Job Mobility and Earnings Instability

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Abstract

There is still no consensus on the causes of the increase of earnings instability in the US. It is difficult to attribute the rise in instability to job mobility because there is no evidence of a contemporaneous increase in turnover or separations. Using an error component model of the covariance structure, this paper shows that job mobility accounts for a substantial part of the increase in earnings instability. The empirical evidence is consistent with the predictions of a search and matching model where an increase in the variance of productivity shocks increases on-the-job search and earnings instability among job changers while leaving job turnover and earnings instability of job stayers approximatively constant.

Keywords: Earnings instability, On-the-job search.
JEL Classification: J21, J31.

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1 Introduction

The evolution of earnings instability –i.e. the variance of the transitory component of individual earnings– in the US is well researched since the work of Gottschalk and Moffitt (1994). Although most scholars agree that earnings instability increased over time, little is known about the causes of its increase (see Gottschalk and Moffitt, 2009, and Meghir and Pistaferri, 2011, for recent and complete oveviews of the literature).

An increase in workers' mobility across jobs (voluntary and involuntary) can potentially lead to transitory fluctuations in earnings if workers either experience an intervening spell of unemployment or experience a change in wages when changing jobs. So far the link between workers' mobility and earnings instability has received scant attention in the vast literature on earnings dynamics probably because identifying a clear decline in job security and job stability has proved elusive: A considerable amount of research has studied the frequency of job changes and most studies found very little if any increase over time at least until the late 1990s.[1]

Even if the frequency of job changes has not increased much over time, earnings instability in consequence of job change may have increased if job changers experience either longer unemployment spells or higher wage losses/gains upon job change (with or without an intervening unemployment spell). Although there is some evidence that the transitory variance of earnings is correlated with the business cycle, the explanation of the rise in instability is likely to go beyond unemployment spells because unemployment declined in the '90s while instability of low-skilled workers continued to increase (Moffitt and Gottschalk, 2012).[2]

In the contrary, there are various pieces of evidence which are suggestive that higher earnings instability may be associated with a higher variance of earnings changes. Kambourov and Manovskii (2008 and 2009) on PSID data show that there is a substantial increase over time in workers' mobility across occupation and that the heterogeneity of workers' occupational experience can account for part of the cross-sectional variance of wages.[3] Poletaev and Robinson

[1]See for example the articles by Jaeger and Huff-Stevens, Gottschalk and Moffitt, Neumark et al. and Valletta in the special issue of the Journal of Labor Economics 17(4), 1999. More recently, Huff-Stevens (2005) concluded that the prevalence of long-term employment relationships for men was stable between 1969 and 2002. Farber (2008) and Hallock (2009) find a decline in worker-firm attachment only in the '90s. Celik et al. (2012) and Davis et al. (2012) find that the fraction of workers who do not change jobs is relatively constant.

[2]Huff Stevens (2001) also finds that increasing displacement can only explain part of the increase in earnings instability since non-displaced workers also experienced a rise in earnings instability during the 1980s.

[3]With the partial exception of Molloy et al. (2013), I am not aware of any studies that have documented directly how the variance of wage returns to employer change has evolved over time. Occupational mobility is likely to be correlated with job change and Kambourov and Manovskii (2008) report a correlation of 0.8

(2008) show that wage losses of displaced workers are larger the larger the distance of the "portfolio" of skills of their occupations before and after job loss. There is also evidence that firm-level productivity dispersion has increased over time in the U.S. and that productivity dispersion across plants is positively correlated with individual wage inequality (Dunne et al., 2004; Leonardi, 2007).[4] Finally some papers claim that there is an increase in firm volatility measured as the variance of growth rates of sales, employment and wages (Comin and Philippon, 2006; Comin et al., 2009).

The contribution of this paper is twofold: first I estimate an error-component model of earnings changes to assess the contribution of job changers to the evolution of the overall transitory variance of earnings; secondly I propose a matching model with on-the-job search to interpret the descriptive evidence. The model is based on the idea that between-firm productivity dispersion is increasing over time and that job changers have higher instability because they match to an increasigly dispersed distribution of firms.

In the empirical part of the paper I use PSID data on earnings changes of male heads of household and divide the sample into job stayers and job changers using the survey information on employer tenure. In the course of the paper I refer to job changers (and job stayers) for convenience, but I look at employment spells after job change i.e. I allow the change to affect individual wages for a certain period of time. I estimate a permanent-transitory variance decomposition model of log earnings changes separately on individuals' spells as job stayers and job changers and find a higher increase over time in the transitory variance of earnings among job changers rather than job stayers.

In the second part of the paper I offer an interpretation of the results. I show that the evidence characterized by rising earnings instability and approximately constant job turnover can be explained within an on-the-job search model. The model predicts that a mean-preserving spread of the distribution of productivity shocks induces more employed workers to search for better jobs and thus increases the variance of wage changes upon job change. Job turnover does not necessarily increase much because not all search turns successfully into a new job match. The implication is a larger increase in earnings instability for job changers than for job stayers and the final section of the paper provides some calibration of the model with plausible

between two-digit occupation switch and employer change.

[4]Dunne et al. (2004) claim that virtually the entire increase in the dispersion of hourly wages in manufacturing between 1975 and 1992 is accounted for by between-plants components.

parameters' values.

The empirical part of this paper is related to the very large literature on earnings instability and here for simplicity I refer only to the few papers which looked at the effects of job change.[5] Gottschalk and Moffitt (1994) made an early attempt to distinguish the contribution of low-tenured workers to the trend of earnings instability. Huff-Stevens (2001) looked at the effect of job change on earnings instability focusing on involuntary displacement. More recently Celik et al. (2012) use CPS, SIPP and employer-employee matched data and find a decrease in earnings instability among job changers due to declining unemployment associated with job change. I find an increase in earnings instability of job changers but the most obvious difference from Celik et al. (2012) is that I use PSID data in levels rather than CPS data in changes. Some recent papers have focused on volatility measures which include zero earnings (i.e. workers remaining without a job) but confound the transitory and the permanent part of the variance (Ziliak et al. 2011, Dynan et al. 2012 and Cappellari and Jenkins 2013). Also related are Cappellari and Leonardi (2013) who use Italian employer-employee matched data to model the effect of tenure within error-component models and Hospido (2012) who decomposes the variance of earnings in the PSID in individual and job-specific effects (however she does not look at the contribution of job changers to the evolution over time of earnings instability).

A different strand of literature has analyzed the economic forces behind the degree of persistence and of variability in earnings building structural models to better characterize behavior. Low et al. (2010) model explicitly labour supply and job mobility in a search and matching framework. Their approach is explicit about distinguishing between shocks and responses to shocks (i.e. job mobility) and between different types of uncertainty, one associated with employment risk (i.e. rates of arrival of job offers), the other with productivity risk (i.e. shocks to the match). Flabbi and Leonardi (2010) and, on a more complex scale, Altonji et al. (2013) estimate a model of wages and transitions between jobs and into unemployment driven by exogenous shocks which are the underlying source of fluctuations. My approach is not structural but I contribute to the earnings dynamics literature by proposing a tractable method to assess

[5]The literature is divided between studies which estimate models of earnings levels and of earnings changes and between those which use PSID data and CPS or administrative data. Most relevant for this paper is Moffitt and Gottschalk (2012) which reviews the results obtained using PSID data with various models. Much of the literature which uses earnings data in changes does not attempt to separate permanent from transitory variances but instead focuses on trends in the variance of one-year changes in annual earnings, often termed "volatility" to distinguish it from "instability" (Shin and Solon, 2011).

the importance of job mobility on earnings instability through a simple empirical model and calibration of a standard on-the-job search model. Differently from some papers in the structural literature, and because I focus on trends over time rather than on the difference between job changers and stayers at a given point in time, endogenous job mobility is not modeled and I work under the assumption that the sorting behaviour of job changers has not changed over time.

The model in this paper is an application of Pissarides (2000) on-the-job search model to the analysis of earnings variance of job stayers and job changers. The model focuses on the effects of voluntary job change rather than of involuntary unemployment. Under this point of view it is complementary to other papers which favor an explanation based on more rapid depletion of skills of the unemployed: Violante (2002) explains the increase in the variance of transitory earnings within a model with different vintages of capital in which workers experience larger wage losses upon separation.

The rest of the paper proceeds as follows. Section 2 describes the data and Section 3 presents the statistical model and the results. Section 4 presents a search and matching model adapted to the study of earnings instability of job stayers and job changers, Section 5 provides a calibration exercise and Section 6 concludes.

2 The Data

I use PSID data on 8,174 male head of households with valid tenure and earnings information for the period 1976-2007 (from 1997 the data are biannual). At the end of the selection process, the final unbalanced panel contains 72,555 observations of 8,174 male heads aged 25 to 60 with valid information on tenure and at least two consecutive years of positive annual earnings (two consecutive years because the estimation is in first differences). Details on the step-by-step sample selection are reported in the Data Appendix.

The earnings variable is "'heads money income from labor"' i.e. the labor portion of money income from all sources: wages, bonuses, overtime, commissions, professional practice, labor part of farm and business income. The nominal measure of earnings is deflated by the GNP personal consumption expenditure deflator with base year 2000. The full sample is divided in job stayers and job changers in the way described below.

2.1 Definition of Job Stayers and Job Changers

The identification of job changes in PSID data set is problematic because the PSID does not collect information on employers. Notwithstanding this difficulty, the PSID is a necessary choice because it is the only dataset with a long enough time span.[6] The variable of primary interest reports the "time the worker has been with his current employer". The tenure question switched from being coded in intervals prior to 1976 to being measured in months: for this reason I use data from 1976 onwards. The question asks about employer tenure therefore in this paper job changers are those who change jobs between firms i.e. they are actually employer changers.[7] I neglect the information on the type of job change because the question is asked only to those who changed within the year. Therefore individuals may have changed voluntarily or involuntarily and may have gone through an unemployment spell as long as they have positive annual labor earnings in two consecutive years.[8]

The study of individuals' earnings instability requires panel observations over time and cannot be simply measured in the year of the change of job.[9] I define job changers those individuals with strictly less than 4 years of tenure (48 months) and job stayers those with 4 or more years of tenure i.e. I assume that the job change affects instability for 4 years after the change. In every year each individual is either a stayer or a changer (Table A.1 shows the number of individuals in each year and if they have employer tenure more or less than 4 years) but tenure is a time-varying characteristic of individuals therefore the same individual may be a changer for 4 years after job change and a stayer if he stays 4 year or longer with the same employer. In other words "job changer" does not refer to a fixed individual characteristic but to a spell as job changer and the same individual may have different spells as job changer and as job stayer.

[6]Many of the difficulties related to measuring job tenure in the PSID are discussed in the paper by Jaeger and Stevens (1999).

[7]See Devereux and Hart (2006) for a study of wage cyclicality of within-firms job changers using English data.

[8]The type of change is defined by the answer to the question: "What happened to the job you had before - did the company go out of business, were you laid off, promoted, or what?". The four reasons identified in the survey are (1) quit, (2) permanently laid-off or fired, (3) business or plant closed, (4) other reason (mainly seasonal or temporary job ended).

[9]One possible concern is that the change in earnings upon job change cannot be exactly measured since the PSID records annual earnings and earnings during the year of the job change are a mixture of the earnings from the old and the new job. However this issue is not crucial for our purposes because we are not studying the variance of earnings changes at the moment of the job change but we look at the effects of job change on the variance of earnings over time.

TABLE 1. PSID distribution of individuals and spells by number of years

Number of years	N of individuals	N of spells as job stayer	N of spells as job changer
1		943	1,134
2	1,159	1,024	1,393
3	942	756	1,026
4	686	574	690
5	620	439	544
6	533	439	383
7	420	333	330
8	392	321	216
9	372	283	151
10	378	291	119
11	254	193	95
12	273	197	61
13	241	166	56
14	243	140	36
15	213	133	21
16	183	131	14
17	174	134	7
18	157	94	4
19	151	87	4
20	135	63	2
21	162	77	2
22	113	52	1
23	101	25	0
24	89	30	0
25	78	18	0
26	48	11	0
27	57	6	0
Total N of individuals	8,174		
Total N of spells		6,960	6,289
Total N of observations	72,555	47,273	25,282

Notes: Individuals are in a spell as job changers when they have less than 4 years of tenure and in a spell as job stayers when they have 4 or more years of tenure.

Table 1 shows the structure of the unbalanced panel with the distribution of individuals by the number of years of presence in the sample (the minimum is 2 consecutive years and the maximum is 27 years, the whole length of the panel). The second and third columns show the length of their spells as job stayers (the number of consecutive years in which they have tenure of 4 years or longer) and job changers (the number of consecutive years in which they have tenure of less than 4 years). The spells as job changer are typically shorter than the spells as job stayer but they can be longer than 4 years because one may change employer several times before the 4 years' threshold and remain a job changer. The same individual contributes his spells as job changer and as job stayer to two different variance-covariance matrices of the model in the following section because the model is estimated separately for changers and stayers.

Selected demographic and socio-economic characteristics are reported in Table 2 across all individuals and separately for the periods when they are job stayers and job changers: as expected, when the 8,174 individuals are job changers, they are younger and have lower labor earnings on average; unsurprisingly the education level, race and region do not change across the spells as job changers and job stayers. Figure 1 plots the cross-sectional variance of log earnings over time for the full sample (top panel) and for the spells as job stayers and job changers (bottom panel). The evolution of the variance of log earnings shows that job changers experienced a much higher increase over time especially during the '80s while the group of job stayers has a stable variance over time.

2.2 Alternative definitions of job change

The employer tenure threshold of 4 years that divides job changers and job stayers is somewhat arbitrary: I choose 4 years because Cappellari and Leonardi (2013) on Italian data find that the effect of tenure on instability goes to zero after the fourth year of tenure. As a robustness check I use a second definition of job changers as those individuals with less than 10 years of tenure i.e. I allow the effects of job change on earnings instability for a much longer time.

There is also an issue of possible mismeasurement of tenure and consequent misallocation of individuals among job changers and job stayers (for tenure records around the threshold of 4 years). For this reason, I also define a third group of job changers as those individuals who record a job change in any year during the sample. In this case a job change occurs if tenure

TABLE 2. PSID descriptive statistics

	Full sample	Job stayers spells	Job changers spells
Age	32.38	35.62	29.84
	(9.17)	(10.26)	(7.26)
Tenure in months	62.93	121.3	17
	(76.2)	(83.13)	(12.2)
HS dropout	0.21	0.22	0.20
HS graduate	0.60	0.61	0.59
College graduate	0.19	0.17	0.20
Married	0.65	0.68	0.61
White	0.61	0.62	0.61
Number of children	1.05	1.23	0.91
	(1.27)	(1.37)	(1.17)
Family size	3.01	3.33	2.76
	(1.59)	(1.70)	(1.45)
Log head labor income	10.432	10.545	10.219
	(0.632)	(0.564)	(0.694)
North east	0.13	0.14	0.13
North central	0.21	0.22	0.20
South	0.50	0.49	0.50
N. observations	72,555	47,273	25,282

Notes: N individuals=8,174. Standard deviation of continuous variables in parentheses. Head labor income is in year 2000 dollars. Individuals are job changers when they have less than 4 years of tenure and job stayers when they have 4 or more years of tenure.

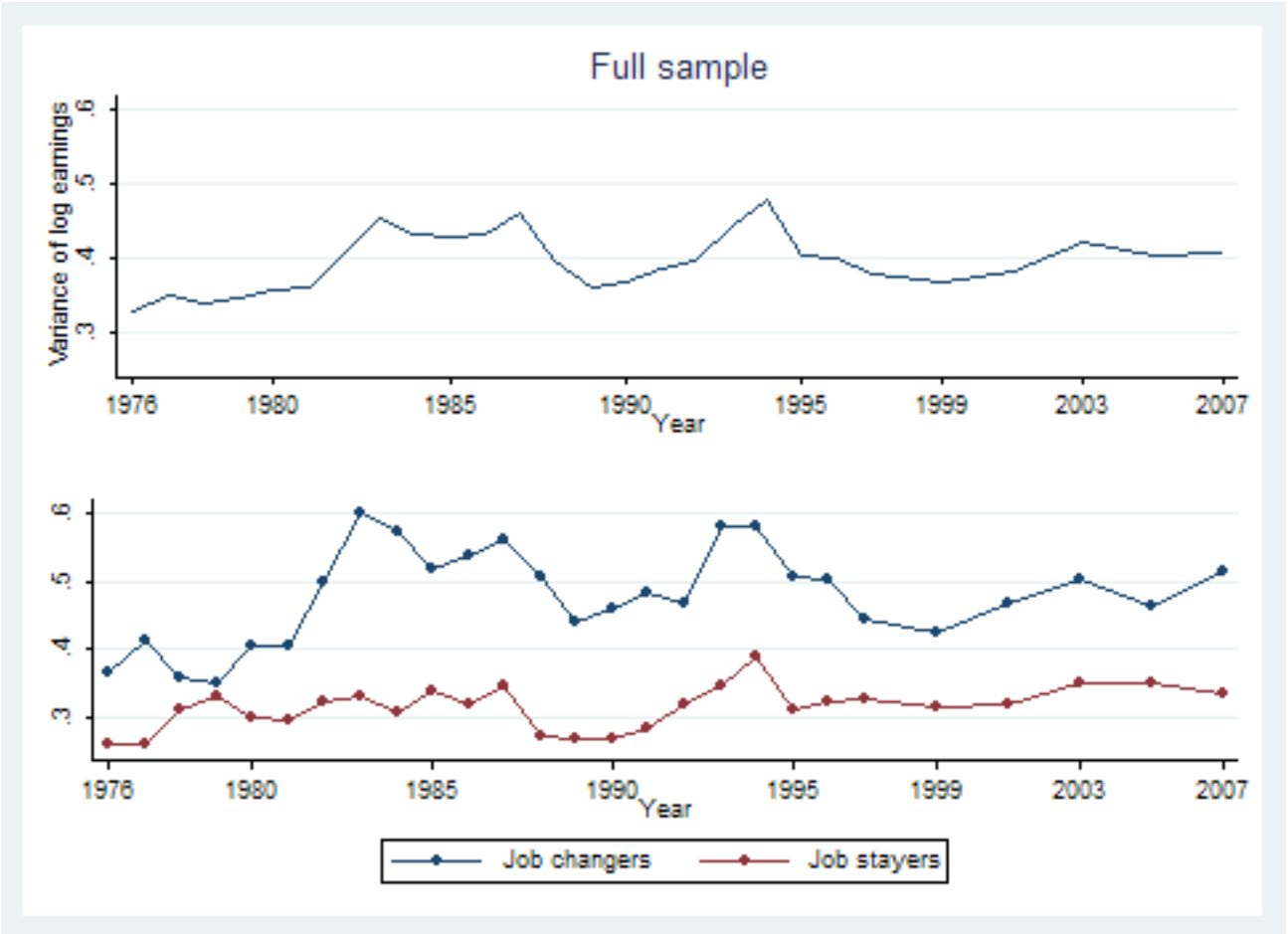

FIGURE 1. The variance of log earnings for the full sample and separately for job stayers and job changers. Individuals are job changers when they have less than 4 years of tenure and job stayers when they have 4 or more years of tenure.

is strictly less than 12 months in any year. Table A.2 shows the distribution of job changes across the 8,174 individuals of the sample: around 50% of them never changed employer while in the sample (the job stayers), the rest (the job changers) have had one or more job changes during the period i.e. they recorded tenure less than 12 months once or more than once (up to 14 times). According to this definition and differently form the previous two, being a job changer or a job stayer are fixed characteristics of individuals. Furthemore, since one is a job changer in year t even if he actually changed job in year t+x (i.e. many years afterwards), this definition uses earnings data both before and after job change to measure instability while in the benchmark definition of job changers I use only earnings data after job change to measure instability of job changers.

Table A.3 in Appendix shows the average tenure in months and the proportion of job changers in the sample according to the three definitions.[10]

3 Error-Component Model and Results

Past literature suggests that in PSID data permanent income is a martingale and transitory income is serially uncorrelated or a first order Moving Average process (see for example Meghir and Pistaferri, 2004, and Blundell et al., 2008).

Before proceeding to model the earnings variance and following large part of the literature, I estimate first-stage residuals:

$$\log w_{it} = X_{it}\beta + u_{it} \tag{1}$$

where the dependent variable is log annual real labor income (in year 2000 dollars), the covariates are age, age squared, year and race dummies. Three different regressions are run, one for each education group (college, high school, less than high school) to allow for time-varying education premia.

I model the residuals u_{it} as the sum of two uncorrelated parts plus measurement error:

$$u_{it} = r_{it} + v_{it} + q_{it} \tag{2}$$

[10]In the first period of the PSID, between 1978 and 1981 the question on tenure asked about position tenure rather than explicitly about employer tenure. This results in a higher percentage of job changers between 1978 and 1981, however if instability is higher immediately after job change this should go in the direction of finding higher instability for job changers in the early years of the PSID rather than in the late years, as I actually find.

The permanent component follows a martingale, $r_{it} = r_{it-1} + \xi_{it}$ where $\xi_{it} \sim (0, \sigma^2_{\xi t})$ denotes the permanent income shock, independently and identically distributed across i and t. The transitory v_{it} is given by an MA(1) process $v_{it} = \theta\varepsilon_{it} + \varepsilon_{it+1}$ with transitory shocks $\varepsilon_{it} \sim (0, \sigma^2_{\varepsilon t})$ uncorrelated with permanent shocks $E(\xi_{it}, \varepsilon_{it}) = 0$.[11] $q_{it} \sim (0, \sigma^2_q)$ is i.i.d. classical measurement error.

Meghir and Pistaferri (2004) show that between a quarter and a third of the transitory income shock variation is due to measurement error in the PSID until 1993. Similarly to them I assume that measurement error is 25 percent of the variance of earnings growth. In the whole sample the variance of log earnings changes is 0.157 while in the sample of job changers is 0.28 and in the one of job stayers is 0.101. Therefore the variances of measurement error σ^2_q are 0.018, 0.012, and 0.034, respectively for the the whole sample, the job stayers and the job changers.

Although in the literature on earnings instability with PSID data, measurement error does not seem to have a crucial importance, one possible concern is that measurement error may affect differently job stayers and job changers.[12] Given the structure of PSID data it is possible that there is greater measurement error in wages among job changers than job stayers because wages are harder to measure among job changers. If somebody changes job during a survey period, his yearly earnings will be the sum of what he earned in the first job plus what he earned in the second job. Probably most people will be able to recall what they would have earned in either job had they worked there for the entire year, but not what they actually did earn for the part of the year that they were actually employed at that employer. To check this possibility I re-estimated the model allowing for measurement error of 33% (at the higher end of Meghir and Pistaferri estimates) of the variance of job changers. The results are available upon request but they do not sustantially differ.

While there is an argument to consider higher measurement error in the earnings of job

[11] The order of the MA component is established empirically: I estimate the autocovariances of the first-differences of the residuals of u. The estimated autocovariances (Table not shown) are initially negative at one lag and fall close to zero after the first lag. The first two lags are significantly different from zero in the full sample and in the sample of stayers and changers. In this sense the three samples show the same pattern of autocovariances. Between lags 2 and 3 they drop again sharply and after lag 3 they are no longer significant. This is suggestive of a low order MA process of order 1 which implies that transitory shocks are persistent and it takes at least one period for the impact of the transitory shock to be felt.

[12] Pischke (1995) finds that the covariance structure of earnings is similar using the PSID validation study and the actual reported PSID earnings. Gottschalk and Huynh (2010) claim that measurement error has little effect on mobility estimates because different types of errors cancel each other out i.e. respondents with high incomes tend to understate their incomes and respondents with low income tend to overstate theirs.

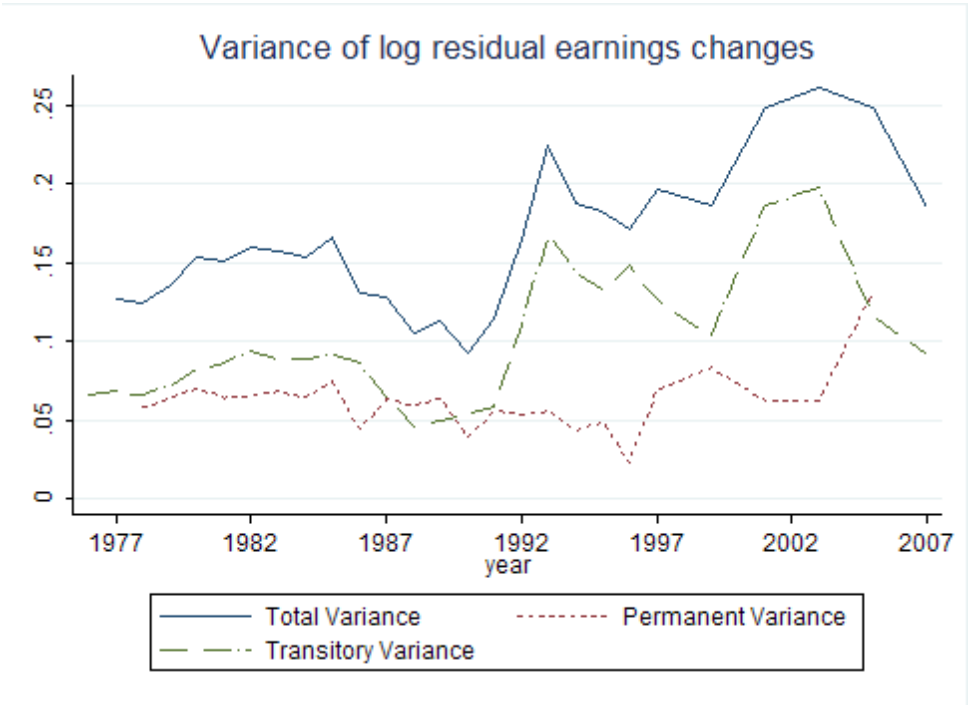

FIGURE 2. Total variance and predicted transitory and permanent components.

changers, there is no evidence that measurement error changed over time nor that it changed differentially for job changers and job stayers.[13]

As it is costumary in this literature the model is estimated in first differences. The estimation is performed using a diagonally weighted minimum distance procedure. The variance-covariance matrix of the model in first differences until year 1997 is:

$$\begin{aligned} cov(\Delta u_{it}, \Delta u_{it-s}) &= \sigma^2_{\xi t} + \sigma^2_{\varepsilon t+1} + (1-\theta)^2\sigma^2_{\varepsilon t} + \theta^2\sigma^2_{\varepsilon t-1} + 2\sigma^2_q \qquad \text{if } s = 0 \\ &= -(1-\theta)\sigma^2_{\varepsilon t} + \theta(1-\theta)\sigma^2_{\varepsilon t-1} - \sigma^2_q \qquad \text{if } s = 1 \\ &= -\theta\sigma^2_{\varepsilon t-1} \qquad \text{if } s > 1 \end{aligned}$$

From 1999 onwards when the PSID is biannual the variance-covariance matrix is:

$$\begin{aligned} cov(\Delta u_{it}, \Delta u_{it-s}) &= 2\sigma^2_{\xi t} + \sigma^2_{\varepsilon t+1} + \theta^2\sigma^2_{\varepsilon t} + \sigma^2_{\varepsilon t-1} + \theta^2\sigma^2_{\varepsilon t-2} + 2\sigma^2_q \qquad \text{if } s = 0 \\ &= -\sigma^2_{\varepsilon t-1} - \theta^2\sigma^2_{\varepsilon t-2} - \sigma^2_q \qquad \text{if } s = 1 \\ &= 0 \qquad \text{if } s > 1. \end{aligned}$$

The model is estimated separately on job changers and job stayers. The minimum distance estimates of θ, $\sigma^2_{\xi t}$ and $\sigma^2_{\varepsilon t}$ reported in Table 3 are conditional on σ^2_q.

[13]Potentially it could have changed over time following a major overhaul of the PSID survey in 1993 which included, among other things, a switch to computer-assisted telephone interviewing, a shift from human to automated editing of the data, and changes in the structure of the income questions. The issue of whether measurement error has increased over time is addressed in Gouskova and Schoeni (2007) and Gottshalk and Moffitt (2009) who conclude that there is no reason to think that respondents have become more or less accurate in their reporting.

TABLE 3. Estimates of error component model: random walk + MA(1)

	Full sample		Job stayers		Job changers	
	coefficient	s.e.	coefficient	s.e.	coefficient	s.e.
θ	0.085	0.023	0.050	0.025	0.034	0.092
	Estimated variances of permanent income shocks					
1976	-	-	-	-	-	-
1977	-	-	-	-	-	-
1978	0.058	0.008	0.024	0.006	0.068	0.023
1979	0.064	0.010	0.032	0.007	0.088	0.023
1980	0.070	0.009	0.023	0.006	0.112	0.026
1981	0.064	0.009	0.035	0.009	0.111	0.026
1982	0.065	0.009	0.034	0.010	0.123	0.023
1983	0.069	0.010	0.033	0.006	0.140	0.037
1984	0.065	0.009	0.032	0.005	0.123	0.035
1985	0.075	0.009	0.052	0.006	0.121	0.033
1986	0.044	0.008	0.029	0.006	0.070	0.027
1987	0.063	0.008	0.040	0.006	0.110	0.026
1988	0.059	0.008	0.022	0.005	0.129	0.027
1989	0.064	0.007	0.019	0.004	0.156	0.026
1990	0.039	0.007	0.025	0.005	0.064	0.024
1991	0.056	0.007	0.022	0.005	0.120	0.025
1992	0.054	0.008	0.022	0.006	0.125	0.027
1993	0.056	0.012	0.019	0.008	0.156	0.043
1994	0.043	0.013	0.008	0.009	0.141	0.050
1995	0.049	0.013	0.024	0.014	0.101	0.034
1996	0.023	0.012	0.004	0.010	0.144	0.042
1997	0.035	0.010	0.040	0.019	0.067	0.046
1999	0.042	0.011	0.027	0.013	0.044	0.049
2001	0.031	0.008	0.026	0.006	0.030	0.032
2003	0.031	0.011	0.033	0.012	0.036	0.045
2005	0.066	0.014	0.050	0.014	0.087	0.057
2007	-	-	-	-	-	-

TABLE 3. Table Continued

	Full sample		Job stayers		Job changers	
	Estimated variances of transitory income shocks					
	coefficient	s.e.	coefficient	s.e.	coefficient	s.e.
1976	0.015	0.015	0.009	0.008	0.096	0.041
1977	0.017	0.006	0.003	0.005	0.050	0.025
1978	0.018	0.008	0.014	0.009	0.022	0.022
1979	0.015	0.006	0.021	0.005	0.010	0.014
1980	0.024	0.008	0.015	0.005	0.036	0.026
1981	0.027	0.006	0.013	0.004	0.062	0.020
1982	0.028	0.006	0.020	0.006	0.038	0.019
1983	0.035	0.009	0.020	0.006	0.090	0.040
1984	0.024	0.006	0.011	0.006	0.048	0.023
1985	0.033	0.008	0.014	0.005	0.082	0.031
1986	0.028	0.006	0.017	0.004	0.041	0.021
1987	0.027	0.007	0.013	0.005	0.050	0.023
1988	0.007	0.005	-0.001	0.002	0.030	0.021
1989	0.004	0.004	0.005	0.003	-0.001	0.012
1990	0.010	0.006	-0.001	0.003	0.049	0.025
1991	0.009	0.006	0.013	0.007	0.001	0.014
1992	0.015	0.007	0.018	0.008	0.020	0.017
1993	0.063	0.016	0.060	0.020	0.072	0.030
1994	0.080	0.018	0.078	0.023	0.081	0.027
1995	0.041	0.011	0.032	0.012	0.072	0.034
1996	0.063	0.020	0.050	0.021	0.014	0.016
1997	0.059	0.020	0.061	0.026	0.074	0.060
1999	0.041	0.010	0.021	0.009	0.107	0.048
2001	0.033	0.008	0.016	0.008	0.072	0.028
2003	0.122	0.017	0.097	0.019	0.179	0.042
2005	0.059	0.011	0.034	0.011	0.135	0.039
2007	0.030	0.018	0.004	0.015	0.088	0.063
			Model statistics			
χ^2 goodness of fit	376.928		363.999		433.992	
Degrees of Freedom	299		299		299	
P-value	0.001		0.006		0.000	

Notes: I impose equality of the variances of the permanent shocks in the first two and in the last two years of the sample period. This is to avoid instability when few moments are used for identification. All estimates are conditional on the variance of measurement error σ_q^2 externally estimated at 0.018, 0.012, and 0.034 respectively for the full sample, job stayers and job changers.

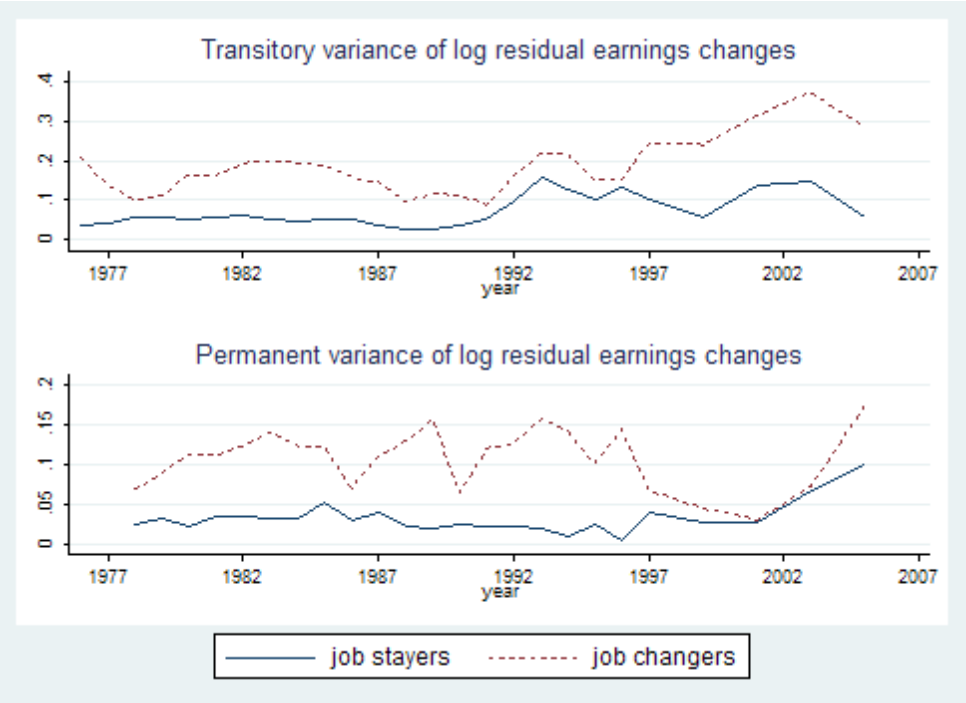

FIGURE 3. Estimates of permanent and transitory variances.

In Figure 2, I use the estimated parameters to predict the permanent and the transitory component of the variance according to the variance-covariance matrix of the model. The figure shows an increasing variance of log residual earnings changes in the '90s driven by the transitory component. Although the sample differs from most papers' choice in the literature (mainly because I drop many individuals with missing tenure information), however these results are consistent with previous papers which have estimated the volatility of first-differenced earnings on PSID data. Virtually all studies in the US literature on volatility show that earnings volatility for men increased during the 1970s, but then levelled off somewhat through to the early- to mid-1980s or fell slightly. Findings about what happened in the '90s depend on the data set used: results derived from the PSID suggest a rise in volatility (Celik et al. 2012, Shin and Solon 2011) whereas those derived using administrative data or CPS suggest that volatility remained flat (Celik et al. 2012, Dahl et al. 2012).[14] The contribution of this paper is in the distinction between job changers and job stayers. To ease the comparison, Figure 3 groups in the same panel the transitory (top panel) and the permanent (bottom panel) variance of job

[14]Also models of earnings levels rather than differences tend to find increases of instability over time. The timing of the increase is however different and it is concentrated in the '80s rather than the '90s (Moffitt and Gottschalk, 2012). The explanation of the difference in results lies in the fact that the variance of short-term one-year changes in earnings is composed of two separate components which have offset each other over time. On the one hand, the rising variance of transitory shocks increases the variance of changes in earnings. On the other hand, however, the rising persistence of those autocorrelated shocks reduces one-year changes in earnings.

stayers and job changers. Job changers have much higher transitory variance than job stayers on average and they also show a different (increasing) trend over time. In other words job changers (or better the spells that individuals spend as job changers) account for most of the rise in the transitory variance that we observe in the full sample.

One possible concern with the results is that earnings instability attributed to job change is due to the effect of industry and occupational-specific wage fluctuations. To purge the estimated transitory variance from fluctuations in occupation- and industry-specific labor income, equation 1 becomes: $\log w_{ijt} = X_{it}\beta + \psi_{jt} + u_{it}$ where the subscript j indicates the industry and ψ_{jt} indicates a set of interactions two-digit industry*year and two-digit occupation*year (industry and occupation are recoded using the Retrospective Files as in Kambourov and Manovskii, 2008). The individual controls X_{it} are unchanged with respect to equation 1. When I compute the transitory variance using this newly estimated residual, the results (not shown, but available upon request) are substantially unchanged wrt. Figure 3.

Finally Figure 4 shows the evolution of the transitory variance estimated on the three samples of job changers: the benchmark sample of job changers with tenure less than 4 years; the sample of job changers with tenure less than 10 years and the sample of ever changers. The trend of instability of these last two groups is flatter. This is somewhat expected if one thinks that the transitory variance in these two groups is computed across individuals who may have changed job long before the year in which the variance is computed or may have not changed job yet (in the case of "ever changers").

3.1 Concluding remarks on the empirical evidence

The descriptive permanent-transitory decomposition highlights the differences across changers and stayers but does not help explaining it. It is unlikely that the difference in instability between job changers (who include both voluntary and involuntary changers) and job stayers is explained by the effect of unemployment because these estimates include only individuals with two consecutive years of positive earnings and therefore (in case) only very short periods of unemployment. Furthermore Huff Stevens (2001) also finds that the increase in the variance of job changers cannot be fully explained by unemployment spells.

The next section will provide a simple model of on-the-job search that gives predictions in

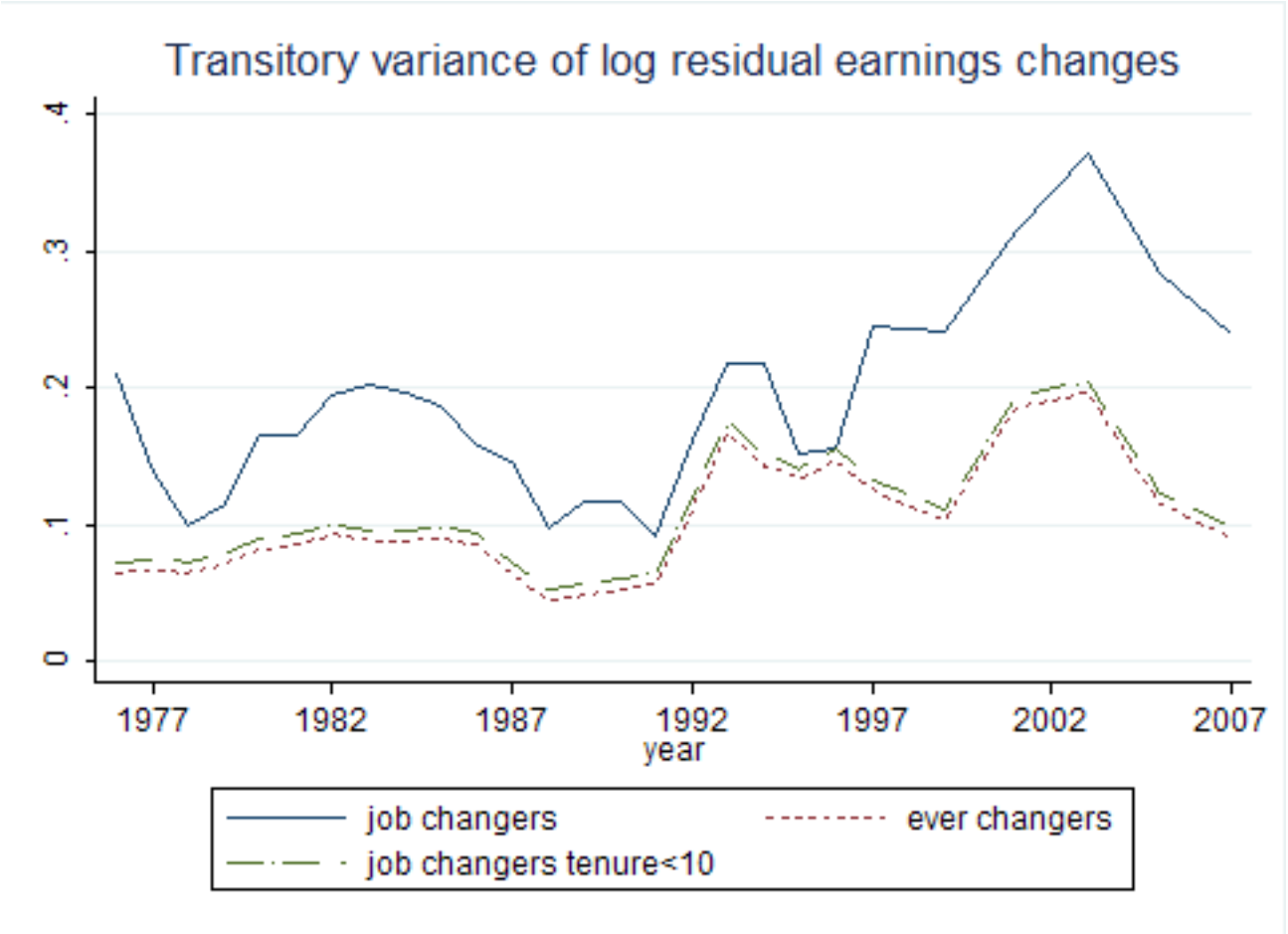

FIGURE 4. Predicted transitory variance component. Three definitions of job changers.

line with the empirical results. The model gives an interpretation of the different evolution of instability across job changers and job stayers highlighting the role of voluntary job change (rather than involuntary job change linked to unemployment) and the role of the variance of wage changes upon job change rather than the increase in turnover (because most evidence points to a limited increase of job turnover at least until recently as discussed in the Introduction). Of course the model neglects many other potential explanations of the differences between job stayers and job changers but focuses on the increasing dispersion of firm-level productivity over time, a fact that is based on the empirical evidence.[15]

4 The Model

I adapt a search and matching model with on-the-job search (Pissarides, 2000) to obtain original results on the evolution over time of the wage variance of job changers and job stayers. The results are obtained through a mean-preserving spread of the productivity shock distribution which may be thought to reflect the increasing uncertainty of demand.[16]

In this model ex-ante identical workers are matched randomly to firms whose distribution of productivities becomes more dispersed over time. The main element of interest is the wage variance of job changers and job stayers as predicted by the model before and after the mean-preserving spread of firm productivities. (As customary in the literature, the model predicts wages rather than total labor earnings which I analyzed in the empirical evidence.)

The comparative statics exercise with the general equilibrium solution of the model is based on the assumption of stationarity of the model. This implies that we are looking at two different points in time and we find them generating different parameters. In the context of the data, this means assuming that observations at the begining (1976) and at the end of the period (2007) belong to two different steady states even if we do not know exactly when the mean-preserving

[15]Different earnings dynamics and different events are associated with the permanent and transitory component of earnings of job changers and job stayers. A job change implies both a permanent wage change (and the jump to a different firm-specific tenure profile) and a transitory wage change (short tenure and on-the-job search may imply more unstable earnings). For job stayers, promotions within the job typically lead to permanent gains while overtime and performance pay typically lead to transitory variations. Furthermore, job stayers may be mostly insured from transitory wage shocks by their firms (Guiso, Pistaferri and Schivardi, 2005).

[16]For example Comin and Philippon (2006) attribute higher firm volatility to higher competition in the goods market. They find that firm volatility increases after deregulation and that the increase in firm-level volatility is correlated with high research and development (R&D) activity as well as more access to debt and equity markets.

spread took place and which is the period before and after the change.

The hypotheses of the model are the following:

(i) Workers are ex-ante identical with permanent productivity p normalized to 1, i.e. the model abstracts from individual permanent characteristics and focuses on the transitory part of earnings.

(ii) Job seekers (employed and unemployed) and jobs are matched via a matching function $m = m(v, u+e)$ where u indicates the unemployed job seekers and e the employed job seekers, v the number of vacancies. Jobs arrive to each searching worker, employed and unemployed, at the rate $\theta q(\theta)$, where $q(\theta) = m(1, \frac{u+e}{v})$ and $\theta = \frac{v}{u+e}$ is the ratio of vacancies to job seekers.[17]

(iii) The match has idiosyncratic productivity x. Every new match is created at maximum productivity px with $x = 1$. After creation the match is hit by an idiosyncratic productivity shock $x \rightsquigarrow G(x)$ with $x \in [0, 1]$ at Poisson rate λ. The shock is transitory: every x' is independent of the previous x.

The model can be characterized by two reservation rules. There is a reservation productivity R such that jobs $x < R$ are destroyed and workers end in unemployment. There is a second reservation productivity S such that workers in jobs $R \leq x \leq S$ seek a new job in the hope of finding a better match x. Workers in jobs $S < x \leq 1$ do not search because they are satisfied with their high-productivity match.

4.1 Workers

The expected returns of the employed worker when she searches on the job (s) and when she does not (ns) are respectively:

$$rW^s(x) = w^s(x) - \sigma + \lambda \int_R^1 \max(W^{ns}(s), W^s(s))dG(s) + \lambda G(R)U - \\ - \lambda W^s(x) + \theta q(\theta)[W^{ns}(1) - W^s(x)]$$

$$rW^{ns}(x) = w^{ns}(x) + \lambda \int_R^1 \max(W^{ns}(s), W^s(s))dG(s) + \lambda G(R)U - \lambda W^{ns}(x)$$

[17] By the usual properties of the matching function $q'(\theta) < 0$ and the elasticity of $q(\theta)$ is in absolute value $0 \leq \eta(\theta) \leq 1$.

Job seekers and non-seekers have different wages $w^s(x)$ and $w^{ns}(x)$. When $x < R$ jobs are destroyed and workers get the value of unemployment U. The difference between $W^s(x)$ and $W^{ns}(x)$ is the cost of search σ and the capital gain the job seeker enjoys when he changes job, $\theta q(\theta)[W^{ns}(1) - W^s(x)]$, where $\theta q(\theta)$ is the rate at which job seekers find a new match and $W^{ns}(1)$ is the value of the new job (jobs are always created at maximum productivity $x = 1$). The flow value of unemployment is:

$$rU = z + \theta q(\theta)[W^{ns}(1) - U]$$

where z is the unemployment benefit.

4.2 Firms

The value of a filled job is also different if the worker is searching or not:

$$rJ^s(x) = x - w^s(x) + \lambda \int_R^1 \max(J^{ns}(s), J^s(s))dG(s) - [\lambda + \theta q(\theta)][J^s(x) - V] \tag{3}$$

$$rJ^{ns}(x) = x - w^{ns}(x) + \lambda \int_R^1 \max(J^{ns}(s), J^s(s))dG(s) - \lambda[J^{ns}(x) - V] \tag{4}$$

When the worker is searching, $J^s(x)$ contains an additional probability that the job is destroyed given by the probability that the job seeker finds a new match: $\theta q(\theta)$. The flow value of a vacancy is:

$$rV = -c + q(\theta)[J^{ns}(1) - V]$$

where c is the flow cost of a vacancy. The zero-profit or free entry condition is $V = 0$.

4.3 Equilibrium

An equilibrium in this model is a value of the thresholds S, R, market tightness θ, wage $w(x)$ and unemployment u.

Changes in the number of employed job seekers come from productivity shocks in and out

of the range $[R, S]$. The evolution of the number of employed job seekers e is given by:

$$\frac{de}{dt} = \lambda(1-u)[G(S) - G(R)] - \lambda e - \theta q(\theta) e. \tag{5}$$

Every period λ job seekers receive a shock and leave the stock of job seekers, those who newly enter (or re-enter) the job seekers' pool are only those who receive a shock in the range $[R, S]$. The number of job changers is given by $\theta q(\theta) e$: they leave the stock of job seekers because they find new jobs. From equation 5, the fraction of employed job seekers in steady state is given by:

$$\frac{e}{(1-u)} = \frac{\lambda[G(S) - G(R)]}{\lambda + \theta q(\theta)} \tag{6}$$

and the job-to-job turnover rate is the fraction of job seekers who find a match i.e. $\frac{\theta q(\theta) e}{1-u}$. The steady state level of unemployment is $u = \frac{\lambda G(R)}{\lambda G(R) + \theta q(\theta)}$.

Wages are set by Nash rule to share the surplus of a match. Therefore for job seekers and non-seekers $i = s, ns$:

$$W^i(x) - U = \frac{\beta}{1-\beta} J^i(x)$$

Substituting the value of a filled job for employed workers and for firms in the Nash rule, we find the wage equation for seekers 7 and non-seekers 8:

$$w^s(x) = (1-\beta)(z+\sigma) + \beta x \qquad \text{for } x \in [R, S] \tag{7}$$

$$w^{ns}(x) = (1-\beta)z + \beta(x + c\theta) \qquad \text{for } x \in (S, 1] \tag{8}$$

where β, z, σ and c are respectively the bargaining power of workers, the unemployment benefit, the search cost for on-the-job seekers and the flow cost of a vacancy. As usual in the Nash bargaining framework, firms and workers share the surplus of a job (hence the term βx in both $w^s(x)$ and $w^{ns}(x)$). Seekers sustain search cost σ for which they are partially compensated (hence the term σ in $w^s(x)$). Since there is an assumption of perfect information, non-seekers (ns) must be paid more than seekers (s) because seekers have to compensate the firm for the likely possibility of the quit (hence the term $c\theta$ in $w^{ns}(x)$).

Wages $w(x)$ in this economy depend from the transitory shock x because are renegotiated

after each shock x.[18]

The reservation rule S is such that the value of a job x, when the worker is searching on the job is equal to the value when she is not searching, $W^{ns}(S) = W^{s}(S)$ (see the Appendix for all equations). The job creation condition is given by $J^{ns}(1)$ and the zero profit condition $V = 0$. The job destruction condition is determined by a job reservation productivity R such that $J^{s}(R) = 0$. The equation that determines S, the job creation condition and the job destruction condition take respectively the following form:

$$\frac{(1+h)(S-R)}{r+\lambda+\theta q(\theta)} = \frac{\beta}{1-\beta}\frac{c}{q(\theta)} - \frac{\sigma}{\theta q(\theta)} \tag{9}$$

$$\frac{(1+h)(1-R)(1-\beta)}{r+\lambda} = \frac{c}{q(\theta)} + \frac{\beta c\theta - (1-\beta)\sigma}{(r+\lambda)} \tag{10}$$

$$(1+h)R - h\overline{x} + \Lambda(R,\theta,\sigma,h) = z + \sigma \tag{11}$$

where $\Lambda(R,\theta,\sigma,h) = \lambda\int_R^1 \max(J^{ns}(s), J^{s}(s))dG(s)$ is the option value of the job with $\frac{d\Lambda}{d\theta} < 0$, $\frac{d\Lambda}{dR} < 0$ and $\frac{d\Lambda}{dh} > 0$.

The job creation condition 10 is negatively sloped in the space R, θ. The last term on the RHS of the equation is the gain from search going to the firm. The expected productivity gain from job creation (LHS) minus the gain from search must be equal to the average creation cost.

The job destruction curve 11 implies that the reservation productivity net of the option value of the job is equal to total workers' costs. The curve is upward sloping in the space R, θ. A higher θ reduces the option value of the job because higher θ implies higher job destruction since a searching worker is more likely to find a job and quit. A higher θ also increases the expected returns from search and therefore more search is undertaken and a job is more likely to be destroyed. This also reduces the option value of a job. All these results are in the Appendix.

[18] Wages in the model depend only on the realizations of the i.i.d shocks x. However, the shock x arrives at the Poisson rate $\lambda < \infty$, i.e. there are periods without shocks. Similarly to the empirical specification, transitory shocks to wages need a certain degree of persistence, in fact, if wages were continuously reset, nobody would search.

4.4 The effects of a mean-preserving spread

The mean-preserving spread of $G(x)$ is modeled as a parametric change in the productivity distribution: $x(h) = x + h(x - \overline{x})$ considering the effect of a marginal dh at $h = 0$.

The mean-preserving spread h shifts the job creation curve out. The intuition is that the mean-preserving spread makes productivities above the mean better and productivities below the mean worse. Since workers and firms do not consider productivities below the job destruction threshold R (because jobs below R are destroyed anyway), the benefits from productivities above the mean outweigh the costs from productivities below the mean. Therefore firms create more vacancies because their expected gain from job creation increases more than the costs (θ is higher) and workers search more because the expected rewards from search are higher (the range $[R, S]$ is wider).

A mean-preserving spread of the productivity distribution $G(x)$ has two effects: more people search (i.e. $\frac{dS}{dh} - \frac{dR}{dh} > 0$) but there are also more vacancies ($\frac{d\theta}{dh} > 0$) therefore more seekers find new jobs and leave the stock of job seekers. As a result the effect on the fraction of job seekers in equation 6 is ambiguous because the mean-preserving spread increases both the numerator and the denominator. The effect on the job-to-job turnover rate= $\frac{\theta q(\theta) e}{1-u}$ is positive but limited by this general equilibrium effect. The effect of the mean-preserving spread on the steady state level of unemployment $u = \frac{\lambda G(R)}{\lambda G(R) + \theta q(\theta)}$ is also ambiguous and depends on the parameters.

These results are due to Pissarides (2000) and are reported in the Appendix, the original contribution of this paper is the extension of the model to the analysis of the variance of wages of job changers and job stayers after the mean-preserving spread in productivity shocks.

Job changers are those among the job seekers in the range $[R, S]$ who have found a new match. Job changers have density $g(x)$ over $[R, S]$ therefore:

$$var\{w_{changers}(x)\} = \beta^2 var\{x \mid R < x < S\}. \tag{12}$$

The variance of wages across job changers unambiguously increases after the mean-preserving spread, because the range of productivities in $[R, S]$ increases. All job changers go from a job with productivity in $[R, S]$ to a new job with productivity $x = 1$ because all vacancies enjoy maximum productivity by assumption. The only meaningful wage variance of job changers is

therefore the variance of wages before the job change or alternatively the variance of the wage change $var(w_{new} - w_{old})$ given that $w_{new} = w^{ns}(1)$ for everybody.

Job stayers are those job seekers (indicated with the superscript s) in $[R, S]$ who did not find a job plus all non-seekers (superscript ns) in the range $(S, 1]$. Job stayers have density $f_s(x) = (1-\theta q(\theta))\frac{g(x)}{I}$ over $[R, S]$ and $f_{ns}(x) = \frac{g(x)}{I}$ over $(S, 1)$ where $I = \int_R^S (1-\theta q(\theta))g(x)dx + \int_S^1 g(x)dx = 1 - G(S)\theta q(\theta) - (1 - \theta q(\theta))G(R)$. Hence:

$$var\{w_{stayers}(x)\} = \left(\int_R^S w^s(x)^2 f_s(x)dx + \int_S^1 w^{ns}(x)^2 f_{ns}(x)dx\right) - \\ - \left(\int_R^S w^s(x) f_s(x)dx + \int_S^1 w^{ns}(x) f_{ns}(x)dx\right)^2. \tag{13}$$

The change in the variance of job stayers wages has an ambiguous sign since the mean-preserving spread increases the range $[R, S]$ but at the same time reduces the range $(S, 1]$.

5 Calibration

Table 4 shows the results of a calibration of the model assuming a uniform distribution of shocks and a matching function of the form $q(\theta) = A\theta^{-a}$ with $a = 0.4$ and $A = 1$. The aim of the calibration exercise is to illustrate the results on job turnover and the wage variance of job stayers and job changers for plausible parameter values: the model is solved for $h = 0$ and $h = 0.1$ representing a mean-preserving spread of the productivity distribution.

The calibration of the model is in two steps: first obtain values for c, σ and z for plausible values of R, S and u, then solve the equilibrium and the equations of the wage variance for job stayers and job changers. The parameters used for λ, r, β are commonly used in the literature: $\lambda = 0.2$, $r = 0.06$ and $\beta = 0.5$. The other parameters c, σ and z (which are not commonly estimated in the literature) are chosen only with the purpose of obtaining plausible values of R, S and u i.e. I solve equations 9 to 11 for c, σ and z imposing $R = 0.4$, $S = 0.6$ and $\theta = 0.47$ (which gives an unemployment rate u=0.11). The result is: c=1.19, $\sigma = 0.42$ and z=0.02. The first column of Table 4 reports the "exogenous parameters". With all the parameters at hand, solving equations 9, 10, 11, 12 and 13 with h=0 (before the mean-preserving spread), I obtain the results in the third column of Table 4: R=0.4, S=0.6, u=0.11, $\theta = 0.47$, standard deviation$(w_{changers}) = 0.031$, standard deviation$(w_{stayers}) = 0.097$ and a job-to-job quit rate of

TABLE 4. The effects of a mean-preserving spread

		h=0	h=1
R	Job destruction threshold	0.38	0.39
S	Search threshold	0.6	0.63
u	Unemployment rate	0.1	0.1
θ	Market tightness	0.47	0.5
$SD(w_{changers})$	SD wages of changers	0.052	0.058
$SD(w_{stayers})$	SD wages of stayers	0.1	0.107
R-S	Search range of productivities	0.22	0.24
$\frac{\theta q(\theta) e}{1-u}$	Job to job turnover	0.033	0.036

Note: Results are obtained assuming a uniform distribution of shocks and a matching function of the form $q(\theta) = A\theta^{-a}$ and solving equations 9 to 13 with parameters values in the first column. The values for A, a, λ, r, β are commonly used in the literature. c, σ and z are chosen to obtain plausible values of R, S and u inverting equations 9, 10 and 11.

3.3%.

A mean-preserving spread of $h = 0.1$ changes the results to: R=0.41, S=0.66, u=0.104, $\theta = 0.56$, standard deviation($w_{changers}$) = 0.035, standard deviation($w_{stayers}$) = 0.107 and a job-to-job quit rate of 3.7% (results reported in the last column of Table 4). Thus the mean-preserving spread implies an increase in on-the-job search ($S - R$ goes from 0.2 to 0.25), a low increase in the job turnover rate $\frac{\theta q(\theta) e}{1-u}$ from 0.033 to 0.037, a 13% increase in the standard deviation of wages for job changers and a lower increase of 6% in the standard deviation of wages for stayers.

In conclusion the model predicts the increasing variance of wages of job changers through the increase in the extent of on-the-job search (the range $[R, S]$) which governs both the number of seekers and the their variance of wages. This feature of the model allows to generate higher wage instability because of a higher search activity on-the-job coupled with an increase in the variance of wage changes upon job change.[19] The table shows only one example obtained with plausible parameters values, but the model can predict this pattern of results for a costellation of parameters.

Of course not all parameters are consistent with an higher increase of the wage variance of job changers rather than job stayers. The first step of the calibration implies finding values

[19]Note that, contrary to the data, in this model the variance of wages of job stayers is always higher than the variance of wages of job changers because job changers are seekers and seekers have lower wages than non seekers because they have to compensate the firm for the likely quit. The aim of the model however is not to model the variance of wages of job changers but its evolution over time relative to job stayers.

for c, σ and z which are compatible with plausible values of R, S and u. Keeping the same assumptions on the other parameters in the first column of Table 4, if I reduce the initial value of R this increases c and σ and decreases z, when R is below 0.3 then z is negative. When I increase the initial value of S, c and σ decrease and z increases. If S is above 0.8 then the increase in the the variance of wages of job stayers increases more than the variance of job changers because the mean-preserving spread barely increases the range S-R (because of the uniform distribution assumption, S has an upper limit). Table **??** in the Appendix shows some robustness checks using different initial conditions on the parameters of the matching function A and a, the interest rate r and the arrival rate of shocks λ.

6 Conclusions

A large literature suggests that earnings instability has increased during the 1980s and 1990s. The contribution of this paper is the assessment of the role of job changers in explaining the rise in instability. I use PSID data on 8,144 individuals and estimate an error-component model separately on (their spells as) job stayers and as job changers. The results –which are robust to several definitions of job change– show that increases in the transitory variance are concentrated among job changers while job stayers have a flatter profile of transitory shocks over time. This implies that job changers account for most of the rise in instability in the full sample.

In the second part of the paper I provide an interpretation of the role of voluntary job-to-job changes in driving the evolution of earnings instability using a search and matching model with on-the-job search. The result of a mean-preserving spread of the distribution of productivity shocks is both an increase in on-the-job search activity and an increase in the wage variance across job changers who experience larger wage changes upon job change. The mean-preserving spread is a way of modelling the empirical fact of an increasing dispersion of productivities across firms; after the mean-preserving spread workers search more because of the higher option value to change and, when they change jobs, their wage changes are larger because the distribution of shocks is more dispersed. Consistently with the empirical evidence, the model predicts a larger increase over time in earnings instability for job changers than for job stayers combined with a "limited" increase in job turnover. This result is valid for a wide and reasonable range of parameters of the model.

This paper complements other explanations of instability based on the rapid depletion of skills of the unemployed (Violante, 2002) and is consistent with the findings obtained in a literature which estimates structural models. For example Flabbi and Leonardi (2010) show that an increase in mobility (the job offer arrival rate in a model with on-the-job search) increases the cross-sectional variance of earnings in the U.S. thus suggesting - although with other methods - that there is a role for job mobility in explaining instability.

The avenues for further research are at least twofold. The first avenue would aim at incorporating job change in error components models (along the lines of Cappellari and Leonardi, 2013, or Hospido, 2012). The second would be to build on-the-job search models that do not assume stationarity thus obtaining a more appropriate description of labor markets evolving over time (in the line of Bowlus and Robin, 2004). A third possible improvement is to study specifically the role of mobility across occupations and industries. Also in this case there exists examples in the literature (Kambourov and Manovskii 2008 and 2009) however none of this papers aims clearly at explaining the role of job change in the rise of earnings instability.

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A Data Appendix

The 1970–2007 PSID core individual file (after dropping the Latino sample) contains information on 58,663 individuals. Dropping those individuals who are never heads of their household between 1976 and 2007, the sample is reduced to 20,979 individuals. Keeping only those who are continuously heads of their household, have a non-missing education record and are aged 25 to 60 over this period leaves us with a sample of 17,053 individuals. I then drop female heads and remain with a sample of 11,751 male heads. I also drop non-continuous and outlying earnings records, eliminating the first and last percentile in each year*education group (college, high school and less than high school). The sample then includes 10,340 individuals. I finally drop those records with missing tenure information and keep individuals with al least two continuous years of earnings (because the model is in first differences): the final unbalanced panel sample includes 8,174 individuals and 72,555 observations. The sample selection criteria are close to Meghir and Pistaferri (2004) except for the exclusion of ibservations with missing tenure information and the trimming of earnings outliers (since this sample is extended to the biannual data after 1997, the trimming cannot be based on an uniform measure of yearly earnings differences).

TABLE A.1. PSID distribution of observations by year

Year	Full sample	Job stayers	Job changers
1976	2,073	1,334	739
1977	2,229	1,410	819
1978	2,516	1,357	1,159
1979	2,766	1,478	1,288
1980	2,878	1,520	1,358
1981	2,875	1,828	1,047
1982	2,857	1,844	1,013
1983	2,808	1,870	938
1984	2,845	1,889	956
1985	2,966	1,934	1,032
1986	3,026	1,943	1,083
1987	3,078	1,937	1,141
1988	2,683	1,729	954
1989	2,664	1,739	925
1990	2,705	1,765	940
1991	2,695	1,783	912
1992	2,670	1,827	843
1993	2,668	1,899	769
1994	2,810	1,990	820
1995	2,946	2,050	896
1996	2,911	2,007	904
1997	2,355	1,633	722
1999	2,420	1,654	766
2001	2,512	1,688	824
2003	2,569	1,722	847
2005	2,633	1,782	851
2007	2,397	1,661	736
Total	72,555	47,273	25,282

Notes: Job changers have less than 4 years of tenure, job stayers have 4 or more years of tenure.

TABLE A.2. Number of job changes per individual

Number of changes	Full sample	1976	1990	2007
0	3,954	1,039	978	1,155
1	2,132	489	668	637
2	1,057	224	450	306
3	526	155	280	145
4	248	74	151	76
5	119	39	76	39
6	67	25	46	21
7	31	9	23	10
8	19	11	13	6
9	10	3	10	0
10	5	2	4	1
11	3	2	3	0
12	2	1	2	1
13	1	0	1	0
Total	8,174	2,073	2,705	2,397

Note: A change of job is identified when tenure is strictly less than 12 months.

TABLE A.3. PSID ditribution of tenure

Year	Average tenure in months	Percentage of job changers with tenure<4	Percentage of job changers with tenure<10	Percentage of ever changers
1976	103.988	0.356	0.664	0.534
1977	104.681	0.367	0.663	0.559
1978	80.058	0.461	0.750	0.566
1979	80.664	0.466	0.750	0.587
1980	82.856	0.472	0.738	0.609
1981	102.613	0.364	0.663	0.617
1982	102.855	0.355	0.660	0.618
1983	104.847	0.334	0.642	0.625
1984	104.822	0.336	0.646	0.634
1985	104.003	0.348	0.645	0.650
1986	103.136	0.358	0.648	0.659
1987	101.823	0.371	0.658	0.657
1988	103.221	0.356	0.627	0.667
1989	104.563	0.347	0.621	0.664
1990	103.950	0.348	0.619	0.666
1991	105.511	0.338	0.609	0.671
1992	109.602	0.316	0.607	0.662
1993	113.136	0.288	0.600	0.650
1994	114.656	0.292	0.593	0.617
1995	113.592	0.304	0.601	0.617
1996	114.903	0.311	0.596	0.615
1997	115.685	0.307	0.597	0.610
1999	114.532	0.317	0.591	0.598
2001	115.092	0.328	0.588	0.585
2003	116.047	0.330	0.599	0.550
2005	113.672	0.323	0.624	0.531
2007	120.380	0.307	0.597	0.533

Notes: Three definitions of job changers: with less than 4 years of tenure, with less than 10 years of tenure or ever changer i.e. those who recorded a job change (less than 12 months tenure) in any year of the sample.

B Model Appendix

The total differential of equation 11 can be written:

$$(1+\frac{d\Lambda}{dR})\frac{dR}{dh} = \overline{x} - R - \frac{d\Lambda}{dh} - \frac{d\Lambda}{d\theta}\frac{d\theta}{dh} \tag{14}$$

The mean-preserving spread has three effects on R: it increases R directly if $\overline{x} > R$, it increases R through market tightness θ, it decreases R by increasing the option value of a job. The reason $\frac{d\Lambda}{dh} > 0$ is the same as before, the truncation of the productivity distribution at R. Substituting the total differential of equation 10 into 14, we obtain that $\frac{d\theta}{dh} > 0$, the effect on $\frac{dR}{dh}$ cannot be signed.

The total differential of equation 9 with respect to h at $h = 0$ gives:

$$\frac{dS}{dh} - \frac{dR}{dh} = -(S-R) + [\frac{\beta}{1-\beta}c(1+\eta\frac{r+\lambda}{\theta q\,(\theta)}) + \frac{(1-\eta)(r+\lambda)\sigma}{\theta^2 q(\theta)}]\frac{d\theta}{dh}$$

where $0 < \eta < 1$ is the elasticity of the matching function $q(\theta)$. Knowing that $\frac{d\theta}{dh} > 0$ and assuming $S - R$ small, the result of a mean-preserving spread is $\frac{dS}{dh} - \frac{dR}{dh} > 0$. This means that the range of productivities over which workers search on the job is larger and the range of productivities over which they do not search is smaller. A mean-preserving spread makes the gap between S and R larger because it increases θ and therefore increases the expected rewards from search. The intuition is again that the mean-preserving spread makes productivities above the mean better and productivities below the mean worse, but workers and firms do not consider productivities below R.

The effects of the mean-preserving spread ($\frac{d\theta}{dh} > 0$ and $\frac{dR}{dh} \lesseqgtr 0$) on the level of unemployment $u = \frac{\lambda G(R)}{\lambda G(R)+\theta q(\theta)}$ are ambiguous and depend on the parameters.

The option value of a job can be written:

$$\Lambda(R,\theta,\sigma,h) = \lambda\int_R^1 \max(J^{ns}(s), J^s(s))dG(s) = \lambda\int_R^S J^s(s)dG(s) + \lambda\int_S^1 J^{ns}(s)dG(s) =$$

$$= \lambda(1-\beta)(1+h)[\frac{1}{r+\lambda+\theta q(\theta)}\int_R^S (x-R)dG(s) + \frac{1}{r+\lambda}\int_S^1 (x-R)dG(s)] - \\ - \frac{\lambda(1-\beta)}{r+\lambda}\left(\frac{\beta}{1-\beta}c\theta - \sigma\right)(1-G(S))$$

$$\frac{d\Lambda}{dR} = \lambda(1-\beta)(1+h)[-\frac{1}{r+\lambda+\theta q(\theta)}(G(S)-G(R)) - \frac{1}{r+\lambda}(1-G(S))] < 0$$

$$\frac{d\Lambda}{d\theta} = -\frac{\lambda(1-\beta)(1+h)}{(r+\lambda+\theta q(\theta))^2}(q(\theta)+\theta q'(\theta))\int_R^S (x-R)dG(s) - \frac{\lambda\beta}{r+\lambda}c(1-G(S)) < 0$$

TABLE B.3. Robustness. The effects of a mean-preserving spread

Parameters	$\Delta SD(w_{ch})$	$\Delta SD(w_{st})$	Δu	$\frac{\theta q(\theta) e}{1-u}$
r=0.03, $\theta = 0.37$	0.032-0.028 (+12.5%)	0.107-0.1 (+7%)	0.125-0.127 (-1.6%)	0.032-0.029 (+9%)
$\lambda = 0.1$, A=0.5, a=0.5	0.033-0.029 (+12%)	0.116-0.11 (+5.4%)	0.102-0.1 (+2%)	0.017-0.016 (+6%)
r=0.03, $\theta = 0.37$, $\lambda = 0.1$, A=0.5, a=0.5	0.021-0.016 (+31%)	0.098-0.093 (+5%)	0.12-0.12 (+0%)	0.011-0.009 (+18%)

Note: Results are obtained assuming a uniform distribution of shocks and a matching function of the form $q(\theta) = A\theta^{-a}$ and solving equations 9 to 13 with parameters values in the first column. The bechmark values are A=1, a=0.4, $\lambda = 0.2$, r=0.06, $\beta = 0.5$, R=0.4, S=0.6, $\theta = 0.47$. The calibration is in two steps: first c, σ and z are obtained inverting equations 9, 10 and 11, then the equibrium is solved with h=0 and h=0.1. Each column shows the difference after-before the mean-preserving spread and the percentage change.

$$\frac{d\Lambda}{dh} = \lambda(1-\beta)[\frac{1}{r+\lambda+\theta q(\theta)}\int_R^S (x-R)dG(s) + \frac{1}{r+\lambda}\int_S^1 (x-R)dG(s)] > 0$$

The total differential of equation 10 reads:

$$\frac{(1-R)(1-\beta)}{r+\lambda} - \frac{1-\beta}{r+\lambda}\frac{dR}{dh} = [\frac{c}{\theta q(\theta)}\eta + \frac{\beta c}{r+\lambda}]\frac{d\theta}{dh} \tag{15}$$

substituting **??** into 14 we obtain:

$$\frac{d\theta}{dh}[\frac{d\Lambda}{d\theta} - (1+\frac{d\Lambda}{dR})(\frac{r+\lambda}{1-\beta}\frac{c}{\theta q(\theta)}\eta + \frac{\beta c}{1-\beta})] = \overline{x} - R - (1+\frac{d\Lambda}{dR})(1-R) - \frac{d\Lambda}{dh} \tag{16}$$

the sign of $\frac{d\theta}{dh}$ is positive because both the RHS and the LHS of equation **??** are negative since $-1 < \frac{d\Lambda}{dR} < 0$. The sign of $\frac{dR}{dh}$ from **??** is ambiguous.

The Table in the Appendix shows some robustness checks using different initial conditions. In the first column the parameters which change with respect to the benchmark and in the following columns the changes in the main results before and after the mean-preserving spread.