Heterogeneous Earnings Risk in Incomplete Markets

E. F. Janssens (e.f.janssens@uva.nl)

UNIVERSITEIT VAN AMSTERDAM

This research is funded through the NWO Research Talent Grant (project number 406.18.514).

Introduction

Questions: whether and to what extent are individuals heterogeneous with respect to the earnings risk they face, and how does this risk change over time? How does earnings risk heterogeneity affect savings, welfare, inequality?

Methodological contributions:

- Novel discrete earnings process that features (rich notion of) heterogeneous time-varying earnings risk
- Novel identification results for bivariate Markov process where one variable is unobserved

Earnings process

Discrete earnings process where individuals face heterogeneous and time-varying earnings risk:

- Extend 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

Example: L (# y earnings levels) = 2, and M (# ξ levels) = 2 ⇒ size extended state space = 4:

$$(\mathcal{Y} \times \mathcal{X}) = \{(\bar{y}(1), \bar{\xi}(1)), (\bar{y}(1), \bar{\xi}(2)), (\bar{y}(2), \bar{\xi}(1)), (\bar{y}(2), \bar{\xi}(2))\}.$$

$$P = \begin{bmatrix} p_{(1,1);(1,1)} & p_{(1,1);(1,2)} & p_{(1,1);(2,1)} & p_{(1,1);(2,2)} \\ p_{(1,2);(1,1)} & p_{(1,2);(1,2)} & p_{(1,2);(2,1)} & p_{(1,2);(2,2)} \\ p_{(2,1);(1,1)} & p_{(2,1);(1,2)} & p_{(2,1);(2,1)} & p_{(2,1);(2,2)} \\ p_{(2,2);(1,1)} & p_{(2,2);(1,2)} & p_{(2,2);(2,1)} & p_{(2,2);(2,2)} \end{bmatrix}, \quad P_{\text{ex}} = \begin{bmatrix} 0.90 & 0.01 & 0.08 & 0.01 \\ 0.01 & 0.30 & 0.60 & 0.09 \\ 0.01 & 0.01 & 0.08 & 0.90 \\ 0.50 & 0.01 & 0.09 & 0.40 \end{bmatrix}$$

Earnings process: related literature

The proposed earnings process is discrete yet can capture/has features of various continuous earnings processes previously proposed in the literature:

- Heterogeneous earnings distributions (Arellano, Blundell, Bonhomme, 2017 (→ ABB2017))
  - Unlike ABB2017, my process also describes how to move from one distribution to another
- Other papers show importance of heteroskedastic earnings shocks, heterogeneous job-loss and job-finding probabilities, heterogeneous persistence, skewness and other non-normalities
  - My process can capture these features
- Heterogeneous expectations (Stoltenberg & Singh, 2020): specific interpretation of ξ

Also, because my process is discrete from onset, it can be readily incorporated in heterogeneous agent macro models

Identification challenge

Earnings process cannot be identified from only an earnings panel. Two identification strategies:

1. Impose restrictions: unobserved variable is time-varying variance → paper proposes improved discretization method for GARCH-type processes
2. Use additional information from savings panel: savings reflect earnings risk faced by individuals
   → under some assumptions, this implies a non-parametric identification strategy

Identification from savings data

Under assumptions on the Markov process $((\mathcal{Y}, \mathcal{X}), P)$ and the savings function $k'(k, y, \xi)$, a panel of earnings and savings of $T \geq 3$ can be used to identify the risk states ξ up to label-swapping, and estimate the earnings process:

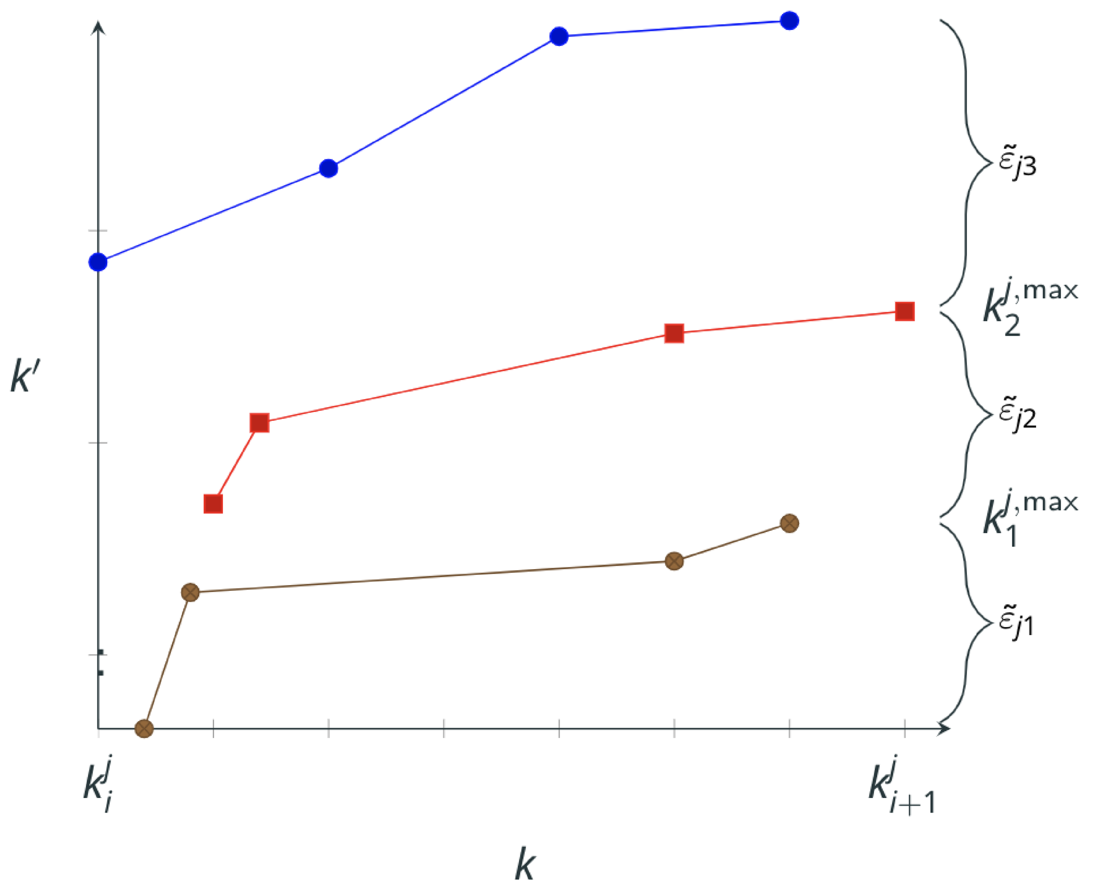
Assumption 1: "Monotonicity"

- If for a given ξ, y and k, k' is larger than for another ξ, but same y and k, it should be larger for all values of k (In example: blue line can't cross red line)

Assumption 2: Effect of ξ on k' should be large enough ("relevance" + "compliers")

- It should be possible to create subdomains $[k_i^j, k_{i+1}^j]$ for which the saving functions k' for the different risk states ξ do not overlap in range
- These subdomains should contain at least M observations of individuals that have higher current savings k but lower next period's savings k' (because these observations imply individuals with different risk states!)

Example of savings function for given level of y and three different values of ξ:



Because assumptions might be violated for some observations (e.g. for hand-to-mouth consumers), use indirect inference and structural model (Aiyagari, 1993) to correct, similar to how Tobit models are estimated with indirect inference

Data: SIPP

Survey of Income and Program Participation

- Use 2014-2018 wave
- Monthly observations on employment status, earnings, net worth and large set of controls
- Frequency of data: → yearly
  - Month-to-month changes are relatively infrequent, unless individual becomes unemployed
  - No variation in the net worth data within each year, only between years
- Focus on 18-67 y.o. in labor force, excluding self-employed. Unemployed if unemployed more than 6 months of year

Data section documents:

- Large conditional dispersion in net worth, conditional on earnings, previous net worth and controls
- Dynamics: individuals with high conditional savings on average have 60% probability to move to low conditional savings state next period; conditional low savers tend to stay low savers

Estimation results

Estimates for 5 levels:

$$(y_{it}, \xi_{it}) \in \begin{bmatrix} \text{unempl., } (\bar{\xi}(1) \text{ or } \bar{\xi}(2)) \\ \text{low earnings, } \bar{\xi}(1) \\ \text{low earnings, } \bar{\xi}(2) \\ \text{high earnings, } \bar{\xi}(1) \\ \text{high earnings, } \bar{\xi}(2) \end{bmatrix}, \hat{P} = \begin{bmatrix} 0.32 & 0.48 & 0.05 & 0.01 & 0.14 \\ 0.01 & 0.74 & 0.00 & 0.24 & 0.01 \\ 0.08 & 0.37 & 0.45 & 0.04 & 0.06 \\ 0.02 & 0.11 & 0.04 & 0.79 & 0.04 \\ 0.11 & 0.15 & 0.30 & 0.14 & 0.30 \end{bmatrix}$$

- Earnings inequality: low earners earn 68% less than average earner, high earnings 58% above average
- Earnings risk inequality: evident from e.g. large differences in job-loss probabilities
- Difference in the dynamics of high and low risk states: low risk states are persistent, high risk states are transitory

Macro implications

- More mass in right tail of wealth distribution, variance increases with 5 %
- (More) dispersion in conditional savings
- Welfare effect: comparing steady states, before revealing types:

$$g^{ss} = \left(\frac{\int_{k,y} V^{\text{ hom. risk}}(k, y) d\Phi_{k,y}^{\text{hom. risk}}}{\int_{k,y,\xi} V^{\text{ het. risk}}(k, y, \xi) d\Phi_{k,y,\xi}^{\text{het. risk}}} \right)^{\frac{1}{1-\gamma}} - 1 = 0.51\%$$