On the Covariance Structure of Earnings and Hours Changes

Econometrica 1989

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Reading Group

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What is the contribution of this paper?

- Present an empirical analysis of individual earnings and hours data from three different longitudinal surveys.
- Catalog the main features of the covariance structure of earnings and hours changes and find that this structure is very similar across data sets and may be adequately summarized by a simple components-of-variance model.
- The results are not favorable to the life-cycle labor supply model: most of the covariation of earnings and hours occurs at fixed hourly wage rates.

The three data sets

- PSID
  - Males 1969-1979
  - Males 1969-1979 SEO(Survey of Economic Opportunity) excluded
- NLS (National Longitudinal Survey) of Men 45-49
- SIME/DIME (the nonexperimental families in the Seattle and Denver Income Maintenance Experiment)

The covariance structure of earnings and hours changes

Table IV contains the experience-adjusted covariances and correlations of changes in the logarithms of annual earnings ($\Delta \log g$) and annual hours ($\Delta \log h$) for the overall sample of household heads from the PSID.

- The first-order autocovariances of changs in earnings and hours are negative. The average covariance of consecutive changes in earnings is -0.06. The average first-order autocovariance of the change in hours is -0.061.
- Contemporaneous changes in earnings and hours are significantly positive correlated. The average covariance is 0.073.
- The absence of any large or statistically significant covariances at lags greater than two years. This suggests that changes in earnings and changes in hours may be adequately summarized by a (possibly nonstationary) bivariate MA(2) processes.

Absence of permanent individual components of variance

- Individual-specific trends in the growth rates of earnings and hours imply

$$
\begin{aligned}
\Delta \log \tilde{g}_{it} &= \phi_{1i} + \varepsilon_{1it} \\
\Delta \log \tilde{h}_{it} &= \phi_{2i} + \varepsilon_{2it}
\end{aligned}
$$

  where ϕ_{1i} and ϕ_{2i} are the individual-specific growth rates of earnings and hours.

- These equations imply

$$
\begin{aligned}
cov[\Delta \log \tilde{g}_{it}, \Delta \log \tilde{g}_{is}] &= var[\phi_{1i}] + cov[\varepsilon_{1it}, \varepsilon_{1is}] \\
cov[\Delta \log \tilde{h}_{it}, \Delta \log \tilde{h}_{is}] &= var[\phi_{2i}] + cov[\varepsilon_{2it}, \varepsilon_{2is}] \\
cov[\Delta \log \tilde{g}_{it}, \Delta \log \tilde{h}_{is}] &= cov[\phi_{1i}, \phi_{2i}] + cov[\varepsilon_{1it}, \varepsilon_{2is}]
\end{aligned}
$$

- The evidence that higher-order autocovariances of earnings and hours changes are jointly equal to zero, however, suggests

$$
var[\phi_{1i}] = 0 \qquad var[\phi_{2i}] = 0
$$

Alternative I-Pure measurement error model

- Assume that the measurement error in reported earnings and hours consists of permanent individual effects together with purely transitory unsystematic measurement error (u_{it} and v_{it})

$$\begin{aligned} \Delta \log \tilde{g}_{it} &= \Delta u_{it} \\ \Delta \log \tilde{h}_{it} &= \Delta v_{it} \end{aligned}$$

- The model implies the covariance structure

$$cov[\Delta \log \tilde{g}_{it}, \Delta \log \tilde{g}_{is}] = \begin{cases} 2\sigma_u, & t = s, \\ -\sigma_u, & |t-s| = 1, \\ 0, & |t-s| > 1; \end{cases}$$

- The data suggests two reasons that the pure measurement error model fails. The first is that first-order autocorrelations of earnings and hours are all less than $\frac{1}{2}$ in absolute value. The second reason is that the covariance structure of earnings and hours changes is far from time stationary.

Alternative II-a two-component model

- Add a single common component of variance of earnings and hours

$$
\begin{aligned}
\Delta \log \tilde{g}_{it} &= \mu \Delta z_{it} + \Delta u_{it} \\
\Delta \log \tilde{h}_{it} &= \Delta z_{it} + \Delta v_{it}
\end{aligned}
$$

  Suppose that Δz_{it} follows an unrestricted second order moving average process.

- The model implies the covariance structure

$$
cov[\Delta \log \tilde{g}_{it}, \Delta \log \tilde{g}_{is}] = \begin{cases} \mu^2 var[\Delta z_{it}] + 2\sigma_u, & t = s, \\ \mu^2 cov[\Delta z_{it}, \Delta z_{is}] - \sigma_u, & |t-s| = 1, \\ \mu^2 cov[\Delta z_{it}, \Delta z_{is}], & |t-s| = 2, \\ 0, & otherwise; \end{cases}
$$

Three implications of a two-component model

- First, provided that $cov[\Delta z_{it}, \Delta z_{it-1}] > 0$, the first order autocorrelations of changes in earnings and hours are all between $-\frac{1}{2}$ and 0.
- Second, if $\mu > 0$ and $cov[\Delta z_{it}, \Delta z_{it-1}] > 0$, the raio

$$\frac{cov[\Delta \log \tilde{h}_{it}, \Delta \log \tilde{g}_{it-j}]}{cov[\Delta \log \tilde{h}_{it}, \Delta \log \tilde{g}_{it}]}$$

  is between $-\frac{1}{2}$ and 0 for $j = 1, -1$.
- Third, the cross-covariance function of earnings and hours is symmetric

$$cov[\Delta \log \tilde{g}_{it}, \Delta \log \tilde{h}_{it-s}] = cov[\Delta \log \tilde{g}_{it}, \Delta \log \tilde{h}_{it+s}]$$

- All four samples povide substantial evidence against the two-component specification.

Alternative III-a three-component model

- To relax the stationarity restriction in the variances of earnings and hours over time, the authors add a transitory component

$$\begin{aligned} \Delta \log \tilde{g}_{it} &= \mu \Delta z_{it} + \Delta u_{it} + \varepsilon_{1it} \\ \Delta \log \tilde{h}_{it} &= \Delta z_{it} + \Delta v_{it} + \varepsilon_{2it} \end{aligned}$$

- The goodness-of-fit test statistics give only mild evidence of departure from the three-component structure.
- The authors conclude that this model gives a reasonable representation of the covariance structure of experience-adjusted earnings and hours changes for all four samples.

Implication of the estimates

- For four samples, the estimates of μ are not significantly different from 1. This suggests that the convariance of earnings and hours arises from changes in hours at fixed hourly wage rates, leading to proportional changes in earnings.

A life-cycle labor supply model

- The labor supply equation

$$\log h_{it} = a_{it} + \eta \log \theta_{it} + \eta \log \lambda_{it}$$

where h_{it} represents the hours choice of individual i in period t, a_{it} is an intercept shift associated with individual and time-period specific preference variation, θ_{it} represents the (unobservable) hourly wage rate, λ_{it} represents the marginal utility of consumption, and η represents the intertemporal substitution elasticity.

- Labor earning equation

$$\log g_{it} = a_{it} + (1 + \eta) \log \theta_{it} + \eta \log \lambda_{it}$$

whre g_{it} represents the earnings of individual i in period t.

- One possible interpretation of the data is that the shared component of earnings and hours variation is mainly preference variation which enters with equal factor loadings in earnings and hours. The life-cycle labor supply model is vacuous: movements in earnings and hours restricted by the theory are empirically negligible.

The othe two possible interpretations

- Earnings differ systematically from the level implied by the life-cycle labor supply model because of long term contracts between firms and workers.
- A third interpretation is that individual wage rates are essentially fixed, and that proportional movements in earnings and hours occur because of changes in the demand for individual labor services.