Heterogeneous Earnings Risk in Incomplete Markets

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Research question: This paper asks whether and to what extent individuals are heterogeneous with respect to the earnings risk they face, and how this risk changes over time.

Motivation: A better understanding of earnings risk helps explain consumption and saving choices, wealth and consumption inequality and the responses to policies.

Innovation: I do not limit earnings risk to a selected number of moments, but consider the entire probability distribution of earnings shocks.

Method: I provide a novel characterization of time-varying heterogeneous earnings risk using a Markov process with heterogeneous transition probabilities. I analyze the identification of this earnings process and estimate its parameters using a non-parametric procedure as well as through indirect inference, using a combination of earnings and savings data from the Survey of Income and Program Participation.

Related literature

- The earnings process in this paper can subsume many properties of earnings previously shown to be important (Arellano, Blundell, and Bonhomme, 2017; Busch, Domeij, Guvenen, and Madera, 2020; Botosaru and Sasaki, 2020, De Nardi, Fella, and Paz-Pardo, 2020, and more).

- Most papers on earnings processes use earnings data only. Some exceptions that use savings/consumption and earnings data jointly:
  - Guvenen and Smith (2014): more restrictive earnings process (Bayesian learning, Gaussian shocks); Alan, Browning, and Ejrnæs (2018): no time-varying sources of unobserved heterogeneity.

- Paper also relates to the literature on discrete earnings process estimation, as in Castaneda, Dıaz-Giménez, and Rıos-Rull (1998) and, more recently, Druedahl and Munk-Nielsen (2020), but this literature doesn't consider unobserved heterogeneity.

- Identification results are related to discussion on identification in hidden Markov models (Bonhomme, Jochmans, & Robin, 2016, 2017), but their identification strategy cannot be applied due to first-order Markov structure of my earnings process.

Earnings process with heterogeneous time-varying earnings risk

I propose a novel earnings process where individuals face heterogeneous and time-varying earnings risk

- Achieved by extending the set of states (earnings levels $y_{it} \in \mathcal{Y} = \{\bar{y}(1), ..., \bar{y}(L)\}$) by an unobservable state $\xi_{it} \in \mathcal{X} = \{\bar{\xi}(1), ..., \bar{\xi}(M)\}$
- Individuals transition between states $(y_{it}, \xi_{it}) \in (\mathcal{Y} \times \mathcal{X})$ according to a stable transition probability matrix P
  $\Rightarrow$ If individuals with same current earnings level y_{it} differ with respect to ξ_{it}, then they have different transition probabilities to next period's y_{it+1}

Advantage: This earnings process can generate a rich interpretation of earnings risk, and due to its discrete nature, can readily be incorporated in an Aiyagari (1994) or Krusell and Smith (1998) framework.

Challenge: This process is not identifiable from only earnings data due to a reduced rank Jacobian.

Identification

Solution: I consider two identification strategies to estimate this earnings process

1. **Restrictions**: use an earnings panel to identify the earnings process, if combined restrictions that follow from a GARCH process (risk heterogeneity $\Rightarrow$ variance heterogeneity)

2. **Additional data**: use a panel of earnings and savings data: under some assumptions, these data can non-parametrically identify the earnings risk individuals face

   - Either use this non-parametric approach directly
   - Alternatively, use this non-parametric method to label individuals, and use the transition matrix between these labeled states as auxiliary statistic in an indirect inference procedure

I estimate the earnings process under both identification strategies using indirect inference and use data from the Survey of Income and Program Participation.

Main findings

1. Individuals do not only face large heterogeneity in earnings levels, but also in earnings risk.
   - The estimates indicate the existence of low and high-risk states, and these states are, among others, distinguishable by their large differences in job-loss probabilities. Individuals in high-risk states are four to ten times as likely to become unemployed next year than individuals in low-risk states.

2. Estimates from both identification strategies indicate that there is a difference in the dynamics of high- and low-risk states.
   - High-risk states are unstable, low-risk states are persistent.

3. Imposing a GARCH structure on the estimates is highly restrictive.
   - This motivates the earnings process this paper proposes, allowing for a richer notion of earnings risk heterogeneity.