Perceived Income Risks

- An outline of the research proposal
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Summary of my research question

- Econometricians have realied only on realized income/earning series to estimate the variance of income shocks of different degrees of persistence. *(Blundell, Pistaferri, and Preston 2008)* But now, since the density forecasts of individual earning growth (perceived income risks) has been directly elicited, we can do the following:
  - Using the additional moments to identify the income risks
    - This is an extention of *("Understanding Permanent and Temporary Income Shocks - Liberty Street Economics" 2019)* from the first moment to the second moments of income risks.
  - Compare it with the risks that are only identified from the realized series, one way to characterize the deviations of perceived income process from the full-information rational expectation benchmark
    - For instance, if agents overestimate their permanent income risks?
    - If agents overestimate the persistence of the income process? *(Rozsypal and Schlafmann)*
    - To what extent, the cross-sectional inequality resulting from the income risks assumed by econometricians are perceived by the agents themselves.
      - If agents know more than econometricians about their individual earnings, the perceived risks may be lower than econometrician's estimates?
      - Or actually, agents, due to inattention or other reasons, tend to think the overall risk is higher?
    - Finally, not just the process of earning itself, but also its covariance with macro-environment, risky asset returns, etc.
      - For instance, if perceived income risks are counter-cyclical, it has important labor supply and portfolio implications. *(Catherine 2019)*
- The advantage of doing this
  - Econometricians have no full access to what agents truely know in their information set. With expectations and perceived income risks help solve this problem.
    - Insurance or information problem in consumption literature: what is interpreted as excessive sensitivity may be simply because agents do not have access to the recently realized shocks. *("Superior Information, Income Shocks, and the Permanent Income Hypothesis | The Review of Economics and Statistics | MIT*

Press Journals" 2019). *("Kaufmann and Pistaferri - 2009 - Disentangling Insurance and Information in Interte.pdf" 2019)*

    - To the extent that agents make decisions based on their perceptions instead of what is considered as the true objective law of the motion, understanding the perceived income risks profile and its correlation structure with other macro variables are the keys to explain their behavior patterns.

- A bigger-picture question
    - The approach that I am proposing here is a natural development from the existing literature of expectation formation. One of the common practices in this literature is to compare the measured expectations from surveys with the law of the systems independently identified by econometricians and interpret all deviations of the former to the latter as the evidence for irrationality. It is true that this has proved to be fruitful and refreshing compared to the earlier macroeconomic tradition that solely relies on the stringent assumption of rationality. But such practices implicitly assume the process discovered by econometricians is the "true" one. It does not recognize at all the use of large-sized surveys of expectations in discovering the law of the system besides making a case about how expectations are not rational. Therefore, a rather obvious reconciliation building upon the existing literature is to utilize jointly the realized data and expectations to understand the "true" process, while allowing for the partial rationality of the modelers and agents in the model.
        - The advantage of doing this is
            - One does not need to make a stringent assumption about either agents' full rationality or econometricians' correctness of model specification.
            - Utilize the information from expectations to understand the true law of the system.
        - Once we take this step, it is natural to incorporate specific mechanisms of expectation formation into a full-fledged structural model that contains optimizing decisions and general equilibrium forces.

An illustration of the idea in with the simplist income process

The income process of individual i is the following

$$\begin{aligned} y_{i,t} &= P_{i,t} + \epsilon_{i,t} \\ P_{i,t} &= P_{i,t-1} + \theta_{i,t} \\ \theta_{i,t} &\sim N(0, \sigma_{\theta,t}) \\ \epsilon_{i,t} &\sim N(0, \sigma_{\epsilon,t}) \end{aligned}$$

Notice transitory and permanent risks are time-varying. For now, we do not break down the individual into different cohorts, i.e. $\sigma_{\theta,t}$ and $\sigma_{\epsilon,t}$ are not cohort specific.

Income growth is

$$\begin{aligned}\Delta y_{i,t+1} &= y_{i,t+1} - y_{i,t} \\ &= P_{i,t+1} + \epsilon_{i,t+1} - P_{i,t} - \epsilon_{i,t} \\ &= \theta_{i,t+1} + \Delta\epsilon_{i,t+1}\end{aligned}$$

Assuming the agent knows perfectly the income process, then standing at time t, the conditional variance of income growth for next period is

$$Var^*_{i,t}(\Delta y_{i,t+1}) = \sigma^2_{\theta,t+1} + \sigma^2_{\epsilon,t+1} \quad \forall i$$

Because of rational expectation, the agent learns about the realization of $\sigma_{\epsilon,t}$, therefore it does not show up in her uncertainty.

What is available to econometricians is the realized cross-sectional variance of income growth (no subscript i) shown below. It is different from uncertainty faced with individuals.

$$Var(\Delta y_{i,t+1}) = \sigma^2_{\theta,t+1} + \sigma^2_{\epsilon,t} + \sigma^2_{\epsilon,t+1}$$

Taking the differences of the population's analogue of the first equation and the second above recover variance of transitory risks $\sigma_{\epsilon,t}$. Recursively using the panel structure, we could recover all the transitory and permanent income risks.

Besides, econometricians also use the following moments.

$$Cov(\Delta y_{i,t}, \Delta y_{i,t+1}) = -\sigma^2_{\epsilon,t}$$

This exercise is based on the assumption that individuals across the population or one defined cohort share the same income process. And also it is rational expectation in the sense that on average individuals get the income process right.

Once we recover permanent and transitory volatilities from above exercise, we can compare them with estimates from only realized income serieses.

Other moments from rational expectation

Besises, econometricians have utilized another moment restrictions: auto correlation of income growth across two periods are

$$\begin{aligned}&Cov^*_t(\Delta y_t, \Delta y_{t+1}) = \\ &= Cov^*_t(\theta_t + \epsilon_t - \epsilon_{t-1}, \theta_{t+1} + \epsilon_{t+1} - \epsilon_t) \\ &= 0\end{aligned}$$

This is, again, different to an econometrician, for whom the covariance is $-\sigma^2_{\epsilon,t}$. The rational agent in the model learns about $\sigma_{\epsilon,t}$.

The serial covariance of expeced income growth across two periods are

$$\begin{aligned}&Cov^*(E_{t-1}(\Delta y_t), E_t(\Delta y_{t+1})) = \\ &= Cov^*(E_{t-1}(\theta_t + \epsilon_t - \epsilon_{t-1}), E_t(\theta_{t+1} + \epsilon_{t+1} - \epsilon_t)) \\ &= 0\end{aligned}$$

A Little Complication due to the Structure of SCE

- The earning growth asked is from m to $m + 12$.
- The survey is asked each month.

A Simple Example with Half-year Surveys of Annual Earning Growth

Earning in year t is a summation of half-year earning.

$$y_t = y_{t'} + y_{t''}$$

The YoY growth of income is below

$$\begin{aligned}
\Delta y_{t''+1} &= y_{(t+1)'} + y_{(t+1)''} - y_{t'} - y_{t''} \\
&= p_{(t+1)'} + \epsilon_{(t+1)'} + p_{(t+1)''} + \epsilon_{(t+1)''} - p_{t'} - \epsilon_{t'} - p_{t''} - \epsilon_{(t)''} \\
&= \theta_{(t)''} + \theta_{(t+1)'} + \theta_{(t+1)''} + \theta_{(t+1)'} + \epsilon_{(t+1)'} + \epsilon_{(t+1)''} - \epsilon_{t'} - \epsilon_{t''} \\
&= \theta_{t''} + 2\theta_{(t+1)'} + \theta_{(t+1)''} + \epsilon_{(t+1)'} + \epsilon_{(t+1)''} - \epsilon_{t'} - \epsilon_{t''}
\end{aligned}$$

The middle-year-on-middle-year income growth is

$$\begin{aligned}
\Delta y_{(t+1)'+1} &= y_{(t+1)''} + y_{(t+2)'} - y_{(t+1)'} - y_{t''} \\
&= p_{(t+1)''} + \epsilon_{(t+1)''} + p_{(t+2)'} + \epsilon_{(t+2)'} - p_{(t+1)'} - \epsilon_{(t+1)'} - p_{t''} - \epsilon_{t''} \\
&= \theta_{(t+1)''} + \theta_{(t+1)'} + \theta_{(t+1)''} + \theta_{(t+2)'} + \epsilon_{(t+1)''} + \epsilon_{(t+2)'} - \epsilon_{(t+1)'} - \epsilon_{t''} \\
&= 2\theta_{(t+1)''} + \theta_{(t+1)'} + \theta_{(t+2)'} + \epsilon_{(t+1)''} + \epsilon_{(t+2)'} - \epsilon_{(t+1)'} - \epsilon_{t''}
\end{aligned}$$

Then for each individual i at t'' and $(t+1)''$ are respectively:

$$Var^*_{i,t''}(\Delta y_{i,t''+1}) = 2\sigma^2_{\theta,(t+1)'} + \sigma^2_{\theta,(t+1)''} + \sigma^2_{\epsilon,(t+1)'} + \sigma^2_{\epsilon,(t+1)''}$$

$$Var^*_{i,(t+1)'}(\Delta y_{i,(t+1)'+1}) = 2\sigma^2_{\theta,(t+1)''} + \sigma^2_{\theta,(t+2)'} + \sigma^2_{\epsilon,(t+1)''} + \sigma^2_{\epsilon,(t+2)'}$$

From end of t'' (end of year t) to the end of $(t+1)'$ (middle of the year $t+1$), the realization of $\theta_{(t+1)'}$ and $\epsilon_{(t+1)'}$ reduces the variance.

Besides, the econometricians have access to following two cross-sectional moments.

$$Var(\Delta y_{i,t''+1}) = \sigma^2_{\theta,t''} + 2\sigma^2_{\theta,(t+1)'} + \sigma^2_{\theta,(t+1)''} + \sigma^2_{\epsilon,(t+1)'} + \sigma^2_{\epsilon,(t+1)''} + \sigma^2_{\epsilon,t'} + \sigma^2_{\epsilon,t''}$$

$$\begin{aligned}
Cov(\Delta y_{i,(t-1)''+1}, \Delta y_{i,t''}) = Cov(&\theta_{(t-1)''} + 2\theta_{t'} + \theta_{t''} + \epsilon_{t'} + \epsilon_{t''} - \epsilon_{(t-1)'} - \epsilon_{(t-1)''}, \\
&\theta_{t''} + 2\theta_{(t+1)'} + \theta_{(t+1)''} + \epsilon_{(t+1)'} + \epsilon_{(t+1)''} - \epsilon_{t'} - \epsilon_{t''}) \\
= \sigma^2_{\theta,t''} - (&\sigma^2_{\epsilon,(t+1)'} + \sigma^2_{\epsilon,t''})
\end{aligned}$$

$$Cov(\Delta y_{i,t''+1}, \Delta y_{i,(t+1)''}) = \sigma^2_{\theta,(t+1)''} - (\sigma^2_{\epsilon,(t+2)'} + \sigma^2_{\epsilon,(t+1)''})$$

The rational expectation assumption also gives following moment restrictions

$$Cov^*_{t''}(\Delta y_t, \Delta y_{t+1}) = 0$$

Standing at any point of the time, for the rational agent, the Δy_t is realizated already. So it should have zero covariance with income growth in future.

This is again, different from the econometrician's problem.

Reference

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