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Abstract

We study the effect of tenure on earnings instability in Italy using two alternative estimation strategies. First we use a descriptive measure of earnings instability and fixed effects regressions. Second, we develop a formal model of earnings dynamics distinguishing permanent from transitory earnings, and exploit variation of tenure and instability over time and across birth cohorts in estimation. We use the two approaches also to evaluate earnings instability associated with temporary contracts (short-tenure contracts). Our results indicate that each year of tenure on the job reduces earnings instability on average by 11%. Workers on a temporary contract have an earnings instability up to 50% higher than workers on a permanent contract.

JEL-Code: J210, J310.

Keywords: earnings instability, earnings dynamics, tenure, temporary contracts, minimum distance estimation.

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1 Introduction

A large volume of literature uses panel data on individual earnings to look at the extent of intertemporal mobility in the distribution of earnings, distinguishing long-term earnings components (which have to do with changes in the quantity and prices of permanent individual characteristics) from a transitory component that captures the extent of earnings instability (see the recent review in Meghir and Pistaferri, 2011).[1]

Among the possible determinants of earnings instability, on-the-job tenure has received little attention. Many papers have focused on estimating the average returns to tenure, but there is still scant evidence on the relationship between tenure and earnings instability.[2] Some previous studies on instability have focused on the U.S. labor market and have established that both quits and layoffs may impact on the transitory variance of wages (see Huff-Stevens, 2001; Hospido, 2012; and Leonardi, 2012).[3] However none of these papers have explicitly modeled the effect of tenure on instability.

In this paper we are the first to model explicitly the impact of on-the-job tenure on earnings instability. Using administrative panel data for Italy, we define earnings instability as the variance of the transitory component of individual earnings. We use two different and complementary approaches for measuring instability. First, we apply the descriptive measure of instability introduced by Gottschalk and Moffitt (1994) which is based on deviations from multi-period averages of individual earnings. This is an intuitive approach which provides an individual-specific measure of instability but ignores the possibility of serial correlation in transitory earnings and life-cycle growth of permanent earnings. Second, we employ a model-based approach that accounts for both possibilities,

[1] An incomplete list of the recent US studies which use earnings levels rather than year-to-year earnings changes includes Gottschalk and Moffitt (2009) and Moffitt and Gottschalk (2012). See also Dickens (2000), Ramos (2003) and Alessie and Kalwij (2007) on the UK, Baker and Solon (2003) on Canada, Cappellari (2004) on Italy, Bingley et al. (2013) on Denmark.

[2] Among the many studies, see Abraham and Farber (1987), Altonji and Shakotko (1987), Topel (1991), Topel and Ward (1992), Neal (1995), Lillard (1999), Altonji and Williams (2005), Dustmann and Meghir (2005). Parent (2002) exploits the different implications in terms of covariance structure of earnings to distinguish between human capital and matching theories. He finds that, in line with the human capital theory, those who start out with a lower wage in a job have a steeper tenure profile. While Parent (2002) looks at the relationship between tenure and long term earnings, in this paper we also assess the impact of tenure on the unstable component of earnings.

[3] A neighbouring and growing literature focuses on earnings volatility, i.e. the variance of year-to-year earnings changes, and finds mixed evidence on the relationship between workers' turnover and volatility; see Venn (2011), Ziliak et al. (2011), Dahl et al. (2011) and Celik et al. (2012). Dynan et al. (2007) and Shin and Solon (2011) point out that measures of earnings volatility are likely to include both permanent as well as transitory shocks to earnings.

in line with the large literature on earnings dynamics. Both approaches lead to similar conclusions of a negative relationship between earnings instability and tenure on-the-job.

Finding that longer tenure is associated with lower instability is consistent with employer learning effects (see for example Lange, 2007) but may well stem from the selection of more stable workers into more stable jobs. We tackle selection issues employing two different estimation strategies. First, when using the individual-specific descriptive measure, we employ a fixed effect estimator that removes any time-invariant source of selection, while controlling for a number of time-varying effects including age. Second, in our model-based approach we exploit variation of tenure and instability between birth cohorts and over time while flexibly allowing for time and cohort effects in instability, so that selection effects operating between cohorts and over time are controlled for in a difference-in-differences setup. Any remaining selection occurring within cohorts is irrelevant because it is not the source of variation used in estimation.

In the U.S. it has been difficult to establish the link between earnings instability and workers' tenure because the empirical literature has found little evidence of a decline in average tenure data.[4] Differently from the U.S., in Italy and in many other continental European countries the diffusion of temporary contracts generates additional variation in tenure across cohorts and constitutes an "institutional" reason of shorter average tenure. There are many types of temporary contracts but typically they are short-tenure contracts that last two or three years and can be renewed only once; they have seen a large diffusion in many European countries in the Nineties. While we cannot use the reforms which introduced temporary contracts as instrument for tenure because they affected the whole economy at the same point in time, we exploit the differential incidence of temporary contracts across cohorts and over time to characterize the relationship between earnings instability and tenure.

In addition to estimating tenure effects, as an alternative way of looking at the determinants of earnings instability we consider the impact of temporary contracts themselves on instability. A large literature has studied the effect of temporary contracts on employment, job flows and wage levels but nobody has looked so far at their effects on earnings instability.[5] Yet, one of the main policy concerns about the diffusion of tempo-

[4] Jaeger and Stevens (1999), Gottschalk and Moffitt (1999) and other contributions in the same Journal of Labor Economics special issue find little evidence of a decrease in workers' tenure. Farber (2008) finds however some decrease in tenure of older workers.

[5] Temporary jobs are known to pay less, offer less training and be less satisfying than regular jobs

rary contracts is their implications in terms of earnings instability and welfare because the temporary part of earnings variance is often un-insurable in presence of imperfect capital markets. In this paper we fill in the gap: using the two alternative measures and estimation strategies described above we provide an estimate of the earnings instability directly associated with a temporary contract. We believe that these results may be useful from the policy point of view.

Our results indicate that workers with seven years of tenure have on average one fifth of earnings instability than workers with zero years of tenure or in other words each year of tenure on the job reduces earnings instability by approximately 11%. In recent years, in particular young workers born in cohorts with a high incidence of temporary contracts have an earnings instability between 50% and 100% higher than workers who belong to cohorts with low incidence of temporary contracts.

The rest of the paper proceeds as follows. Section 2 describes the institutional background. Section 3 describes the data with particular attention to the evolution of average tenure on the job and the diffusion of temporary contracts in Italy. Section 4 introduces the results obtained with the window-average models. Section 5 describes the error component models of the impact of tenure and temporary contracts. Section 6 describes the results and Section 7 concludes.

2 Institutional Background

Similarly to other European countries, labour market flexibility has increased in Italy over the last twenty years, through a series of measures which introduced various kinds of temporary contracts without changing the legislation on permanent, open-ended contracts.

In Italy the first wave of reforms of temporary contracts took place in the mid eighties with the introduction of apprenticeship contracts. This type of contract is widely used because it is convenient for employers for various reasons. Firstly, they have lower labour costs for apprentices and pay a wage that is set by national collective bargaining agreements at a level that is significantly lower than the norm. Also they pay social security

(Booth et al., 2002; Kahn, 2007); workers on temporary jobs search more (Kahn, 2012). The evidence on whether temporary jobs are stepping stones to permanent jobs is mixed (Booth et al., 2002; Autor and Houseman, 2012).

contributions at a lower rate. Finally, firms pay no dismissal costs when contracts expire and this is why they are attracted to it as a useful substitute for other types of temporary contracts.[6]

Another type of temporary contract which was very popular especially in the late 1980s is the so-called work-and-training contract, which was very similar to an apprenticeship contract and was used in particular to hire non-manual workers. (The main difference with apprenticeships is that all training was supposed to take place within the firm rather than with external bodies.) Its supposed mis-use by employers –in particular the failure to provide the required training– gave rise to many litigations, which in turn led to a reduced utilization of this contract through the mid-1990s and finally to its abolition in the early 2000s.

Other types of temporary contracts have always existed but the most important reform was the "Treu-Package" (named after the then minister of labour) which in 1997 legalized temporary work agencies and liberalized both apprenticeship and fixed-term contracts (i.e. ordinary dependent employment contracts with a fixed term). Temporary work provided through agencies and fixed-term contracts are used as churning policies and buffer stock against downturns. Agency workers are typically more expensive than workers hired with a standard open-ended contract but they can be dismissed at will, while fixed-term contracts have a legal duration of two years and can be renewed only once.

As a result of this reform the average tenure and its distribution in the population changed, particularly in younger cohorts more exposed to the new contracts. In Table 2 of Section 3 we document a different accumulation of tenure across cohorts. This potentially constitutes an interesting case study also for other countries although it does not constitute a natural experiment because the introduction of temporary contracts was neither exogenous nor limited to specific sections of the population.

While it is clear that temporary contracts decreased average tenure among young cohorts, their implication with regards to earnings instability is not straightforward and

[6]The lower labour costs are intended to compensate firms for the training costs that they incur. However the training content of this type of employment is usually low, even if it is regulated by labour laws. Firms are required to share training costs by giving apprentices time off work (for a minimum number of paid hours) to attend external training courses that are provided by local authorities or accredited training institutes (and sponsored by the Regions) outside the premises of the firm. At the end of the training periods, each apprentice should receive a certificate for the qualification they have acquired in their field of work.

may depend on the type of temporary contract.

First, it is actually well known that temporary contracts might lower the commitment of employers to employees and vice-versa (Booth et al., 2002). It could be that employees never invest in any particular job because they know it is only temporary, and overall productivity suffers. Or it could be that with multiple changes, employees are able to find better matches than under the previous regime and productivity is enhanced overall. Then, even though there is more instability because employees change jobs more frequently, the wage level is higher than it would be otherwise.

Second, the issue of selection into temporary contracts may be important. If for example the least stable workers are the first to be offered temporary contracts then temporary contracts just act as a mechanism to sort workers into those who generally have short tenure and those who tend to stay longer in the same job. While overall this would have no impact on earnings instability, it would raise instability for those on temporary contracts and lower it for those on permanent contracts. In this paper we do not address explicitly the selection of workers into tenure or temporary contracts for lack of convincing instruments. However, the estimation of our models exploits variation of earnings instability and tenure or temporary contracts between the cells defined by birth cohorts and time periods, while flexibly allowing for time and cohort effects to capture unobserved heterogeneity along those dimensions. Any remaining selectivity operating within-cells is irrelevant to our results because it is not used in estimation.

Finally, if temporary contracts were used multiple times to substitute for open-ended contracts they could have no effect at all. The legal duration of a fixed-term contract is of two years therefore the introduction or the increase of this type of contracts is bound to decrease tenure but if they are merely a re-labeling of an old arrangement, they could have no impact at all on earnings instability. This use of temporary contracts however should be limited because they can be renewed only once at maximum for a total duration of four years.

In this paper we provide a rich descriptive model of the effect of tenure and temporary contracts on the wage covariance, however we do not establish the cause of earnings instability in the face of changes in institutional arrangements because we do not have exogenous variation in institutions. Thus we have to look at the results as descriptive and not proscriptive.

3 Data Description

The data are drawn from the Italian Social Security Administration (INPS) archives and span the years 1985-2003. The original dataset collects social security records of a 1/90 random sample of employees born on the 10th of March, June, September, and December of every year.

The dataset contains individual longitudinal records generated using social security numbers. However, since the INPS collects information on private sector employees for the purpose of computing retirement benefits, employees are only followed through their employment spells in the private sector. The dataset stops following individuals who move into self-employment, the public sector, the agricultural sector, the underground economy, unemployment and retirement. This selection is common for administrative data which typically include the private sector only. To provide some information on Italian private sector employment in comparison to other sectors of the economy, we can use external data sources. Using the Bank of Italy data (Survey of Households Income and Wealth, SHIW) for 1998, it appears that the private sector constitutes 52% of total employment, agriculture represents only 2% while public employment and self-employment represent 23% each.[7] In this paper we do not model selection from the private sector into other states (public sector, self-employment, unemployment and retirement) however the data on transitions into other states show that workers are very stable in the private sector. After two years (always using SHIW data) 83% of employed male workers of age between 21 and 55 in 1998 are still working in the private sector, 7.5% moved to the public sector, only 3% to self-employment and 4.8% to unemployment and pension. As is common with administrative data sources, the amount of observable individual characteristics in the INPS data is limited. We have information on employees' age, gender, occupation (blue collar-white collar), yearly earnings, number of paid weeks, the initial and final month of job matches and the type of contract (permanent-temporary, unfortunately we have no information on different types of temporary contracts).

[7]While there is evidence that wages are less volatile in the public sector compared to the private one (Cappellari, 2002), there are no studies on earnings instability among the self-employed and agricultural workers, whose wages are likely to be more volatile than those of private sector employees.

3.1 Sample selection rules

The administrative data in electronic form start in January 1985 and the start date of all contracts already running at that date are artificially set to January 1985. In order to measure tenure accurately, we consider only matches starting after the 1st of January 1985. Since such a selection rule leaves few observations in 1985 compared to the other years in the panel, we consider data from 1986 onwards. We keep in the sample all male workers aged 21 to 55 with positive earnings who work as blue collars or white collars in the non-agricultural private sector between 1986 and 2003. The selection on age is aimed at avoiding the extremes of the working career, because employment volatility just after entry into the labour market or close to retirement may blur the measurement of structural earnings instability. As customary in this literature, we focus on males since their labour force participation is less endogenously intermittent relative to females.

Previous studies such as Haider (2001), Baker and Solon (2003) and Moffitt and Gottschalk (2012) demonstrated the existence of relevant age and calendar time effects in both the permanent and the transitory components of earnings. Since we estimate tenure effects over a long period, it is crucial to control for age and time effects. To disentagle the two effects within our econometric model of earnings dynamics, we form subsamples defined by the year of birth (birth cohorts) and use them jointly in estimation. In order to ease the identification of age-earnings profiles within each cohort we set the minimum length of observation of a cohort to ten years. Given our sample selection on age, this implies that we consider cohorts of individuals born between 1940 (who turn 55 in 1995, in the tenth year of data in the sample) and 1973 (who turn 21 in 1994, and can be observed ten times before the end of the sample). Cohorts born between 1948 and 1965 are observed eighteen times (i.e. over the whole sample period), while cohorts born before 1948 or after 1965 the number of data points monotonically decreases, going from seventeen for those born in 1947 and 1966 to ten for the oldest and youngest cohort born in 1940 and 1973. There are 34 birth cohorts in total. It needs to be stressed that besides allowing the identification of time and cohort effects, the cohort-by-year variation is important in our paper since it provides with variation in tenure and incidence of temporary contracts, in turn two key variables in our models (see next section).

In the course of the paper we use weekly earnings (yearly earnings divided by the number of weeks paid). For the cases of multiple job spells in the same year we consider

the longest spell. In order to reduce the influence of outliers we drop the top and bottom three observations from the cohort-specific yearly wage distribution. We also exclude individual earnings histories characterised by excessive churning (which might inflate the measurement of earnings instability) and require for each individual a minimum of five consecutive earnings observations, a selection rule that is intermediate between the one used by Baker and Solon (2003), i.e. continuous earnings strings, and the approach of Haider (2001), who allows individuals to move in and out of the sample with the only requirement of having two positive but not necessarily consecutive valid observations on earnings.

The dataset resulting from these selections includes 48,226 individuals with at least five consecutive years of valid wages with 552,209 person-year observations over the years 1986-2003; this is indicated as "Truncated sample" in Table 1, because it is obtained from job spells truncated at January 1 1985. The truncation of the sample (and the consequent dropping of matches which started before the first year of the dataset) is a common procedure with administrative data which do not contain information on tenure at entry. However, there is a potential issue of whether the truncation of the sample induces some bias. To gain some sense about the relevance of such bias, in Table 1 we also report statistics referring to the "Full sample" i.e. the sample obtained without the truncation of job spells started prior to January 1st 1985. Table 1 shows the average age and log earnings (mean and standard deviation) of individuals in each year of the full sample and of the truncated sample: the comparison of these variables across the two samples does not seem to indicate the presence of a bias due to truncation. However about 24% of the observations and 18% of individuals are thrown out because of this, and it is possible that short tenure jobs (those with poor matches) will be over-represented in the sample because most stably-employed men with long tenure in 1985 are likely to never show up in the data. Since employment generally becomes more stable at higher ages, more of the older men are likely to be totally excluded and this may lead to lower earnings persistence. We approach this problem estimating a baseline model unconditional on tenure on both the truncated and the full sample and checking the robustness of the results to sample selection.

Table 1 also shows the incidence of temporary contracts by year: it is evident that temporary contracts are more widespread during the years in which there is a reform

Table 1. *Descriptive statistics*

	N of obs		Age		Mean of log wages		Std. dev. of log wages		% temporary contracts		Tenure
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(2)
1986	31382	13358	33.50	32.33	5.88	5.84	0.35	0.37	0.02	0.05	10.24
1987	33357	16523	33.92	32.46	5.92	5.86	0.36	0.37	0.04	0.08	17.45
1988	35504	19641	34.42	32.78	5.93	5.87	0.37	0.37	0.05	0.09	23.56
1989	37145	22227	34.99	33.22	5.96	5.91	0.37	0.37	0.06	0.10	28.85
1990	38064	24496	35.47	33.66	5.98	5.94	0.38	0.38	0.06	0.09	33.35
1991	40469	27970	35.88	34.10	6.01	5.96	0.39	0.39	0.05	0.06	36.92
1992	40928	29328	36.44	34.66	6.01	5.97	0.39	0.39	0.04	0.05	42.47
1993	44985	35432	36.95	35.64	6.00	5.97	0.40	0.40	0.03	0.04	38.71
1994	45256	36443	37.50	36.23	5.98	5.95	0.40	0.40	0.03	0.04	44.70
1995	45085	37164	38.00	36.84	5.99	5.96	0.42	0.41	0.03	0.04	48.23
1996	44305	37355	38.40	37.37	6.00	5.97	0.41	0.41	0.03	0.04	52.61
1997	43791	37650	38.84	37.93	6.02	6.00	0.42	0.42	0.03	0.04	57.06
1998	42846	37340	39.37	38.52	6.03	6.01	0.42	0.42	0.06	0.07	61.07
1999	42856	38002	39.69	38.93	6.03	6.01	0.44	0.44	0.06	0.07	62.27
2000	41652	37044	40.37	39.66	6.03	6.01	0.44	0.44	0.05	0.06	66.84
2001	40069	35723	41.05	40.37	6.05	6.03	0.44	0.44	0.05	0.05	71.57
2002	38118	34133	41.64	41.01	6.05	6.04	0.45	0.45	0.05	0.05	75.73
2003	36045	32380	42.21	41.62	6.06	6.04	0.45	0.45	0.05	0.05	79.84
NT	721857	552209									
N	58326	48226									

Notes. The full sample is indicated by (1), the truncated sample is indicated by (2). The truncated sample contains only matches starting after the 1st of January 1985.

i.e. in 1988 when there is the peak use of "work-and-training" contracts and in 1998 with the introduction of the "Treu" reform. The table shows the average incidence in the population of males aged 21 to 55 by year, however the percentage of temporary contracts vary also by cohort of birth. In estimation we will exploit variation in the incidence of temporary contracts by cohort.

3.2 Descriptive statistics on tenure

Table 2 shows the average tenure in months of workers in permanent and temporary contracts within selected cohorts. We select young cohorts because they have a higher incidence of temporary contracts. All cohorts observed since the beginning of the panel start with low average tenure because the average refers only to contracts started after

January 1985. Comparing the cohorts born in 1965 in year 1995 with the cohort born 1970 in 2000 and the cohort born 1973 in 2003 (i.e. after ten years), the accumulation of tenure on permanent contacts is similar: older cohorts accumulate on average a slightly longer tenure as a result of the lower job mobility of older workers relative to younger ones.

Table 2 also shows the average tenure of workers in temporary contracts for the same cohorts. As explained in Section 2, the diffusion of temporary contracts is not limited to the late 1990s. In the late 1980s the so-called "work and training" contracts were very popular, so that the overall share of temporary contracts reached 18 percent in 1988 for the cohort born in 1965. In 1997 the "Treu" reform introduced new forms of temporary employment, and our data show that their incidence increased substantially between 1997 and 1998 for the youngest cohorts (17% and 21% is the incidence of temporary contracts in the cohorts born in 1970 and 1973 in the year 1998). Comparing the two columns of Table 2 it is clear that while permanent workers accumulate tenure on the job, the average tenure of temporary workers is always below 30 months. This table shows that the incidence of temporary contracts has an effect on the overall average tenure of a given cohort in a given year.

3.3 The intertemporal covariance structure of earnings

We use all valid wage observations in our sample to estimate the covariance structure of earnings for the thirty four birth cohorts. While not solving issues of endogenous panel attrition, such an unbalanced panel design is certainly less restrictive compared with analyses based on balanced panels.

We plot estimated variances and covariances averaged across birth cohorts in Figure 1. Earnings dispersion appears to increase at a steady pace over the period. These patterns reproduce the evidence for Italy provided by other studies, see e.g. Brandolini et al. (2002). Covariances at various lags are at a lower level compared with the variance, but still show an upward trend. As expected, the distance between covariances at increasing lags decreases over lags and covariances tend to stabilize to a long-term level. Such a pattern is consistent with an underlying process of earnings dynamics formed by some long-term component plus some mean-reverting component characterized by low order autoregression (Gottschalk and Moffitt, 2009). These features of the earnings process will

Table 2. *Average tenure in months*

	Cohort born 1965		Cohort born 1970		Cohort born 1973	
	permanent contracts	temporary contracts	permanent contracts	temporary contracts	permanent contracts	temporary contracts
1986	9.34	6.67				
1987	16.23	10.80				
1988	22.68	12.87				
1989	28.48	15.21				
1990	33.22	14.16				
1991	36.44	14.89	20.04	11.94		
1992	41.69	16.39	23.23	14.96		
1993	41.53	14.52	26.12	15.64		
1994	47.88	14.77	31.87	14.81	24.32	9.34
1995	52.70	17.98	35.44	16.49	25.76	11.97
1996	56.66	19.22	39.40	14.87	28.00	14.05
1997	60.78	18.59	43.43	15.55	31.89	15.83
1998	66.54	23.87	48.00	18.09	37.37	16.36
1999	68.60	20.10	48.92	20.11	39.46	15.92
2000	72.16	20.18	54.03	26.58	44.37	19.46
2001	76.11	25.33	58.25	29.47	49.61	23.09
2002	80.04	21.42	63.64	22.99	55.10	22.79
2003	85.49	21.83	68.71	29.17	59.66	27.42

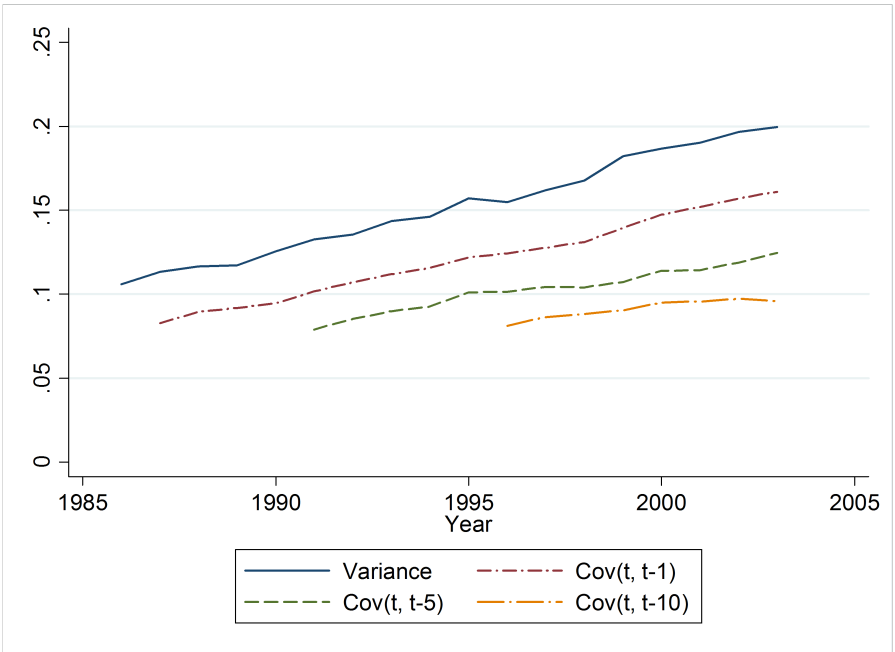

Fig. 1. *Earnings variances and covariances*

be allowed for in our formal model of Section 5.

4 The early method by Gottschalk and Moffitt

The initial attempt to establish the relationship between earnings instability and tenure can be provided using the early method by Gottschalk and Moffitt (1994). To compute individual transitory variances we take data within a window $[t-q, t+q]$ and consider individuals with continuous earnings strings within that window. The mean of each individual's earnings constitute his permanent component of earnings, the variance of each individual's deviations from his own mean component constitutes his transitory component of earnings which is our measure of earnings instability. The formula of the transitory variance for each individual i is the following: $\sigma^2_{iw} = \frac{1}{2q} \sum_{s=t-q}^{t+q} (w_{it} - w_i)^2$ where w_i is the average of the individual's log wages within the window $[t-q, t+q]$. Repeating this calculation moving the fixed-length window forward, provides a series of earnings instability for each individual.

Throughout this section we present results for q=2 (i.e. using a time windows of 5 years); we find results to be robust when using q=4. Figure 2 shows the average σ^2_{iw} and is generated using the full sample but the equivalent figure from the truncated sample is very similar. The graph displays instability both for the overall sample and averaged by

cohort.

Several aspects are worth noting. First, at the overall level, earnings instability appears to be constant through the 1990s, but starts rising around 1998 and by 2003 reaches a level that is almost 50 percent higher than the initial one. The timing matches the institutional reforms of temporary contracts. A second fact to note is that the increasing trend is not a specific feature of some cohorts, but is shared by all cohorts observed over the late 1990s-early 2000s period. Younger cohorts, though, present larger instability, roughly double than the one of older cohorts therefore it is likely that younger cohorts are driving the increase in instability in later years. Finally, the birth cohort of 1965 shows a decline of earnings instability between 1990 and 1995, while joining the generalized upward trend post-1998. Recall from the last section that this cohort was exposed to the diffusion, and later disappearance, of the work-and-training contracts of the 1980s, and the declining earnings instability parallels the reduced incidence of this type of contracts for this cohort: another piece of evidence that earnings instability and temporary employment are positively correlated.

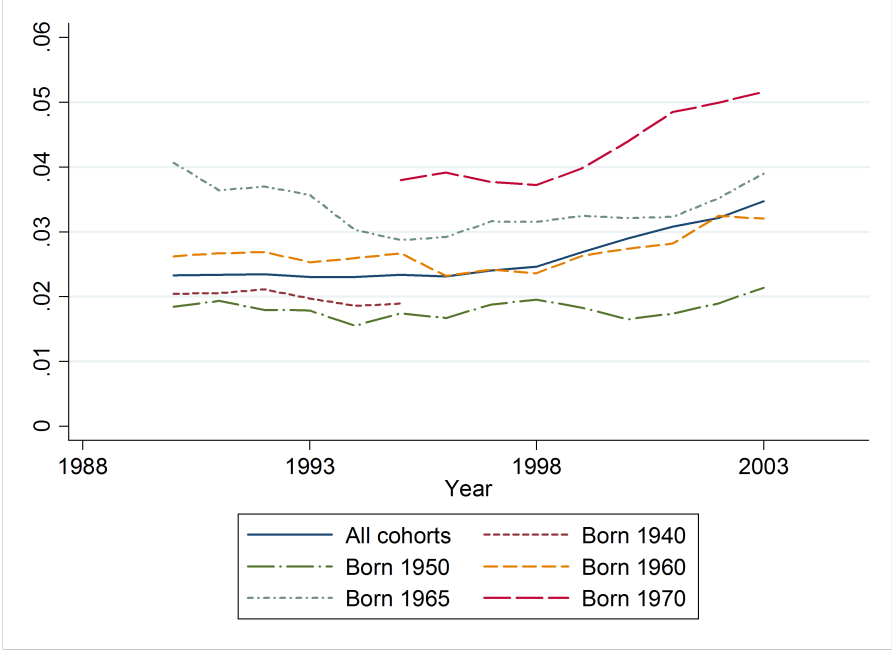

Fig. 2. *Earnings instability by cohort, Gottschalk and Moffitt (1994) method.*

Having computed individual specific measures of earnings instability over time, we can now characterize the relationship between instability and tenure by means of fixed effects regressions:

$$\sigma^2_{iwt} = X_{it}\beta + \delta ten_{it} + u_i + e_{it} \quad (1)$$

where individual controls X_{it} includes a set of year, occupation, age, region, firm size and one digit industry dummies; u_i is an individual fixed effect. The parameter of interest is δ which measures the impact on earnings instability of ten_{it} which indicates a measure of individual tenure. In the first column of Table 3 ten_{it} is tenure measured in months, in the second column is a spline in tenure with knots at 1, 2, 3 and 4 years of tenure. Alternatively, we assess the effect of employment stability using temporary contracts. This is done in the third column of Table 3, where the regressor of interest is the share of time spent on temporary contracts within the five-year window (computed as the number of years spent on temporary contracts over the total). In this latter case we provide results from both the truncated sample and the full sample (column 4), whereas tenure indicators can be derived only in the truncated sample.

The results in the table show a clear decline of instability with tenure. The first column shows a significant decline of instability with each month of tenure, the specification with tenure splines in the second column confirms this result. Finally the third column shows that instability increases with the average time spent on temporary contracts. This last coefficient is much larger because temporary contracts are measured as a time share rather than in number of months. In the last column of the table we show the results on temporary contracts based on the full sample of workers: the coefficient is very similar to the one obtained on the truncated sample, a further confirmation that considering only spells which started during the sample is unlikely to generate a serious bias.

The Gottschalk and Moffitt (1994) approach is very simple and intuitive and generates individual-specific measures of instability which, instead, are not available when using more formal models. However it has disadvantages. First, it assumes constant permanent earnings and white noise transitory earnings. The literature on individual earnings dynamics has shown that both assumptions are unrealistic, as individual earnings dynamics are characterized by life-cycle effects in permanent earnings and serial correlation of transitory shocks. Secondly, the method does not necessarily get at the exact turning points in the time series of transitory variances when the turning points fall within the time windows used for the averaging of individual earnings. We overcome both types of limitations with the formal models of the next Section.

Table 3. *The impact of tenure and temporary contracts: Gottschalk and Moffitt (1994) method*

	Truncated sample						Full sample	
	coeff.	s.e.	coeff.	s.e.	coeff.	s.e.	coeff.	s.e.
Months of tenure	-0.0002	(0.0000)						
0<tenure<=12 months			-0.0040	(0.0002)				
12<tenure<=24 months			-0.0024	(0.0001)				
24<tenure<=36 months			-0.0013	(0.0001)				
36<tenure<=48 months			-0.0004	(0.0000)				
48<tenure			-0.0001	(0.0000)				
Time in temp. contracts					0.0499	(0.0014)	0.0531	(0.0013)
Constant	0.0743	(0.0226)	0.1359	(0.0225)	0.0680	(0.0226)	-0.0184	(0.0390)
R-square	0.0293		0.0727		0.0166		0.0165	
NT	552209		552209		552209		721857	
N	48226		48226		48226		58326	

Notes: All models include individual fixed effects and are estimated on a five-year window. Time in temporary contracts refer to the percentage of years that each individual has spent in temporary contracts within the five-year window.

5 Models of earnings instability and employment flexibility

In this section we provide a model-based analysis of the relationship between earnings instability and employment flexibility. In this way we overcome the shortcomings deriving from using the descriptive measure of the last section. A vast literature on individual earnings dynamics demonstrates the relevance of serial correlation in transitory shocks and life-cycle effects in permanent earnings, which are both ignored when using the descriptive measure. Now we specify a fully-fledged model of earnings dynamics that allows for these characteristics of the earnings process.

Both in this and in the previous section, earnings instability is defined as the variance of transitory earnings shocks. Thanks to its strong assumptions, the simple approach of the last section allowed quantifying transitory shocks at the individual level and, as a consequence, provided individual-specific measures of earnings instability, which we could condition on individual tenure or contract type using fixed effects regressions. Instead, in this section the variance of shocks is specified as a model parameter which does not vary at the individual level. In the absence of individual-level variation in the resulting instability, we estimate the effects of tenure and type of contracts on earnings instability exploiting variation across birth cohorts and time periods. We will ensure that the estimated effects do not reflect omitted heterogeneity across cohorts and time periods by controlling for time and cohort effects throughout the model.

We now introduce a benchmark model of earnings dynamics that is similar to other models in the earnings dynamics literature; next we expand this model introducing tenure and type of employment contract.

5.1 Benchmark model

We specify our models in terms of log-earnings deviations from period- and cohort-specific mean log earnings. Removing period- and cohort-specific means is equivalent to including cohort-specific age dummies, which is crucial in our context since we are interested in individual life cycle profiles that may be confounded by cohort-specific wage growth. This "de-meaning" strategy was first introduced by Baker and Solon (2003), who noted that it is a flexible way to control for age effects. Other papers in the literature have been

using first stage regressions that include in the right hand side polynomials in age, cohort effects and other individual characteristics (see e.g. Meghir and Pistaferri, 2004, and Moffitt and Gottschalk, 2012). Empirically, we obtain de-meaned log earnings as residuals from cohort-specific regressions of log-wages on time dummies. Individual log-earnings deviations (w) from the period- and cohort-specific mean are the sum of a permanent (long-term) component (y) and an orthogonal transitory shock (v), orthogonality holding by definition of permanent and transitory components of earnings:

$$w_{it} = y_{it} + v_{it}; \qquad E(y_{it}v_{it}) = 0 \tag{2}$$

We control for heterogeneous life-cycle effects by allowing permanent earnings to evolve according to an individual-specific linear profile in age, what is known as Random Growth (henceforth RG) process:[8]

$$y_{it} = (\alpha_i + \beta_i A_{it})\pi_t \lambda_c; \quad (\alpha_i, \beta_i) \sim (0, 0; \sigma_\alpha^2; \sigma_\beta^2; \sigma_{\alpha\beta}) \tag{3}$$

where $c = c(i)$ denotes the birth cohort of person i. We allow the process to be shifted by a period-specific loading factor π_t and cohort specific loading factor λ_c that accounts for aggregate shifts in the long-term earnings distribution (π_{1986} and λ_{1957} are normalized to one for identification). This simple model can capture important features of individual earnings dynamics. Variances of intercepts and slopes of the profile correspond to different sources of earnings heterogeneity that have theoretical counterparts in human capital models, such as heterogeneous returns to schooling (intercepts) and heterogeneous returns to experience (slopes). Also the covariance between intercepts and slopes is a relevant parameter in the RG model. Many studies have found the covariance to be negative. With $\sigma_{\alpha\beta} < 0$, individuals starting-off on a low wage will see their earnings grow faster than initially higher paid individuals, which may either reflect Mincerian cross-overs due to training, or the willingness of those on fast tracks to accept low paid jobs at labour market entry.

We model transitory earnings as an AR(1) process with cohort-specific initial condi-

[8] An alternative model for the permanent part is random walk (henceforth RW). Random walk models of long-term earnings have been used by Dickens (2000) and Meghir and Pistaferri (2004). We will introduce the RW parameterisation later in this section when we will allow for tenure effects in the permanent earnings component.

tions and age dependent variance of shocks. Baker and Solon (2003) specified the variance of transitory shocks as a quartic in age and and exploited variation in age across cohorts and time periods for estimation, finding significant age variation. Here we use a more flexible exponential spline. Our exponential specification ensures non-negativity of the age-related component, while preserving flexibility through the spline function.[9] Our benchmark transitory earnings are written as:

$$v_{it} = \tau_t u_{it} = \tau_t(\rho u_{it-1} + \varepsilon_{it}); \qquad \varepsilon_{it} \sim (0; \sigma^2_{\varepsilon ct}); \qquad u_{i0} \sim (0; \eta_c \sigma^2_0) \tag{4}$$

where τ are period-specific factor loadings and u_{i0} is the initial condition for person i, whose variance is cohort-specific. Period- and cohort- specific shifters τ_t and η_c allow us to control for aggregate shifts in the distribution of transitory earnings.[10] Finally the variance of shocks varies over cohorts and time periods as a function of the average age in the cohort A_{ct}:

$$\sigma^2_{\varepsilon ct} = \sigma^2_{\varepsilon} exp[g_1(A_{ct})] \tag{5}$$

where A_{ct} is the age in period t of individuals born in cohort c, $g_1()$ is a spline with knots at 26, 31, 36 and 41 years of age. Thus, we exploit variation in average age across periods and cohorts to identify its impact on earnings instability. Note that time and cohort effects are already controlled for through the non-parametric shifters τ_t and μ_c, so that $g_1(.)$ will pick up variation in instability due to age, and not to time and cohorts effects.

5.2 Modeling the impact of tenure

Our interest is to characterize the effect on earnings instability of workplace tenure and type of employment contract. We achieve this by exploiting variation across cohorts and time, while controlling for cohort and time effects throughout the model. We also allow tenure and type of contracts to affect the permanent earnings component, so that the effects estimated on instability will not depend on omission of their impact on the

[9] We have also experimented with ARMA(1,1) specifications. However, when we model the impact of tenure on instability, moving average components are difficult to identify. For the sake of comparability, we therefore adopt the AR(1) specification throughout the paper. Baker and Solon (2003) report similar issues in a model of instability without tenure.

[10] Other authors have used for identification the cohort-specific variance of initial conditions –see e.g. Haider (2001) and Baker and Solon (2003).

permanent component. We estimate separate models for workplace tenure and type of employment contract.

We model the impact of tenure on earnings instability by using an exponential spline with knots at 1, 2, 3 and 4 years of tenure so that our specification of the variance of shocks becomes:

$$\sigma^2_{\varepsilon ct} = \sigma^2_{\varepsilon} exp[g_1(A_{ct})g_2(T_{ct})] \tag{6}$$

where T_{ct} is the average tenure in period t for members of birth cohort c, and $g_2()$ is a spline function. We account for tenure effects in the permanent component through a job-specific unit-root shock resulting in a Random Walk process (RW henceforth). Thence the overall specification of permanent earnings becomes a RG plus RW:[11]

$$y_{it} = (\alpha_i + \beta_i A_{it} + S_{it} r_{it})\pi_t \lambda_c; \qquad r_{it} = r_{it-1} + q_{it}; \qquad q_{it} \sim (0, \sigma^2_q) \tag{7}$$

where S_{it} is a dummy variable for job stayers between $t-1$ and t. Our model with workplace tenure results by extending the benchmark model using the two equations above.

We are not the first to model tenure in earnings variance models, however we are the first to model the transitory component of earnings with respect to tenure. Previous studies' interest in the relationship between permanent earnings and tenure has been motivated by testing between alternative theories of wage determination. Parent (2002) considers human capital versus matching theories of wage dynamics and models time-varying match effects using a RG specification for permanent wages, providing support for human capital models. However, there are reasons to believe that job tenure should also affect earnings instability. Specifically, we should expect earnings instability to decrease with job duration if there is employer learning on the quality of the match over time, or if firms are more willing to insure earnings against volatile shocks the more they know match quality (see Lange, 2007; Guiso et al., 2005). The earnings model set up in this Section encompasses tenure effects in both the transitory and permanent components of the earnings process.

[11] The RG plus RW specification is used in Baker and Solon (2003) and Moffitt and Gottschalk (2012). In their case, both processes evolve over age, whereas in our case the two processes evolve along two different dimensions, age and workplace tenure.

5.3 Modeling the impact of temporary contracts

As discussed in Section 3, much of the variation in tenure comes from the diffusion of temporary contracts. An alternative way to measure the relevance of firm seniority for earnings instability is to look at the type of contract, open-ended or temporary. The underlying idea is that temporary contracts are associated with job turnover and do not favor the accumulation of seniority, so that if tenure reduces instability, then we should expect larger instability on temporary contracts relative to open-ended ones. Moreover, insofar as temporary contracts are less favourable to the development of job-specific skills and are characterized by less training compared with open-ended contracts, we expect the distribution of long-term earnings to be more compressed among temporary workers.

To model the impact of contract types on instability, we exploit variation in the incidence of temporary contracts across cohorts and time periods. We define two dummies for such incidence being between 5 and 10 percent, or above 10 percent, $F1_{ct}$ and $F2_{ct}$, and specify the variance of shocks as a function of the two dummies and the age spline:

$$\sigma^2_{\varepsilon ct} = \sigma^2_{\varepsilon} exp[g_1(A_{ct})(\phi_1 F1_{ct} + \phi_2 F2_{ct})] \tag{8}$$

For long-term earnings, we take an approach similar to the one used for instability, and allow their variance to be a function of the incidence of fixed term contracts over cohort-period cells:

$$var(y_{it}) = (\sigma^2_{\alpha} + 2A_{ct}\sigma_{\alpha\beta} + A^2_{ct}\sigma^2_{\beta})\pi^2_t \lambda^2_c exp(\gamma_1 F1_{ct} + \gamma_2 F2_{ct}) \tag{9}$$

Our model of earnings instability and temporary contacts results by extending the benchmark model using the two equations above.

6 Results

We begin our discussion by considering Figure 3 which plots the variance decomposition into long-term and transitory components predicted by the benchmark model of equations 2 to 5 averaged over birth cohorts. The predicted total variance of earnings replicates quite closely the patterns of the raw variance displayed in Figure 1, indicating that the fitting performance of the model is rather good.

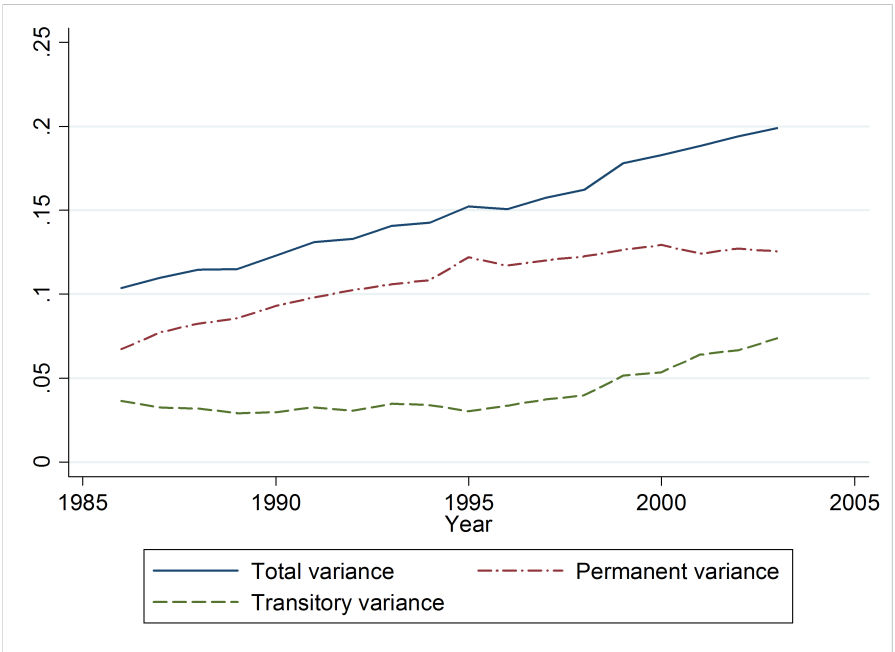

Fig. 3. *Predicted Variance Components*

These patterns suggest that increasing overall inequality in the late 1980s and early 1990s is essentially the result of widening long-term wage differentials, as would result from a widening distribution of skill premia, say in the presence of skill-biased technical change. Trends in the last part of the period have a different nature: while the growth of permanent inequality levels-off after 1995-1996, earnings instability displays an upward pattern over the last years of observation, consistently with the increased labour market flexibility brought about by labour market reforms in this period.

6.1 Benchmark model

Parameter estimates of "core" earnings components are reported in Table 4, while the estimated time and cohort shifters are reported in the Appendix. The results for the benchmark model of Section 5.1 are reported in column (1) and (2) respectively for the truncated and the full sample. We focus our comments on the transitory component which is our main interest in this paper. We first notice that parameter estimates are remarkably stable across columns indicating that the truncation of the sample is not likely to induce a serious selection bias. The only notable difference regards the variance of transitory shocks σ_ε^2 and their initial condition σ_0^2 which is larger in the truncated sample consistently with the idea that shorter tenure is associated with more instability.

Note however that age patterns of instability are very similar in the two samples. The estimated coefficients of the exponential spline function in age (the g_1's) are all precisely estimated, and reveal that the evolution of instability is not monotone over the life-cycle: instability decreases at the beginning of the working life, stabilizes over its central part and then starts rising towards the end of the life-cycle. A similar non-monotonic pattern of instability over age has also been found by Baker and Solon (2003) adopting a quartic specification. In comparison to them we find a very similar autoregressive coefficient ρ (0.57 vs. 0.54): the estimated AR(1) coefficient ρ implies that, after 5 years, 6 percent ($0.57^5 * 100$) of a transitory innovation contributes to transitory earnings.

Looking now at the persistent component, it appears that the random growth coefficients are precisely estimated and indicate substantial heterogeneity of initial earnings (σ_α^2) and of earnings growth (σ_β^2): an individual with β_i one standard deviation above the mean experiences earnings growth 1.4% ($0.0002^{\frac{1}{2}} * 100$) faster than the mean. Finally the covariance between intercepts and slopes of the RG is positive ($\sigma_{\alpha\beta} > 0$), which may reflect heterogeneous ability in human capital accumulation, both in terms of schooling and learning-by-doing.

6.2 Model with tenure

Parameter estimates for the model which includes tenure, laid out in equations 6 and 7, are reported in column (1) of Table 5. The g_2 coefficients relate earnings instability with tenure (the spline has knots at 1, 2, 3 and 4 years of tenure) and show that instability decreases with seniority on the job. Specifically tenure decreases rapidly over the first 3 years of the match and then flattens out over the fourth year and afterwards. Importantly, the tenure effects that we estimate are obtained while controlling for the relationship between earnings instability and age (through the g_1's) so that the result is net of any spurious influence that may emerge in the presence of correlation between age and tenure.

Predictions from this model are summarized in Figure 4, which plots the predicted variance of transitory shocks $\widehat{\sigma}^2_{\varepsilon ct}$ against tenure. Predictions are averaged over cohorts. The picture shows a clear downward trend with tenure. More specifically, the average instability is 0.055 at the start of the job match and 0.011 after 7 years of tenure, implying an yearly reduction rate of approximately 11% ($=\frac{0.055-0.011}{0.055*7} * 100$). The reduction is concentrated in the first three years of the match where the average yearly reduction rate

Table 4. *Benchmark Model*

	Truncated sample		Full sample	
	coeff.	s.e.	coeff.	s.e.
		Permanent component		
σ^2_α	0.0204	(0.0013)	0.0201	(0.0011)
$\sigma_{\alpha\beta}$	0.0021	(0.0001)	0.0020	(0.0001)
σ^2_β	0.0002	(0.0000)	0.0002	(0.0000)
		Transitory component		
σ^2_ε	0.0718	(0.0096)	0.0332	(0.0035)
σ^2_0	0.0736	(0.0123)	0.0550	(0.0082)
ρ	0.5721	(0.0084)	0.5740	(0.0067)
g_{11}	-0.0143	(0.0150)	-0.0157	(0.0148)
g_{12}	-0.0184	(0.0094)	-0.0272	(0.0091)
g_{13}	-0.0070	(0.0095)	-0.0150	(0.0089)
g_{14}	-0.0983	(0.0075)	-0.0994	(0.0066)
g_{15}	0.0966	(0.0110)	0.0966	(0.0095)
SSR	0.3832		0.2778	
NT	552209		721857	
N	48226		58326	

Notes: All models include time and cohort shifters in both the permanent and the transitory components reported in Table appendix. The models are estimated on 4,686 earnings moments over the period 1986-2003 and 34 birth cohorts born between 1940 and 1973. The g_1 coefficients indicate the spline of the average age in the cohort with knots at 26, 31, 36, 41 years of age.

is 20% ($=\frac{0.055-0.022}{0.055*3} * 100$). We observe that the inclusion of tenure impacts the other parameter of the transitory component: in particular the spline in age shows a change in the coefficients at the start of the life cycle; the autoregressive coefficient ρ and the variance of the initial conditions $\widehat{\sigma}_0^2$ are marginally reduced with respect to the benchmark model.

Regarding the permanent variance component, we notice that the inclusion of a random walk in tenure does not affect significantly the estimates of the random growth in age and yields a marginally significant random walk coefficient, implying that persistent inequality increases linearly with tenure. We stress that the presence of tenure in the permanent component ensures that the results in Figure 4 do not reflect the omission of tenure effects in the permanent component. We further assess that the results of a declining instability in tenure is robust to model specification in two ways. First we exclude tenure effects form the permanent component (column 2 of Table 5) and second we specify tenure effects in the permanent component using the same exponential spline that we use in the transitory component (column 3 of Table 5).[12] In both cases, notwithstanding the different modeling of tenure in the permanent component, results on the tenure coefficients on earnings instability g_2 are remarkably robust and confirm that most of the reduction of instability occurs in the first three years of the match.

6.3 Model with temporary contracts

In the last part of Section 4 we discussed an alternative way to test our idea that shorter tenure is associated with earnings instability, namely to parameterize the variance components models with respect to the type of job contracts, temporary or open-ended. We do this by letting the dispersion of permanent and transitory earnings in the benchmark model to shift with the average proportion of temporary workers across period-cohort cells. Since time and cohort effects are already controlled for in the model by means of flexible loading factors, we are confident that the estimates will capture the association between variance components and contract type and will not be affected by other unobserved factors that vary by cohort and time period.

Results from this exercise are in Table 6, using both the truncated and the full sample.

[12] In this latter case the variance of the permanent component in equation 3 is written: $var(y_{it}) = (\sigma_\alpha^2 + 2A_{ct}\sigma_{\alpha\beta} + A_{ct}^2\sigma_\beta^2)\exp[b_1(T_{ct})]\pi_t^2\lambda_c^2$ where b_1 is a spline function of average tenure with knots at 1, 2, 3 and 4 years of tenure.

Table 5. *Models with Tenure*

	(1)		(2)		(3)	
	coeff.	s.e.	coeff.	s.e.	coeff.	s.e.
			Permanent component			
σ_α^2	0.0167	(0.0010)	0.0204	(0.0014)	0.0308	(0.0035)
$\sigma_{\alpha\beta}$	0.0021	(0.0001)	0.0021	(0.0001)	0.0029	(0.0003)
σ_β^2	0.0002	(0.0000)	0.0002	(0.0000)	0.0003	(0.0000)
σ_q^2	0.0015	(0.0010)				
b_{11}					0.3397	(0.0501)
b_{12}					0.0669	(0.0310)
b_{13}					-0.0012	(0.0161)
b_{14}					0.0096	(0.0113)
b_{15}					0.0037	(0.0095)
			Transitory component			
σ_ε^2	0.0489	(0.0124)	0.0576	(0.0113)	0.0252	(0.0064)
σ_0^2	0.0575	(0.0116)	0.0729	(0.0124)	0.0532	(0.0132)
ρ	0.4236	(0.0200)	0.5560	(0.0082)	0.5553	(0.0096)
g_{11}	0.0468	(0.0374)	0.0640	(0.0262)	0.0823	(0.0277)
g_{12}	0.0283	(0.0176)	0.0197	(0.0130)	0.0284	(0.0136)
g_{13}	0.0362	(0.0141)	0.0062	(0.0106)	0.0139	(0.0106)
g_{14}	-0.0968	(0.0087)	-0.0920	(0.0077)	-0.0918	(0.0074)
g_{15}	0.1309	(0.0140)	0.1043	(0.0119)	0.0994	(0.0115)
g_{21}	-0.3892	(0.2968)	-0.4514	(0.2187)	-0.6203	(0.2341)
g_{22}	-0.3167	(0.1511)	-0.3455	(0.1044)	-0.4561	(0.1073)
g_{23}	-0.3548	(0.0963)	-0.3416	(0.0719)	-0.3544	(0.0730)
g_{24}	-0.1616	(0.0733)	-0.1286	(0.0558)	-0.1687	(0.0566)
g_{25}	-0.1950	(0.0512)	-0.0961	(0.0379)	-0.1227	(0.0400)
SSR	0.3708		0.3789		0.3755	

Notes: NT=552,209 and N=48,226. The models differ in the way tenure is modeled in the permanent component. Model (1) includes tenure as a RW in the permanent component. Model (2) includes tenure only in the transitory component. Model (3) includes a spline in years of tenure in the permanent component. All models include time and cohort shifters in both the permanent and the transitory components reported in Table appendix. The models are estimated on 4,686 earnings moments over the period 1986-2003 and 34 birth cohorts born between 1940 and 1973. The g_1 coefficients indicate the spline of the average age in the cohort with knots at 26, 31, 36, 41 years of age. The g_2 and b_1 coefficients indicate the spline of the average tenure in the cohort with knots at 1, 2, 3, 4 years of tenure.

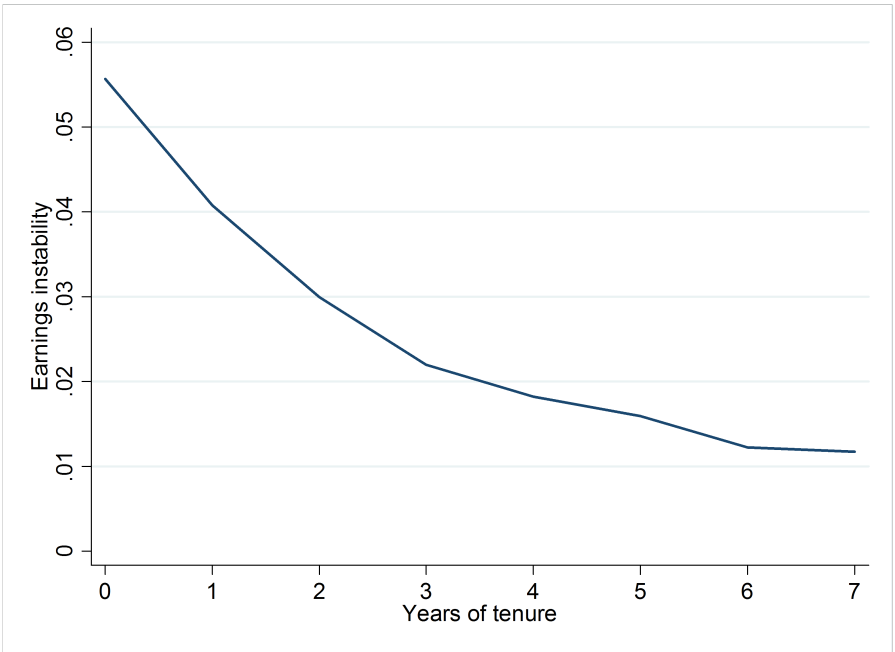

Fig. 4. *Estimated earnings instability by tenure*

Parameter estimates for coefficients other than the ones linking variance components to contract types are pretty similar to the ones estimated for the benchmark model, either on the truncated and the full sample. The coefficients linking contract type to permanent and transitory earnings shocks (γ and ϕ respectively) attract the signs we would expect a priori, indicating that individuals on fixed term contracts have on average a lower permanent variance of earnings and a higher instability relative to permanent workers. The lower permanent variance reflects a compressed distribution of long-term earnings for temporary workers, which may emerge insofar as temporary contracts are less favourable to the development of job-specific skills and are characterized by less training compared with open-ended contracts.

In order to assess the sensitivity of our findings on the effects of temporary contracts on earnings instability, we estimate a version of the model in which contract types are not allowed to impact on long-term earnings, see columns (2) and (4) in Table 6. The similarity of the estimate coefficients ϕ on the temporary contracts in columns (1) and (3) with respect to columns (2) and (4) suggest that the effects on instability do not depend on the omission of temporary contracts in the permanent component.

Using parameter estimates we can predict the transitory earnings variance associated with temporary contracts. Figure 5 refers to the full sample but the results on the truncated sample are virtually identical. In particular, we average predicted transitory

variances over cells defined by the incidence of temporary contracts, namely below 5% and above 10%, and plot estimated averages over time. There is a clear gap in the average transitory earnings variance between cohorts with low and high incidence of temporary contracts. The gap is of the order of 50% and (with little variation) it is stable until 1998. From the introduction of the "Treu" reform that liberalized temporary contracts the gap rapidly rises until it reaches almost a 100% difference in 2003, the last year of the sample.

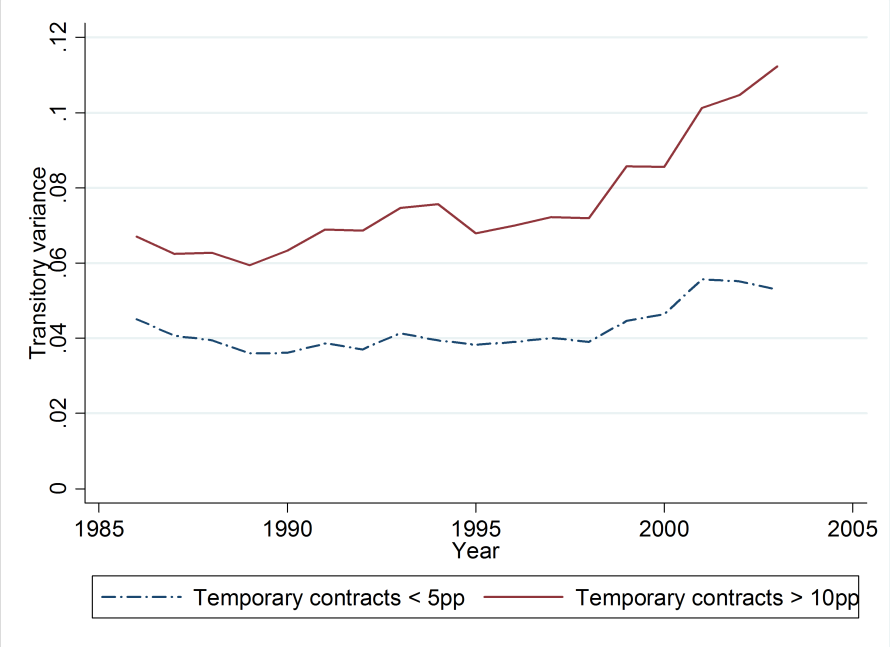

Fig. 5. *Predicted transitory variance by incidence of temporary contracts.*

7 Discussion and Conclusion

In this paper we use Italian panel data to estimate the impact of on-the-job tenure on earnings instability. Although other papers (Huff-Stevens, 2001; Hospido, 2012; Leonardi, 2012) have looked into the effect of voluntary and involuntary job changes on instability, we are the first to develop a formal model which accounts for tenure in the decomposition of the earnings variance. We find that the dispersion of long-term earnings profiles increases with tenure while earnings instability declines with tenure. We estimate that each year of tenure is associated with a 11% reduction in instability. We reach similar conclusion of a negative relationship between earnings instability and tenure also adopting an

Table 6. *Model with temporary contracts*

	Full sample				Truncated sample			
	(1)		(2)		(3)		(4)	
	coeff.	s.e.	coeff.	s.e.	coeff.	s.e.	coeff.	s.e.
				Permanent component				
σ^2_α	0.0205	(0.0011)	0.0202	(0.0011)	0.0211	(0.0014)	0.0206	(0.0014)
$\sigma_{\alpha\beta}$	0.0020	(0.0001)	0.0020	(0.0001)	0.0021	(0.0001)	0.0021	(0.0001)
σ^2_β	0.0002	(0.0000)	0.0002	(0.0000)	0.0002	(0.0000)	0.0002	(0.0000)
γ_1	-0.0736	(0.0186)			-0.0996	(0.0181)		
γ_2	-0.0080	(0.0407)			-0.0950	(0.0438)		
				Transitory component				
σ^2_ε	0.0298	(0.0038)	0.0315	(0.0038)	0.0600	(0.0093)	0.0669	(0.0102)
σ^2_0	0.0553	(0.0082)	0.0553	(0.0082)	0.0738	(0.0122)	0.0740	(0.0123)
ρ	0.5717	(0.0071)	0.5749	(0.0068)	0.5611	(0.0086)	0.5723	(0.0085)
g_{11}	-0.0065	(0.0159)	-0.0090	(0.0157)	-0.0002	(0.0151)	-0.0088	(0.0155)
g_{12}	-0.0103	(0.0120)	-0.0147	(0.0121)	0.0064	(0.0125)	0.0006	(0.0132)
g_{13}	-0.0062	(0.0092)	-0.0101	(0.0094)	0.0033	(0.0098)	-0.0019	(0.0103)
g_{14}	-0.0993	(0.0066)	-0.0994	(0.0067)	-0.0975	(0.0074)	-0.0981	(0.0076)
g_{15}	0.0965	(0.0095)	0.0977	(0.0095)	0.0959	(0.0110)	0.0981	(0.0111)
ϕ_1	0.1161	(0.0456)	0.0342	(0.0403)	0.1417	(0.0475)	0.0354	(0.0436)
ϕ_2	0.1383	(0.0696)	0.0900	(0.0583)	0.2307	(0.0723)	0.1202	(0.0641)
SSR	0.2766		0.2778		0.3817		0.3835	
NT	721857		721857		552209		552209	
N	58326		58326		48226		48226	

Notes: The model includes time and cohort shifters in both the permanent and the transitory components reported in Table appendix. The models are estimated on 4,686 earnings moments over the period 1986-2003 and 34 birth cohorts born between 1940 and 1973. The g_1 coefficients indicate the spline of the average age in the cohort with knots at 26, 31, 36, 41. The ϕs and γs are the coefficients on two dummies which indicate that the incidence of temporary contracts across cohorts and time periods is between 5 and 10 percent and above 10 percent.

alternative approach based on the early descriptive measure of instability introduced by Gottschalk e Moffitt (1994).

Although this quantification of the effect of tenure on instability does not imply any particular interpretation, these results are potentially consistent with different models of wage determination. The results are consistent with matching models where overall earnings profiles tend to their long-term component as individuals settle down in their job and information on their ability is revealed. Lange (2007) finds that in the U.S. the initial expectation error about match quality declines by 50% in three years which approximately equals our estimate of a reduction of 11% in earnings instability per year of tenure. Models of firm-provided insurance can also potentially account for these findings. Guiso et al. (2005) compute permanent and transitory shocks to firms' profits and workers' wages and find that firms provide workers with full insurance only against transitory shocks. This implicit-contract setting is consistent with our results if insurance provision grows with tenure and leads to a decline of earnings instability.

We also look explicitly at the effect of temporary (short-tenure contracts) on earnings instability. We find that cohorts of workers with a high incidence of temporary contracts experience on average between 50% and 100% more transitory earnings variance than cohorts with low incidence (less than 5%). The exercise of this paper is potentially relevant from the policy point of view for many European countries, which starting from the late 1990s experienced an increasing diffusion of short term contracts. Many authors have stressed that the welfare effects of these reforms depend on their impact on employment probability. Here we have provided evidence that, even conditional on being employed, there are additional channels through which these new type of jobs affect individual welfare, namely through an increased uncertainty surrounding long-term earnings profiles.

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A Additional tables

Table A.1. *Benchmark Model (full sample): time shifters of permanent and transitory variance 1986=1.*

	coeff.	s.e.		coeff.	s.e.
π_{1987}	1.038005	0.007401	τ_{1987}	1.087768	0.035844
π_{1988}	1.038887	0.00864	τ_{1988}	1.138253	0.050339
π_{1989}	1.025734	0.009291	τ_{1989}	1.126757	0.054704
π_{1990}	1.037321	0.010219	τ_{1990}	1.145671	0.057793
π_{1991}	1.034015	0.011077	τ_{1991}	1.191393	0.058877
π_{1992}	1.025831	0.011941	τ_{1992}	1.165352	0.057112
π_{1993}	1.013717	0.012725	τ_{1993}	1.217348	0.058854
π_{1994}	0.997888	0.013365	τ_{1994}	1.198706	0.057778
π_{1995}	1.016307	0.0144	τ_{1995}	1.179552	0.057012
π_{1996}	0.970955	0.014457	τ_{1996}	1.199954	0.05795
π_{1997}	0.959732	0.015033	τ_{1997}	1.233026	0.060202
π_{1998}	0.946085	0.015327	τ_{1998}	1.251283	0.060796
π_{1999}	0.938265	0.015973	τ_{1999}	1.384105	0.06764
π_{2000}	0.925378	0.016156	τ_{2000}	1.396208	0.069623
π_{2001}	0.885462	0.015674	τ_{2001}	1.507249	0.076452
π_{2002}	0.87556	0.015938	τ_{2002}	1.528069	0.07824
π_{2003}	0.847522	0.015956	τ_{2003}	1.595572	0.082591

Table A.2. *Benchmark Model (full sample): cohort shifters and cohort initial conditions 1957=1.*

	coeff.	s.e.		coeff.	s.e.
λ_{1940}	0.677619	0.024972	η_{1940}	0.520679	0.17859
λ_{1941}	0.678765	0.025492	η_{1941}	0.318524	0.162779
λ_{1942}	0.725109	0.025553	η_{1942}	0.507037	0.184385
λ_{1943}	0.736581	0.025603	η_{1943}	0.567242	0.205767
λ_{1944}	0.729159	0.024546	η_{1944}	0.169003	0.162703
λ_{1945}	0.770897	0.026497	η_{1945}	0.533559	0.186226
λ_{1946}	0.79242	0.025217	η_{1946}	0.803803	0.216823
λ_{1947}	0.761235	0.02454	η_{1947}	0.707954	0.177605
λ_{1948}	0.785976	0.024184	η_{1948}	0.906493	0.215135
λ_{1949}	0.785479	0.024112	η_{1949}	0.995168	0.218015
λ_{1950}	0.803147	0.023457	η_{1950}	1.007369	0.210231
λ_{1951}	0.833191	0.02505	η_{1951}	0.933314	0.227838
λ_{1952}	0.874869	0.026732	η_{1952}	0.640491	0.161412
λ_{1953}	0.896928	0.026971	η_{1953}	0.98276	0.208438
λ_{1954}	0.905432	0.028068	η_{1954}	0.800803	0.177504
λ_{1955}	0.970376	0.030682	η_{1955}	0.851368	0.19372
λ_{1956}	1.004126	0.029597	η_{1956}	1.32847	0.258833
λ_{1958}	1.068531	0.031692	η_{1958}	1.176564	0.226338
λ_{1959}	1.10725	0.031934	η_{1959}	1.064434	0.204579
λ_{1960}	1.097455	0.033442	η_{1960}	1.03293	0.210009
λ_{1961}	1.115409	0.034389	η_{1961}	1.1769	0.233429
λ_{1962}	1.15407	0.03619	η_{1962}	1.270154	0.253846
λ_{1963}	1.169348	0.035437	η_{1963}	1.304909	0.245268
λ_{1964}	1.137559	0.03622	η_{1964}	1.145566	0.23059
λ_{1965}	1.246669	0.040897	η_{1965}	1.314659	0.263056
λ_{1966}	1.250654	0.041506	η_{1966}	0.792923	0.170271
λ_{1967}	1.300042	0.045587	η_{1967}	0.80036	0.174456
λ_{1968}	1.31246	0.046852	η_{1968}	0.767574	0.167974
λ_{1969}	1.321546	0.050479	η_{1969}	1.068305	0.255569
λ_{1970}	1.371921	0.059838	η_{1970}	0.989798	0.220898
λ_{1971}	1.502359	0.063807	η_{1971}	1.072003	0.239439
λ_{1972}	1.410568	0.072421	η_{1972}	1.024346	0.257407
λ_{1973}	1.341765	0.076371	η_{1973}	1.219976	0.282487

Table A.3. *Benchmark Model (truncated sample): time shifters of permanent and transitory variance 1986=1.*

	coeff.	s.e.		coeff.	s.e.
π_{1987}	1.040816	0.01471	τ_{1987}	0.871632	0.044965
π_{1988}	1.053351	0.016522	τ_{1988}	0.835706	0.052144
π_{1989}	1.041737	0.017236	τ_{1989}	0.804993	0.052931
π_{1990}	1.053712	0.018266	τ_{1990}	0.79589	0.052907
π_{1991}	1.030472	0.018924	τ_{1991}	0.830831	0.053806
π_{1992}	1.027441	0.020203	τ_{1992}	0.791039	0.050922
π_{1993}	1.011962	0.021089	τ_{1993}	0.828869	0.052973
π_{1994}	0.996061	0.021816	τ_{1994}	0.810822	0.051723
π_{1995}	1.003226	0.022933	τ_{1995}	0.802674	0.051407
π_{1996}	0.959133	0.022807	τ_{1996}	0.813665	0.052263
π_{1997}	0.946327	0.023082	τ_{1997}	0.831907	0.053725
π_{1998}	0.937803	0.023584	τ_{1998}	0.833609	0.053985
π_{1999}	0.927875	0.024292	τ_{1999}	0.923094	0.059811
π_{2000}	0.908981	0.024017	τ_{2000}	0.932162	0.061285
π_{2001}	0.870948	0.023423	τ_{2001}	1.003987	0.066217
π_{2002}	0.861393	0.023896	τ_{2002}	1.023222	0.067843
π_{2003}	0.829818	0.023732	τ_{2003}	1.067509	0.071125

Table A.4. *Benchmark Model (truncated sample): cohort shifters and cohort initial conditions 1957=1.*

	coeff.	s.e.		coeff.	s.e.
λ_{1940}	0.668176	0.030464	η_{1940}	0.717092	0.25984
λ_{1941}	0.645756	0.030479	η_{1941}	0.29856	0.179886
λ_{1942}	0.717682	0.03168	η_{1942}	0.216708	0.203883
λ_{1943}	0.723959	0.031484	η_{1943}	0.404334	0.251487
λ_{1944}	0.723722	0.029675	η_{1944}	0.018602	0.165153
λ_{1945}	0.785124	0.030898	η_{1945}	0.491153	0.221104
λ_{1946}	0.792374	0.029641	η_{1946}	0.762706	0.272091
λ_{1947}	0.756293	0.029401	η_{1947}	0.36894	0.171413
λ_{1948}	0.7907	0.028317	η_{1948}	0.761619	0.24025
λ_{1949}	0.786259	0.028708	η_{1949}	0.924813	0.238893
λ_{1950}	0.801219	0.026865	η_{1950}	0.916636	0.257495
λ_{1951}	0.815068	0.028781	η_{1951}	1.039755	0.366418
λ_{1952}	0.883713	0.031646	η_{1952}	0.707679	0.209603
λ_{1953}	0.902467	0.031479	η_{1953}	0.82125	0.2161
λ_{1954}	0.907061	0.034041	η_{1954}	0.651357	0.20339
λ_{1955}	0.964511	0.034354	η_{1955}	1.01326	0.262644
λ_{1956}	1.018596	0.034232	η_{1956}	1.287894	0.309327
λ_{1958}	1.076604	0.036501	η_{1958}	0.975567	0.235282
λ_{1959}	1.110394	0.03641	η_{1959}	1.043483	0.227989
λ_{1960}	1.123193	0.03853	η_{1960}	1.014369	0.227314
λ_{1961}	1.095499	0.036744	η_{1961}	1.130497	0.255064
λ_{1962}	1.158804	0.040718	η_{1962}	1.134899	0.255053
λ_{1963}	1.191249	0.040269	η_{1963}	1.261389	0.263644
λ_{1964}	1.140173	0.040487	η_{1964}	1.098565	0.224127
λ_{1965}	1.246796	0.045508	η_{1965}	1.185844	0.255653
λ_{1966}	1.255919	0.046652	η_{1966}	1.189993	0.2785
λ_{1967}	1.30231	0.050961	η_{1967}	1.248398	0.304962
λ_{1968}	1.307561	0.052549	η_{1968}	1.184031	0.292307
λ_{1969}	1.323304	0.056418	η_{1969}	1.730048	0.457923
λ_{1970}	1.37382	0.065671	η_{1970}	1.60201	0.39763
λ_{1971}	1.505366	0.070753	η_{1971}	1.806631	0.449189
λ_{1972}	1.419724	0.078576	η_{1972}	1.711165	0.468543
λ_{1973}	1.359448	0.08267	η_{1973}	2.036315	0.523657

Table A.5. *Model with Tenure (truncated sample): time shifters of permanent and transitory variance 1986=1.*

	coeff.	s.e.		coeff.	s.e.
π_{1987}	1.037717	0.014443	τ_{1987}	0.897811	0.075611
π_{1988}	1.049984	0.016314	τ_{1988}	0.925579	0.100079
π_{1989}	1.037876	0.017036	τ_{1989}	0.950055	0.119312
π_{1990}	1.050675	0.018086	τ_{1990}	0.971381	0.1337
π_{1991}	1.030493	0.01873	τ_{1991}	1.071219	0.154881
π_{1992}	1.026493	0.020099	τ_{1992}	1.047344	0.159535
π_{1993}	1.010185	0.020345	τ_{1993}	1.115443	0.166832
π_{1994}	0.991581	0.021198	τ_{1994}	1.135431	0.178214
π_{1995}	0.99852	0.022356	τ_{1995}	1.139238	0.182722
π_{1996}	0.956867	0.022347	τ_{1996}	1.189754	0.194897
π_{1997}	0.945913	0.022761	τ_{1997}	1.247888	0.208333
π_{1998}	0.939736	0.023353	τ_{1998}	1.266562	0.213073
π_{1999}	0.935758	0.024015	τ_{1999}	1.443682	0.24428
π_{2000}	0.91941	0.023743	τ_{2000}	1.488007	0.254855
π_{2001}	0.885274	0.023139	τ_{2001}	1.678699	0.293691
π_{2002}	0.877162	0.023504	τ_{2002}	1.743425	0.307277
π_{2003}	0.84807	0.023353	τ_{2003}	1.853009	0.332308

Table A.6. *Model with Tenure (truncated sample): cohort shifters and cohort initial conditions 1957=1.*

	coeff.	s.e.		coeff.	s.e.
λ_{1940}	0.686349	0.030322	η_{1940}	0.891889	0.351188
λ_{1941}	0.66282	0.030153	η_{1941}	0.312361	0.212907
λ_{1942}	0.733415	0.031126	η_{1942}	0.241004	0.249888
λ_{1943}	0.739563	0.031182	η_{1943}	0.434684	0.298603
λ_{1944}	0.737525	0.02906	η_{1944}	0.248377	0.162808
λ_{1945}	0.800065	0.030168	η_{1945}	0.248377	0.162808
λ_{1946}	0.806549	0.029117	η_{1946}	0.827156	0.32765
λ_{1947}	0.769091	0.029081	η_{1947}	0.420225	0.21628
λ_{1948}	0.80295	0.027985	η_{1948}	0.852698	0.315053
λ_{1949}	0.798082	0.028243	η_{1949}	1.029807	0.299438
λ_{1950}	0.812436	0.026361	η_{1950}	0.982251	0.323375
λ_{1951}	0.82502	0.028082	η_{1951}	1.247829	0.507092
λ_{1952}	0.890846	0.030563	η_{1952}	0.741507	0.262014
λ_{1953}	0.909511	0.030522	η_{1953}	0.780283	0.248269
λ_{1954}	0.91231	0.032872	η_{1954}	0.636607	0.237181
λ_{1955}	0.967877	0.03299	η_{1955}	1.098068	0.338885
λ_{1956}	1.01946	0.032751	η_{1956}	1.402994	0.398478
λ_{1958}	1.07434	0.0347	η_{1958}	0.956563	0.284131
λ_{1959}	1.106448	0.034434	η_{1959}	1.035885	0.275785
λ_{1960}	1.116436	0.036152	η_{1960}	1.016432	0.279237
λ_{1961}	1.090104	0.034217	η_{1961}	1.258768	0.34151
λ_{1962}	1.149828	0.037695	η_{1962}	1.1675	0.313411
λ_{1963}	1.177621	0.036989	η_{1963}	1.331156	0.334743
λ_{1964}	1.132889	0.036808	η_{1964}	1.210032	0.292486
λ_{1965}	1.225852	0.041245	η_{1965}	1.285242	0.338207
λ_{1966}	1.231912	0.041635	η_{1966}	1.196899	0.37176
λ_{1967}	1.272813	0.045295	η_{1967}	0.872505	0.309602
λ_{1968}	1.275704	0.046351	η_{1968}	0.71286	0.273097
λ_{1969}	1.291439	0.049519	η_{1969}	1.121665	0.46474
λ_{1970}	1.330385	0.056724	η_{1970}	0.844358	0.346471
λ_{1971}	1.436643	0.06084	η_{1971}	0.895347	0.392503
λ_{1972}	1.365393	0.065957	η_{1972}	0.854824	0.388683
λ_{1973}	1.319763	0.068042	η_{1973}	1.08967	0.472565

Table A.7. *Model with Temporary Contracts (full sample): time shifters of permanent and transitory variance 1986=1.*

	coeff.	s.e.		coeff.	s.e.
π_{1987}	1.037344	0.007383	τ_{1987}	1.07718	0.036161
π_{1988}	1.037875	0.008607	τ_{1988}	1.119778	0.050183
π_{1989}	1.024593	0.009249	τ_{1989}	1.102804	0.053934
π_{1990}	1.036115	0.010163	τ_{1990}	1.116877	0.056721
π_{1991}	1.032488	0.011005	τ_{1991}	1.16142	0.057593
π_{1992}	1.023618	0.011848	τ_{1992}	1.141385	0.056043
π_{1993}	1.011239	0.012593	τ_{1993}	1.193528	0.057956
π_{1994}	0.99517	0.013213	τ_{1994}	1.177285	0.05699
π_{1995}	1.013695	0.01422	τ_{1995}	1.155292	0.056294
π_{1996}	0.968099	0.014268	τ_{1996}	1.178083	0.057194
π_{1997}	0.957165	0.014836	τ_{1997}	1.206227	0.059253
π_{1998}	0.943994	0.01514	τ_{1998}	1.21782	0.060305
π_{1999}	0.936955	0.015816	τ_{1999}	1.334772	0.067167
π_{2000}	0.924172	0.01604	τ_{2000}	1.340021	0.068491
π_{2001}	0.883831	0.015552	τ_{2001}	1.45362	0.074866
π_{2002}	0.87358	0.015802	τ_{2002}	1.478141	0.076851
π_{2003}	0.84617	0.015828	τ_{2003}	1.539374	0.082313

Table A.8. *Model with Temporary Contracts (full sample): cohort shifters and cohort initial conditions 1957=1.*

	coeff.	s.e.		coeff.	s.e.
λ_{1940}	0.675995	0.024873	η_{1940}	0.5223	0.178272
λ_{1941}	0.677224	0.025391	η_{1941}	0.320106	0.162434
λ_{1942}	0.723683	0.025467	η_{1942}	0.504061	0.183039
λ_{1943}	0.735242	0.025528	η_{1943}	0.565331	0.204628
λ_{1944}	0.727129	0.024397	η_{1944}	0.349805	0.123349
λ_{1945}	0.770327	0.026409	η_{1945}	0.349805	0.123349
λ_{1946}	0.791328	0.025144	η_{1946}	0.79768	0.215002
λ_{1947}	0.76026	0.024475	η_{1947}	0.702952	0.176174
λ_{1948}	0.785043	0.024121	η_{1948}	0.900652	0.213519
λ_{1949}	0.784622	0.024057	η_{1949}	0.986779	0.215466
λ_{1950}	0.802334	0.023408	η_{1950}	0.996407	0.207485
λ_{1951}	0.832396	0.025005	η_{1951}	0.92719	0.226446
λ_{1952}	0.874092	0.026688	η_{1952}	0.633879	0.15978
λ_{1953}	0.896268	0.026933	η_{1953}	0.973079	0.206189
λ_{1954}	0.904874	0.028035	η_{1954}	0.796805	0.176016
λ_{1955}	0.969922	0.030649	η_{1955}	0.849907	0.192829
λ_{1956}	1.003893	0.029571	η_{1956}	1.327673	0.257547
λ_{1958}	1.068796	0.031667	η_{1958}	1.179956	0.225672
λ_{1959}	1.107866	0.031913	η_{1959}	1.072119	0.204421
λ_{1960}	1.098301	0.033438	η_{1960}	1.023682	0.206832
λ_{1961}	1.116162	0.034347	η_{1961}	1.169716	0.229907
λ_{1962}	1.154711	0.0362	η_{1962}	1.266532	0.251452
λ_{1963}	1.169636	0.035418	η_{1963}	1.30909	0.244286
λ_{1964}	1.139414	0.036198	η_{1964}	1.130142	0.227835
λ_{1965}	1.246511	0.040898	η_{1965}	1.297702	0.260541
λ_{1966}	1.247129	0.04159	η_{1966}	0.796602	0.172404
λ_{1967}	1.298144	0.045611	η_{1967}	0.809433	0.177928
λ_{1968}	1.306612	0.047108	η_{1968}	0.784211	0.17302
λ_{1969}	1.313486	0.050584	η_{1969}	1.109872	0.267152
λ_{1970}	1.366646	0.060062	η_{1970}	1.020712	0.229674
λ_{1971}	1.500966	0.064224	η_{1971}	1.089271	0.245479
λ_{1972}	1.411426	0.072844	η_{1972}	1.041924	0.264359
λ_{1973}	1.342357	0.076686	η_{1973}	1.246663	0.290638

Table A.9. *Model with Temporary Contracts (truncated sample): time shifters of permanent and transitory variance 1986=1.*

	coeff.	s.e.		coeff.	s.e.
π_{1987}	1.040126	0.014653	τ_{1987}	0.858313	0.045438
π_{1988}	1.052329	0.01643	τ_{1988}	0.819227	0.051927
π_{1989}	1.040328	0.017099	τ_{1989}	0.788229	0.052237
π_{1990}	1.051781	0.018067	τ_{1990}	0.779381	0.052074
π_{1991}	1.028325	0.01867	τ_{1991}	0.813457	0.052909
π_{1992}	1.023942	0.019852	τ_{1992}	0.780008	0.050401
π_{1993}	1.007986	0.020662	τ_{1993}	0.817856	0.052615
π_{1994}	0.991497	0.021326	τ_{1994}	0.802618	0.05156
π_{1995}	0.998363	0.022378	τ_{1995}	0.793723	0.051185
π_{1996}	0.95421	0.022237	τ_{1996}	0.804186	0.051918
π_{1997}	0.941424	0.022485	τ_{1997}	0.820434	0.05325
π_{1998}	0.932904	0.022976	τ_{1998}	0.820522	0.053512
π_{1999}	0.923696	0.023712	τ_{1999}	0.898426	0.058886
π_{2000}	0.90448	0.023483	τ_{2000}	0.90168	0.059866
π_{2001}	0.866727	0.022907	τ_{2001}	0.969015	0.064373
π_{2002}	0.856669	0.023345	τ_{2002}	0.991164	0.066109
π_{2003}	0.82577	0.023192	τ_{2003}	1.034248	0.069899

Table A.10. *Model with Temporary Contracts (truncated sample): cohort shifters and cohort initial conditions 1957=1.*

	coeff.	s.e.		coeff.	s.e.
λ_{1940}	0.663816	0.030064	η_{1940}	0.723445	0.260381
λ_{1941}	0.641618	0.030083	η_{1941}	0.300223	0.177922
λ_{1942}	0.713314	0.031289	η_{1942}	0.22227	0.202606
λ_{1943}	0.719911	0.031171	η_{1943}	0.405169	0.248779
λ_{1944}	0.718899	0.029281	η_{1944}	0.257394	0.135016
λ_{1945}	0.782129	0.030578	η_{1945}	0.257394	0.135016
λ_{1946}	0.788955	0.029346	η_{1946}	0.757697	0.268729
λ_{1947}	0.753246	0.029152	η_{1947}	0.37413	0.170922
λ_{1948}	0.787829	0.028072	η_{1948}	0.759981	0.239551
λ_{1949}	0.783668	0.028489	η_{1949}	0.921015	0.236032
λ_{1950}	0.798818	0.026665	η_{1950}	0.909727	0.254945
λ_{1951}	0.812864	0.028597	η_{1951}	1.046157	0.36855
λ_{1952}	0.881536	0.031461	η_{1952}	0.706897	0.208012
λ_{1953}	0.900634	0.031319	η_{1953}	0.811579	0.212378
λ_{1954}	0.90558	0.033903	η_{1954}	0.651921	0.201257
λ_{1955}	0.963381	0.034217	η_{1955}	1.016977	0.261952
λ_{1956}	1.017912	0.034114	η_{1956}	1.289685	0.307864
λ_{1958}	1.076832	0.036396	η_{1958}	1.007126	0.237744
λ_{1959}	1.11113	0.036311	η_{1959}	1.072335	0.230068
λ_{1960}	1.124752	0.038458	η_{1960}	1.024824	0.226941
λ_{1961}	1.097642	0.036671	η_{1961}	1.154452	0.258028
λ_{1962}	1.159633	0.040693	η_{1962}	1.149171	0.255256
λ_{1963}	1.193513	0.04016	η_{1963}	1.265634	0.263211
λ_{1964}	1.143098	0.040401	η_{1964}	1.104227	0.223664
λ_{1965}	1.24952	0.045402	η_{1965}	1.182804	0.254355
λ_{1966}	1.255372	0.046652	η_{1966}	1.23394	0.290136
λ_{1967}	1.304112	0.050898	η_{1967}	1.284804	0.31577
λ_{1968}	1.302163	0.052772	η_{1968}	1.225292	0.303517
λ_{1969}	1.312914	0.056466	η_{1969}	1.803601	0.479101
λ_{1970}	1.367173	0.065908	η_{1970}	1.651732	0.411537
λ_{1971}	1.505231	0.071226	η_{1971}	1.831601	0.457708
λ_{1972}	1.422185	0.079295	η_{1972}	1.733147	0.477066
λ_{1973}	1.357752	0.083167	η_{1973}	2.07253	0.535639