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On the persistence of income shocks over the life cycle: Evidence, theory, and implications ☆

Fatih Karahan [a], Serdar Ozkan [b,*]

[a] Federal Reserve Bank of New York, 33 Liberty Street, New York, NY 10045, United States
[b] Federal Reserve Board, 20th and C Streets, NW, Washington, DC 20551, United States

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ABSTRACT

How does the persistence of earnings change over the life cycle? Do workers at different ages face the same variance of idiosyncratic earnings shocks? This paper proposes a novel specification for residual earnings that allows for an age profile in the persistence and variance of labor income shocks. We show that the statistical model is identified, and we estimate it using Panel Study of Income Dynamics data. We find that shocks to earnings are only moderately persistent (around 0.75) for young workers. Persistence rises with age, up to unity, until midway through life. The variance of persistent shocks exhibits a U-shaped profile over the life cycle (with a minimum of 0.01 and a maximum of 0.05). These results suggest that the standard specification in the literature (with age-invariant persistence and variance) cannot capture the earnings dynamics of young workers. We also argue that a calibrated job turnover model can account for these nonflat profiles. The key idea is that workers sort into better jobs and settle down as they age; in turn, magnitudes of wage growth rates decline, thereby decreasing the variance of shocks. Furthermore, the decline in job mobility results in higher persistence. Finally, we investigate the implications of age profiles for consumption–savings behavior. The welfare cost of idiosyncratic risk implied by the age-dependent income process is up to 1.6 percent of lifetime consumption lower compared with its age-invariant counterpart. This difference is mostly due to a higher degree of consumption insurance for young workers, for whom persistence is moderate. These results suggest that age profiles of persistence and variances should be taken into account when calibrating life-cycle models.

1. Introduction

Two important determinants of idiosyncratic labor income risk are the persistence and variance of shocks. How does the persistence of earnings change over the life cycle? Do workers at different ages face the same variance of idiosyncratic shocks? Answers to these questions are central to many economic decisions in the presence of incomplete financial markets. Uninsured idiosyncratic risk affects the dynamics of wealth accumulation, consumption inequality, and the effectiveness of

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* Corresponding author.
E-mail addresses: Fatih.Karahan@ny.frb.org (F. Karahan), Serdar.Ozkan@frb.gov (S. Ozkan).
URLs: http://www.newyorkfed.org/research/economists/karahan/index.html (F. Karahan), http://www.serdarozkan.me (S. Ozkan).

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self-insurance through asset accumulation. Thus, income risk is an important topic of study for quantitative macroeconomics. Moreover, the age profile of persistence and variance of shocks can provide information about the economic mechanisms underlying earnings risk. For these purposes, we propose and estimate a novel specification for idiosyncratic earnings that allows for a life-cycle profile in the persistence and variance of earnings shocks.

We are motivated by the observation that changes in earnings occur for different reasons over the working life. For young workers, job-to-job transitions might play an important role. Midway through a career, settling down into senior positions as well as bonuses, promotions, or demotions may account for workers' earnings dynamics. Older workers are more likely to develop health problems that reduce their productivity. These changes differ in nature and, more specifically, in persistence and magnitude. Thus, we doubt that the variance and persistence of shocks are constant throughout a lifetime.

In our empirical analysis, we decompose residual earnings into an individual-specific fixed effect, a persistent component, and a transitory component. The novel feature of our specification is that both the persistence parameter of the $AR(1)$ component and the variance of innovations to transitory and persistent components are allowed to vary by age. This paper, to the best of our knowledge, is the first study that estimates a lifetime profile of earnings persistence and variance together.[1]

We show that this specification is identified and estimate it using earnings data from the Panel Study of Income Dynamics (PSID). Our results reveal that persistence increases at early stages in the working life: Starting from 0.75, it rises to unity. These differences are sizable: 70 percent of a shock received during a worker's early years in the labor market dies out over the next five years, whereas if the shock is received at age 40, 15 percent of it would fade out during the next five years. As for the variance of persistent shocks, we find a U-shaped profile (with a minimum of 0.01 and a maximum of 0.05). A shock of one standard deviation implies a 26 percent change in annual earnings for a 24-year-old. The corresponding number for a 40-year-old is only 12 percent. The variance of transitory shocks increases for the first five years but remains flat for the rest of the working life. These results suggest that the standard specification in the literature (with age-invariant persistence and variance of shocks) cannot capture the earnings dynamics of young workers.

We then ask the question of whether these life-cycle profiles are statistically significant. To tackle this question, we estimate life-cycle profiles by dividing the working life into three stages. Here, we assume that persistence and variances are constant within a stage but might differ from one stage to another. We test whether the persistence and the variance of shocks differ significantly across the three age intervals. We strongly reject the hypothesis of a flat profile for the persistence and the variance of persistent shocks, but not for the variance of transitory shocks.

The estimates of persistence in the literature are close to unity. The age-dependent estimate of persistence lies substantially below one for most of the working life. We argue that the high persistence in the literature is driven by targeting the linear, if not convex, increase in residual earnings inequality over the working life. Namely, estimation avoids lower levels of persistence, which would imply a concave rise in inequality. The age-dependent income process matches the inequality profile without high levels of persistence, thanks to the inverse relationship between the persistence and the variance of labor income shocks that our estimates reveal.

The features of the covariance structure in earnings that lead to the finding of age-dependent persistence are also consistent with alternative specifications of the income process where persistence is age-invariant but the variance is age-dependent. Specifically, a process containing a random walk component and an $AR(1)$ component (as in Baker and Solon, 2003 and Moffitt and Gottschalk, 2011) can generate an increase in the ratio of two-lag covariance to one-lag covariance over the life cycle, which we show is the key to the identification of the persistence profile. The advantage of the age-dependent specification is that it is more suitable for use in quantitative life cycle macro models, as it requires one fewer state variable.

To explore one possible mechanism behind the rise in persistence and the decrease in the variance of persistent shocks early in life, we study the implications of the job turnover model by Jovanovic (1979). In this model, unemployed workers match with firms and draw a match-specific productivity, unobservable to both the firm and the worker. Output is the sum of match productivity and a white noise. Firms pay workers their expected productivity. After observing the output, both the worker and the firm update their beliefs about the match productivity in a Bayesian fashion. In the end of the period, based on their beliefs, workers decide whether to quit and meet another firm or stay in the same job.

In a simple calibration exercise, we show that the model is quite successful in generating the age profiles in the data, that is, the increase in persistence and the decrease in variance of persistent shocks early in working life. The mechanism behind this result can be summarized as follows: The model implies that wages of stayers follow a random walk, whereas the autocorrelation of wages is very small for quitters. The overall persistence is a combination of these two. As workers age, they sort into jobs with better match productivities and settle down, which results in an increase in the number of stayers, thereby resulting in an increase in persistence. Similarly, as match productivity is being revealed, the magnitude of changes in beliefs, and thus wages, decrease and in turn the variance of persistent shocks declines. This mechanism is known to have

[1] There are several other studies that take into account variation in persistence and variance of shocks. Baker and Solon (2003) and Moffitt and Gottschalk (2011) allow for age-specific variances in transitory shocks, and Sabelhaus and Song (2010) also let both the permanent and the transitory shocks vary with age and cohort. Hause (1980) estimates a process that has an $AR(1)$ component with time-specific persistence and variance of shocks. Alvarez et al. (2010) investigate the heterogeneity in the persistence of shocks across individuals. Feigenbaum and Li (forthcoming) find a U-shaped earnings uncertainty profile over the life cycle.

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