Journal of Economic Dynamics & Control 94 (2018) 24–42

Contents lists available at ScienceDirect

Journal of Economic Dynamics & Control

journal homepage: www.elsevier.com/locate/jedc

Identifying heterogeneous income profiles using covariances of income levels and future growth rates☆

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ARTICLE INFO

Article history:
Received 11 March 2018
Revised 20 June 2018
Accepted 7 July 2018

JEL classification:
J31
D91
E21

Keywords:
Income risk
Heterogeneity
Consumption-saving

ABSTRACT

This paper shows that a central implication of heterogeneous income profiles (HIP) is that the covariance between the level of income and future income growth rates must become strongly positive from about age 40. Covariances of income levels and future growth rates therefore have strong identifying power for HIP. We show that adding such moments to an estimation can reverse seemingly strong evidence of HIP. We show this both in a small sample Monte Carlo study and using PSID data. Our results are robust to including a fixed effect correlated with the HIP component.

1. Introduction

Understanding the income risk households face is important for many economic questions. It is a central determinant of precautionary saving in life-cycle consumption models affecting both the degree of insurance implied by the model and its ability to explain wealth inequality. Assumptions on income risk are also important for asset pricing and the welfare costs of business cycle fluctuations.

Estimation of income processes consequently has a long history in economics with early contributions by Lillard and Willis (1978) and MaCurdy (1982).[1] A longstanding, but so far inconclusive, discussion has evolved around the key distinction between whether agents face *heterogeneous income profiles* (henceforth HIP) as opposed to very persistent (or even permanent) shocks (in the literature referred to as *restricted income profiles*, RIP). Using PSID data, Guvenen (2009) found strong evidence of HIP, while Hryshko (2012) concluded against it.

In this paper, we argue that covariances between the income level and future income growth rates are very useful for identifying HIP even in the small samples with attrition typically used in the literature. Under HIP, the share of the variance of income attributable to the unobserved heterogeneous growth rates is strongly increasing in age, and 10–15 years into the

☆ We thank Alessandro Martinello, Thomas Høgholm Jørgensen and Mette Ejrnæs for helpful comments. Financial support from the Danish Innovation Fund (URBAN grant) and the Danish Council for Independent Research in Social Sciences (Grant no. 5052-00086) are gratefully acknowledged.

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[1] For a review of the early literature see Meghir and Pistaferri (2011).

https://doi.org/10.1016/j.jedc.2018.07.003
0165-1889/

life-cycle an individual's level of income is thus very informative about his unobserved heterogeneous growth rate. Therefore, a central implication of HIP is that sufficiently late in life, there must be a strong positive covariance between the level of income and income growth. In contrast, the covariances between income levels and future growth rates are always zero or negative in RIP models. We show this both analytically and in simulations.

To further improve identification, we firstly focus on growth rates about 4–12 years after the measurement of the level. This mitigates contamination from any short-run dynamics (mean reversion). Secondly, we calculate the growth rate over a longer period than just one year (again 4-12 years), which increases the signal-to-noise ratio. To be specific, one example of a moment would be the covariance between the income level at age 40 and the growth rate between age 45 and 54. Our approach thus suffices with 15 years of observations, which is readily available in the PSID. Identification is, however, stronger in data sets with a longer time dimension and less attrition.

In the first part of the paper, Section 2.2, we show through simulations of small samples with attrition that our proposed moments have strong identifying power for a broad range of parameterizations encompassing those estimated in the literature.

In the second part of the paper, Section 3, we estimate a misspecified income process allowing for HIP on simulated data that does not feature HIP. We show that the estimated model misinterprets the data and incorrectly finds large and precisely estimated HIP, but that the misspecification is clearly visible when we look at the covariances of the income level and future growth rates.

In the third and final part of the paper, Section 4, we turn to data from the Panel Study of Income Dynamics (PSID). We estimate a model with HIP targeting the entire variance-covariance matrix of income growth, and find apparently large and precisely estimated heterogeneity in income profiles. Extending the set of moments with covariances between the level of income and future growth rates reverses this result, resulting in a negligible estimated HIP component.

Section 5 concludes.

1.1. Related literature

Our approach is related to the MaCurdy-test proposed in MaCurdy (1982) (see also Abowd and Card, 1989). The MaCurdy-test uses that the autocovariances of one-year income growth rates must become positive under HIP considering observations far enough apart, while they remain weakly negative under RIP. Simulation evidence in both Guvenen (2009) and Hryshko (2012), however, shows that the test has very low power in small samples and cannot be relied upon in practice. The moments we consider, however, display excellent identifying power even in small samples subject to attrition.

Our rejection of HIP is in line with the results in Hryshko (2012). He showed that evidence of HIP can disappear once more general models are estimated. From his analysis however, it is not clear which part of the covariance matrix is driving this conclusion. Furthermore, even his most general model has a poor fit of the over-identifying restrictions. This indicates misspecification, which makes his test for no HIP hard to interpret. In contrast, our approach yields a clear, interpretable reason for the rejection of HIP as well as stark supporting graphical evidence.

Recent research (Altonji et al., 2013; Arellano et al., 2017; Browning et al., 2010; De Nardi et al., 2016; Guvenen et al., 2016) has argued that the true income process is somewhat more complicated than what a linear Gaussian model can deliver. Our results indicate that in order to precisely identify a HIP component in a method of moments based estimation it is crucial to target covariances of level and future growth rates. We show this in full detail for a rather simple income process, but further also show (in Section 2.5) that our method is able to correctly detect the HIP component when data is estimated from the highly complex income process in Guvenen et al. (2016).

2. Identification of HIP

In this section, we analytically derive large sample covariances which are informative with respect to the presence of HIP, and use simulations to investigate their ability to identify HIP in small samples.

2.1. Income process

We use the same income process as in Guvenen (2009). Specifically, we assume that log-income is given by

$$y_{it} = \alpha_i + \beta_i t + p_{it} + \xi_{it} \tag{2.1}$$

$$\begin{aligned} p_{it} &= \rho p_{it-1} + \psi_{it}, \quad p_{i0} = 0 \\ &(\alpha_i, \beta_i) \sim \mathcal{N}\left(0, \begin{bmatrix} \sigma_\alpha^2 & \sigma_{\alpha,\beta} \\ \sigma_{\alpha,\beta} & \sigma_\beta^2 \end{bmatrix}\right), \ \sigma_{\alpha,\beta} \equiv \rho_{\alpha,\beta}\sigma_\alpha\sigma_\beta \\ &\xi_{it} \sim \mathcal{N}(0, \sigma_\xi^2) \\ &\psi_{it} \sim \mathcal{N}(0, \sigma_\psi^2) \end{aligned} \tag{2.2}$$