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Wage dynamics in the presence of unobserved individual and job heterogeneity☆

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HIGHLIGHTS

- We develop a wage model with individual effects, job effects and a persistent shock
- Estimated persistence is robust to any distribution of the unobserved heterogeneity
- Once individual and job effects are considered persistence is significant but small
- The variance of the job effects is 40% of the variance of the individual component

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ABSTRACT

This paper develops an error-components model for wages that incorporates individual fixed effects, job-specific effects, and a persistent shock with an autoregressive structure over time. The novel feature of the model is that the estimation of this dynamic persistence is robust to any distributional form for the unobserved individual and job components, and the relationship between them. Then, additional assumptions are considered to separately identify the relative magnitude of these two components. In the data drawn from the PSID, we find that — once individual and job-specific effects are taken into account — the estimated persistence is significant but small. In addition, the ratio of the estimated variance of the job-specific effects to the variance of the individual time-invariant component is 40%.

1. Introduction

Models of wage dynamics are routinely used as a representation of uncertainty in quantitative macroeconomic models of consumption and savings, public finance or wealth inequality.[1] The conclusions that can be drawn from those models critically depend on the type of income process that is used. In addition, there is a large literature on longitudinal earnings in labor economics, even if some of the papers did not have an explicit objective to provide a representation of income uncertainty.[2]

This paper relates to the literature on univariate models of earnings that decomposes wage variability into a systematic part formed by both observable and unobserved individual characteristics, and another part due to shocks that might have some persistence over time. An encompassing model in this literature would include individual fixed effects, a permanent shock (unit root or some persistent component which evolves slowly over time), and a transitory shock (white noise or with some moving-average structure that quickly vanishes away).[3] The objects of interest in this model would be the variance of the fixed effects (as a measure of the rela-

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[1] See Heathcote et al. (2009, 2013) for recent surveys.

[2] See Meghir and Pistaferri (2011) for a comprehensive review of the literature.

[3] Guvenen (2007) adds another fixed effect interacted with an age trend and assumes that households learn about their individual-specific income profile over time. In Browning et al. (2010) we can find models of one single earnings shock instead of two, and lots of heterogeneity. Some papers have considered income processes with heteroskedastic shocks, and/or non-normal and mixing distributions (Horowitz and Markatou, 1996; Chamberlain and Hirano, 1999; Geweke and Keane, 2000; Alvarez and Arellano, 2004; Meghir and Pistaferri, 2004; Bonhomme and Robin, 2010, and Hospido, 2012, among others). A further generalization is Arellano et al. (2014), who develop a flexible earnings model that allows to capture interesting nonlinearities. Finally, Browning and Ejrnæs (2014) relax the almost universally assumed assumption in this literature that the persistent and transitory shocks are uncorrelated.

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tive importance of pre-market factors), of the permanent and the transitory shocks, and the persistence of these. The aim of this paper is to use the panel structure of the data and the information on observable events — like job changes — to help us better interpret that persistence.

In particular, we propose a model that incorporates individual fixed effects, which are time-invariant; job effects that change across jobs but remain constant within the same position; and a persistent shock, with an autoregressive structure. Based on the modeling choices and the identifying assumption, orthogonality conditions can be constructed to obtain a generalized method of moments (GMM) estimate of the autoregressive parameters, net of workers and jobs composition. Under this fixed effects perspective, the estimation of the persistence will be robust to any distribution of the unobserved components. Then, additional assumptions are considered to separately identify the relative magnitude of the individual and job-specific effects.

In principle, permanent shocks like unit roots or individual fixed effects imply very extreme types of persistence. In the canonical model, for instance, the individual fixed effect is a random variable realized at birth that persists forever through the random walk. Our model instead allows to quantify to what extent individual fixed effects are time invariant (or do they change when individuals change jobs), and to what extent the persistent shock is related to the job effects.

In our sample, drawn from the 1968–1993 Panel Study of Income Dynamics (PSID), we find that — once we control for individual and job-specific effects — the autoregressive persistence is significant but small. In addition, we find that the time series dependence is higher for those individuals who do not change jobs and for those who quit voluntarily. The higher persistence for the job stayers and for those who move voluntarily could be associated to jobs with higher security or to jobs less vulnerable to economic fluctuations. For the whole sample, the ratio of the estimated variance of the job-specific effects to the variance of the individual time-invariant component is around 40%. The relative magnitude of these components is of substantive economic interest, as noted by Woodcock (2011). If wage variation primarily reflects workers' characteristics, then individual wages will be highly persistent, largely invariant to where individuals work, and the potential returns to job mobility will be small. If, on the contrary, job-specific variability is important, then the cost of involuntary displacements will be large, but so will the returns to search.

The paper is at the intersection of three important literatures. First, there is a large econometric and mostly structural literature on earnings dynamics (Lillard and Willis, 1978; MaCurdy, 1982; Abowd and Card, 1989; Meghir and Pistaferri, 2004; Browning et al., 2010). This literature studies the variance of permanent and transitory labor income shocks, and the persistence of these. A mostly untouched question in this area is how job effects fit into such dynamics. Second, this paper relates to the strand of the literature that considers error component models and stresses the importance of individual and firm effects in explaining wages (Topel and Ward, 1992; Light and McGarry, 1998; Abowd et al., 1999; Woodcock, 2008, 2011; Torres et al., 2013). Similarly to those references, the model in this paper includes individual and job effects but, differently to them, the model considers time-varying dependence as well. Finally, there is a developing literature on multivariate models of wages, job mobility, labor supply decisions and other variables. Recent papers by Low et al. (2010), Altonji et al. (2013) or Liu (2013) make important contributions in the line of work that attempts to estimate the effect of job mobility, labor supply or the accumulation of tenure on wage risk.[4]

Those three strands of the literature have in common the aim of providing an informed description of wages as uncertain but *exogenous* processes faced by individuals. A different approach has been followed by the search literature that has developed structural models of the labor market to disentangle the effects of different types of shocks or search frictions in general on the determination of wages in equilibrium (Postel-Vinay and Robin, 2002; Cahuc et al., 2006; Buchinsky et al., 2010; Postel-Vinay and Turon, 2010). These models study earnings trajectories allowing for endogenous job change decisions, but with heterogeneity playing a very limited role and in many cases considering i.i.d. productivity shocks.[5] The simple single-equation approach considered here allows for persistence in shocks and heterogeneous components, but at the cost of imposing a strong assumption such as the exogeneity of job change decisions.[6]

The rest of the paper is organized as follows. Section 2 presents the model and explains the estimation strategy. Section 3 describes the data and Section 4 shows the estimation results. Section 5 places this paper in relation to the existing literature. Finally, Section 6 concludes with a summary and a future research agenda.

2. Model and estimation

This section presents an error components model of wages that incorporates individual effects, job effects, and persistent transitory shocks. Then we consider the dynamic representation of the model that allows us to implement a GMM estimation method and discuss the main identifying assumption.

2.1. The model and the identifying assumption

The model is

$$y_{it} = \mu_i + \phi_{J(i,t)} + u_{it}, (t = 2, \ldots, T; \quad i = 1, \ldots, n)^{7} \tag{1}$$

where y_{it} is a log wage residual for individual i at time t, μ_i is a worker effect, $\phi_{J(i,t)}$ is a job effect, and u_{it} is the autoregressive shock process:

$$u_{it} = \rho u_{it-1} + v_{it}, \tag{2}$$

with v_{it} white noise: $E(v_t) = 0, \forall\, t; \quad E(v_t v_s) = 0, \forall\, t \neq s$.[8] Notice that we abstract from additive aggregate effects by regarding y_{it} as a deviation from a time effect.[9] μ_i is an individual specific fixed effect which does not change over time. The job effect, $\phi_{J(i,t)}$, is assumed to change across different jobs for the same individual, but it remains constant within a given position.[10] We assume $E(\mu) = 0$, and $E(\phi_{J(\cdot)}) = 0$, whereas the distribution of both μ_i, and $\phi_{J(i,t)}$, and the relationship between them are left completely unrestricted.

Let q_{it} be a job change indicator such that $q_{it} = 1$ if worker i moves from her current job to start a new one in $t + 1$. The complementary indicator is $s_{it} = 1 - q_{it}$. Thus, if $s_{it-1} = 1$ then $\phi_{J(i,t)} = \phi_{J(i,t-1)}$, and $\Delta y_{it} = \Delta u_{it}$, where Δ is the first difference operator.

The dynamic representation of the model in Eqs. (1)–(2) is:

$$\begin{aligned} y_{it} - \rho y_{it-1} &= (1-\rho)\mu_i + \phi_{J(i,t)} - \rho\phi_{J(i,t-1)} + v_{it} \\ &= \eta_i + \phi_{J(i,t)} - \rho\phi_{J(i,t-1)} + v_{it}, \end{aligned}$$

where $\eta_i = (1 - \rho)\mu_i$.

The assumption that allows us to identify ρ is that the transitory shocks v_{it} are mean independent of current and past job changes given past transitory shocks, individual effects, and job effects:

$$E\left(v_{it} | s_i^t, y_{it-1}, \eta_i, \phi_{J(i)}\right) = 0, \tag{3}$$

[4] Differences between this paper and their papers are discussed in Section 5.

[5] Pavan (2008), on the contrary, allows persistent shocks to the job effects.

[6] For a formal discussion and a test of the identifying assumption, see Sections 2.1 and 2.4, respectively.

[7] As a matter of notation, we assume that the first observation occurs at $t = 1$.

[8] Previous literature in earnings dynamics has found that autoregressive models are consistent with the empirical findings that there are large cross-individual heterogeneity and persistent autocorrelation over time (Abowd and Card, 1989, among others). Here we focus on a first-order process to simplify the presentation.

[9] In the earnings dynamics literature it is standard to adopt this two step procedure. In the first stage regression, the log of real hourly wages is regressed on control variables — such as race or education — and time dummies, to eliminate group heterogeneities and the aggregate conditions of the economy. Then, in the second stage, the unobserved heterogeneity and dynamics of the residuals, y_{it}, are modeled.

[10] This component can be interpreted as job-specific human capital or an idiosyncratic firm effect on wages. Empirically it is not possible to distinguish between firm effects and worker–firm match effects without employer–employee matched data.