_i' \ddot{\mathbf{Y}}_i)$ can be interpreted as an IV estimator employing the within-job means as instruments for the within-individual means. Under homoskedasticity and the presence of individual fixed constants, c_i, this IV estimator is consistent but less efficient. Thus, we could use the usual Hausman test to compare the FE and the FEWJ estimation results. But heteroskedasticity has been detected and the usual Hausman test formula cannot be applied because the asymptotic variance of the difference of the estimators diverges from the difference in the asymptotic variances.

As pointed out by Hausman (1978), we can compute a regression-based form of the test that turns out to be asymptotically equivalent to the original form of the Hausman test. Define $\widehat{\ddot{\mathbf{H}}} \equiv \widetilde{\mathbf{H}}(\widetilde{\mathbf{H}}'\widetilde{\mathbf{H}})\widetilde{\mathbf{H}}'\ddot{\mathbf{H}}$ the liner projection of $\ddot{\mathbf{H}}$ on $\widetilde{\mathbf{H}}$. Estimating the model

$$\ddot{\mathbf{Y}} = \ddot{\mathbf{H}}\boldsymbol{\beta} + \widehat{\ddot{\mathbf{H}}}\boldsymbol{\lambda} + error \qquad \text{(A-6)}$$

and doing a standard F test of H_0: $\boldsymbol{\lambda} = 0$ under homoskedasticity result in the usual Hausman statistic.[42] Then, we computed the robust version of the F test to take into account serial correlation and heteroskedasticity. We used this regression-based procedure to compare the estimation results from the FEWJ (or FE on stayers' subsample) estimator and the conditional FE estimator.

A-2 Data appendix

This appendix adds details of the definition and construction of variables used in the econometric analysis and reports estimation results not presented in the text.

Table A-1 displays means and standard deviations of the wage regressors; Table A-4 should be considered its supplement because it contains means and standard deviations

[42] We can get the same statistic through two equivalent and similar procedures:

- Replacing $\widetilde{\mathbf{H}}$ with $\widehat{\mathbf{v}}$ in model (A-6), where $\widehat{\mathbf{v}}$ is the conformable least squares residual matrix of the reduced form model $\ddot{\mathbf{H}} = \widetilde{\mathbf{H}}\boldsymbol{\Pi} + \mathbf{v}$.
- Substituting $\widetilde{\mathbf{H}}$ for $\widehat{\ddot{\mathbf{H}}}$ in model (A-6); indeed $\widehat{\ddot{\mathbf{H}}} = \widetilde{\mathbf{H}}$ because $\widetilde{\mathbf{H}}'\ddot{\mathbf{H}} = \widetilde{\mathbf{H}}'\widetilde{\mathbf{H}}$.

of the interactions between individual and job characteristics used to augment the wage equation and to perform the conditional FE procedure. Table A-2 reports the fraction of temporary workers by personal and job characteristics in 2000 and 2002, while Table A-3 presents the distribution of employees by mobility and contract type. Table A-5 and Table A-6 are integral parts of Table 5 and Table 9, respectively, but they are not reported in the text for sake of brevity. Indeed, they contain estimated coefficients and robust standard errors for the 70 interactions between individual and job characteristics used to proxy the correlation between personal characteristics and firm unobservables. Finally, Table A-7 reports the estimation results of the selection rules related to attrition and participation in labour market as employee, respectively.

Hourly wage variable

The dependent variable $\ln w_{it}$ has been computed using question 1 sections "TUTTANNO" and "MESILAV", question 3, and question 7 of the annex B1 of the questionnaire of the SHIW. In question 1 sections "TUTTANNO" and "MESILAV" employees are asked to specify whether they have worked for all the year long (12 months) or not. If not, they are asked to specify how many months they have worked . In question 3 employees are asked to report the average weekly working hours including overtime, considering the activity performed during the interview time. In question 7 they are asked to display the total earned income in euros from the job performed during the interview year, summing the average monthly net earnings (including overtime) times the number of months worked, the additionally monthly salary ("13th month" salary, "14th month" salary, etc...), bonuses or special emoluments, and other compensation (productivity bonuses, commissions, etc...). Fringe benefits are excluded and the total earned income reported in question 7 is net of taxes and social security contributions. Using this information we computed the natural logarithm of the average net hourly wage applying the following formula:

$$\ln w_{it} = \ln\Big(\frac{\text{total earned income}}{\#\text{ of months} \cdot \text{average weekly hours} \cdot 4}\Big). \tag{A-7}$$

We applied this formula both in 2000 and in 2002, and then we calculated the CPI-deflated wage, so that our dependent variable is the average net real hourly wage at 2002 prices.

Temporary and permanent contracts

The dummy variable TC_{it} has been built using question 1 section "CONTRATT" of the annex B1 (information about the employees' job) of the SHIW questionnaire. The question requires to indicate the contract choosing between permanent, fixed-term, and worker for temporary job agency. Thus, the dummy variable for the contract type is equal to 0 when the employee answers to have a permanent contract, it is equal to 1 if the worker replies to belong to the last two categories.

It would be interesting to distinguish the effects on wages of fixed-term contracts from the effects on wages of temporary job agencies contracts. The small number of observations of workers for temporary job agency has forced us to group together in the same category these two temporary workers' types. Indeed, the fraction of workers for temporary work agencies is 0.21% over the full sample and 3.4% over temporary workers' subsample, corresponding to 9 observations.

Table A-1: Means and standard deviations (overall, between, and within individuals) of variables used in wage equations.

	Variable	Mean	Std.Dev.	Variable	Mean	Std.Dev.	Variable	Mean	Std.Dev.
Overall	ln($wage$)	2.09	0.413	High school	0.40	0.489	Industry & Mining	0.30	0.458
Between			0.366			0.481			0.424
Within			0.191			0.092			0.174
Overall	TC	0.06	0.240	University degree or more	0.13	0.341	Building & Construction	0.05	0.216
Between			0.198			0.339			0.194
Within			0.135			0.035			0.096
Overall	TC×Tenure	0.64	3.890	Up to 4 employees	0.08	0.264	Wholesale	0.10	0.299
Between			3.363			0.232			0.269
Within			1.956			0.125			0.131
Overall	Tenure	16.07	10.818	From 5 to 19	0.18	0.382	Transport & Communication	0.04	0.194
Between			10.709			0.330			0.164
Within			1.538			0.193			0.105
Overall	Experience	21.18	10.789	From 20 to 49	0.12	0.319	Credit & Insurance	0.05	0.209
Between			10.744			0.259			0.199
Within			1.000			0.187			0.067
Overall	North-East	0.26	0.438	From 50 to 99	0.08	0.275	Business services	0.03	0.179
Between			0.438			0.217			0.145
Within			0.000			0.169			0.105
Overall	North-West	0.24	0.427	From 100 to 499	0.11	0.310	Domestic services	0.04	0.186
Between			0.427			0.264			0.156
Within			0.000			0.163			0.102
Overall	Centre	0.22	0.417	500 or more	0.12	0.329	Other sectors	0.37	0.482
Between			0.417			0.282			0.459
Within			0.000			0.169			0.147
Overall	South	0.18	0.380	Public sector	0.32	0.466	Female	0.41	0.492
Between			0.380			0.434			0.492
Within			0.000			0.170			0.000
Overall	Islands	0.10	0.305	Blue collar	0.42	0.493	Head of Household	0.47	0.499
Between			0.305			0.475			0.478
Within			0.000			0.132			0.143
Overall	None or Elementary	0.08	0.274	White collar	0.49	0.500	Married	0.70	0.460
Between			0.269			0.465			0.456
Within			0.048			0.183			0.059
Overall	Middle school	0.30	0.460	Manager	0.09	0.286	Part-timer	0.08	0.269
Between			0.453			0.251			0.244
Within			0.080			0.137			0.114
Overall	Professional school	0.08	0.278	Agricolture	0.03	0.174	$N =$		2,185
Between			0.263			0.155	$T =$		2
Within			0.091			0.079	$NT =$		4,370

Source: SHIW - Bank of Italy, 2000 and 2002.

Table A-2: Rate of temporary workers[†] by year, personal, and firm characteristics.

Year	2000	2002		2000	2002
Overall	7.14	5.08	Overall	7.14	5.08
Tenure			*Firm size*		
Up to 1 year	23.17	6.25	Up to 4	11.69	7.43
From 1 to 2	19.05	14.75	From 5 to 19	13.20	7.61
From 2 to 3	14.29	13.08	From 20 to 49	6.97	4.25
From 4 to 5	10.39	6.94	From 50 to 99	2.76	7.22
From 6 to 10	6.69	7.72	From 100 to 499	6.91	4.91
More than 10	3.67	2.72	500 or more	3.15	2.38
Experience			Public Sector	5.59	3.92
Up to 3 years	22.80	18.18	*Industry*		
From 4 to 5	8.86	10.48	Agriculture	31.75	24.66
From 6 to 10	7.58	9.79	Industry & Mining	4.32	3.13
More than 10	5.23	3.62	Building & Construction	10.68	8.93
Education			Wholesale & Retail Trade	12.33	6.51
None or Elementary	12.92	13.48	Transport & Communication	5.88	3.45
Middle school	8.93	5.49	Credit & Insurance	0.96	1.03
Professional school	5.49	3.74	Business services	8.22	2.78
High school	4.63	3.44	Domestic services	11.25	9.09
University degree or more	7.96	4.39	Public administration	6.11	4.43
Area			*Gender*		
North-East	2.30	2.84	Male	6.03	4.25
North-West	5.54	3.63	Female	8.74	6.28
Centre	5.52	4.09	*Household position*		
South	11.75	7.83	Head of household	4.73	3.77
Islands	18.58	11.50	Other	9.32	6.26
Occupation			*Marital status*		
Blue collar	10.24	7.86	Married	5.26	4.07
White collar	5.14	3.46	Other	11.46	7.41
Manager	3.38	1.09	*Working Hours*		
Job mobility			Full-time	5.69	4.40
Movers	20.09	13.84	Part-time	23.20	13.58
Stayers	5.66	4.08	Observations	2,185	2,185

Source: SHIW - Bank of Italy, 2000 and 2002.
Notes: [†]The rate of temporary workers is computed as the ratio of the number of temporary workers to the number of employed workers. Data are percentages of total employment.

Table A-3: Contract mobility and job mobility between 2000 and 2002.

	Total		Stayers		Movers	
Transition	Frequence	%	Frequence	%	Frequence	%
From TC to Permanent	102	4.67	78	3.98	24	10.71
From Permanent to TC	57	2.61	47	2.40	10	4.46
Always Permanent	1,972	90.25	1,803	91.94	169	75.45
Always TC	54	2.47	33	1.68	21	9.38
Total	2,185	100.00	1,961	100.00	224	100.00

Source: SHIW - Bank of Italy, 2000 and 2002.

Table A-4: Means and standard deviations for **S** variables.

Variable definition	Mean	Std.Dev.	Variable definition	Mean	Std.Dev.
Firm size 1×age	2.709	9.944	Industry 2×age×tenure	190.011	428.845
Firm size 2×age	6.610	14.893	Industry 3×age×tenure	37.710	226.326
Firm size 3×age	4.391	12.656	Industry 4×age×tenure	55.824	244.794
Firm size 4×age	3.328	11.450	Industry 5×age×tenure	27.473	174.997
Firm size 5×age	4.423	13.096	Industry 6×age×tenure	36.116	198.106
Firm size 6×age	5.311	14.523	Industry 7×age×tenure	17.042	130.897
Firm size 7×age	14.499	21.653	Industry 8×age×tenure	20.171	152.449
Industry 1×age	1.296	7.465	Industry 9×age×tenure	330.133	548.207
Industry 2×age	11.632	18.614	Firm size 1×experience×tenure	22.317	134.534
Industry 3×age	1.939	8.852	Firm size 2×experience×tenure	57.375	211.500
Industry 4×age	3.765	11.822	Firm size 3×experience×tenure	40.156	176.992
Industry 5×age	1.631	8.285	Firm size 4×experience×tenure	34.261	171.485
Industry 6×age	1.903	8.872	Firm size 5×experience×tenure	46.576	192.581
Industry 7×age	1.231	6.861	Firm size 6×experience×tenure	60.484	207.649
Industry 8×age	1.442	7.743	Firm size 7×experience×tenure	163.715	314.862
Industry 9×age	16.431	22.206	Industry 1×experience×tenure	17.676	148.874
Firm size 1×experience	1.289	5.562	Industry 2×experience×tenure	113.227	279.096
Firm size 2×experience	3.351	8.715	Industry 3×experience×tenure	24.038	155.791
Firm size 3×experience	2.210	7.244	Industry 4×experience×tenure	32.525	157.034
Firm size 4×experience	1.746	6.631	Industry 5×experience×tenure	16.073	107.217
Firm size 5×experience	2.277	7.445	Industry 6×experience×tenure	19.307	111.257
Firm size 6×experience	2.836	8.324	Industry 7×experience×tenure	8.699	75.336
Firm size 7×experience	7.476	12.094	Industry 8×experience×tenure	11.771	98.790
Industry 1×experience	0.739	4.685	Industry 9×experience×tenure	181.567	324.399
Industry 2×experience	6.069	11.099	Firm size 1×tenure	0.892	4.267
Industry 3×experience	1.096	5.509	Firm size 2×tenure	2.227	6.651
Industry 4×experience	1.867	6.725	Firm size 3×tenure	1.554	5.776
Industry 5×experience	0.864	4.788	Firm size 4×tenure	1.274	5.333
Industry 6×experience	0.923	4.627	Firm size 5×tenure	1.744	6.169
Industry 7×experience	0.515	3.314	Firm size 6×tenure	2.241	6.933
Industry 8×experience	0.716	4.378	Firm size 7×tenure	6.143	10.465
Industry 9×experience	8.397	12.415	Industry 1×tenure	0.569	3.983
Firm size 1×age×tenure	38.014	202.514	Industry 2×tenure	4.294	8.934
Firm size 2×age×tenure	96.496	319.511	Industry 3×tenure	0.830	4.546
Firm size 3×age×tenure	68.478	276.275	Industry 4×tenure	1.268	5.104
Firm size 4×age×tenure	57.818	261.741	Industry 5×tenure	0.599	3.631
Firm size 5×age×tenure	79.548	300.499	Industry 6×tenure	0.794	4.130
Firm size 6×age×tenure	105.072	341.782	Industry 7×tenure	0.397	2.768
Firm size 7×age×tenure	296.167	531.745	Industry 8×tenure	0.436	3.041
Industry 1×age×tenure	27.113	206.676	Industry 9×tenure	6.887	10.775

Source: SHIW - Bank of Italy, 2000 and 2002.

Table A-5: Coefficients and standard errors for **S** variables in the conditional FE estimation of the augmented wage model.

Variable definition	Coeff	S.E.†	Variable definition	Coeff	S.E.†
Firm size 2×age	0.0057	0.0140	Industry 3×age×tenure	0.0000	0.0012
Firm size 3×age	0.0199	0.0146	Industry 4×age×tenure	-0.0015	0.0013
Firm size 4×age	0.0228	0.0145	Industry 5×age×tenure	0.0003	0.0013
Firm size 5×age	0.0171	0.0149	Industry 6×age×tenure	0.0003	0.0017
Firm size 6×age	0.0187	0.0158	Industry 7×age×tenure	0.0001	0.0015
Firm size 7×age	0.0278	0.0137	Industry 8×age×tenure	-0.0013	0.0017
Industry 2×age	0.0503	0.0240	Industry 9×age×tenure	0.0004	0.0011
Industry 3×age	0.0245	0.0331	Firm size 2×experience×tenure	-0.0003	0.0009
Industry 4×age	0.0644	0.0239	Firm size 3×experience×tenure	0.0007	0.0010
Industry 5×age	0.0318	0.0258	Firm size 4×experience×tenure	0.0006	0.0009
Industry 6×age	0.0016	0.0306	Firm size 5×experience×tenure	0.0004	0.0009
Industry 7×age	0.0037	0.0333	Firm size 6×experience×tenure	0.0004	0.0010
Industry 8×age	0.0338	0.0303	Firm size 7×experience×tenure	0.0006	0.0009
Industry 9×age	0.0113	0.0251	Industry 2×experience×tenure	0.0009	0.0009
Firm size 2×experience	-0.0135	0.0138	Industry 3×experience×tenure	-0.0002	0.0012
Firm size 3×experience	-0.0250	0.0137	Industry 4×experience×tenure	0.0014	0.0011
Firm size 4×experience	-0.0258	0.0139	Industry 5×experience×tenure	-0.0002	0.0011
Firm size 5×experience	-0.0285	0.0147	Industry 6×experience×tenure	-0.0016	0.0016
Firm size 6×experience	-0.0251	0.0155	Industry 7×experience×tenure	-0.0005	0.0016
Firm size 7×experience	-0.0385	0.0142	Industry 8×experience×tenure	0.0003	0.0016
Industry 2×experience	-0.0254	0.0193	Industry 9×experience×tenure	-0.0002	0.0010
Industry 3×experience	-0.0069	0.0281	Firm size 2×tenure	0.0198	0.0265
Industry 4×experience	-0.0331	0.0193	Firm size 3×tenure	-0.0071	0.0287
Industry 5×experience	-0.0094	0.0220	Firm size 4×tenure	0.0115	0.0322
Industry 6×experience	0.0279	0.0278	Firm size 5×tenure	-0.0239	0.0441
Industry 7×experience	0.0241	0.0276	Firm size 6×tenure	0.0182	0.0418
Industry 8×experience	-0.0056	0.0239	Firm size 7×tenure	-0.0057	0.0397
Industry 9×experience	0.0005	0.0206	Industry 2×tenure	0.0317	0.0455
Firm size 2×age×tenure	0.0009	0.0010	Industry 3×tenure	-0.0218	0.0322
Firm size 3×age×tenure	-0.0003	0.0012	Industry 4×tenure	-0.0264	0.0260
Firm size 4×age×tenure	0.0002	0.0011	Industry 5×tenure	-0.0059	0.0304
Firm size 5×age×tenure	0.0002	0.0011	Industry 6×tenure	-0.0236	0.0285
Firm size 6×age×tenure	-0.0000	0.0011	Industry 7×tenure	-0.0208	0.0292
Firm size 7×age×tenure	0.0001	0.0010	Industry 8×tenure	-0.0091	0.0271
Industry 2×age×tenure	-0.0012	0.0010	Industry 9×tenure	-0.0215	0.0275
F-test of joint significance of interactions:				$F(70, 2184)$=1.46 p-value=0.0081	

Source: SHIW - Bank of Italy, 2000 and 2002.

Notes: †Arellano (1987) robust standard errors have been computed.

Table A-6: Coefficients and standard Errors for **S** variables in the conditional FE estimation of the augmented wage model controlling for weekly working hours.

Variable definition	Coeff	S.E.†	Variable definition	Coeff	S.E.†
Firm size 2×age	0.0041	0.0122	Industry 3×age×tenure	-0.0005	0.0011
Firm size 3×age	0.0148	0.0132	Industry 4×age×tenure	-0.0017	0.0011
Firm size 4×age	0.0162	0.0130	Industry 5×age×tenure	0.0001	0.0012
Firm size 5×age	0.0126	0.0131	Industry 6×age×tenure	-0.0001	0.0014
Firm size 6×age	0.0130	0.0138	Industry 7×age×tenure	-0.0005	0.0014
Firm size 7×age	0.0238	0.0119	Industry 8×age×tenure	-0.0011	0.0014
Industry 2×age	0.0510	0.0200	Industry 9×age×tenure	0.0003	0.0010
Industry 3×age	0.0308	0.0297	Firm size 2×experience×tenure	-0.0002	0.0008
Industry 4×age	0.0576	0.0201	Firm size 3×experience×tenure	0.0006	0.0008
Industry 5×age	0.0290	0.0216	Firm size 4×experience×tenure	0.0004	0.0008
Industry 6×age	0.0051	0.0257	Firm size 5×experience×tenure	0.0002	0.0008
Industry 7×age	0.0108	0.0283	Firm size 6×experience×tenure	0.0002	0.0008
Industry 8×age	0.0331	0.0244	Firm size 7×experience×tenure	0.0005	0.0008
Industry 9×age	0.0094	0.0208	Industry 2×experience×tenure	0.0009	0.0008
Firm size 2×experience	-0.0118	0.0121	Industry 3×experience×tenure	0.0003	0.0011
Firm size 3×experience	-0.0218	0.0126	Industry 4×experience×tenure	0.0013	0.0010
Firm size 4×experience	-0.0216	0.0127	Industry 5×experience×tenure	-0.0002	0.0010
Firm size 5×experience	-0.0226	0.0132	Industry 6×experience×tenure	-0.0014	0.0013
Firm size 6×experience	-0.0191	0.0139	Industry 7×experience×tenure	-0.0001	0.0014
Firm size 7×experience	-0.0332	0.0127	Industry 8×experience×tenure	0.0001	0.0013
Industry 2×experience	-0.0286	0.0163	Industry 9×experience×tenure	-0.0003	0.0009
Industry 3×experience	-0.0123	0.0255	Firm size 2×tenure	0.0385	0.0234
Industry 4×experience	-0.0322	0.0162	Firm size 3×tenure	0.0047	0.0264
Industry 5×experience	-0.0103	0.0185	Firm size 4×tenure	0.0273	0.0281
Industry 6×experience	0.0215	0.0245	Firm size 5×tenure	-0.0134	0.0390
Industry 7×experience	0.0101	0.0233	Firm size 6×tenure	0.0367	0.0364
Industry 8×experience	-0.0105	0.0194	Firm size 7×tenure	0.0204	0.0344
Industry 9×experience	0.0014	0.0175	Industry 2×tenure	0.0355	0.0384
Firm size 2×age×tenure	0.0007	0.0009	Industry 3×tenure	-0.0125	0.0275
Firm size 3×age×tenure	-0.0000	0.0010	Industry 4×tenure	-0.0252	0.0235
Firm size 4×age×tenure	0.0003	0.0009	Industry 5×tenure	-0.0112	0.0266
Firm size 5×age×tenure	0.0004	0.0010	Industry 6×tenure	-0.0205	0.0255
Firm size 6×age×tenure	0.0001	0.0009	Industry 7×tenure	-0.0195	0.0259
Firm size 7×age×tenure	0.0001	0.0009	Industry 8×tenure	-0.0088	0.0244
Industry 2×age×tenure	-0.0016	0.0008	Industry 9×tenure	-0.0154	0.0249
F-test of joint significance of interactions:				$F(70, 2184)$=1.30 p-value=0.0478	

Source: SHIW - Bank of Italy, 2000 and 2002.

Notes: †Arellano (1987) robust standard errors have been computed.

Table A-7: Probit estimates of selection equation into 2002 employees' sample† (1) and participation equation in labour market (2).

	(1)				(2)		
Variable	Coeff.		S.E.	Variable	Coeff.		S.E.
TC	-0.4218	***	0.1512	Age	0.2454	***	0.0096
TC×Tenure	-0.0038		0.0267	Age^2	0.0088		0.0573
TC×Tenure^2/100	-0.0001		0.0007	Average Age^2	-0.3206	***	0.0584
Tenure	0.0239		0.0185	Children 0–5 years	-0.1856		1.0892
Tenure^2/100	-0.0000		0.0000	Aver. Ch 0–5 years	0.1566		1.0894
Experience^2/100	-0.1153	***	0.0338	Children 6–14 years	0.0381		0.5519
Firm size - Reference: Up to 4				Aver. Ch 6–14 years	-0.0351		0.2760
From 5 to 19	1.6248	*	0.8372	Children 15–18 years	-0.0262		0.5104
From 20 to 49	1.2048		0.9589	Aver. Ch 15–18 years	0.0655		0.2554
From 50 to 99	0.5526		1.1038	Spouse Working	0.0022		0.1133
From 100 to 499	1.2309		1.1312	Av. Spouse Working	0.0832		0.1195
500 or more	1.2398		1.1939	Married	0.0064		0.2272
Public Sector	0.5968		1.3462	Average Married	-0.0778		0.2319
Occupation - Reference: Blue collar				*Area* - Reference: North East			
White collar	-0.0756		0.0815	North-West	-0.0441		0.0393
Manager	-0.0875		0.1317	Centre	-0.0550		0.0396
Industry - Reference: Agriculture				South	-0.2125	***	0.0418
Industry & Mining	-0.6530		0.8586	Islands	-0.2894	***	0.0484
Building & Construct.	-0.2433		1.6889	*Education* - Reference: None or Elementary			
Wholesale & Retail Tr.	-1.2110		1.0297	Middle school	0.2795	***	0.0578
Transport & Commun.	-6.2778	**	2.6358	Professional school	0.3195	***	0.0800
Credit & Insurance	-1.4693		2.5222	High school	0.3193	***	0.0589
Business services	-0.7516		1.4409	University degree or +	0.2900	***	0.0751
Domestic services	-0.4485		1.0420	*Education*×*Gender*-Reference: None or Elem.×Female			
Public administration	-1.9214		1.2546	Middle school×Female	-0.0037		0.0895
Head of Household	0.2309	***	0.0793	Professional school×Female	0.3711	***	0.1222
Married	0.4599	***	0.0820	High school×Female	0.5735	***	0.0881
Part-time	-0.2630	**	0.1137	University degree or +×Female	0.7109	***	0.1092
Female	0.1862	**	0.0758	Female	-0.7092	***	0.0797
Constant	0.9702	***	0.3322	2002	-0.5089	***	0.1024
LR-test of joint significance of interactions:				Constant	-4.3562	***	0.2009
χ^2_{70}=163.7 p-value=0.0000							
Observations			2,706	Observations			10,394
Censored			521	Censored			6,024
Pseudo R^2			0.187	Pseudo R^2			0.162
Log-likelihood			-1078.0	Log-likelihood			-5928.0
LR of joint significance:	χ^2_{96}=495.2 p-value=0			LR of joint significance:	χ^2_{27}=2288.7 p-value=0		

Source: SHIW - Bank of Italy, 2000 and 2002.

Notes: †70 interactions between individual and job characteristics are included in the probit equation for attrition but the associated estimation results are not reported for sake of brevity. * significant at 10%; ** significant at 5%; *** significant at 1%.

Seniority and work experience

The wage regressor for seniority, T_{it}, has been built using question B13 of the SHIW questionnaire: "How old were you when you began the activity that you were performing at 31-12-2002(2000)?". Thus, using age information we computed the work experience accumulated by the employees in the job the worker was performing at the interview time. This means that our information about seniority is in years; there is no other information in the survey to derive a more precise measure.

Work experience has been computed using age information and answers to question B07 of the SHIW questionnaire: "How old were you when you began to work?". Also work experience is in years and, furthermore, it is a potential experience since we do not know if there have been any unemployment spells between the working starting date and the interview time.

Both the information used to compute seniority and the one used to calculate work experience are affected by measurement errors: they have been detected because of inconsistencies in answering to the same question in 2000 and 2002.[43] Thus, we decided to introduce some assumptions and correct the detected inconsistencies for the 2,185 employees in our sample.

We assume that the 2000 answer to question B07 about the age at which the individual began to work is more reliable, since the worker was temporally closer to his (her) life moment during which (s)he started working (and so the worker should have a lower probability of wrongly answering to question B07). Therefore, we corrected the 2002 answer to question B07, using the 2000 answer and adding 2 years.

As regard seniority, we corrected the detected inconsistencies according to the following procedure: if the worker started the activity (s)he was performing at the 2002 interview time before 2000, then seniority in 2000 is equal to seniority in 2002 minus 2.

Part-time contracts

In all the specifications of the wage equation we have introduced a dummy variable which is equal to 1 if the worker has a part-time contract and 0 otherwise. This dummy variable has been built using question 1, section "PARTIME" of the annex B1 of the SHIW questionnaire. The question simply requires to indicate if you are working as part-timer or full-timer. Therefore, employees are required to self-define their contracts choosing between "part-time" or "full-time": we do not apply any particular definition of part-time based on the number of working hours.

Weekly working hours

In subsection 6.4.1 we have presented estimation results after controlling for weekly working hours, wh_{it}. This wage regressor reports the workers' average weekly working hours during the interview year. Thus, it simply reports the answers to question 3 section "ORETOT" of the annex B1 of the SHIW questionnaire: "Overall, how many hours did you work on average per week (including overtime)?".

[43] For instance, the same worker gives two different answers to question B07 in 2000 and 2002, when we would expect the same answer in both years since the date at which the worker began his(her) first job activity is unique and it cannot be time-variant.

A-3 Sensitivity analysis: assuming time-constancy of the stayers' industry dummies

In this appendix we replicate the econometric analysis presented in subsection 6.2 imposing time-constancy on stayers' industry dummies. The aim is to understand whether the measurement error that is likely to affect industry dummies is able to bias the estimation results of our variables of primary interest.

We have applied two approaches to get the time-constancy of the stayers' industry dummies: (i) deleting the stayers whose industry dummies are time-variant; (ii) correcting the stayers' 2002 answers about industry according to the 2000 answers. The estimation results for the variables of primary interest are reported in Table A-8.

We can note that the estimation results coming from the application of the conditional procedure are in line with those presented in subsection 6.2. The wage penalty is now a bit bigger (13%) and the temporary workers' wage returns to seniority are 2.3–2.5 percentage points larger than the permanent workers' ones. Furthermore, applying the correction procedure (ii) to the stayers' industry dummies, both the wage penalty and the returns to seniority for temporary workers are statistically different from zero at a 5% significance level.

Table A-8: FE on stayers and conditional FE estimates of the wage model with time-constant industry dummies for stayers.

	FE on Stayers			Conditional FE‡		
Variable	Coeff	S.E.†	p-value	Coeff	S.E.†	p-value
Dropping stayers who changed industry between 2000 and 2002						
TC	-0.0940	0.1000	0.346	-0.1369	0.0709	0.054
TC×Tenure	0.0163	0.0143	0.254	0.0234	0.0126	0.062
TC×Tenure^2/100	-0.0003	0.0003	0.281	-0.0005	0.0004	0.127
Tenure				-0.0290	0.0202	0.151
Tenure^2/100	0.0006	0.0003	0.041	0.0006	0.0003	0.061
Observations			3,040			3,488
R^2			0.029			0.085
Adjusted R^2			0.024			0.059
F-test of joint significance for interactions:				$F(70, 1743)$=2.23 p-value=0.000		
Correcting stayers' time-variant industry dummies according to 2000 answers						
TC	-0.1326	0.0774	0.087	-0.1412	0.0621	0.023
TC×Tenure	0.0196	0.0133	0.143	0.0258	0.0125	0.039
TC×Tenure^2/100	-0.0004	0.0003	0.201	-0.0007	0.0004	0.067
Tenure				-0.0148	0.0144	0.304
Tenure^2/100	0.0005	0.0003	0.097	0.0004	0.0003	0.138
Observations			3,922			4,370
R^2			0.031			0.072
Adjusted R^2			0.027			0.052
F-test of joint significance for interactions:				$F(70, 2184)$=1.93 p-value=0.000		

Source: SHIW - Bank of Italy, 2000 and 2002.

Notes: †Arellano (1987) robust standard errors have been computed. ‡Within-individual estimation results of the wage model augmented by 70 interactions between individual and job characteristics; the 70 interactions are included in the wage equation but not reported.

A-4 Conditional FE estimation on movers

Table A-9 reports the estimation results, via FE and using the movers' subsample, of wage model (1) (first three columns) and of the augmented wage equation[44] (last three columns). Even if the estimated coefficients of our variables of primary interest are not statistically different from zero, we can note that, when we introduce the interactions between personal and job characteristics, something changes.

Firstly, the estimated coefficient associated to the dummy variable for contract type becomes larger in modulus (from -0.0942 to -0.1595). The impression that we underestimate the wage penalty for temporary workers if we do not take into account of the correlation between the job-specific component and the wage regressors seems to be confirmed.

Secondly, the estimated coefficient of the interaction between the type of contract and seniority becomes positive, going from -0.0051 to 0.0251. If we do not consider the presence of the job-specific component in the composite error term, we underestimate the temporary employees' wage returns to seniority.

[44] In this case we have 65 interactions instead of 70 because we grouped together the industry dummies "transport and communication" and "credit and insurance" to avoid problems of perfect multicollinearity.

Table A-9: FE and conditional FE estimates of the wage model using the movers' subsample.

	FE on Movers			Conditional FE‡ on Movers		
Variable	Coeff	S.E.†	p-value	Coeff	S.E.†	p-value
TC	-0.0942	0.0919	0.3070	-0.1595	0.1187	0.1800
TC×Tenure	-0.0051	0.0397	0.8990	0.0251	0.0669	0.7080
TC×Tenure^2/100	0.0015	0.0018	0.4030	0.0007	0.0040	0.8610
Tenure	-0.0003	0.0108	0.9780	0.0104	0.0651	0.8730
Tenure^2/100	-0.0001	0.0004	0.8140	-0.0029	0.0015	0.0490
Experience^2/100	-0.0492	0.0900	0.5850	-0.1054	0.1024	0.3040
Firm size - Reference: Up to 4						
From 5 to 19	0.1118	0.0993	0.2620	0.0566	1.0592	0.9570
From 20 to 49	-0.0034	0.1051	0.9740	-0.9301	1.0387	0.3710
From 50 to 99	0.0578	0.1142	0.6130	-0.8238	1.1155	0.4610
From 100 to 499	0.0401	0.1114	0.7190	-1.1424	1.2026	0.3430
500 or more	0.0878	0.1215	0.4710	-1.9189	1.4876	0.1980
Public Sector	0.2307	0.1204	0.0570	-0.4672	1.3593	0.7310
Occupation - Reference: Blue collar						
White collar	-0.0444	0.0893	0.6190	-0.1294	0.0967	0.1820
Manager	-0.1435	0.1927	0.4570	-0.1148	0.1848	0.5350
Industry - Reference: Agriculture						
Industry & Mining	0.4123	0.1666	0.0140	0.4186	1.5106	0.7820
Building & Construction	0.4863	0.1671	0.0040	5.5658	3.0783	0.0720
Wholesale & Retail Trade	0.3898	0.1651	0.0190	-0.5210	1.6148	0.7470
Transport & Communication	0.3446	0.1901	0.0710	1.7825	1.8303	0.3310
Credit & Insurance	0.2289	0.1973	0.2470	1.9873	1.8505	0.2840
Business services	0.4186	0.2351	0.0760	1.0127	1.9823	0.6100
Domestic services	0.3563	0.1991	0.0750	2.6444	2.2600	0.2430
Public administration	0.3290	0.1698	0.0540	1.6374	1.6644	0.3260
Head of Household	0.0313	0.0971	0.7480	0.1175	0.1022	0.2520
Married	0.2134	0.2123	0.3160	0.0977	0.2564	0.7040
Part-time	0.2370	0.1430	0.0990	0.2428	0.1573	0.1240
2002	0.1053	0.0504	0.0380	0.1174	0.0557	0.0360
Constant	1.3850	0.3490	0.0000	1.2855	0.3855	0.0010
Observations			448			448
R^2			0.142			0.413
Adjusted R^2			0.089			0.263
F-test of joint		$F(26, 223)$	p-value		$F(91, 223)$	p-value
significance:		4.62	0.000		19.02	0.000
White/Koenker		$F(\ 2, 223)$	p-value		$F(\ 2, 223)$	p-value
heteroskedasticity test:		4.52	0.012		13.29	0.000
F-test of joint significance for interactions:				$F(65, 222)$=3.65		p-value=0.000
Strict exogeneity test:	$F(25, 173)$=1.90		p-value=0.001	$F(25, 108)$=1.06		p-value=0.403

Source: SHIW - Bank of Italy, 2000 and 2002.

Notes: †Arellano (1987) robust standard errors have been computed. ‡Within-individual estimation results of the wage model augmented by 65 interactions between individual and job characteristics; the 65 interactions are included in the wage equation but not reported.

References

[1] Abowd, J.M., Kramarz, F., Margolis, D.N., 1999. High wage workers and high wage firms. Econometrica 67(2), 251–333.

[2] Arellano, M., 1987. Computing robust standard errors for within-groups estimators. Oxford Bulletin of Economics and Statistics 49(4), 431–434.

[3] Ashenfelter, 0., 1978. Estimating the effect of training programs on earnings. The Review of Economics and Statistics 60(1), 47–57.

[4] Barron, J.M., Black, D.A., Loewenstein, M.A., 1989. Job matching and on-the-job training. Journal of Labor Economics 7(1), 1–19.

[5] Bentolila, S., Dolado, J.J., 1994. Labour flexibility and wages: lessons from Spain. Economic Policy 9(1), 54–99.

[6] Blanchard, O., Landier, A., 2002. The perverse effect of partial labour market reform: fixed-term contracts in France. The Economic Journal 112(480), F214–F244.

[7] Booth, A.L., Francesconi, M., Frank, J., 2002. Temporary jobs: stepping stones or dead ends? The Economic Journal 112(480), F189–F213.

[8] Brown, S., Sessions, J.G., 2003. Earnings, education, and fixed-term contracts. Scottish Journal of Political Economy 50(4), 492–506.

[9] Dolado, J.J., García-Serrano, C., and Jimeno, J.F., 2002. Drawing lessons from the boom of temporary jobs in Spain. The Economic Journal 112(480), F270–F295.

[10] Farber, H.S., 1999. Alternative and part-time employment arrangements as a response to job loss. Journal of Labor Economics 17(4), S142–S169.

[11] Gagliarducci, S., 2005. The dynamics of repeated temporary jobs. Labour Economics 12(4), 429–448.

[12] Guadalupe, M., 2003. The hidden costs of fixed term contracts: the impact on work accidents. Labour Economics 10(3), 339–357.

[13] Güell, M., 2000. Fixed-term contracts and unemployment: an efficiency wage analysis. Industrial Relation Section, Princeton University, Working Paper No. 433, February.

[14] Hagen, T., 2002. Do temporary workers receive risk premiums? Assessing the wage effects of fixed-term contracts in West Germany by a matching estimator compared with parametric approaches. Labour 16(4), 667–705.

[15] Hausman, J.A., 1978. Specification tests in econometrics. Econometrica 46(6), 1251–1271.

[16] Heckman, J.J., 1976. The common structure of statistical models of truncation, sample selection, and limited dependent variables and a simple estimator for such models. Annals of Economic and Social Measurement 5, 475–492.

[17] Heckman, J.J., 1978. Dummy endogenous variables in a simultaneous equation system. Econometrica 46(4), 937–959.

[18] Heckman, J.J., Ichimura, H., Todd, P.E., 1997. Matching as an econometric evaluation estimator: evidence from evaluating a job training programme. Review of Economic Studies 64(221), 605–654.

[19] Jimeno, J.F., Toharia, L., 1993. The effects of fixed-term employment on wages: theory and evidence from Spain. Investigaciones Económicas 17(3), 475–494.

[20] Letourneux, V., 1998. Precarious employment and working conditions in the European Union. Office for Official Publications of the European Communities: Luxembourg.

[21] Light, A., McGarry, K., 1998. Job change patterns and the wages of young men. The Review of Economics and Statistics 80(2), 276–286.

[22] Loh, E.S., 1994. Employment probation as a sorting mechanism. Industrial and Labor Relations Review 47(3), 471–486.

[23] Montanari, A., 2003. Un caso di legittima differenziazione retributiva tra lavoratori a termine e no. Rivista Italiana di Diritto del Lavoro 22(2), 373–378.

[24] Mundlak, Y., 1978. On the pooling of time series and cross section data. Econometrica 46(1), 69–85.

[25] Rebitzer, J.B., Taylor, L.J., 1991. A model of dual labor markets when product demand is uncertain. The Quarterly Journal of Economics 106(4), 1373–1383.

[26] Rosen, S., 1974. Hedonic prices and implicit markets: product differentiation in pure competition. Journal of Political Economics 82(1), 34–55.

[27] Wooldridge, J.M., 1995. Selection corrections for panel data models under conditional mean independence assumptions. Journal of Econometrics 68(1), 115–132.

[28] Wooldridge, J.M., 2002. Econometric analysis of cross section and panel data. The MIT Press: Cambridge.