Financial Literacy, Portfolio Choice, and Wealth Inequality: A General Equilibrium Approach

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November 14, 2023

Question: Aggregate Implications of Financial Literacy

U.S. corr(a,r) | Norway corr(a,r)

Financial Literacy

- *Households' "ability to process economic information and make informed decisions about financial planning, wealth accumulation, debt, and pensions"* (Lusardi and Mitchell, 2014)

Motivation

- More literate HHs experience higher asset returns (Clark et al., 2015; Von Gaudecker, 2015; Bianchi, 2017)
- Increasing policy interest in workplace and school-based personal finance education

Research Questions

- What are equilibrium effects of policies to raise financial literacy on wealth inequality?
- How will such policies affect portfolio choices & equity premia of different wealth groups?

This Paper: Financial Literacy in General Equilibrium

Framework: life-cycle + incomplete market + general equilibrium model

- *Portfolio choice*: risk-free ("*bonds*") vs. risky ("*stocks*") assets
- *Financial literacy accumulation*: increases an individual household's expected stock return
- *Equilibrium*: aggregate capital income is distributed according to financial literacy

Quantification : matched to U.S. average financial literacy + stock market participation rate in SCF

Key Findings: policy effects of subsidizing financial literacy accumulation

① Avg FinLit ▲ ⇒ stock demand ▲ ⇒ stock price ▲ ⇒ smaller *net increase* in aggregate capital

– **PE** vs. **Hypothetical GE** (+ market clearing) vs. **GE** (+ subsidy financed by capital income tax)

② Redistribution of *capital incomes* from top to middle wealth quartiles ⇒ *wealth inequality* ▼

Contribution to Macroeconomics & Household Finance Literature

① **Financial literacy** varies across households; improves investment outcomes More
- Calvet et al. (2007, 2009), Von Gaudecker (2011), Van Rooij et al. (2011), McKay (2013), Clark et al (2015), Jappelli and Padula (2016), Lusardi et al (2017), Bianchi (2018), Gambacorta et al. (2023)

② Life-cycle **portfolio choice** and equity *participation* puzzle
- Merton (1969), Cocco (2005), Cocco et al. (2005), Gomes and Michaelides (2005), Yao and Zhang (2005), Yogo (2015), Fagereng et al. (2017), Catherine (2022), Athreya et al. (2023)

③ Sources of **return heterogeneity**: type dependence vs. scale dependence
- Fagereng et al. (2020), Bach et al. (2020), Gaillard and Wangner (2022W)

④ Heterogeneity in wealth returns amplifies **wealth inequality**
- Gabaix et al. (2016), Cao and Luo (2017), Benhabib et al. (2019), Hubmer et al. (2021), Xavier (2021W), Mihet (2022W)

Contribution: GE + FinLit allows counterfactual analysis of policies to achieve financial parity

Model In A Nutshell ▸ Choice Variables ▸ Recursive HHP ▸ Need Math?

- **Life-cycle**: household born at $t = 25$, retires at $t = t_R = 65$, dies at $t = T = 80$
  - *Stochastic* pre-retirement labor income + *deterministic* pension benefits ▸ Details
- **Portfolio choice**: a risk-free bond vs. *a stock "portfolio"* with idiosyncratic risks
  - *Frictions*: ① borrowing & short-sale const., ② per-period stock market participation cost
- **Financial literacy**: akin to human capital $\rightarrow$ increases risk-adjusted stock return
  - *Why dynamic choice?* ① FinLit depreciates, ② accumulating FinLit is costly

- **Market clearing**: (bonds = gov't debt) & (stocks = productive capital) ▸ Details

⋆ **What's new**: ***financial literacy in "a" general equilibrium framework***
  - Assumption ①: FinLit is *not* used in production
  - Assumption ②: aggregate capital income is distributed according to HH's FinLit

  $\Rightarrow$ Raising FinLit has *pecuniary externality* on equity premium $\rightarrow$ redistributive implication

- **Not in this model**: aggregate risk, $\mathrm{corr}(\text{labor}, \text{capital income shocks})$, housing choice ▸ SCF

Quantifying the **Equilibrium Effects** of Financial Literacy

⋆ Model matched to U.S. average FinLit + stock market participation rate in SCF (2016-2019) Details

Key model fit:	Data	Model
Avg. FinLit score	2.19	2.18
Participation rate	54.1%	54.6%

Baseline Economy			
Risk-free return	2.32%	Market equity premium	5.38%
Capital income tax	9.77%	Equity premium for min. FinLit	4.41%

⋆ Decomposing *equilibrium effects* of subsidizing FinLit acquisition:

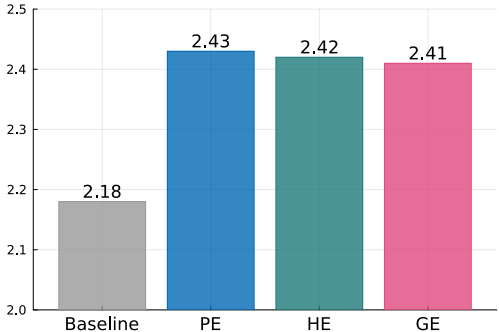
capital-input ratio for e.g. on $\frac{K}{Y}$

- **PE** Partial equilbrium — *Short-run* outcomes w/ no return adjustments — $2.2\% \uparrow$
- **HE** "Hypotethical" GE — + Asset market clears w/ subsidy *from heaven* — $0.4\% \uparrow$
- **GE** Full general equilbrium — + Gov't budget balance raising capital income tax — $0.1\% \uparrow$

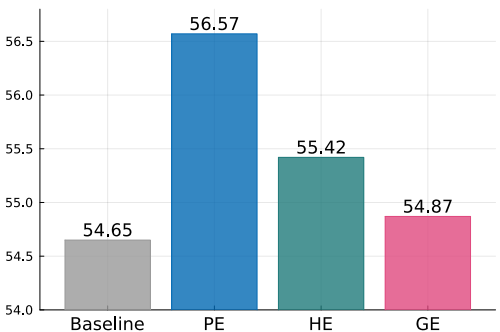
Key Finding ①: FinLit Increases *Participation Rate* in PE vs. GE

⋆ *Policy experiment:* 75% *subsidy for FinLit cost financed by capital income tax*

(a) Financial Literacy



(b) Stock Market Participation Rate

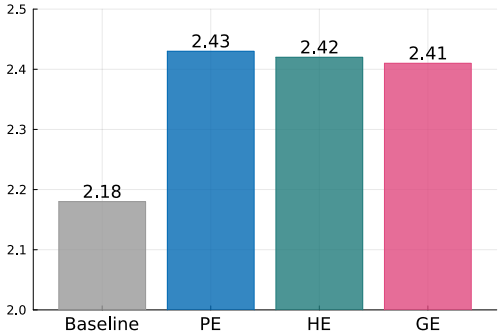


- **HE** Stock investment ▲ ⇒ stock price ▲ ⇒ stock return ▼ ⇒ avg. equity premium ▼
- **GE** To finance subsidy, capital income tax ▲ ⇒ bond return ▲ ⇒ avg. equity premium ▼

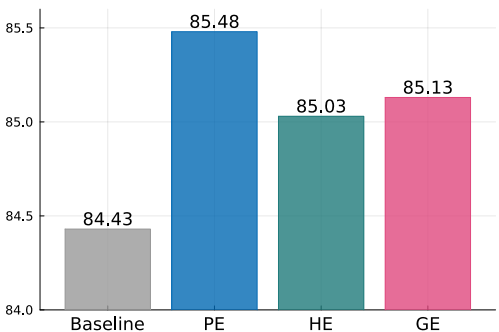
Key Finding ①: FinLit Increases *Conditional Portfolio Share* in PE vs. GE

⋆ *Policy experiment: 75% subsidy for FinLit cost financed by capital income tax*

(a) Financial Literacy



(b) Portfolio Share Conditional on Participation



- **HE** Avg. equity premium ▼ ⇒ attenuates the net increase in aggregate capital
- **GE** Tax channel increases r^b ⇒ marginal participants exit ⇒ *conditional* portfolio share ▲

Key Finding ②: Heterogeneous Effects across Wealth Quartiles

	Expected Equity Premium		Stock Market Participation Rate		Cond. Portfolio Share in Stocks	
	Baseline	Δ GE	Baseline	Δ GE	Baseline	Δ GE
Q1	4.93	-0.11	0.00	**0.00**		
Q2	4.96	0.01	27.41	0.25	73.16	4.80
Q3	5.26	-0.01	91.17	0.62	92.44	0.81
Q4	5.40	-0.12	100.00	**0.00**	80.23	-0.57
Total	5.14	-0.06	54.65	0.22	84.43	0.70

- Wealthiest ***always*** participate vs. poorest ***never*** → *evidence for participation subsidy*
- Expected equity premium falls for:
  - `Q1`: cannot afford FinLit accumulation even when subsidized
  - `Q4`: attained max FinLit prior to subsidy; exprience devaluation of stock holdings
- Capital incomes redistributed from `Q4` to `Q2–Q3` ⇒ Gini index decreases from 56.3% to 55.9%

Conclusion

Framework: Dynamic GE with *portfolio choice* and *financial literacy accumulation*

Key Findings

- Equilibrium price adjustment limits the FinLit effect on stock market expansion
- Improving financial literacy mitigates wealth inequality
  by redistributing capital income from the top to middle wealth quartiles

Discussion

- *Contribution*: GE framework sheds light on the interplay between financial literacy and equity premium, allowing for a full counterfactual analysis on financial education initiatives
- *Policy suggestion*: participation subsidies to promote the bottom quartile's stock investments

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I. Framework

Financial Literacy Premium on Stock Returns

⋆ *At the beginning of each age $t \leq T$, a **household-specific stock return** realizes:*

$$\tilde{r}(f_t) = \underline{r}^\star + r^X(f_t) + \sigma^X \eta_t, \ \eta \sim \mathcal{N}(0,1)$$

- FinLit f *linearly* increases mean excess return $r^X(f) \in [r^X(f_{\min}), r^X(f_{\max})] = [0, 0.01]$
- *Base* expected return for $f_{\min}$: $\mathbb{E}_\eta[\tilde{r}(f_{\min})] = \underline{r}^\star + r^X(f_{\min}) = \underline{r}^\star$ (*equilibrium* object)

⋆ ***Stock market clears** s.t. more literate HHs take a larger share of aggregate capital income:*

$$r^\star K^\star = \int \tilde{r}(f) a d\Gamma = \int \left(\underline{r}^\star + r^X(f) + \sigma^X \eta\right) \cdot a d\Gamma$$

- Marginal product of capital $r^\star = g_k(K, L) - \delta_K$ determined by a firm's FOC

⋆ *Aggregate effects of **policy interventions to raise average FinLit** $F^\star = \int f d\Gamma$:*

① Aggregate capital $K^\star \blacktriangle \Rightarrow$ average stock return $r^\star \blacktriangledown$

② Average mean excess return $r^X(F^\star) \blacktriangle \Rightarrow$ base stock return $\underline{r}^\star \blacktriangledown$

Labor Income and Pension Benefit

Model Overview

- **Pre-retirement** $(t \leq t_R)$: Inelastic supply of *stochastic* efficiency units of labor

$$\log(l_{t+1}) = m_t + \rho \log(l_t) + \varepsilon_t$$

where $m_t = (\text{deterministic component at age t}), \rho \in (0,1), \varepsilon_t \sim \mathcal{N}(0, \sigma_l^2)$

- **Post-retirement** $(t > t_R)$: Deterministic pension benefit

$$\log(l_t) = \log \lambda + \log(l_{t_R}), \text{ w/ } \lambda \in (0,1)$$

- Government levies a labor income tax to fund the pension system

$\Rightarrow$ Disposable labor income net of housing cost h_t and labor income tax τ^l

$$w^\star \tilde{l} = \begin{cases} (1-h_t)(1-\tau^l) l_t & t \leq t_R \\ (1-h_t)\lambda l_{t_R} & t > t_R \end{cases}$$

Portfolio Choice and Financial Literacy Premium

▸ Model Overview

At age $t \leq T$, a household chooses:

① **Gross saving**: $\mathcal{S}_{t+1}$

② **Portfolio share in stocks**: $\kappa \in [0, 1]$

- Borrowing & short-sale constraints + per-period fixed participation cost: $\theta > 0$

③ **Financial literacy**: $f_{t+1} = (1 - \delta_f) f_t + e_t$

- Depreciation rate $\delta_f \rightarrow e_t = (\text{financial literacy accumulation at age } t)$
- Resource cost for FinLit accumulation: $\Phi(e_t) = \phi e_t^{\iota}$ with $\iota > 1$

*At the beginning of $t + 1$, a **household-specific stock return** realizes:*

$$\tilde{r}(f_{t+1}) = \underline{r}^{\star} + r^X(f_{t+1}) + \sigma^X \eta_{t+1}, \ \eta \sim \mathcal{N}(0, 1)$$

⋆ FinLit increases the mean excess return $r_f^X(\cdot) > 0$ with bounds $r^X \in [0, r^X(f_{\max})]$

⋆ *Base* expected return for participants with minimum FinLit: $\mathbb{E}_\eta[\tilde{r}(f_{\min})] = \underline{r} + r^X(f_{\min}) = \underline{r}$

Recursive Household Problem

Model Overview

$$V_t(\mathcal{X}_t, f_t; l_t, \eta_t) = \max_{c_t, \kappa_t, e_t} \left\{ (1-\beta) c_t^{1-1/\psi} + \beta \mathbb{E}_{l,\eta} \left[V_{t+1}^{1-\gamma}(\mathcal{X}_{t+1}, f_{t+1}; l_{t+1}, \eta_{t+1}) \right]^{\frac{1-1/\psi}{1-\gamma}} \right\}^{\frac{1}{1-1/\psi}}$$

s.t.
$$\mathcal{X}_{t+1} = \underbrace{\left[\kappa_t \tilde{R}(f_{t+1}) + (1-\kappa_t) R^b\right]}_{\text{gross returns to wealth}} \underbrace{\left(\mathcal{X}_t - c_t - (1-\varphi_t)\Phi(e_t) - (1-\vartheta_t)\theta \cdot \mathbb{1}(\kappa_t > 0)\right)}_{\equiv \mathcal{S}_{t+1},\ \text{gross saving}} + \underbrace{w\tilde{l}_{t+1}}_{\text{labor inc}}$$

$$f_{t+1} = (1-\delta_f) f_t + e_t$$
$$\tilde{R}(f_{t+1}) = 1 + (1-\tau^r)\left(\underline{r} + r^X(f_{t+1}) + \sigma^X \eta_{t+1}\right),\ \eta \sim \mathcal{N}(0,1)$$
$$R^b = 1 + (1-\tau^r) r^b$$
$$\mathcal{X}_{t+1} \geq 0, \kappa_t \in [0,1]$$

- **Preferences**: Epstein-Zin with EIS ψ; risk aversion γ
- **States**: cash on hand $\mathcal{X}_t$, FinLit f_t ($+$ stochastic labor $l_{t \leq t_R}$; stock return risks η_t)
- **Choices**: consumption c_t; wealth share invested in stocks κ_t; FinLit investment e_t
- **Frictions**: liquidity constraints; FinLit investment cost $\Phi(e_t)$; stock market participation cost θ
  $\Rightarrow$ *Intertemporal optimization*: paying to accumulate f today raises $\tilde{r}(f)$ tomorrow
- **Policy interventions**: ① ***FinLit investment subsidy*** φ_t; ② stock market participation subsidy ϑ_t

Stock Market Clears

▸ Model Overview ▸ Full GE DEF ▸ What if $A^I(F) > 0$?

- Aggregate saving in stocks supplies capital to production
- Perfectly competitive firm w/ CRS production $Y = g(K, L) = AK^{\alpha}L^{1-\alpha}$

$$r^{\star} = g_k(K, L) - \delta_K, w^{\star} = g_l(K, L)$$

- Stock market clearing returns $(r^{\star}, \underline{r}^{\star})$ with *endogenous* return heterogeneity:

$$K^{\star} = \int (\kappa \cdot \mathcal{S}) d\Gamma(\mathcal{X}, f; l, \eta, t)$$

$$r^{\star}K^{\star} = \int \left(\underline{r}^{\star} + r^{X}(f) + \sigma^{X}\eta\right) \cdot (\kappa \cdot \mathcal{S}) d\Gamma(\mathcal{X}, f; l, \eta, t)$$

⋆ **HE** As average financial literacy $F^{\star} = \int f d\Gamma$ increases:

① Average HHs expect higher $\tilde{r}(\cdot) \Rightarrow K^{\star}\blacktriangle \Rightarrow$ rental rate of capital $r^{\star}\blacktriangledown$

② Average mean excess return $r^{X}(F^{\star})\blacktriangle \Rightarrow$ *base* return $\underline{r}^{\star}\blacktriangledown$ *(FinLit is a zero-sum game!)*

Government Budget Balance

Model Overview | Full GE DEF

- Gov't levies a labor income tax τ^l to finance the pension system:

$$\tau^l w^\star \int l_t d\Gamma_{t \leq t_R} = \lambda w^\star \int l_t d\Gamma_{t > t_R}$$

- Gov't supplies a risk-free bond with return $r^{b\star}$ s.t.

$$B^\star = \int (1-\kappa) \mathcal{S} d\Gamma(\mathcal{X}, f; l, \eta, t)$$

- Gov't levies a capital income tax τ^r on both assets to finance debt payments and subsidies

$$G^\star + r^{b\star} B^\star = \tau^{r\star} \int \left(r^{b\star}(1-\kappa) + \tilde{r}(f)\kappa\right) \mathcal{S} d\Gamma(\mathcal{X}, f; l, \eta, t)$$

$$G^\star = \int \Big(\varphi_t \Phi(e) + \vartheta_t \theta \cdot \mathbb{1}(\kappa_t > 0)\Big) d\Gamma(\mathcal{X}, f; l, \eta, t)$$

$\star$ **GE** Increase in gov't expenditure $G^\star \Rightarrow \tau^{r\star} \blacktriangle \Rightarrow B^\star \blacktriangledown \Rightarrow r^{b\star} \blacktriangle \Rightarrow$ equity premium $\blacktriangledown$

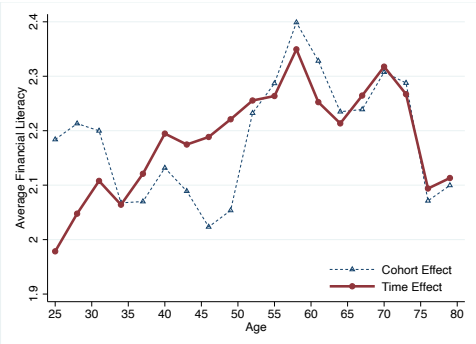
II. Data and Calibration

SCF: Age, Wealth, and *Measured* Financial Literacy

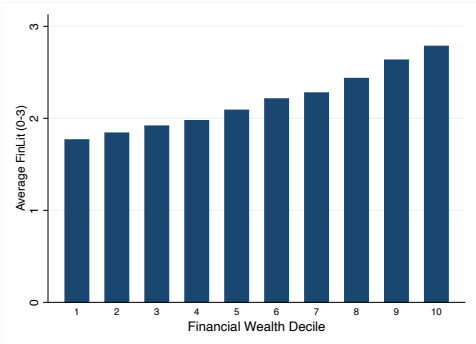
Back

- Financial literacy score in *Survey of Consumer Finance (SCF, 2016-2019)*
  = HH's understanding of ① risk diversification, ② inflation, ③ interest rate Big 3Q
- FinLit *increases toward retirement age* and *varies across wealth groups*

(a) Life-cycle of Average FinLit Score



(b) Average FinLit by Wealth Groups



Quantification and Model Fit

Detail | Validation: reg on FinLit

Internally calibrated:

- Average financial literacy $\rightarrow$ financial literacy investment cost coefficient ϕ
- Average participation rate $\rightarrow$ per-period fixed stock market participation cost θ

Externally calibrated:

- FinLit premium on stock returns $r^X(f_{\max}) = 0.01$ from Clark et al. (2015) CLM (2015)
- Discount factor, EIS, risk aversion from Gomes and Michaelides (2005)

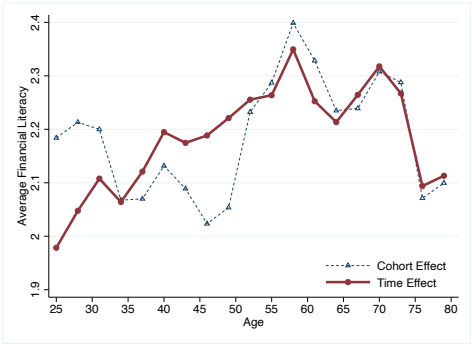
Table: Baseline Model Fit

	Data	Model	
Distribution of financial literacy			
Avg. FinLit age 18-25	1.98	1.98	⋆
Avg. FinLit age 26-80	2.19	2.18	⋆
S.D. FinLit age 26-80	0.86	0.93	
(Avg. FinLit 76-80)/(Avg. FinLit 71-75)	0.91	0.93	
Stock market participation			
Avg. saving rate (%)	95.5	97.5	
Avg. participation rate (%)	54.1	54.1	⋆
Conditional portfolio share in stocks (%)	46.4	84.4	

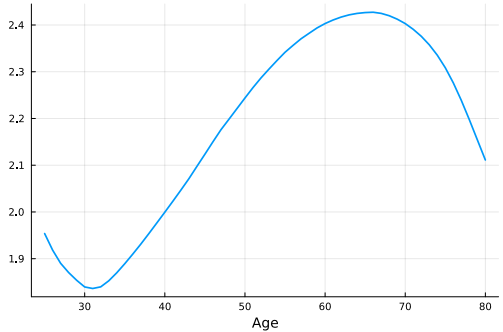
⋆ Internally calibrated. Data source: SCF 2016-2019.

Validation: Life-cycle Profile of Financial Literacy

(a) Data (Target Average: 2.19)

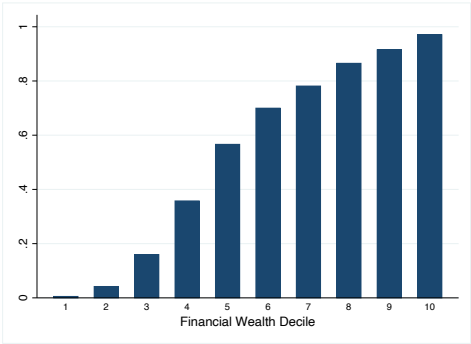


(b) Model (Simulated Average: 2.18)

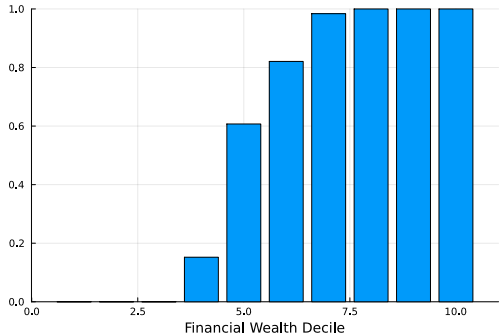


Validation: Stock Market Participation by Wealth Groups

(a) Data (Target Average: 0.54)



(b) Model (Simulated Average: 0.54)



Validation: FinLit & Stock Investments, Data vs. Model

Back

$$(\text{Investment Outcome})_i = c + \beta \cdot \text{FinLit}_i + \Gamma X_i + \varepsilon_i \text{ for household } i$$

	Positive holdings of public equities?		Conditional wealth share in stocks	
	Data	Model	Data	Model
	(1)	(2)	(3)	(4)
Financial literacy score (0-3)	0.061***	0.089***	0.012*	0.101***
	(0.006)	(0.000)	(0.006)	(0.000)
ihs(net worth)	0.012***	0.310***	0.004***	-0.090***
	(0.001)	(0.000)	(0.001)	(0.000)
ihs(income)	0.096***	0.050***	0.007	0.141***
	(0.008)	(0.000)	(0.005)	(0.000)
Mean value	0.541	0.546	0.441	0.844
R-sq.	0.321	0.731	0.025	0.304
No. Obs	10997	2.75M	6858	1.5M

- Source: SCF 2016-2019. +p<0.10, *p<0.05, **p<0.01, ***<0.001. **Col (1), (3): Author's replication of Cupák et al. (2022)**.
- Controls: age, age sq., [Data: + business ownership, inheritance, HH size, kids, female, employed, education, race, marital status, year FE]

1 unit increase in financial literacy is associated with:

- Probability of holding public equities: $6.1\%\text{p}$ ▲ in data, vs. $8.9\%\text{p}$ ▲ in model
- Conditional wealth allocated into equity: $1.2\%\text{p}$ ▲ data, vs. $10.1\%\text{p}$ ▲ in model

III. Quantitative & Policy Analyses

Baseline vs. Counterfactual After FinLit Subsidy

Back Full Table

Consider a subsidy on FinLit investment cost: $\varphi = 0.75$, where $(\text{net cost}) = (1-\varphi)\Phi(e_t)$

Table: Comparative Statics

		Baseline (1)	ΔPE (2)	ΔHE (3)	ΔGE (4)
Avg. FinLit (out of 3)	$\mathbb{E}[f]$	2.18	0.25	0.23	0.22
Risk-free return (%)	r^b	2.32		-0.01	0.08
Avg. equity premium (%)	$r - r^b$	5.38		-0.06	-0.10
Base. equity premium (%)	$\underline{r} - r^b$	4.41		-0.09	-0.13
Capital income tax rate (%)	$\tau^{r\star}$	9.77		-0.01	1.00
Stock / capital (level)	$\mathbb{E}[\kappa \cdot \mathcal{S}]$	4.40	0.15	0.03	0.01
Capital-output ratio	K/Y	2.29	0.05	0.01	0.00

Note: The baseline returns and tax rate are in %. Corresponding changes (compared to the baseline) are in %p.

- Growth rate of average financial literacy between: $10.16 - 11.26\%$
- **PE** Increase in average financial literacy raises aggregate stock investment
- **HE** As markets clear, both *average* and *base* equity premia fall
- **GE** Capital income tax τ^r rises to finance subsidies; decreased saving motives $\rightarrow$ raise r^b

FinLit Subsidy Effects in PE vs. GE

Equity Premium

⋆ *Consider a policy experiment:*

- To subsidize 75% of each HH's financial literacy cost
- Financed by a constant capital income tax on both assets

⋆ *The proposed subsidy increases:*

[PE]

- *Average financial literacy* by 11.26%
- *Stock market participation rate* by $1.92\%\text{p}$
- *Cond. wealth share in stocks* by $1.05\%\text{p}$

FinLit Subsidy Effects in PE vs. GE

▸ Equity Premium

⋆ *Consider a policy experiment:*

- To subsidize 75% of each HH's financial literacy cost
- Financed by a constant capital income tax on both assets

⋆ *The proposed subsidy increases:*

	[PE]		+ market clearing [Hypothetical EQM]
• *Average financial literacy* by	11.26%	vs.	10.68%
• *Stock market participation rate* by	$1.92\%\text{p}$	vs.	$0.77\%\text{p}$
• *Cond. wealth share in stocks* by	$1.05\%\text{p}$	vs.	$0.60\%\text{p}$

⋆ *Financial literacy effect on stock market expansion is attenuated because:*

- HE Stock investment ▲ $\Rightarrow$ stock price ▲ $\Rightarrow$ stock return ▼ $\Rightarrow$ avg. equity premium ▼

FinLit Subsidy Effects in PE vs. GE

▸ Equity Premium

★ *Consider a policy experiment:*

- To subsidize 75% of each HH's financial literacy cost
- Financed by a constant capital income tax on both assets

★ *The proposed subsidy increases:*

	[PE]		+ market clearing [Hypothetical EQM]		+ finance w/ tax [Full GE]
• *Average financial literacy* by	11.26%	vs.	10.68%	vs.	10.16%
• *Stock market participation rate* by	$1.92\%\text{p}$	vs.	$0.77\%\text{p}$	vs.	$0.22\%\text{p}$
• *Cond. wealth share in stocks* by	$1.05\%\text{p}$	vs.	$0.60\%\text{p}$	vs.	$0.70\%\text{p}$

★ *Financial literacy effect on stock market expansion is attenuated because:*

- **HE** Stock investment ▲ $\Rightarrow$ stock price ▲ $\Rightarrow$ stock return ▼ $\Rightarrow$ avg. equity premium ▼
- **GE** To finance subsidy, capital income tax ▲ $\Rightarrow$ bond return ▲ $\Rightarrow$ avg. equity premium ▼

Heterogeneous Effects Across Wealth Quartiles: *Equity Premium*

Wealth Quartile	$\mathbb{E}[f]$ Average Financial Literacy			$\mathbb{E}[\tilde{r}(f)] - r^b$ Expected equity premium		
	Baseline	Δ PE	Δ GE	Baseline	Δ PE	Δ GE
	(1)	(2)	(3)	(4)	(5)	(6)
Q1	1.56	0.07	0.07	4.93	0.02	-0.11
Q2	1.64	0.49	0.42	4.96	0.16	0.01
Q3	2.56	0.40	0.38	5.26	0.13	-0.01
Q4	2.98	0.02	0.02	5.40	0.01	-0.12
Total	2.18	0.25	0.22	5.14	0.08	-0.06

- *Expected equity premium* $\mathbb{E}[\tilde{r}(f)] - r^b = \underline{r} + r^X(f)$ *falls for*:
  - Q1: cannot afford FinLit accumulation even when subsidized; $r^X(f_{\min}) = 0$
  - Q4: attained max FinLit prior to subsidy; exprience devaluation of stock holdings

Heterogeneous Effects Across Wealth Quartiles: *Stock Investments*

Wealth Quartile	$\mathbb{E}[\mathbb{1}(\kappa > 0)]$ Participation rate			$\mathbb{E}[\kappa \mid \kappa > 0]$ Conditional portfolio share		
	Baseline	Δ PE	Δ GE	Baseline	Δ PE	Δ GE
	(1)	(2)	(3)	(4)	(5)	(6)
Q1	**0.00**	0.00	0.00			
Q2	27.41	4.89	0.25	73.16	6.57	4.80
Q3	91.17	2.79	0.62	92.44	0.83	0.81
Q4	**100.00**	0.00	0.00	80.23	-0.21	-0.57
Total	54.65	1.92	0.22	84.43	1.05	0.70

- Middle quartiles increase stock investments, while the increase is attenuated in GE
- Top quartile's equity premium decreases in net $\rightarrow$ portfolio share in stocks ▼
- Wealthiest ***always*** participate vs. poorest ***never*** $\rightarrow$ *evidence for participation subsidy*

FinLit Subsidy Mitigates Wealth Inequality

More policies

Table: Share of financial assets (%) held by each wealth groups:

	Wealth		Bond		Stocks	
Wealth Quartile	Baseline (1)	Δ GE (2)	Baseline (3)	Δ GE (4)	Baseline (5)	Δ GE (6)
Q1	1.52	0.01	5.77	0.05	0.00	0.00
Q2	8.85	0.04	25.49	-0.99	2.87	0.44
Q3	23.82	0.35	13.25	-0.99	27.62	0.81
Q4	65.80	-0.40	55.49	1.93	69.51	-1.25
Total	100.00	0.00	100.00	0.00	100.00	0.00

- Redistribution of top quartile's stock investment income to middle quartiles
  - $\Rightarrow$ Q1-Q3 now holds $+0.4\%$p more of the economy's wealth
  - $\Rightarrow$ Gini index decreases from 56.3% to 55.9%

Alternative Policies: Age-Specific Subsidies

Back

- 75% FinLit subsidy only ① for age 25-80; ② for age 61-25; ③ for 25-40
- $+$ Participation subsidy 50%: ④ for age 25-40

	Baseline (I)	Counterfactual (II)	FinLit Age 25-80 ①	FinLit Age 61-65 ②	FinLit Only Age 25-40 ③	+ Participation Age 25-40 ④
Risk-free return (%)	**2.32**	2.31	**2.40**	**2.39**	2.31	2.31
Avg. equity premium (%)	5.38	5.33	5.28	5.34	5.35	5.35
Base equity premium (%)	4.41	4.32	4.28	4.36	4.36	4.36
Capital income tax rate (%)	**9.77**	9.76	**10.76**	**10.27**	10.06	**10.06**
Wage	1.02	1.02	1.02	1.02	1.02	1.02
Avg. FinLit	2.18	2.42	2.41	2.26	2.32	2.42
S.D. Finlit	0.93	0.84	0.84	0.89	0.89	0.84
Participation rate (%)	**54.65**	55.42	**54.87**	54.57	**54.88**	**62.52**
Cond. portfolio share in stocks	84.43	85.03	85.13	84.68	84.79	86.04
Gini Index (%)	56.34	56.03	55.97	56.18	56.24	55.38

APPENDIX

Xavier (2020): Wealth Returns from *SCF* Paper

$$R_\omega = \sum_c \omega_c R_c$$

- R_c return on asset c, ω_c total wealth share
- Wealth = yield component + capital gain

Wealth component	Yield	Capital gain	Return
Interest-earning assets	2.1%	–	2.1%
Public equity	1.8%	4.9%	6.7%
Private businesses	9.0%	4.4%	13.4%
Real estate	4.2%	1.1%	5.3%
Debt	2.7%	–	2.7%
Other financial assets	–	0.4%	0.4%
Other nonfinancial assets	–	1.9%	1.9%

Aggregate yearly return, average over 1990-2019

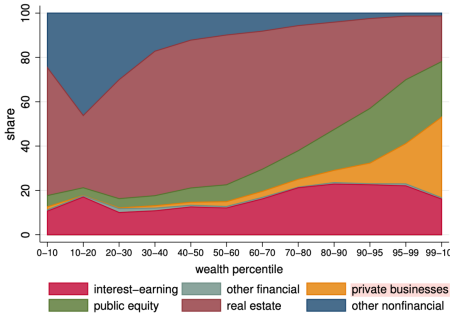
⇒ Aggregate U.S. annual return: **6.8%**

Xavier (2020): Return Heterogeneity in the U.S.

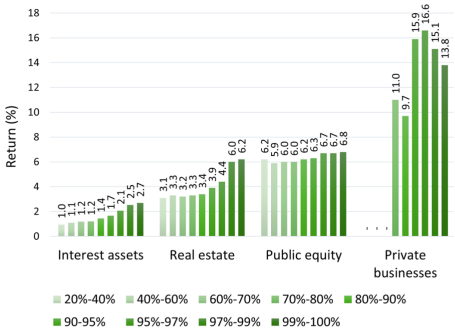
Slide 1 | Lit Review | Norway corr(a,r)

- From SCF (Left: 2019, Right: 1989-2019):

(a) Portfofolio Composition

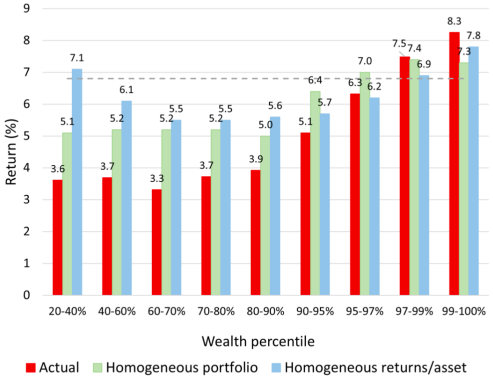


(b) Returns by Asset Class



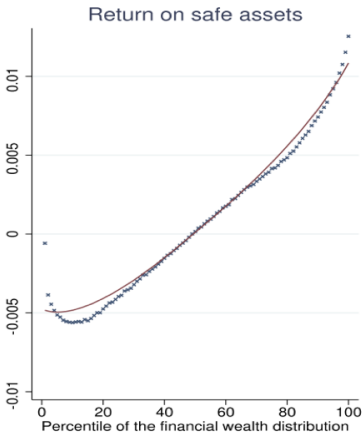
Xavier (2020): Return Heterogeneity in the U.S. (Cont'd)

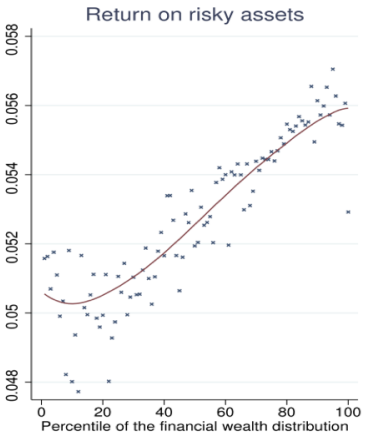
- For each wealth (percentile) group i and asset class c,
  average wealth return $R_i = \sum_c \omega_{ic} R_{ic}$ where ω_{ic}: total wealth share



Fagereng et al. (2020)

Page 1 | Lit Review | U.S. corr(a,r) | Paper





- Persistent return heterogeneity: ssset returns increases with financial wealth

Potential Channels for FinLit Premium

Lit Review

Financial literacy is *positively* related to:

- **Stock market participation**
  - van Rooij et al. (2011), Yoong (2011), Jappelli and Padula (2015), Cupak et al. (2022)
- **More effective investment decisions**
  - Calvet et al. (2007, 2009): avoiding underdiversification, inertia, disposition effect
  - Guiso and Jappelli (2008), von Gaudecker (2011) : portfolio diverstification
  - Bilias et al. (2010): limited resources $\rightarrow$ portfolio intertia
  - Bucher-Koenen and Ziegelmeyer (2014): selling off losing assets
  - Bhutta, Blair and Dettling (2021): higher propensity of having 3 months of liquid savings
- **Advanced retirement planning**
  - Bucher-Koenen and Lusardi (2011), van Rooij et al. (2011), Clark et al. (2015)

Financial Literacy Questionnaires

Back

Survey of Consumer Finance (SCF): "Big Three" Questions

① **Risk Diversification** Buying a single company's stock usually provides a safer return than a stock mutual fund. *True, False, Do not know, Prefer not to say*

② **Inflation** Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account? *More than today, Exactly the same, Less than today, Do not know, Prefer not to say*

③ **Interest Rate** Suppose you had $100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow? *More than $102, Exactly $102, Less than $102, Do not know, Prefer not to say*

U.S. National Financial Capability Study (NFCS): "Big Five" Questions

④ **Mortgage** A 15-year mortgage typically requires higher monthly payments than a 30-year mortgage, but the total interest paid over the life of the loan will be less. *True, False, Do not know, Prefer not to say*

⑤ **Bond Price** If interest rates rise, what will typically happen to bond prices? *They will rise, They will fall, They will stay the same, There is no relationship, Do not know, Prefer not to say*

SCF: Stock Market Exposure Increases with FinLit

Reg: category

$$(\text{Investment Outcome})_i = c + \beta \cdot \text{FinLit}_i + \Gamma X_i + \varepsilon_i \text{ for household } i$$

	Positive holdings of public equities?		Cond. fin. wealth share in stocks		Cond. net worth share in stocks	
	(1)	(2)	(3)	(4)	(5)	(6)
Financial literacy score (0-3)	0.061***	**0.056*** **	0.012*	**0.007**	0.013**	**0.010***
	(0.006)	**(0.006)**	(0.006)	**(0.006)**	(0.004)	**(0.004)**
ihs(net worth)	0.012***	0.011***	0.004***	0.004***	0.002***	0.002***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
ihs(income)	0.096***	0.094***	0.007	0.005	0.019***	0.018***
	(0.008)	(0.008)	(0.005)	(0.005)	(0.003)	(0.003)
Above-average risk tolerance		0.072***		0.064***		0.039***
		(0.008)		(0.007)		(0.005)
Mean value	0.541	0.541	0.441	0.441	0.191	0.191
R-sq.	0.321	0.326	0.025	0.036	0.074	0.082
No. Obs	10997	10997	6858	6858	6858	6858

- Source: SCF 2016-2019. +p<0.10, *p<0.05, **p<0.01, ***<0.001. **Col (1)-(4): Author's replication of Cupák et al. (2022)**.
- Controls: bus. ownership, inheritance, HH size, kids, age, age sq., female, employed, education, race, marital status, year FE

Even after controlling for risk aversion, 1 unit increase in FinLit is associated with:

- Probability of equity holding: $5.6\%\text{p}$ ▲
- Conditional share of financial wealth (any assets) allocated into equity: $0.7\%\text{p}$ $(1.0\%\text{p})$▲

SCF: Stock Market Exposure Increases with FinLit (Categorical)

Back

$$(\text{Investment Outcome})_i = c + \sum_j \beta_j \cdot \mathbb{1}(\text{FinLit} = j) + \Gamma X_i + \varepsilon_i \text{ for household } i$$

	Positive holdings of public equities?		Cond. fin. wealth share in stocks		Cond. net worth share in stocks	
Ref. group: FinLit = {0,1}	(1)	(2)	(3)	(4)	(5)	(6)
FinLit=2	0.059***	**0.058*** **	0.002	0.000	-0.015+	**-0.015+**
	(0.012)	(0.012)	(0.010)	(0.011)	(0.008)	(0.008)
FinLit=3	0.138***	**0.129*** **	0.022+	0.014	0.016+	**0.012**
	(0.013)	(0.013)	(0.012)	(0.012)	(0.009)	(0.009)
ihs(net worth)	0.011***	0.011***	0.004***	0.004***	0.002***	0.002***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
ihs(income)	0.096***	0.093***	0.007	0.005	0.019***	0.018***
	(0.008)	(0.008)	(0.005)	(0.005)	(0.003)	(0.003)
Above-average risk tolerance		0.072***		0.063***		0.039***
		(0.008)		(0.007)		(0.005)
Mean value	0.541	0.541	0.441	0.441	0.191	0.191
R-sq.	0.322	0.327	0.026	0.036	0.077	0.085
No. Obs	10997	10997	6858	6858	6858	6858

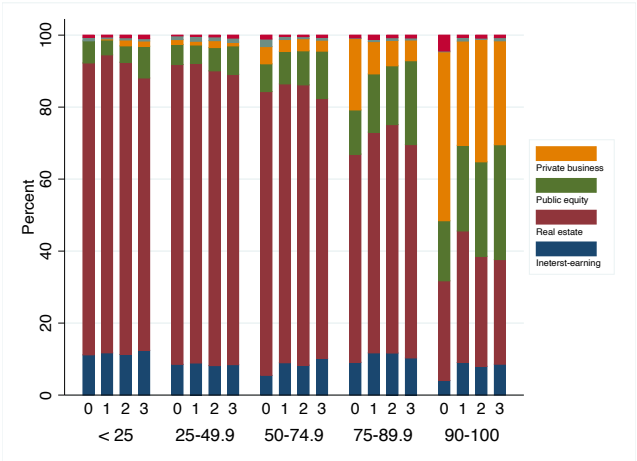
- Source: SCF 2016-2019. +p<0.10, *p<0.05, **p<0.01, ***<0.001. **Col (1)-(4): Author's replication of Cupák et al. (2022)**.
- Controls: bus. ownership, inheritance, HH size, kids, age, age sq., female, employed, education, race, marital status, year FE

⇒ Financial literacy is positively correlated with *equity holdings*, both *extensive* and *intensive*

SCF: Gross Portfolio Composition by FinLit + Networth

Back

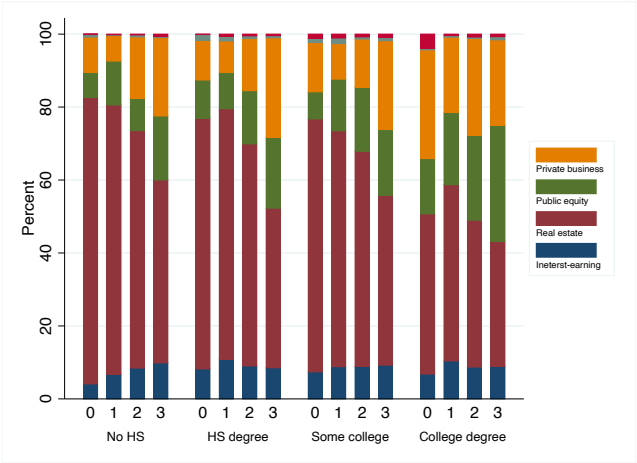
Wealth | Education | Age



SCF: Gross Portfolio Composition by FinLit + Education

Back

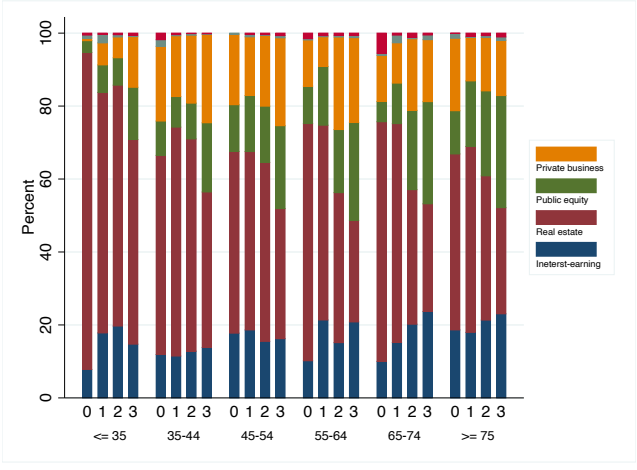
Wealth | Education | Age



SCF: Gross Portfolio Composition by FinLit + Age

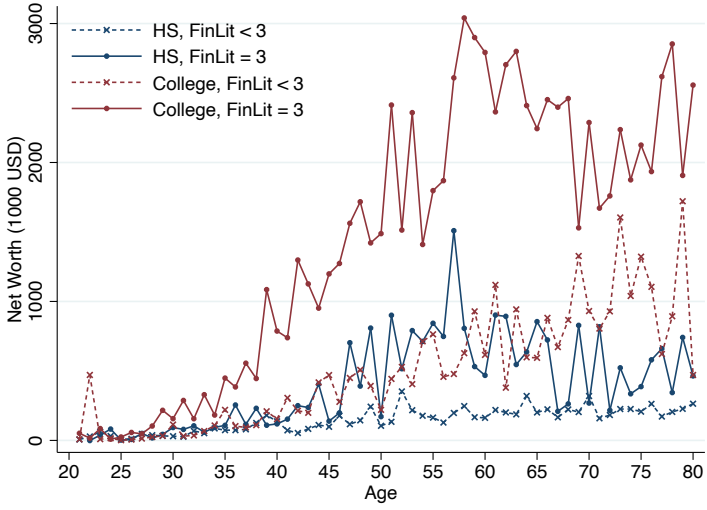
Back

Wealth | Education | Age



SCF: Life-cyle Net Worth by FinLit & Education

Back



Definition: General Equilibrium

Back

A steady-state equilibrium consists of $(K^\star, F^\star, r^{b\star}, r^\star, \underline{r}^\star, \tau^{r\star})$ s.t.

(1) Given $(r^{b\star}, r^\star, \underline{r}^\star, \tau^{r\star})$, household problem gives rise to $\Gamma(\mathcal{X}, f; l, \eta, t)$

(2) Firm's problem characterizes:

$$r^\star = g_k(F^\star, K^\star, L^\star) - \delta_K, w^\star = g_l(F^\star, K^\star, L^\star)$$

(3) Inelastic labor supply

$$L = \int l d\Gamma(\mathcal{X}, f; l, \eta, t < t_R)$$

(4) Aggregate financial literacy

$$F^\star = \int f d\Gamma(\mathcal{X}, f; l, \eta, t)$$

Definition: General Equilibrium (cont'd)

Back

A steady-state equilibrium consists of $(K^\star, F^\star, r^{b\star}, r^\star, \underline{r}^\star, \tau^{r\star})$ s.t.

(5) Gov't budget constraints

$$\tau^l w \int l d\Gamma(\mathcal{X}, f; l, \eta, t < t_R) = \lambda w \int l d\Gamma(\mathcal{X}, f; l, \eta, t \geq t_R) \tag{1}$$

$$G^\star + r^{b\star} B^\star = \tau^{r\star} \int \left(r^{b\star}(1-\kappa) + \tilde{r}(f)\kappa \right) \mathcal{S} d\Gamma(\mathcal{X}, f; l, \eta, t) \tag{2}$$

(6) Market clearing conditions

$$B^\star = \int (1-\kappa) \cdot \mathcal{S} d\Gamma(\mathcal{X}, f, ; l, \eta, t) \tag{3}$$

$$K^\star = \int \kappa \cdot \mathcal{S} d\Gamma(\mathcal{X}, f, ; l, \eta, t) \tag{4}$$

$$r^\star K^\star = \int \left(\underline{r}^\star + r^X(f) + \sigma^X \eta \right) (\kappa \cdot \mathcal{S}) d\Gamma(\mathcal{X}, f, ; l, \eta, t) \tag{5}$$

Parameterization

Back

Parameter		Value
Household Preference		
Discount factor	β	0.96
Elasticity of substitution	ψ	0.5
Risk aversion	γ	5.0
Labor process		
Persistency	ρ^l	0.91
Variance	σ^l	0.21
Pension replacement rate	λ	0.36
Financial literacy		
Deprecation rate in literacy	δ_f	0.02
Investment cost: coefficient	ϕ	0.22
Investment cost: convexity	ι	1.75
Stock market		
Mean excess return	$r^X(f_{\max})$	0.01
Standard deviation	σ^X	0.157
Per-period fixed participation cost	θ	0.09
Production		
Depreciation rate in capital	δ_K	0.08
Capital Intensity	α	0.36
Govt debt to GDP ratio	B/Y	0.82

Clark, Lusardi, Mitchell (2015) ▸ Modeling: FinLit ▸ Calibration Strategy ▸ Paper

$$(\text{Investment Outcome})_i = c + \alpha \text{FinLit} + \beta X_i + \varepsilon_i$$

FinLit & Portfolio Performance *(for Fed employees)*

Compared to the least sophisticated (FinLit 0-1), the most sophisticated (FitLit 4-5):

- Held 11.52% points more stock
- Anticipate earning 3.5 b.p. per month more in excess returns
- Had 40% higher portfolio volatility
- Held portfolios with about 1.71%p less idiosyncratic risk

- Controls: age, sex, whether married, salary, plan balance, years at Fed

Clark, Lusardi, Mitchell (2015): Cont'd

Portfolio outcomes and financial knowledge:

	Equity allocation	Monthly excess return	Monthly SD	%NSR
	1	*2*	*3*	*4*
Med. FinLit Index (2–3)	2.506 (2.781)	0.012 (0.011)	0.118 (0.159)	−1.164 (0.818)
High FinLit Index (4–5)	11.522*** (2.729)	0.035*** (0.011)	0.696*** (0.157)	−1.708** (0.801)
Age	−0.627*** (0.059)	−0.001*** (0.000)	−0.036*** (0.003)	0.084*** (0.016)
Male	4.027*** (1.103)	0.019*** (0.004)	0.294*** (0.065)	0.277 (0.298)
Married	2.089* (1.204)	0.007 (0.005)	0.103 (0.070)	−0.457 (0.339)
Salary ($10k)	0.292* (0.162)	0.000 (0.001)	0.014 (0.010)	−0.045 (0.043)
Total balance ($100k)	1.881*** (0.312)	0.006*** (0.001)	0.096*** (0.019)	−0.427*** (0.082)
Tenure	−0.558*** (0.070)	−0.001** (0.000)	−0.028*** (0.004)	0.124*** (0.018)
N	2,763	2,763	2,763	2,763
R^2	0.157	0.058	0.148	0.058
Mean of dep var (%)	61.347	0.618	4.069	6.680
SD of dep var (%)	29.656	0.117	1.737	7.789

- Reference category: low FinLit (= 0–1 correct)
- Controls: age, sex, whether married, salary, plan balance, years at Fed

What if $A' > 0$?

Back Plot Reg LitReview

- *Suppose financial literacy leads to productivity growth*
- Perfectly competitive firms w/ CRS production

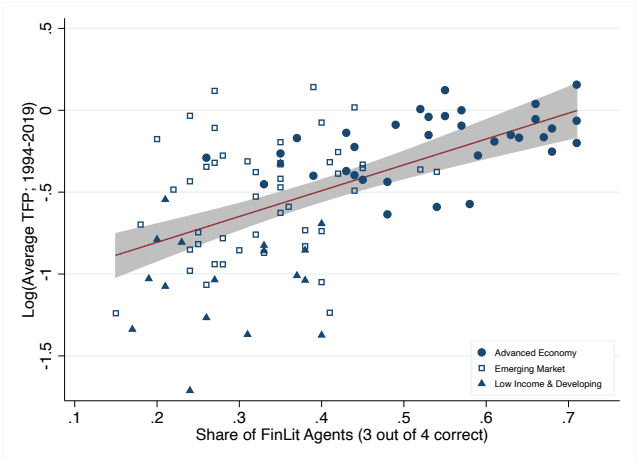
$$Y = g(F, K, L) = A(F)K^{\alpha}L^{1-\alpha} \text{ with } A'(\cdot) > 0$$
$$\Rightarrow r^{\star} = g_k(F, K, L), w^{\star} = g_l(F, K, L)$$

As average financial literacy F increases:

- Literacy-return premium increases stock demands
  $\Rightarrow$ Larger capital supply $\Rightarrow$ market returns to stocks $r^{\star}\blacktriangledown$ ("*total demand effect*")
- Higher average financial literacy translates into more efficient capital allocation
  $\Rightarrow$ Positive externality on TFP $\Rightarrow$ market returns to stocks $r^{\star}\blacktriangle$ ("*productivity effect*")

Cross-Country FinLit & Log(TFP)

Back



FinLit Enhances TFP

Back

- S&P global survey of population share of FinLit adults in 150 countries Data

$$\log\left(\overline{\text{TFP}}_{2014-2019}\right) = \beta_0 + \beta_1(\text{Share FinLit}_{2014}) + \gamma X + \varepsilon$$

	All Countries			Advanced Market		
	(1)	(2)	(3)	(4)	(5)	(6)
Share of FinLit Adults	1.286***	-0.049	-0.060	0.857***	0.409**	**0.428****
	(0.201)	(0.280)	(0.267)	(0.145)	(0.144)	(0.153)
Log(GDP per capita; avg 94-13)		0.254***	0.249***		0.308***	0.275**
		(0.037)	(0.054)		(0.063)	(0.096)
Financial Development (94-13)			0.034			0.071
			(0.185)			(0.166)
R-sq.	0.237	0.513	0.513	0.317	0.618	0.620
No. Obs	100	100	100	34	34	34

- Source: S&P Global FinLit Survey (2014), Penn World Table 10.0, IMF Financial Development Index (Scale 0-1). *p<0.05, **p<0.01, ***p<0.001

★ Discipline $A'(F)$ s.t. 1%p ▲ in pop. share of FinLit adults → 0.5% TFP growth

Lit Review: Financial Development & Growth

Back

Cole, Chien and Lustig (ReStud, 2011)

Paper

- Impact of heterogeneous trading technologies on asset prices & inequality
  - Active vs. passive traders, portfolio choice (bonds vs. stocks)
- Fraction of total wealth held by *active traders* determines asset prices
  - Actively respond to price variation & absorb aggregate risk created by non-participants

Cole, Greenwood, Sanchez (Econometrica, 2016)

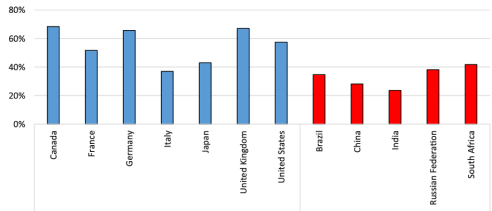
Paper

- Financial system in determining *technology adoption*
  - Intermediary's ability to monitor and control a firm's cash flow
- Contract between *financial intermediaries* and firms

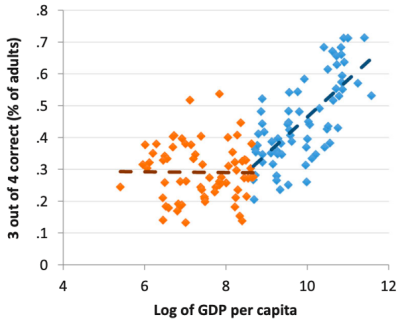
Klapper & Lusardi (2020): Cross-country FinLit

Paper Back

- **Data**: 2014 S&P Global Survey including *financial literacy* questions on:
  ① risk diversification, ② inflation, ③ basic numeracy ④ interest compounding
- **DEF**: Agents are *financially literate* if they know at least 3 out of 4 concepts
- **Sample**: 150K nationally representative, randomly selected adults in 140 countries
- Women, the poor, and younger respondents are less literate
- Worldwide, just one in three adults are financially literate



Klapper & Lusardi (2020): Country characteristics



- Country-level literacy is (+) correlated w/ regulation, (-) w/ uncertainty avoidance
- EU countries w/ lower diversification knowledge $\leftrightarrow$ smaller financial stability

Counterfactual: Full Table

Back

		Baseline (1)	ΔPE (2)	ΔHE (3)	ΔGE (4)
Risk-free return (%)	r^b	2.32		-0.01	0.08
Avg. equity premium (%)	$r - r^b$	5.38		-0.06	-0.10
Base. equity premium (%)	$\underline{r} - r^b$	4.41		-0.09	-0.13
Capital income tax rate (%)	$\tau^{r\star}$	9.77	0.00	-0.01	1.00
Stocks (level)	$\mathbb{E}[\kappa\mathcal{S}]$	4.40	0.15	0.03	0.01
Capital-output ratio	K/Y	2.29	0.05	0.01	0.00
Avg. FinLit	$\mathbb{E}[f]$	2.18	0.25	0.23	0.22
S.D. Finlit	$\mathrm{S.D}[f]$	0.93	-0.10	-0.09	-0.09
Saving rate (%)	$\mathbb{E}[\mathbb{1}(\mathcal{S} > 0)]$	97.518	0.00	0.03	0.02
Participation rate (%)	$\mathbb{E}[\mathbb{1}(\kappa > 0)]$	54.65	1.92	0.77	0.22
Cond. portfolio share in stocks (%)	$\mathbb{E}[\kappa \vert \kappa > 0]$	84.43	1.05	0.60	0.70
Gini index (%)		56.34	-0.26	-0.31	-0.37