The Equity Premium and the One Percent

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Question

Question: Does wealth/income distribution matter for asset pricing?

Intuitive answer: Yes: as the rich get richer, they buy risky assets and drive up prices

[Statements] that "business is good" and "times are booming"... represent the point of view of the ordinary business man who is an "enterpriser-borrower." They do not represent the sentiments of the creditor, the salaried man, or the laborer...

—Irving Fisher, "Introduction to Economic Science", 1910

Motivation

- With complete markets and time- and state-separable utility, a representative agent (RA) exists (Constantinides, 1982)
- But, that does not mean that the wealth distribution is irrelevant for asset pricing, because:
  1. RA's preference in general depends on the initial wealth distribution, and non-standard
  2. RA constructed using Second Welfare Theorem, but possibility of multiple equilibria (ambiguous comparative statics)
  3. Requirement for Gorman (1953) aggregation very strong (identical homothetic preferences)

Contribution

Theoretical Show in a heterogeneous-agent GE model that wealth inequality among risk aversion/belief types affects the equity premium:

- equilibrium uniqueness in a two period model with Epstein-Zin agents with heterogeneous risk aversion, belief, and discount factor
- shifting wealth from less-stock holder to more-stock holder reduces equity premium

Empirical Rising inequality (top 1% income share) negatively predicts returns:

- holds in- and out-of-sample in U.S.
- robust to controls and using top estate tax rate change as instrument
- holds in post-1970 cross-country panel

Literature

Asset pricing theory: Dumas (1989), Wang (1996), Basak & Cuoco (1998), Gollier (2001), Chan & Kogan (2002), Hara, Huang, & Kuzmics (2007), Guvenen (2009), Longstaff & Wang (2012), Bhamra & Uppal (2014), Gârleanu & Panageas (2015), etc.

Return prediction: Shiller (1981), Lettau & Ludvigson (2001), Welch & Goyal (2008), Hansen & Timmermann (2015)

Inequality and asset pricing: Johnson (2012)

(Simplified) Model

- Standard general equilibrium model with incomplete markets (GEI) and constant relative risk aversion (CRRA) preferences:
  - States: $s = 1, \dots, S$
  - Assets: $j = 1, \dots, J$. Asset j pays A_{sj} in state s
  - Agents: $i = 1, \dots, I$. Agent i has CRRA utility

$$U_i(x) = \begin{cases} \left(\sum_{s=1}^{S} \pi_{is} x_s^{1-\gamma_i}\right)^{\frac{1}{1-\gamma_i}}, & (\gamma_i \neq 1) \\ \exp\left(\sum_{s=1}^{S} \pi_{is} \log x_s\right), & (\gamma_i = 1) \end{cases}$$

  where $\gamma_i > 0$: relative risk aversion, $\pi_{is} > 0$: subjective probability of state s
  - Aggregate endowment $e \in \mathbb{R}^S_{++}$; agent i's endowment $e_i = w_i e$, where w_i: wealth share (collinear endowments)
- $U_i(x)$ is homogeneous of degree 1 (for convenience); just a monotonic transformation of additive CRRA utility

Definition of equilibrium

- Agent i solves

$$\begin{aligned} \underset{x,y}{\text{maximize}} \quad & U_i(x) \\ \text{subject to} \quad & q'y \leq 0, \; x \leq e_i + Ay, \end{aligned}$$

  where
  - $q = (q_1, \dots, q_J)'$: vector of asset prices,
  - $y = (y_1, \dots, y_J)'$: number of shares held,
  - $A = (A_{sj})$: payoff matrix of assets
- Equilibrium $(q, (x_i), (y_i))$ is defined by
  1. (Agent optimization) $(x_i, y_i) \in \mathbb{R}_+^S \times \mathbb{R}^J$ maximizes utility,
  2. (Market clearing) $\sum_{i=1}^I y_i = 0$

Characterization of equilibrium

Theorem

Let everything be as above. Then there exists a unique equilibrium. The equilibrium portfolio (y_i) is the solution to the planner's problem

$$\begin{aligned} \underset{(y_i)\in\mathbb{R}^{JI}}{\text{maximize}} \quad & \sum_{i=1}^{I} w_i \log U_i(e_i + Ay_i) \\ \text{subject to} \quad & \sum_{i=1}^{I} y_i = 0. \end{aligned}$$

Letting $\sum_{i=1}^{I} w_i \log U_i(e_i + Ay_i) - q' \sum_{i=1}^{I} y_i$ be the Lagrangian with Lagrange multiplier q, the equilibrium asset price is q.

- Note: Pareto weights (w_i) are exogenous

General model

- General model:
  - Two period ($t = 0, 1$), two assets (stock and bond)
  - $I + 1$ agents, $i = 0$: hand-to-mouth laborer with income share $1 - \alpha_t$; $i \geq 1$: capitalist with income share $\alpha_t w_i$ with $\sum w_i = 1$
  - EZ preference with unit EIS, arbitrary discount factor, risk aversion, and belief
- Main theoretical results:
  1. Unique equilibrium and analytical characterization
  2. Equity premium independent of labor income share $1 - \alpha_t$
  3. Shifting wealth from bond investor to stock investor reduces equity premium (Shifting wealth from impatient to patient investor increases P/D ratio)
- Note: all top wealth & income share data include poor agents in population, but theoretically the poor are irrelevant, at least for equity premium (only within-capitalist inequality matters)

Who holds more stocks?

- Individual problem reduces to $\max_\theta \mathrm{E}_i[u_i(R(\theta))]$, where
  - θ: fraction of wealth invested in stock,
  - $R(\theta) = R\theta + R_f(1-\theta)$: gross return on portfolio,
  - $u_i(x) = \frac{1}{1-\gamma_i} x^{1-\gamma_i}$: CRRA utility, and
  - E_i: expectation under agent i's belief
- A risk tolerant or optimistic agent is the natural stock holder

Proposition

1. *Suppose agents have common beliefs. If $\gamma_1 > \cdots > \gamma_I$, then $0 < \theta_1 < \cdots < \theta_I$.*
2. *Suppose agents 1, 2 have common risk aversion. If agent 1 is more pessimistic, then $\theta_1 < \theta_2$.*

Does inequality predict returns?

- According to theory, shifting wealth from less- to more-stock holder reduces equity premium
- Using household asset allocation data (e.g. from Survey of Consumer Finances), many papers show that the rich are more heavily invested in stocks (Carroll, 2002; Campbell, 2006; Bucciol & Miniaci, 2011; Calvet & Sodini, 2014)
- Hence rising inequality should negatively predict subsequent returns

Proxying capitalist inequality from income inequality

- Using Piketty & Saez (2003) top income share data w/o realized capital gains, by Taylor approximation

$$\mathrm{KGR}(x) := \frac{\mathrm{top}(x) - \mathrm{top}(x)^{\mathrm{excg}}}{1 - \mathrm{top}(x)} \approx \alpha \rho_x \frac{Y_x^k}{Y^k},$$

where

  - $\alpha = Y^k / Y$: aggregate capital income share,
  - ρ_x: fraction of realized capital gains income to capital income for top x%,
  - Y_x^k / Y^k: capital income share of top x% to aggregate capital income
- KGR = capital gains ratio
- Saez & Zucman (2016) data suggests ρ_x explains almost all of $\mathrm{KGR}(x)$

Decomposition of KGR

	Dependent Variable: log(KGR(x))					
	(1)	(2)	(3)	(4)	(5)	(6)
Regressors (t)	0.1%	1%	10%	1%	1%	1%
Constant	-0.11	-0.31	0.87	-4.10	-2.68	-2.67
	(0.39)	(0.38)	(0.41)	(1.72)	(0.088)	(0.44)
log(α)	1.38***	0.93***	1.63***	-0.00		
	(0.29)	(0.31)	(0.31)	(1.11)		
log(ρ_x)	0.90***	1.04***	1.22***		1.00***	
	(0.08)	(0.11)	(0.11)		(0.11)	
log(Y_x^k/Y^k)	0.85***	1.22***	3.64***			1.87***
	(0.10)	(0.24)	(0.56)			(0.55)
Sample	1922--2012	1916--2012	1962--2012	1916--2012	1916--2012	1916--2012
R^2	0.93	0.90	0.93	0.00	0.78	0.14

Time series of KGR(1)

- KGR(1) actually looks very much like the detrended top 1% income share series

TopkKalmanPlot-eps-converted-to.pdf

Interpretation of KGR(1)

- KGR likely captures capitalist wealth inequality rather than timing of realizing capital gains because
  1. Estate tax $\uparrow \implies$ KGR $\downarrow$,
  2. KGR $\uparrow \implies$ rich invest more in stocks

	Dependent: t to $t+1$ change in asset class wealth share					
	Equities share			Bonds share		
Regressors (t)	0.1%	1%	10%	0.1%	1%	10%
Constant	-0.98	-1.35	-0.48	-0.03	-0.45	-0.36
	(0.52)	(0.58)	(0.21)	(0.47)	(0.62)	(0.28)
KGR(x)	0.64***	0.52***	0.15***	0.07	0.21	0.09
	(0.24)	(0.19)	(0.05)	(0.25)	(0.21)	(0.07)
Sample	1913--2012	1913--2012	1917--2012	1913--2012	1913--2012	1917--2012
R^2	0.06	0.06	0.05	0.00	0.01	0.01

Regression using KGR(1)

Regressors (t)	Dependent Variable: t to $t+1$ Excess Market Return (1)	(2)	(3)	(4)	(5)	(6)
Constant	11.92	11.30	17.30	9.10	14.65	13.59
	(2.74)	(4.06)	(8.07)	(16.82)	(10.84)	(3.63)
KGR(1)	-2.69***	-2.70**	-3.38*	-2.89*	-2.56**	-2.79**
	(1.00)	(1.25)	(1.76)	(1.54)	(1.12)	(1.37)
Δ log(GDP)		0.36				
		(0.48)				
log(CGV)			-2.15			
			(2.97)			
log(P/D)				0.99		
				(5.66)		
log(P/E)					-1.12	
					(4.21)	
CAY						1.25*
						(0.76)
Sample	1913--2015	1930--2015	1930--2015	1913--2015	1913--2015	1945--2015

5-year regressions

rscat_top1k-eps-converted-to.pdf

(a) Scatter plot.

FiveYrPred-eps-converted-to.pdf

(b) Time series plot.

Figure: Year t to year $t+5$ excess stock market return (annualized) vs. year t $\mathrm{KGR}(1)$, 1913–2015.

Out-of-sample performance of KGR

- Test $\beta = 0$ (variable x_t not useful for prediction) in

$$R_{t+1} = \alpha + \beta x_t + \varepsilon_{t+1}$$

  using Hansen & Timmermann (2015) out-of-sample test
- $0 < \rho < 1$: fraction of sample set aside for initial estimation

	Predictor in the ALT Model				
ρ	KGR(1)	KGR(10)	KGR(0.1)	log(P/D)	log(P/E)
0.2	3.67***	6.07***	2.67**	-0.12	0.77*
	(0.0040)	(0.0010)	(0.0131)	(0.1367)	(0.0515)
0.3	2.16**	3.19***	1.43**	0.23	1.34**
	(0.0153)	(0.0068)	(0.0436)	(0.1245)	(0.0360)
0.4	1.42**	2.94***	0.64*	-0.42	0.58*
	(0.0388)	(0.0081)	(0.0901)	(0.2781)	(0.0845)

Difference in mean-squared prediction errors

CumSum_top1k-eps-converted-to.pdf

(a) KGR(1).

CumSum_top10k-eps-converted-to.pdf

(b) KGR(10).

CumSum_PD-eps-converted-to.pdf

CumSum_PE-eps-converted-to.pdf

Using tax policy as instrument

- Current and lagged top estate tax rate (ETR) changes significantly correlated with KGR
- Can be used as instruments to address causality

	Dependent Variable: $\mathrm{KGR}(x)_t$		
Regressors	0.1%	1%	10%
Constant	1.52	2.37	3.11
$\Delta\mathrm{ETR}_t$	-0.04***	-0.06***	-0.07***
$\Delta\mathrm{ETR}_{t-1}$	-0.03**	-0.04*	-0.04*
$\Delta\mathrm{ETR}_{t-2}$	-0.07***	-0.10***	-0.10***
$\Delta\mathrm{ETR}_{t-3}$	-0.06***	-0.08***	-0.08***
R^2	0.26	0.24	0.19

IV regressions using tax rate change as instrument

Dependent Variable: t to $t+1$ Excess Market Return			
	KGR(x) version		
Regressors (t)	0.1%	1%	10%
Constant	18.09	22.58	28.43
	(24.05)	(23.85)	(24.78)
KGR(x)	-10.79**	-7.52**	-6.91**
	(4.54)	(3.27)	(3.08)
%ΔIP	-1.51***	-1.49***	-1.46***
	(0.51)	(0.49)	(0.48)
log(P/E)	3.71	2.61	1.90
	(9.98)	(10.02)	(10.64)
J statistic	0.65	0.69	0.75
	($p = 0.72$)	($p = 0.71$)	($p = 0.69$)

Cross-country panel regressions

- Theoretical model is about a closed economy
- Theory should apply to "relatively closed" economies:
  1. Large economy (U.S.),
  2. Small country with home bias (emerging countries)
- Theory should not apply to small open economies (e.g., Europe)
- For any relatively open economy, inequality of international investors (proxy: U.S.) should matter
- Hence redo exercise with local and U.S. inequality series and Mishra (2015) home bias measure

Regressions using local and U.S. top income shares

Dependent Variable: t to $t+1$ Stock Return				
	(1)	(2)	(3)	(4)
Regressors (t)	All	Advanced	ex-U.S.	ex-U.S.
Top 1%	-0.94*	-1.01*	-0.42	2.61
	(0.52)	(0.49)	(0.70)	(1.55)
U.S. KGR(1)			-2.51***	-0.53
			(0.43)	(0.75)
Top 1% $\times$homebias				-5.44**
				(2.42)
U.S. KGR(1) $\times(1-\text{homebias})$				-4.17**
				(1.60)
Country FE	Yes	Yes	Yes	Yes
Obs.	815	712	769	687
R^2 (w,b)	(.00,.05)	(.01,.03)	(.02,.13)	(.03,.27)

Conclusion

- Effect of wealth distribution on asset prices is intuitive (Fisher narrative) but there are only a few theoretical papers and almost no empirical work
- Provided a simple GE model with heterogeneous wealth/risk aversion and derived negative relation between inequality and equity premium
- Rising inequality (top 1% income share) negatively predicts returns:
  - holds in- and out-of-sample in U.S.
  - robust to controls and using top estate tax rate change as instrument
  - holds in post-1970 cross-country panel