What Accounts for the Growing Fluctuations in Family Income in the US?

Peter Gottschalk and Sisi Zhang

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Variance of transitory log earnings grew primarily in 1970’s and early 1980’s.
Variance of transitory log family income grew throughout the period.

Figure 5
Transitory Variance of Log Annual Family Income, by Year
Question and Objective

**Question addressed**–

- What accounts for the differences in recent trends in the variance of earnings and family income?
- Do these changes reflect changes in
  - permanent income (i.e. non-mean reverting changes)
  - transitory changes in income (i.e. mean reverting)
Objective
Provide consistent links between family income instability and instability of income components

- Studies of family income instability are implicitly studies of changes in the joint distribution of income components $j = 1..J$:

$$y = \sum y_j,$$

$$f(y_1...y_J) \text{ is pdf of joint distribution}$$

- Studies of individual components focus on the marginal distribution of each component
Overview of Presentation

1 Background
   1 Why do we care about income instability?
   2 What do these considerations imply about the income source?

2 Methodology
   1 Intuition of source of identification
   2 Relationship between the joint distribution of income sources and the variance of the log family income?
   3 Methods to identify and estimate permanent and transitory components of individual sources of income
   4 Method to aggregate up to the permanent and transitory components of family income

3 Data

4 Findings

5 Conclusions
Implicit normative basis for interest in changes in variability of income and implied income concept

1. Risk aversion
   1. Friedman’s (1957) classic permanent income hypothesis
   2. Aversion to fluctuations in family income
      1. No aversion to fluctuations in earnings that are offset costlessly
      1. Blundell et al. – considerable consumption smoothing takes place in response to transitory shocks
Aversion to inequality

1. Yearly or lifetime depends on ability to save or borrow
   - If lifetime then no aversion to transitory fluctuations
2. Aversion to fluctuations in family income
   - No aversion to fluctuations in earnings that are offset by transfers
Preference for mobility

1 Increases in transitory fluctuations are a source of mobility

2 Shorrocks measure of mobility
3 Origin independence implies preference for fewer observations on diagonal of transition matrix

2 If rank reversal is preferred then aversion to increases in the variance of the permanent component

3 Income concept is again family income
1. Understand the source of changes in the distribution of earnings

2. Almost all explanations are implicitly about changes in the variance of the permanent component
   1. Skill bias technological change
   2. Immigration
   3. Changes in institutions

3. Explanations for transitory very different
   1. Changes in job transitions
   2. Changes in unemployment dynamics
Intuition

- Permanent component causes income to be correlated across time.
- Transitory component does not, if the lag is sufficiently long for auto-correlated errors to die off.
- So the permanent component is identified by sufficiently far off diagonal elements of the covariance matrix.
Intuition

Consider two extreme cases

**Case A**

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<td>1.44</td>
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</tbody>
</table>

1 The variance of total income changes on the diagonal,

so the variance of either permanent or transitory income had to have changed

2 Since "long"covariances are zero, the variance of permanent income is zero

3 Therefore changes in cross-sectional variance reflects changes in variance of transitory income.
Intuition

Case B

\[
\begin{array}{ccccccc}
\text{t} & 1 & 2 & \ldots & 11 & 12 & 13 \\
1 & 1.0 & 1.2 & 1.3 & 1.3 & 1.2 \\
2 & 1.44 & 1.56 & 1.56 & 1.44 \\
\ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots \\
11 & & 1.69 & 1.69 & 1.56 \\
12 & & & 1.69 & 1.56 \\
13 & & & & 1.44 \\
\end{array}
\]

- The variance went up and then back down as in Case A
- But the covariances are not zero and changed along with the variances.
  - This implies that the variance of permanent income changed
  - What is not so obvious is that the cross sectional variance reflects only permanent variance
  - If \( \rho(y_{it}y_{is}) = 1 \) then \( \sigma(y_{it}y_{is}) = \sigma(y_{is}) \sigma(y_{is}) \), which is satisfied
The covariances are same as in Case B
But the variances are now higher .
Subtract the variance in B from the variance in C to get the variance of the transitory component
**Summary of intuition**

- Long covariances give the needed information to identify the variance of permanent income.
- The variance of the transitory component is the additional to total variance.
Methods for Single Source of Income

A bit more formally, let

\[ Y_{it}^k = \tilde{Y}_t^k + \varepsilon_{it}^k \]  
\[ \varepsilon_{it}^k = \alpha_t^k \mu_i^k + \beta_t^k \nu_{it}^k \]

- \( \tilde{Y}_t^k \) is the conditional mean log income from source \( k \).
- \( \varepsilon_{it}^k \) is the person specific error component.
- \( \beta_t^k \nu_{it}^k \) is the transitory (i.e. mean reverting) component.
- \( \alpha_t^k \mu_i^k \) is the permanent (i.e. non-mean reverting) component.

Implied variances and covariances of \( \varepsilon_{it} \)

\[ \sigma_{\varepsilon_{it}}^2 = \alpha_t^2 \sigma_\mu^2 + \beta_t^2 \sigma_\nu^2 \]  
\[ \sigma_{\varepsilon_{it},\varepsilon_{is}} = \alpha_t \alpha_s \sigma_\mu^2 + \beta_t \beta_s \sigma_{\nu \nu} \]
Methods for Single Source of Income Estimation

Estimation methods

#1–Parametric Statistical Model

1. Make assumptions about time series properties of $\mu_{it}$ and $v_{it}$

2. Use GMM to estimate parameters of the model using all $T(T+1)/2$ covariances

#2–Smoothing method

1. Moving window

2. Permanent component—variance of individual mean incomes

3. Transitory component—variance of deviations around individual means
Methods for Single Source of Income

Estimation

3–Semi-parametric method—what we use in this paper

- No restrictions on time series properties of $\mu_{it}$ and $\nu_{it}$

Estimation

1. Use sufficiently long lags to eliminate transitory component (i.e. $\sigma_{\nu_t\nu_s} = 0$). So

$$
\sigma_{\varepsilon_{it}, \varepsilon_{is}} = \alpha_t \alpha_s \sigma^2_{\mu} + \beta_t \beta_s \sigma_{\nu_t\nu_s}
$$

reduces to

$$
\sigma_{\varepsilon_{it}, \varepsilon_{is}} = \alpha_t \alpha_s \sigma^2_{\mu}
$$

2. Take logs

$$
\ln (\sigma_{\varepsilon_t, \varepsilon_s}) = \ln \sigma^2_{\mu} + \ln \alpha_t + \ln \alpha_s
$$

3. Minimize distance between empirical and theoretical covariances

$$
\min \left( \ln(s_{\hat{\varepsilon}_t, \hat{\varepsilon}_s}) - \left( \ln \sigma^2_{\mu} + \ln \alpha_t + \ln \alpha_s \right) \right)^2
$$
Rewrite as the projection

$$\ln(s_{\hat{t}, \hat{s}}) = \ln \sigma^2 + \ln \alpha_t + \ln \alpha_s + \epsilon$$  \hspace{1cm} (11)

The parameters ($\sigma^2$ and $\alpha' s$) are obtained from the regression

$$\ln(s_{\hat{t}, \hat{s}}) = \gamma_0 + \sum_{j=1}^{T} \gamma_s D_s + \epsilon$$ \hspace{1cm} (12)

since $E(\hat{\gamma}_0) = \ln \sigma^2$ and $E(\hat{\gamma}_j) = \ln \alpha_j$

Recover transitory component as difference between total and permanent variances
Methodology for Multiple Sources of Income

Variance of ln family income

Variance log family income is a nonlinear function of variances and covariances of subcomponents of log income. Using Taylor series it can be shown that

\[
\sigma^2(Y^k_t) \approx \sum_{k=1}^{K} \left[ \left( \frac{E(y_k)}{E(Y_T)} \right)^2 \sigma^2(Y^k_t) + \sum_{l=1}^{K} \left( \frac{E(y_k)E(y_l)}{(E(Y_T))^2} \right) \sigma(Y^k_t, Y^l_t) \right]
\]

(13)

- \( y_k \) – income from source \( k \)
- \( Y^k_t \) – log income from source \( k \)
- \( \frac{E(y_k)}{E(Y_T)} \) – mean of source \( k \) relative to total income
- \( \sigma^2(Y^k_t) \) – variance of log income from source \( k \)

So \( \sigma^2(Y^k_t) \) depends on full covariances structure across sources
Consider two income sources ($k = m, f$) and two periods.

\begin{align*}
Y_{it}^m &= \alpha_t^m \mu_i^m + \beta_t^m v_{it}^m \\
Y_{it}^f &= \alpha_t^f \mu_i^f + \beta_t^f v_{it}^f
\end{align*}

(14) (15)

Implies the following $4 \times 4$ covariance matrix

\begin{align*}
&\begin{array}{c|c|c|c}
Y_{it}^m & Y_{it}^m & Y_{it}^f & Y_{it}^f \\
\hline
Y_{it}^m & \alpha_{mt}^2 \sigma_{\mu m}^2 & \alpha_{mt} \alpha_{ms} \sigma_{\mu m}^2 & \alpha_{mt} \alpha_{ft} \sigma_{\mu}^2 (fm) & \alpha_{mt} \alpha_{fs} \sigma_{\mu}^2 (fm) \\
Y_{it}^m & \alpha_{ms} \sigma_{\mu m}^2 & \alpha_{ms} \sigma_{\mu}^2 (fm) & \alpha_{ms} \alpha_{ft} \sigma_{\mu}^2 (fm) & \alpha_{ms} \alpha_{fs} \sigma_{\mu}^2 (fm) \\
Y_{it}^f & \alpha_{ft}^2 \sigma_{\mu f}^2 & \alpha_{ft} \sigma_{\mu f}^2 & \alpha_{ft} \alpha_{fs} \sigma_{\mu f}^2 \\
Y_{it}^f & \alpha_{fs} \sigma_{\mu f}^2 & \alpha_{fs} \sigma_{\mu f}^2 \\
\end{array}
\end{align*}

The $2 \times 2$ sub-matrix in upper right gives the correlations in income sources that also affect the variance of log family income.
Data

Panel Study of Income Dynamics (PSID)

- Income year 1970-2004 (skipped interview every other year after 1996)

Sample

- Families with male household heads age 20-59
- Exclude over-sampled (SEO, Latino)
- Trim 1% from top and bottom of marginal distributions of each income source in each year
Steady increase in variance of total income reflects continued increase in both permanent and transitory variance.
Male Head Earnings— Increase in total and transitory variances concentrated in 1970’s and early ’80’s
Spouses earnings—Continued increase in variance of total family income can’t be explained by spousal earnings since both total and transitory variances decline.
Trend in Marginal Distribution of Other Income

- Other income—Large increase in both total and transitory variances starting in the mid-1980’s (note scale) Recent decline in transitory variance.

[Graph showing trend in marginal distribution of other income with years from 1970 to 2004 on the x-axis and variance on the y-axis. The graph includes lines for total variance, permanent variance, transitory variance, and a polynomial fit for transitory variance.]
The covariance between the transitory earnings of heads and spouses increased over the recent period.

- This rising covariance is consistent with a decline in the ability to share risk and an increase in instability of family income.
The increase in the positive covariance between head’s earnings and other transitory income also contributed to the increase in family income instability.
Relative Importance of Changes in Variances and Covariances

- Use the approximation to the variance of log family income shown earlier to estimate the partial impact of changes in the variances and covariances

$$\Delta \sigma^2(Y^T) \approx \left( \frac{\bar{y}_1}{\bar{y}_T} \right)^2 \Delta \sigma^2(Y^1)$$ (16)

To reduce impact of noise $\Delta$ is defined by the change in variances (or covariances) averaged over 3 years

- Summing across impact of all variances and covariances will not exactly match observed change in variance log family income because
  - Approximation holds only in limit
  - Variances and covariances require samples of positive income from those source
  - Trimming eliminates different sample members
Relative Importance of Changes at Intensive Margin

Impact of Changes in Transitory Income Components on the Variance of Transitory Family Income
Relative Importance of Changes at Intensive Margin
Conclusions and Next Steps

Conclusions

- Transitory variance of head’s earnings stopped growing in mid-1980’s while family income instability continued to rise
- Largely a result of increases in covariances in transitory across income sources

Next Steps

- Estimate covariance structure of the extensive margin
- Bound potential selection effects (much harder)