

# Can Public Debt Crowd in Private Investment?

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Christian Bayer<sup>1,2</sup>, **Fabio Stohler**<sup>1</sup>

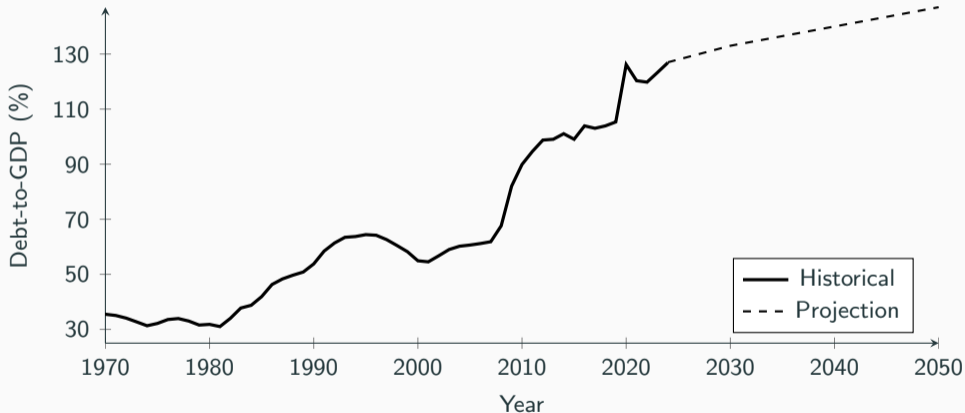
40th meeting of the European Economic Association

<sup>1</sup>University of Bonn

<sup>2</sup>CEPR, CESifo, IZA, ECONtribute

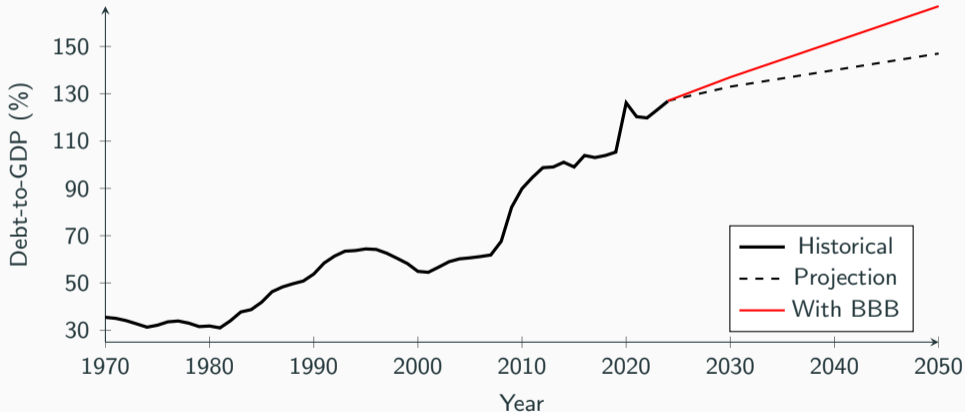
# U.S. public debt has surged and is projected to keep rising

**Figure 1:** U.S. Debt-to-GDP Ratio, Historical Data (FRED) and Projections (EIU, 2025)



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**Crowing out channels:** interest rate & taxes  $\uparrow$   $\rightarrow$  **capital, labor & output**  $\downarrow$

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**What is the net of these effects?**

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- **Theoretical result:** crowding in exists
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  - for large increases crowding in channel disappears
- **Quantitative results:** incorporating crowding out and liquidity channels
  - higher debt can crowd in up to **0.5 percentage points** annual growth
  - welfare increases by **2.5 percentage points** of consumption equivalence

### Interaction of heterogeneity and fiscal policy:

Aiyagari (1995), Heathcote (2005), Challe and Ragot (2010), Krueger and Perri (2011), Kaplan and Violante (2014), McKay and Reis (2016), Bernardino (2020), Brinca et al. (2024), Bayer, Born, and Luetticke (2022), Angeletos, Lian, and Wolf (2024)

### Optimal level of government debt with heterogeneous agents:

Woodford (1990), **Aiyagari and McGrattan (1998)**, Flodén (2001), Röhrs and Winter (2015), Bhandari et al. (2016), **Röhrs and Winter (2017)**, Dyrda and Pedroni (2023), Le Grand and Ragot (2025)

### Background risk and portfolio choice:

Pratt and Zeckhauser (1987), Kimball (1993), Gollier and Pratt (1996), Viceira (2001), Fagereng, Guiso, and Pistaferri (2017), Catherine, Sodini, and Zhang (2024)

# Model

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## Households HH

- obtain income from **idiosyncratic labor**  $w_t h_{it} n_{it}$
- **risk-free** asset income  $R_t a_{it}$  (government debt  $b_{it}$  and capital  $k_{it}$ )
- **risky** equity income  $\pi_t e_{it}$  from holdings of an intermediate goods variety

# Model overview

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## Firms Innovators Production

- innovator produces new varieties at price  $q_t$  resulting in growth
- symmetric interm. firms produce differentiated varieties as monopolists determining  $\pi_t$
- final goods bundler combines capital  $K_t$ , labor  $N_t$ , and varieties  $\mathcal{E}_t = \int_0^1 e_{it} di$

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## Government Details

- supplies **bonds**  $B_t$ , **taxes** households  $\tau_t^L$ , and has **wasteful expenditure**  $G_t$

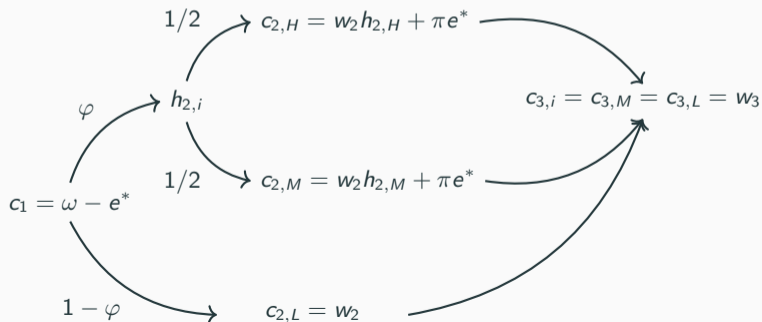
## Proposition

$$\frac{\partial e^*}{\partial B} > 0 \quad \text{and} \quad \frac{\partial V}{\partial B} > 0$$

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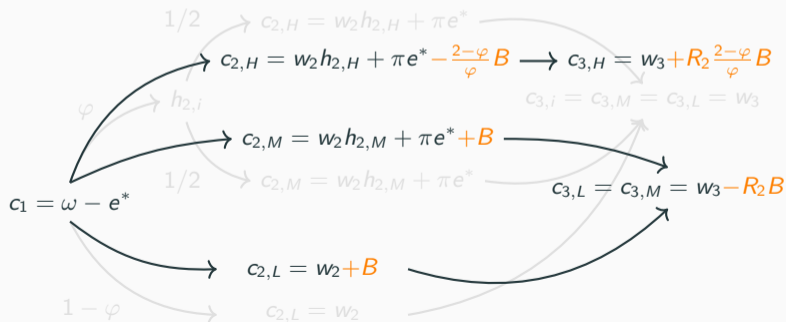
Figure 2: Allocations for  $B = 0$



## Proposition

$$\frac{\partial e^*}{\partial B} > 0 \quad \text{and} \quad \frac{\partial V}{\partial B} > 0$$

Figure 2: Allocations for  $0 < B$



debt increase  $B \uparrow$

- reduces **consumption dispersion**
- reduces effect of labor **income risk**
- allows to take on **investment risk**

## Quantitative Exercise

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Government budget constraint along BGP

$$(r_t - g_t)\tilde{B}_t = \tau_t^L \tilde{w}_t N_t - \tilde{G}_t$$

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alternative preferences, fixed growth rate, illiquid capital

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alternative preferences, fixed growth rate, illiquid capital

**Questions:**

- Does government debt **crowd in** risky investment and growth?
- Does crowding in **compensate classic crowding out** effects?

# Higher debt crowds out labor and capital...

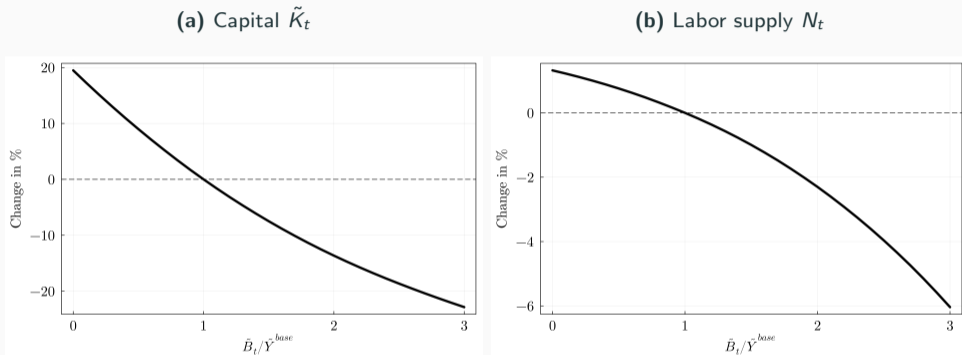


Figure 3: Varying government debt  $\tilde{B}_t$  and adjusting labor income tax  $\tau_t^L$  residually

- higher debt  $\tilde{B}_t \Rightarrow$  higher tax rate  $\tau_t^L \Rightarrow$  **crowding out** of capital  $\tilde{K}_t$  and labor  $N_t$

...but initially crowds in growth and welfare

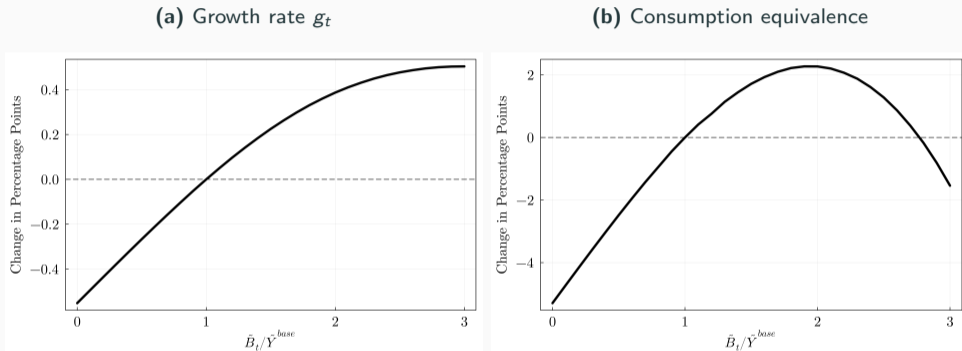
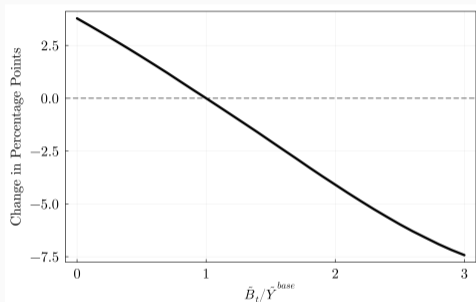


Figure 4: Varying government debt  $\tilde{B}_t$  and adjusting labor income tax  $\tau_t^L$  residually

- debt **crowds in growth** up to 0.5 percentage points annually
- **consumption equivalence rises** by up to 2.5 percentage points

# Debt reduces wealth inequality and stimulates poor households' risky investment

(a) Wealth Gini



(b) Investment change at 200% debt-to-GDP

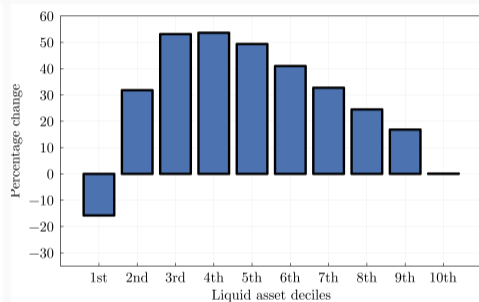
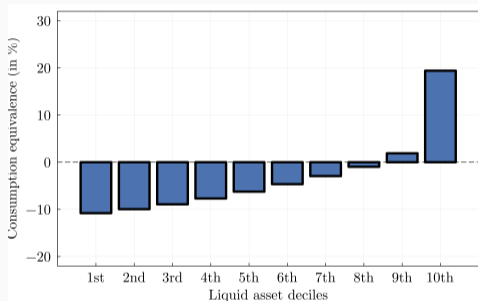


Figure 5: Wealth inequality and relative investment rates

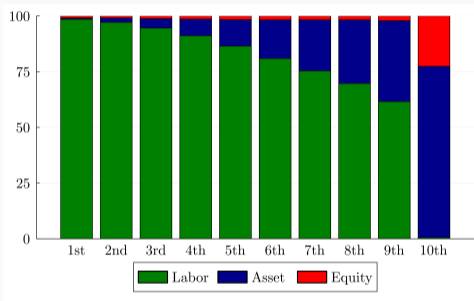
- higher debt **reduces wealth inequality** through risk-free asset accumulation
- households at the lower end of the distribution **invest more** in risky equity

# Highest wealth decile benefits in utility terms due to asset income

(a) CE over wealth deciles at 200% debt-to-GDP



(b) Shares of income sources along wealth deciles

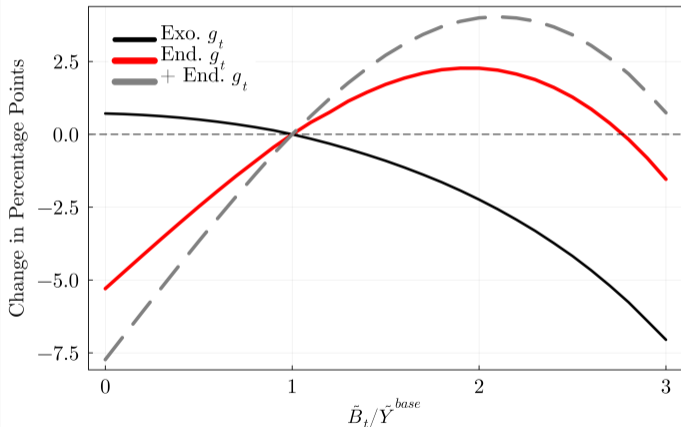


**Figure 6:** Consumption equivalence and income shares along wealth deciles

- **equity holders benefit from  $B \uparrow$**   $\Rightarrow$  crowding in equity investment
- households at the **bottom of the distribution suffer**

# Changing the debt level and adjusting taxes $\tau_t^L$ with fixed growth

Figure 7: Consumption equivalence

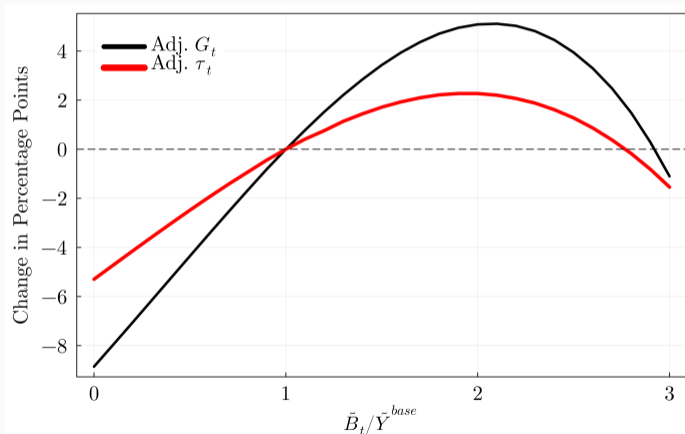


$$(r_t - \bar{g})\tilde{B}_t = \tau_t^L \tilde{w}_t N_t - \tilde{G}_t$$

- lower debt-to-GDP ratio is optimal
- growth essential driver of welfare result

# Changing the debt level and adjusting Government expenditure $G_t$

Figure 8: Consumption equivalence



$$(r_t - g_t)\tilde{B}_t = \tau_t^L \tilde{w}_t N_t - \tilde{G}_t$$

- less crowding out and more crowding in
- higher debt-to-GDP ratio is optimal
- welfare gain at optimal debt-to-GDP ratio larger

## Conclusion

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## Yes! Public debt can crowd in private investment





- Higher debt improves household insurance, crowding in risky investment
- Leads to initially higher growth and welfare before crowding out reverses results
- Endogenous growth is a key driver of welfare effects






**Thank you!**






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# Literature



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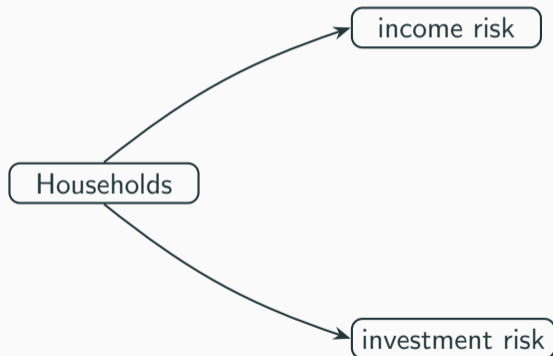
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# Appendix

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Households		Production	Government
Earn Income	Trade Assets	Development and Production of Goods	Fiscal Authority
<p><b>Wages <math>w_t</math></b></p> <ul style="list-style-type: none"> <li>Supply labor <math>N_{it}</math></li> <li>Idiosyncratic risk <math>h_{it}</math></li> </ul> <p><b>Interest <math>R_t</math></b></p> <ul style="list-style-type: none"> <li>Liquid, riskless asset <math>a_{it}</math></li> </ul> <p><b>Profits <math>\pi_{it}</math></b></p> <ul style="list-style-type: none"> <li>From backyard technology <math>i</math></li> <li>with <math>e_{it}</math> number of varieties <math>j</math></li> </ul>	<p><b>Riskless, liquid <math>a_{it}</math></b></p> <ul style="list-style-type: none"> <li>Real, riskless, and liquid asset</li> <li>Borrowing constraint <math>a_{it} \geq \underline{A}</math></li> </ul> <p><b>Risky, illiquid <math>e_{it}</math></b></p> <ul style="list-style-type: none"> <li>Only traded with prob. <math>\lambda</math></li> <li>Irreversible <math>e_{it+1} \geq e_{it} \geq 0</math></li> <li>Fails with prob. <math>1 - \varphi</math></li> <li>Enhances growth <math>g_t</math></li> </ul> <p>⇒ <b>Incomplete Markets</b></p>	<p><b>Intermediate Bundler</b></p> <ul style="list-style-type: none"> <li>Buys differentiated goods <math>Q_{ijt}</math></li> <li>Bundles goods into <math>Q_t</math></li> </ul> <p><b>Final Goods Producer</b></p> <ul style="list-style-type: none"> <li>Use capital <math>K_t</math>, labor <math>N_t</math>, and bundle <math>Q_t</math> to produce <math>Y_t</math></li> </ul> <p><b>Innovator</b></p> <ul style="list-style-type: none"> <li>Produces new varieties <math>\Delta_t</math></li> <li>Sells at price <math>q_t</math> to households</li> </ul> <p>⇒ <b>Endogenous TFP</b></p>	<p><b>Tax &amp; Transfer</b></p> <ul style="list-style-type: none"> <li>Taxes labor and profits <math>\tau^L</math></li> <li>Lump-sum transfers <math>Tr_t</math></li> </ul> <p><b>Liquidity provision</b></p> <ul style="list-style-type: none"> <li>Supplies government bonds <math>B_t</math></li> </ul> <p><b>Govern. consumption</b></p> <ul style="list-style-type: none"> <li>Wasteful government expenditure <math>G_t</math></li> </ul>

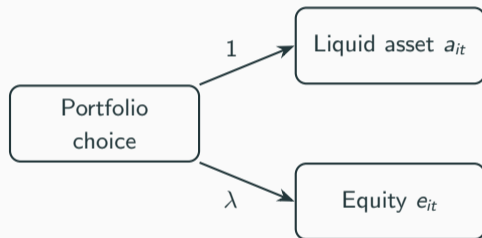
**Figure 9:** Idiosyncratic risk of the household



$$\log h_{it} = \rho_h \log h_{it-1} + \epsilon_t$$

lose all  $e_{it}$  with prob.  $1 - \varphi$

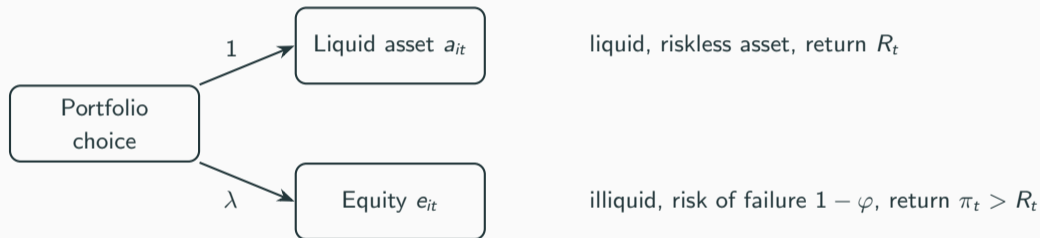
**Figure 10:** Households portfolio problem



liquid, riskless asset, return  $R_t$

illiquid, risk of failure  $1 - \varphi$ , return  $\pi_t > R_t$

**Figure 10:** Households portfolio problem



Tradeoff consumption vs. insurance against risk vs. investment opportunity in  $e_{it}$

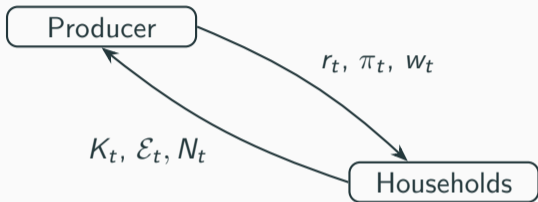
[Details](#)

**Figure 11:** Households interaction with other agents



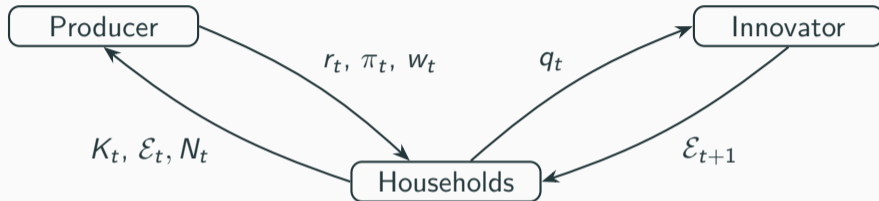
Households

Figure 11: Households interaction with other agents



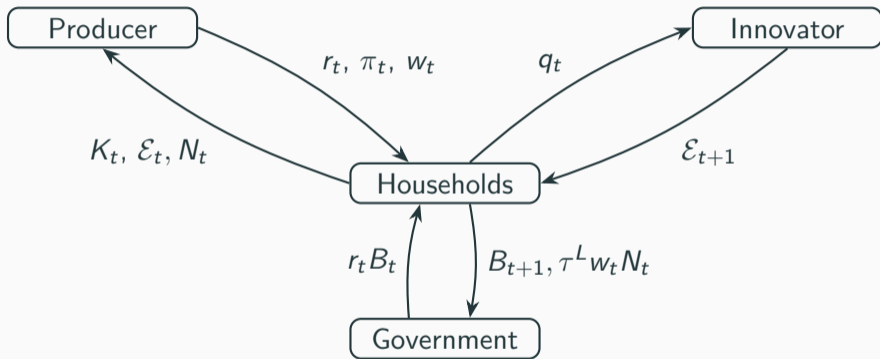
- supply safe asset  $K_t$ , risky asset  $E_t$ , and labor  $N_t$  to firm
- receive interest income  $r_t$ , profits  $\pi_t$ , and wage  $w_t$

Figure 11: Households interaction with other agents



- buy new varieties  $\mathcal{E}_{t+1}$  from innovator at price  $q_t$

Figure 11: Households interaction with other agents



- raises debt  $B_{t+1}$  and collects taxes  $\tau_t^L w_t N_t$
- repays interest cost of debt  $r_t B_t$

- Households solve portfolio problem

$$\text{Cases: } \begin{cases} (1 - \lambda) : & V_t^n(a, e, h) = \max_{c, n, a'} u(c, n) + \beta W(a', e, h) \\ \lambda : & V_t^a(a, e, h) = \max_{c, n, e', a'} u(c, n) + \beta W_{t+1}(a', e', h) \end{cases}$$

$$\text{s.t. } c + a' = aR(a, R_t) + (1 - \tau^L)w_t h n,$$

and  $a' \geq \underline{A}$

- Households solve portfolio problem

Cases: 
$$\begin{cases} (1 - \lambda) : & V_t^n(a, e, h) = \max_{c, n, a'} u(c, n) + \beta W(a', e, h) \\ \lambda : & V_t^a(a, e, h) = \max_{c, n, e', a'} u(c, n) + \beta W_{t+1}(a', e', h) \end{cases}$$

Consumption-saving decision

$$\begin{aligned} \text{s.t. } & c + a' = aR(a, R_t) + \pi e + (1 - \tau^L)w_t h n, \\ & \text{and } a' \geq \underline{A} \end{aligned}$$

with:

$$\begin{aligned} W(a, e, h) = & \varphi \left( \lambda \mathbb{E}_t[V_{t+1}^a(a, e, h')] + (1 - \lambda) \mathbb{E}_t[V_{t+1}^n(a, e, h')] \right) \\ & + (1 - \varphi) \left( \lambda \mathbb{E}_t[V_{t+1}^a(a, 0, h')] + (1 - \lambda) \mathbb{E}_t[V_{t+1}^n(a, 0, h')] \right) \end{aligned}$$

- Households solve portfolio problem

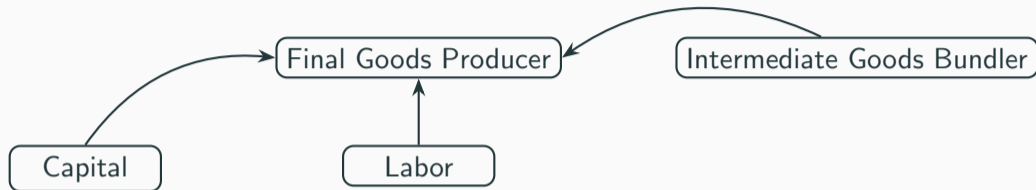
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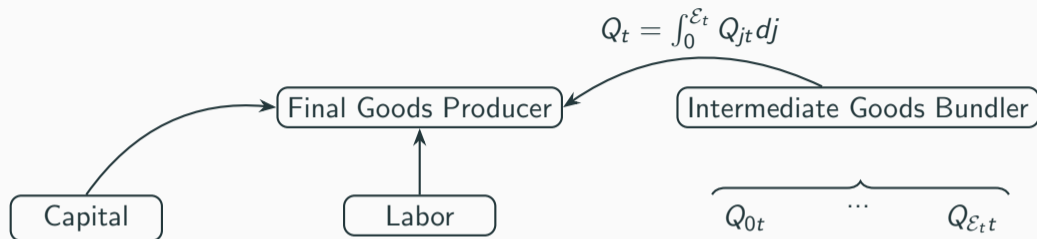
Safe-risky decision

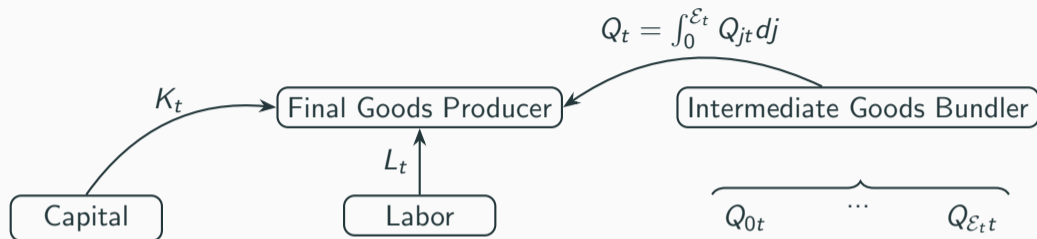
$$\begin{aligned} \text{s.t. } & c + a' + q_t e' = aR(a, R_t) + (q_t + \pi)e + (1 - \tau^L)w_t h n, \\ & \text{and } a' \geq \underline{A} \end{aligned}$$

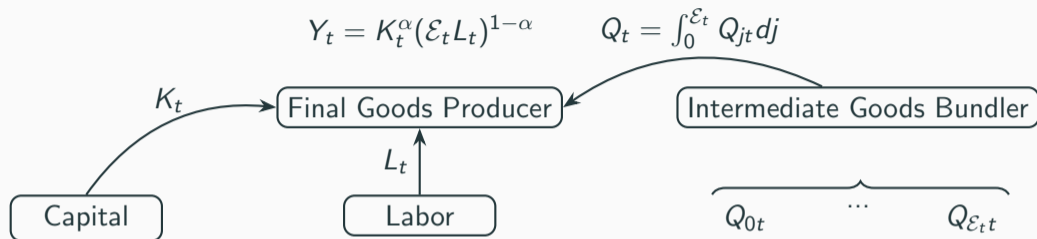
with:

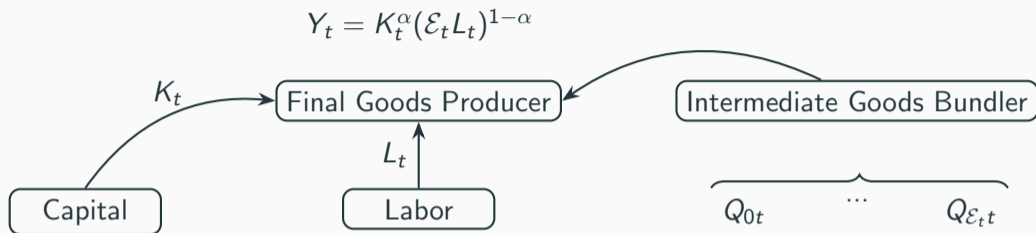
$$\begin{aligned} W(a, e, h) = & \varphi \left( \lambda \mathbb{E}_t[V_{t+1}^a(a, e, h')] + (1 - \lambda) \mathbb{E}_t[V_{t+1}^n(a, e, h')] \right) \\ & + (1 - \varphi) \left( \lambda \mathbb{E}_t[V_{t+1}^a(a, 0, h')] + (1 - \lambda) \mathbb{E}_t[V_{t+1}^n(a, 0, h')] \right) \end{aligned}$$







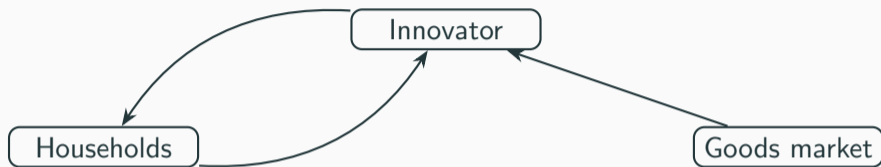


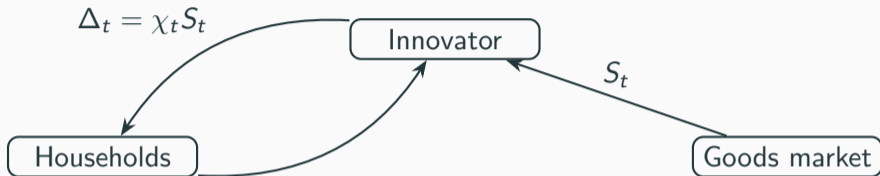


Prices are determined as:

$$r_t + \delta = \phi \alpha \frac{Y_t}{K_t}, \quad w_t = \phi(1 - \alpha) \frac{Y_t}{N_t}, \quad \text{and} \quad \pi_t = (1 - \phi) Y_t.$$

$\alpha$  denotes the capital share in income,  $1 - \phi$  denotes the profit share.  $r_t$ ,  $\delta$ ,  $w_t$ , and  $\pi_t$  represent the interest rate, depreciation, wage rate, and profits

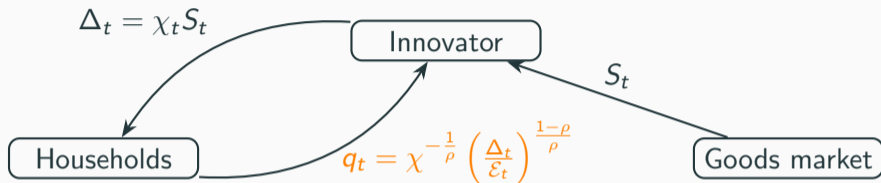




with **externality** as in Comin and Gertler (2006) and Kung and Schmid (2015)

$$\chi_t = \chi \left( \frac{\mathcal{E}_t}{S_t} \right)^{1-\rho}$$

R&D expenditure  $S_t$ , existing varieties  $\mathcal{E}_t$ ,  $\rho$  and  $\chi$  as scalars



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R&D expenditure  $S_t$ , existing varieties  $\mathcal{E}_t$ ,  $\rho$  and  $\chi$  as scalars

**Firms:** produce according to  $Y_t = K_t^\alpha (\mathcal{E}_t N_t)^{1-\alpha}$ , with  $\mathcal{E}_t = \int_0^1 e_{it} di$  as intermediate input

$\mathcal{E}_t$  denotes the number of varieties in the economy

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- interest rate  $r_t$  and wage rate  $w_t$  from **marginal products** of final goods producer
- profits  $\pi_t$  from **monopolistic competition** of intermediate goods producer

[Details](#)

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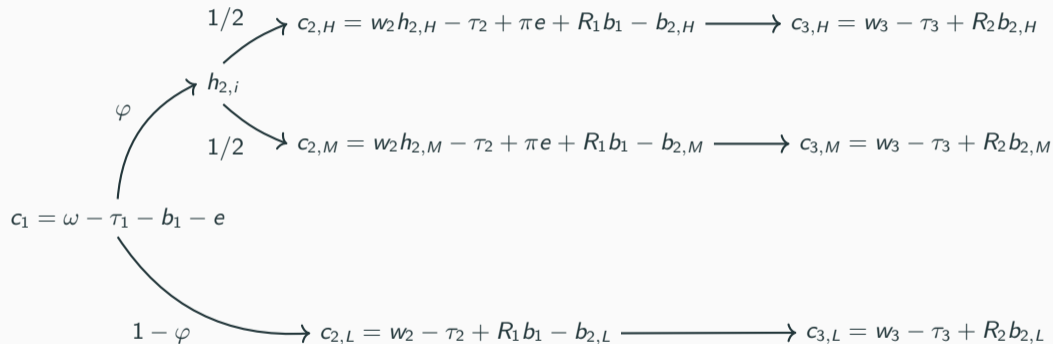
[Details](#)

**Government:** holds debt, consumes, and runs tax and transfer system

$$G_t + Tr_t + (1 + r_t)B_t = B_{t+1} + T_t$$

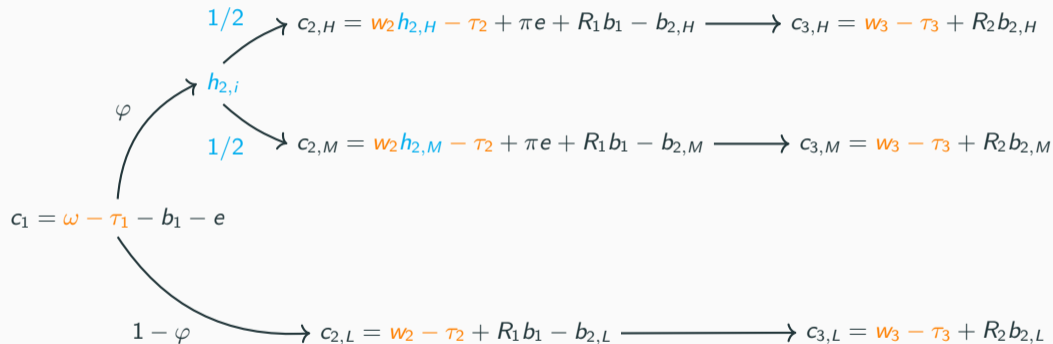
- **repays debt**  $(1 + r_t)B_t$ , **provides transfers**  $Tr_t$  and has **wasteful consumption**  $G_t$
- collects **labor taxes**  $T_t = \tau_t^L w_t \int_0^1 h_{it} n_{it} di$   $\tau_L$  and raises new debt  $B_{t+1}$

Figure 12: Setup of the three-period model



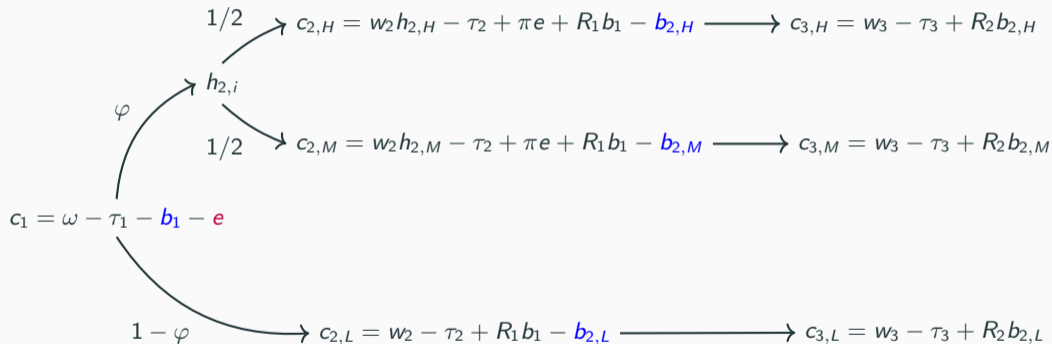
- ex-ante identical households live three periods,  $q_t = 1$  and  $\alpha = 0$
- maximize ex-ante life-time utility  $V(c_1, c_{2,H}, c_{2,M}, c_{2,L}, c_{3,H}, c_{3,M}, c_{3,L})$

Figure 12: Setup of the three-period model



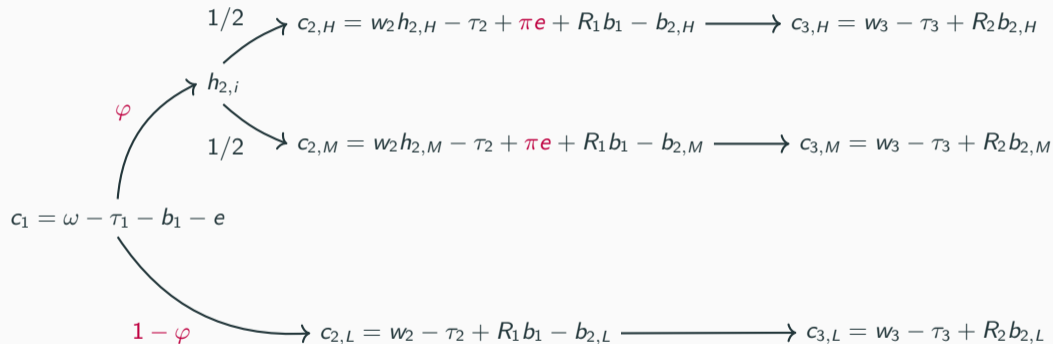
- households obtain (after-tax) income  $w - \tau_1$ ,  $w_2 - \tau_2$ , and  $w_3 - \tau_3$
- labor productivity  $h_{2,i}$  is stochastic in period two

Figure 12: Setup of the three-period model



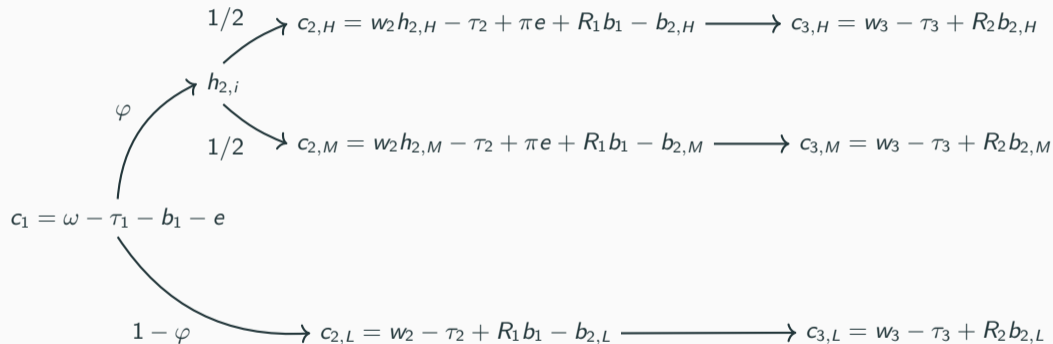
- save in risk-free debt  $b_1 \geq 0$ ,  $b_{2,i} \geq 0$  to smooth consumption
- opportunity to invest in risky asset  $e \geq 0$  in first period

Figure 12: Setup of the three-period model



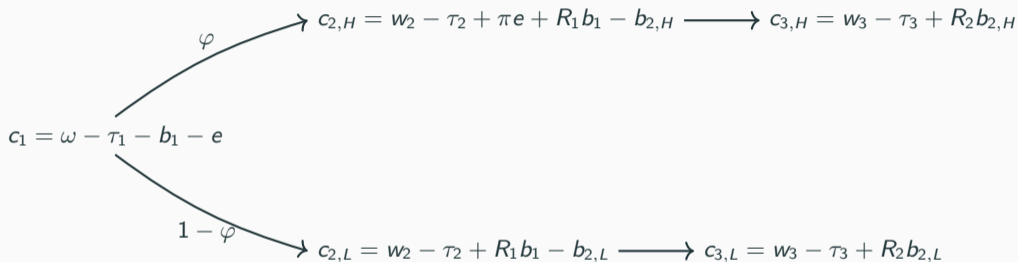
- with probability  $\varphi$  risky investment generates payoff  $\pi e$ , with  $1 - \varphi$  investment lost
- investment only lasts one period

Figure 12: Setup of the three-period model



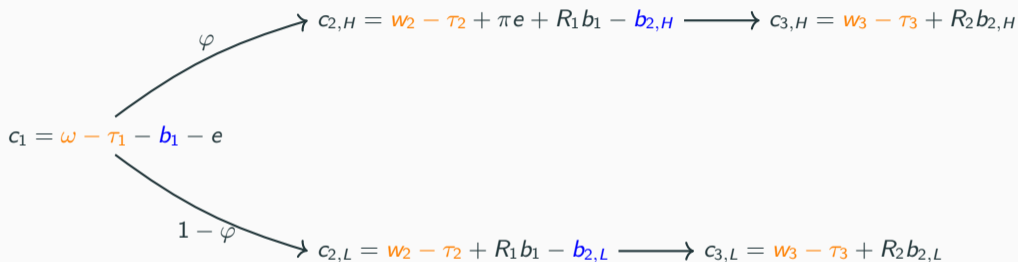
- Government:  $\tau_1 = -\mathcal{B}$ ,  $\tau_2 = (R_1 - 1)\mathcal{B}$ , and  $\tau_3 = R_2\mathcal{B}$
- Firms:  $w_t = w_t(\mathcal{E}_t)$  with  $\mathcal{E}_t = \int_0^1 e_{it} di$  and  $w_2 < w_3$

Figure 13: Setup of the three-period model



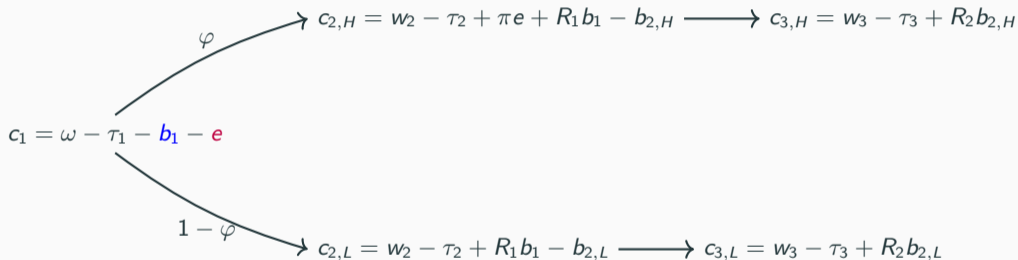
- assume ex-ante identical households live three periods and  $h_{it}n_{it} = 1$  and  $q_t = 1$
- maximize ex-ante life-time utility  $V(c_1, c_{2,H}, c_{2,L}, c_{3,H}, c_{3,L})$

Figure 13: Setup of the three-period model



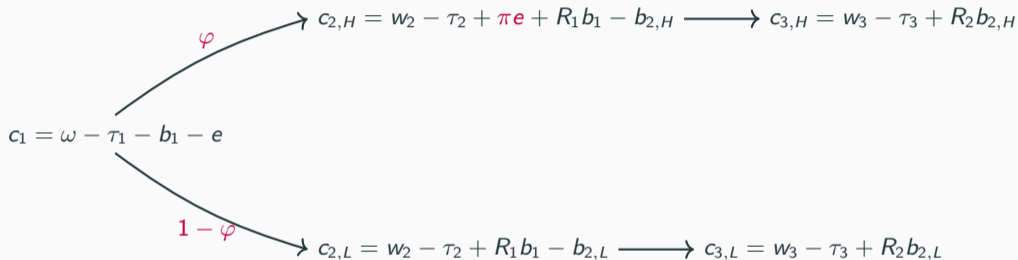
- households obtain (after-tax) income  $w - \tau_1$ ,  $w_2 - \tau_2$ , and  $w_3 - \tau_3$
- can save in risk-free government debt  $b_1 \geq 0$ ,  $b_{2,i} \geq 0$  to smooth consumption

Figure 13: Setup of the three-period model



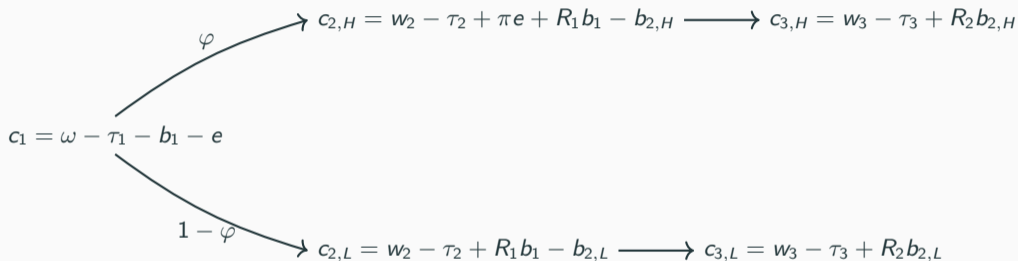
- portfolio choice between safe asset  $b_1$  or risky asset  $e$

Figure 13: Setup of the three-period model



- with probability  $\varphi$  risky investment generates payoff  $\pi e$ , with  $1 - \varphi$  investment lost
- successful households have declining income profile

Figure 13: Setup of the three-period model



- Government:  $\tau_1 = -\mathcal{B}$ ,  $\tau_2 = (R_1 - 1)\mathcal{B}$ , and  $\tau_3 = R_2\mathcal{B}$
- Firms:  $w_t = w_t(\mathcal{E}_t)$  with  $\mathcal{E}_t = \int_0^1 e_{it} di$  and  $w_2 < w_3$

# HHs maximize subject to labor income risk, return risk, and incomplete markets

Back

$$V_t = \max_{\{c_{it}, n_{it}, a_{it+1}, e_{it+1}\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t u(c_{it}, n_{it})$$

$$\text{s.t.} \quad c_{it} + a_{it+1} + q_t e_{it+1} = (1 - \tau_t^L) w_t h_{it} n_{it} + R_t a_{it} + (q_t + \pi_t) e_{it}$$

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- labor productivity  $h_{it}$  fluctuates according to AR(1)  $\log h_{it} = \rho_h \log h_{it-1} + \epsilon_t$ 
  - households cannot insure risk fully due to market incompleteness

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- insure against labor risk via portfolio choice between  $a_{it+1}$  and  $e_{it+1}$ 
  - risky asset is lost with probability  $1 - \varphi$

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- households supply labor  $n_{it}$  but face taxes  $\tau_t^L$ 
  - tax changes affect labor supply decision

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- households supply labor  $n_{it}$  but face taxes  $\tau_t^L$ 
  - tax changes affect labor supply decision

**New features:** labor choice + taxation + capital

Risk

Portfolio

VF

Interactions

## Table 1: Calibration Details (Quarterly Frequency)

Parameter	Value	Description	Source / Target
<b>Households</b>			
$\beta$	0.986	Discount factor	$K/Y = 9.0$ Auclert et al. (2021)
$\gamma$	2	Inverse Frisch	Chetty et al. (2011)
$\lambda$	0.3%	Portfolio adj. prob.	Income Gini = 0.5
$\omega$	0.88	Scale labor disutility	$N_t = 1.0$ along BGP
$\rho_h$	0.98	Labor income persistence	Storesletten, Telmer, and Yaron (2004)
$\sigma_h$	0.16	Labor income std.	Storesletten, Telmer, and Yaron (2004)
<b>Firms</b>			
$\alpha$	0.31	Capital share	62% labor income
$\epsilon$	1.19	Substitution elasticity	profit share of 10%
$\delta$	1.75%	Depreciation rate	Bayer, Born, and Luetticke (2022)
$\rho$	<b>0.1</b>	<b>Growth to equity inv.</b>	<b>conservative value based on estimates</b>
$\chi$	0.1	New varieties scalar	Growth rate of 0.5% qtlly.
$\varphi$	92.5%	Prob. keeping equity	Güvener, Kaplan, and Song (2014)
<b>Government</b>			
$\tau^L$	37.8%	Tax rate level	$G/Y = 0.2$