Hours Risk, Wage Risk, and Life-Cycle Labor Supply

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Motivation

- Given risk averse agents, riskiness of consumption is strictly welfare decreasing.
- Main cause of consumption uncertainty is (labor) income uncertainty.
- What can be done to mitigate consumption uncertainty?
  - Consumption insurance / Self insurance (Hall, 1978; Blundell et al., 2008).
  - **Reduction of labor income risk**
- This is why we need to understand its sources:
  - Hourly wage: main focus of the current literature
    - loss/gain of human capital
    - technological change
  - Work hours :
    - care for the elderly or children
    - health shocks
    - taste shocks

Research Question

- How big are the shares of earnings growth risk driven by
  1. hours shocks
  2. wage shocks
- How important are permanent and transitory components?
  - **NOTE:** The impact of wage shocks includes their impact on hours.
  - This depends on the degree of insurance against wage shocks (e.g., through labor supply and savings reactions).
- What is the Marshallian elasticity of labor supply?

Focus: Married males. For them the intensive margin is more important than the extensive margin.

Methodology

- Obtain wage and hours residuals by OLS and IV respectively.
- Estimate variance process of wage residuals.
- Use moment conditions from the labor supply model to disentangle hours shocks from labor supply reactions to permanent wage shocks.
- Estimate parameter of transmission of permanent shocks to the marginal utility of wealth (related to the consumption-insurance parameter).

→ can be used with an estimate for the Frisch elasticity (from IV) to calculate the Marshall elasticity.

Literature Review - 1

- Closely related papers: Alan et al. (forthcoming); Blundell et al. (2008, 2016), Heathcote et al. (2014)
- Those studies only consider wage shocks
- Heathcote et al. (2014): Only incorporate completely insured or uninsured shocks
- Blundell et al. (2008, 2016); Alan et al. (forthcoming): Estimate partial insurance parameter via correlation of income shocks with consumption.
- In contrast, we use the structure of the labor supply model to estimate the insurance parameter using income and labor supply data alone.

The Model: Utility

Our model usses a separable CRRA in-period utility function, where b_t is a taste-shifter for the disutility of labor.

$$\mathrm{v}_t = \frac{c_t^{1-\vartheta}}{1-\vartheta} - b_t \frac{h_t^{1+\gamma}}{1+\gamma}, \qquad \vartheta \geq 0, \gamma \geq 0. \tag{1}$$

Then b can be decomposed into an observable and an idiosyncratic component:

$$b_t = \varsigma \Xi_t + \upsilon_t \tag{2}$$

We model hours shocks as shocks to υ_t.

The Model: Labor Supply

The standard life-cycle model of consumption and labor supply with this in-period utility function yields the following structural labor supply equation (MaCurdy, 1981; Altonji, 1986):

$$\Delta \ln h_t = \frac{1}{\gamma}\left[-\left(\ln(1+r_{t-1}) + \ln\rho\right) + \Delta \ln w_t - \varsigma \Delta \Xi_t + \boldsymbol{\eta_t} + \boldsymbol{\Delta \upsilon_t}\right] \tag{3}$$

- $\frac{1}{\gamma}$ is the Frisch elasticity of labor supply
- w are hourly wages, h are hours worked
- Ξ contains taste shifters
- ρ is the discount factor, r is the risk-free real interest rate
- $\boldsymbol{\upsilon}$ is a vector of idiosyncratic shocks
- $\boldsymbol{\eta}$ is a function of the expectation error in the marginal utility of wealth
- $\boldsymbol{\eta}$ turns negative for a positive permanent wage shock.
- We want to separate $\boldsymbol{\eta}$ from $\boldsymbol{\upsilon}$!

The Model: Wages

$$\Delta \ln w_t = \theta \Delta X_t + \Delta \omega_t \tag{4}$$

Log labor income is given by

$$\Delta \ln y = \Delta \ln w + \Delta \ln h \tag{5}$$

- X is a matrix of human-capital variables
- ω is a vector of idiosyncratic shocks, which are i.i.d.

Stochastic Process

Wage and hours shocks follow the same process. For $x \in \{\upsilon, \omega\}$:

$$
\begin{aligned}
x_t &= p_t^x + \tau_t^x \\
p_t^x &= p_{t-1}^x + \zeta_t^x \\
\tau_t^x &= \theta_x \epsilon_{t-1}^x + \epsilon_t^x \\
\zeta_t^x &\sim N\left(0, \sigma_{\zeta,x}^2\right), \quad \epsilon_{it}^x \sim N\left(0, \sigma_{\epsilon,x}^2\right) \\
E\left[\zeta_t^x \zeta_{t-l}^x\right] &= 0, \quad E\left[\epsilon_t^x \epsilon_{t-l}^x\right] = 0 \quad \forall l \in \mathbb{Z}_{\neq 0}
\end{aligned}
$$

- For wage shocks, all parameters $\left(\theta_j, \sigma_{\epsilon^j}^2, \sigma_{\zeta^j}^2\right)_{j \in \{u, \upsilon\}}$ are identified through combinations of the autocovariance moments of the shock terms (Hryshko, 2012).
- The *transitory* hours shock process is estimated in the same way.
- Only *permanent* shocks impact the marginal utility of wealth.

The Transmission of Shocks

The expectation error for shocks to marginal utility of wealth is a linear function of the permanent shocks. (Consistent with life-time budget constraint approximation in the vein of Blundell et al. (2008))

$$\eta_t = -\phi_t^\lambda \left(\widehat{\Delta lnh_t^{per}} + \widehat{\Delta lnw_t^{per}} \right), \quad \ln \phi_t^\lambda \sim N\left(\mu_\phi, \sigma_\phi^2\right), \tag{6}$$

where $\widehat{\Delta lnh_t^{per}}$ and $\widehat{\Delta lnw_t^{per}}$ are the permanent idiosyncratic changes log hours/wages. ϕ_t^λ varies between and within individuals, as it depends on the individual's assets, among other things. Then the idiosyncratic change in hours due to both permanent shock types is:

$$\widehat{\Delta lnh_t^{per}} = \frac{1-\phi_t^\lambda}{\gamma + \phi_t^\lambda}\zeta_t^\omega + \frac{1}{\gamma + \phi_t^\lambda}\zeta_t^\upsilon \tag{7}$$

$\kappa = \frac{1-\phi_t^\lambda}{\gamma+\phi_t^\lambda}$ gives the uncompensated reaction to a permanent wage change, the Marshallian labor supply elasticity.

Consumption growth

- η is directly related consumption growth with factor $\frac{1}{\vartheta}$:

$$\Delta \ln c_t = \frac{1}{\vartheta}\left[\ln(1 + r_{t-1}) + \ln \rho - \eta_t\right] \tag{8}$$

- Theory predicts that ϕ_t^λ is positive. The larger ϕ_t^λ, the harder a permanent shock hits.
- We calibrate the variance of $\ln \phi_t^\lambda$ based on estimates in Alan et al. (forthcoming)

Transmission Diagram

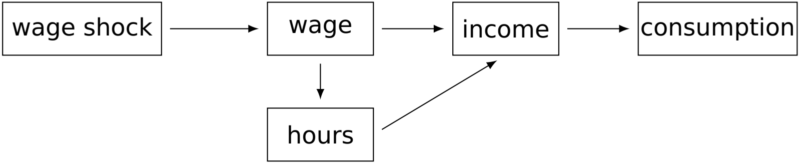


Figure 1: Transmission of Permanent Wage Shock

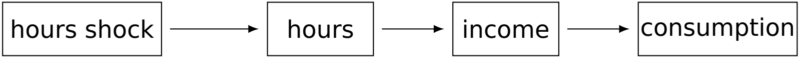


Figure 2: Transmission of Permanent Hours Shock

Data and Instruments

- PSID - Panel Study of Income Dynamics
- Period for years 1971-1996
- Only working males

Table 1: Descriptives

	mean	s.d.
Age	41.35	8.66
Annual hours of work	2220.28	530.11
Hourly wage	26.86	22.83
Number of kids in household	1.64	1.39
N	46340	

Note: Own calculation based on the PSID. Monetary values inflated to 2005 real dollars.

- Instruments for differenced log wage in the labor supply equation:age, education, education^2, age × education, age × education^2, age^2 × education and age^2 × education^2.

Results - AR and Transmission parameters

Table 2: Wage Process

	I	II	III	IV
	Full sample	Age≥40	High educ	No children < 7
θ_ω	0.2701	0.3450	0.2737	0.1832
	(0.0090)	(0.0241)	(0.0325)	(0.0212)
$\sigma_{\epsilon,\omega}$	0.1337	0.1382	0.0772	0.1166
	(0.0017)	(0.0030)	(0.0015)	(0.0025)
$\sigma_{\zeta,\omega}$	0.1770	0.1554	0.1765	0.1639
	(0.0009)	(0.0014)	(0.0007)	(0.0011)
N	46340	20607	19831	24547

Note: Own calculation based on the PSID. Bootstrapped standard errors in parentheses.

Hours Process

Table 3: Hours variances and labor supply elasticity

	I	II	III	IV
	Full sample	Age>=40	High educ	No children <7
θ_{υ}/γ	0.1515	0.4013	0.1140	0.2463
	(0.0039)	(0.0059)	(0.0065)	(0.0053)
$\sigma_{\epsilon,\upsilon}/\gamma$	0.1114	0.0730	0.0709	0.0790
	(0.0011)	(0.0012)	(0.0014)	(0.0012)
$\sigma_{\zeta,\upsilon}/\gamma$	0.1990	0.2102	0.1648	0.1914
	(0.0010)	(0.0327)	(0.0010)	(0.0058)
$1/\gamma$	0.3614	0.4020	0.2851	0.3148
	(0.0856)	(0.3778)	(0.0975)	(0.1080)
$E[\phi_t^{\lambda}]$	1.8918	1.4084	0.5668	0.9565
	(0.1117)	(4.0920)	(0.0436)	(1.2774)
$E[\kappa]$	-0.0767	-0.0023	0.1302	0.0631
	(0.0105)	(0.0254)	(0.0078)	(0.0164)

Note: Own calculation based on the PSID. Clustered standard errors for $1/\gamma$, bootstrapped standard errors for other coefficients in parentheses.

Decompositions

We now decompose idiosyncratic changes in earnings growth as shares due to the four different shock types. We show the results for risk, which only includes the changes unknown at period t. In the paper we do the same exercise for the variance.

$$V\left(\widehat{\Delta \ln y}\middle| I_{t-1}\right) = E\left[\left(\widehat{\Delta \ln y_t} - E\left[\widehat{\Delta \ln y_t}|I_{t-1}\right]\right)^2 \middle| I_{t-1}\right] = \frac{\sigma^2_{\zeta,\upsilon} + (\gamma+1)^2\sigma^2_{\zeta,\omega}}{(\gamma+\phi^{\lambda}_t)^2} + \frac{1}{\gamma^2}\left(\sigma^2_{\epsilon,\upsilon} + (\gamma+1)^2\sigma^2_{\epsilon,\omega}\right) \tag{9}$$

Decomposition of Earnings Risk

Table 4: Decomposition of risk of earnings growth

	I Full sample	II Age>=40	III High educ	IV No children <7
$V\left(\widehat{\Delta \ln y} \middle| I_{t-1}\right)$	0.08	0.0803	0.0731	0.0788
$\sigma_{\epsilon,\omega}$	0.0331	0.0375	0.0098	0.0235
$\sigma_{\zeta,\omega}$	0.0205	0.0194	0.0381	0.0275
$\sigma_{\epsilon,\upsilon}$	0.0124	0.0054	0.005	0.0062
$\sigma_{\zeta,\upsilon}$	0.014	0.018	0.0201	0.0217

Note: Earnings growth risk with ϕ^{λ} set to sample mean. First line: Total earnings risk at mean given by equation (9).
Own calculation based on the PSID.

Impact of shocks on life-time earnings

We perform a quick back of the envelope calculation for the impact of positive permanent shocks on lifetime income. Shocks received at thrity and calculated at the mean of ϕ^{λ}. The end of the life-cycle is at 65.

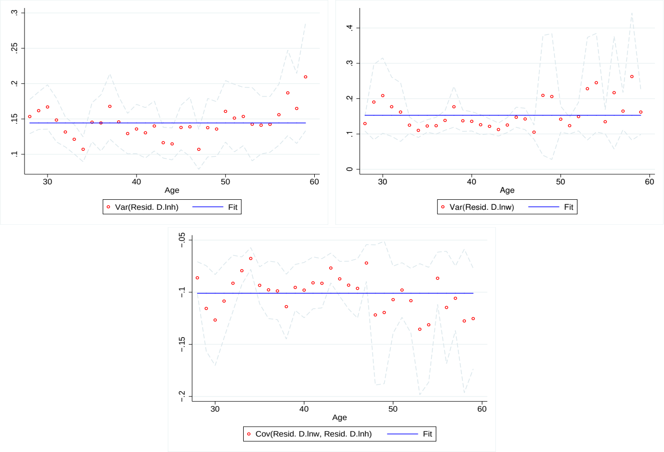
- A positive wage shock of one standard deviation: 150 000 Dollar
- A positive hours shock of one standard deviation: 124 000 Dollar

However at full insurance ($\phi^{\lambda} = 0$)

- A positive wage shock of one standard deviation: 252 000 Dollar
- A positive hours shock of one standard deviation: 208 000 Dollar

Model Fit

Figure 3: Model fit for hours and wage variance as well as their covariance.



Note: Empirical and theoretical variance and covariance moments of residuals obtained from the estimation of equations (10) and (3) for the main sample with bootstrapped 95 percent confidence interval.

Partial Consumption Insurance

We benchmark our estimates of consumption insurance of permanent shocks to those in the literature:

- We assume a ϑ of 2.
- With this calibration a positive permanent wage shock of 1 percent leads to a change in consumption of 0.76 percent.
- Blundell et al. (2008) find a partial insurance parameter of 0.64 with respect to income shocks in their full sample.
  - The firgures are comparable at a Marshallian elasticity close to zero. Then a wage shock and an income shock coincide.

Summary

- We decompose idiosyncratic earnings growth risk into wage and hours shocks.
  - Both hours and wage shocks are quantitatively important.
  - Wage shocks always dominate.
- Permanent wage shocks also dominate the impact on life-time earnings.
- In the paper we show that (permanent) hours shocks are not an artifact of some subsample and improve the fit of the model substantially.
- Overall, the model fits the variance moments across ages quite well.
- The Marshall elasticity is small and negative as in most studies of this kind.

Measurement Error

- Measurement error appears additively in logged variables. For example: $\ln \tilde{x} = \ln x + me_{x,t}$. We calibrate the variance using data from Bound et al. (1994).
- The adjusted equations are:

$$\Delta \ln \tilde{w}_t = \alpha X_t + \Delta \omega_t + \Delta me_{w,t} \tag{10}$$

$$\begin{aligned} \Delta \ln \tilde{h}_t = & \frac{1}{\gamma}\left[-\ln(1+r_{t-1}) - \ln \rho + \Delta \ln \tilde{w}_t - \varsigma \Delta \Xi_t + \eta_t + \Delta \upsilon_t\right] \\ & - \frac{1}{\gamma} \Delta me_{w,t} + \Delta me_{h,t}. \end{aligned} \tag{11}$$

Note that we will have to correct for the measurement error in wages in the hours equation in the second moments of the residuals.

Labor Supply Estimation

Table 5: Frisch Labor Supply Equation Estimation

	I	II	III	IV
	Full sample	Age>=35	High educ	With children
$\Delta \ln(wage)$	0.3614	0.4020	0.2851	0.3148
	(0.0856)	(0.3778)	(0.0975)	(0.1080)
N	46340	20607	19831	24547
Kleibergen and Paap (2006) F stat	18.4680	1.2408	11.7317	11.6739

Note: Own calculation based on the PSID. Clustered standard errors in parentheses.

Decomposition of Earnings Variance

Table 6: Decomposition of variance of earnings growth

	I Full sample	II Age>=40	III High educ	IV No children <7
$V\left(\widehat{\Delta \ln y}\right)$	0.1464	0.1293	0.0857	0.1071
$\sigma_{\epsilon,\omega}$	0.0532	0.0581	0.0158	0.0400
$\sigma_{\zeta,\omega}$	0.0426	0.0326	0.0398	0.0319
$\sigma_{\epsilon,\upsilon}$	0.0216	0.0082	0.0090	0.0100
$\sigma_{\zeta,\upsilon}$	0.0290	0.0304	0.0210	0.0252

Note: Variance of $\widehat{\Delta \ln y}$ when all other shock variances are set to zero.
First line: actual variance of $\widehat{\Delta \ln y}$ given by equation (**??**).
Own calculation based on the PSID.

Alternative Samples

Table 7: Permanent hours shock variances in alternative samples

	I	II	III	IV
	Main	Blue collar	Exclude years 81-82	Only stayers
$\sigma_{\zeta,\upsilon}/\gamma$	0.1990	0.2087	0.2066	0.1918
	(0.0010)	(0.0018)	(0.0025)	(0.0016)
N	46340	38030	40999	35901

Note: Own calculation based on the PSID. Bootstrapped standard errors in parentheses.

Alternative Models

Table 8: AR Hours Estimation in Alternative Models

	I Main Model	II σ_ϕ halved	III $\sigma_{\zeta,\upsilon} = 0$	IV $\sigma_{\zeta,\upsilon} = 0$ & $\sigma_{\epsilon,\upsilon} = 0$
θ_υ/γ	0.1515	0.1515	0.1454	
	(0.0039)	(0.0039)	(0.0013)	
$\sigma_{\epsilon,\upsilon}/\gamma$	0.1114	0.1114	0.1501	
	(0.0011)	(0.0011)	(0.0005)	
$\sigma_{\zeta,\upsilon}/\gamma$	0.1990	0.2116		
	(0.0010)	(0.0026)		
$E[\phi_t^\lambda]$	1.8918	1.4317	2.4705	20.7997
	(0.1117)	(0.0691)	(0.1784)	(3.2642)
$E[\kappa]$	-0.0767	-0.0767	-0.1450	-0.6952
	(0.0105)	(0.0105)	(0.0111)	(0.0093)
$DF(\Theta)$	1.9398×10^{-11}	7.0055×10^{-11}	3.8247×10^{-05}	0.0005

Note: Own calculation based on the PSID. Bootstrapped standard errors in parentheses.

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