Session 3, Part 2
In Search of the Origins of Financial Fluctuations:
The Inelastic Markets Hypothesis

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Why are financial markets so volatile?

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- Common feature across modern behavioral and rational asset pricing models:
  - Markets are macro elastic: E.g., if a sovereign wealth fund buys 10% of the US stock market, equity prices would rise by less than 1%.

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  - Flows in financial markets do not matter,
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  for prices and expected returns.
- We propose an alternative view:
  - Markets are macro inelastic: Flows have a large impact on prices and future excess returns.
- We refer to this as the inelastic markets hypothesis (IMH).

Our insights

- A new asset pricing theory of inelastic financial markets:
  - Why are markets inelastic?
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- We find that
  - If you buy \$1 worth of the aggregate stock market (selling bonds), this increases the valuation of the aggregate stock market by \$5
  - If you buy 1% worth of the aggregate stock market (selling bonds), this increases the valuation of the aggregate stock market by 5% (where $M = 5$ to simplify: we find $M \in [3, 8]$)
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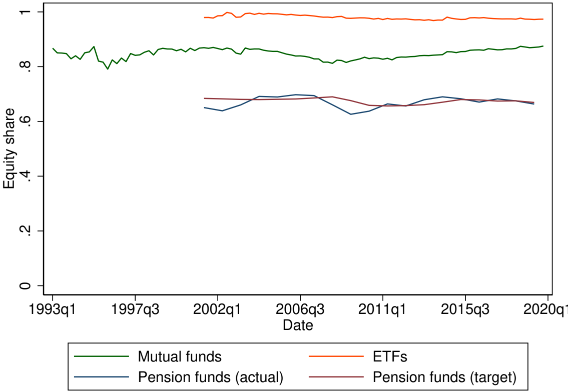
  - This is symmetric between buys and sells
- New measurement of flows into equity markets:
  - Explore links to prices, macro variables, and survey expectations.
- More broadly, a framework to connect prices, fundamentals, and portfolio flows and holdings to understand prices and expected returns across markets and asset classes.

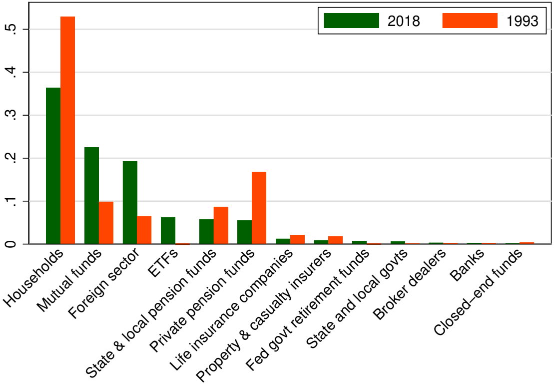
Why may markets be inelastic?

- Many funds are constrained:
  - A 100% equity fund provides no elasticity.
  - Funds with a fixed-share mandate (70/30 stocks-bonds) is still very constrained.



Why may markets be inelastic?

- Who times the market aggressively?
  - Survey suggests broker dealers or hedge funds.
  - Hedge funds are also small ($\sim$5% of market) and reduce allocations in bad times (outflows or risk constraints, Ben-David et al. '12).



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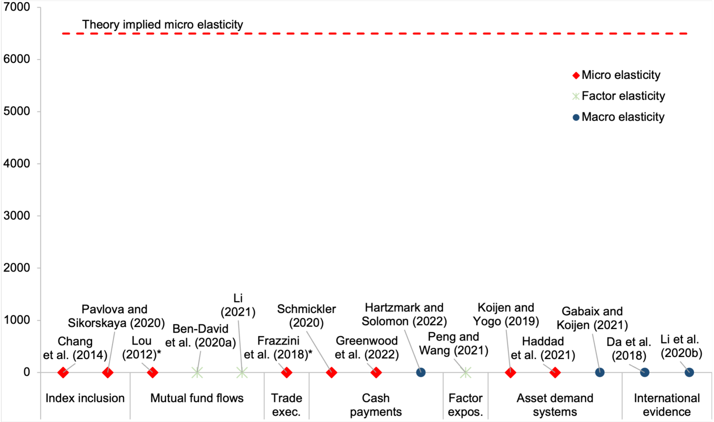

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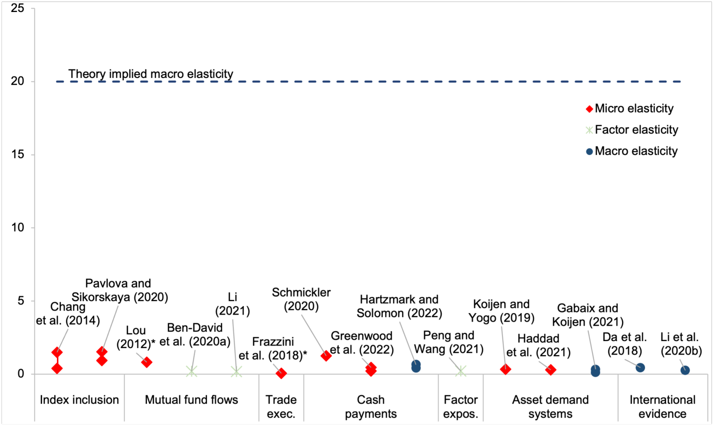
  - Theory: micro elasticity $\gg$ macro elasticity.



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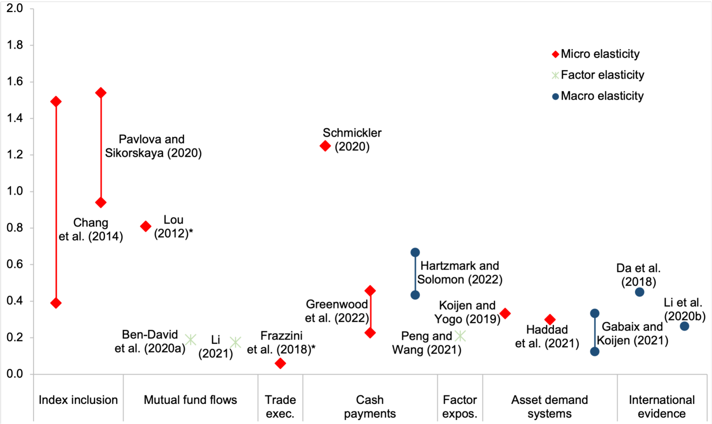

Inelastic markets contradicts common beliefs in finance

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- Two surveys before our paper circulated:
  - "Academic": Participants to VirtualFinance.org and Harvard PhD students.
  - "#EconTwitter": General public, with a large fraction of academics.
- Median answer: $M = 0$
- Median answer with $M > 0$: $M = 0.01$

Literature review

- Our focus: The market's macro elasticity
  - Micro elasticity: Kyle '85, Shleifer '86, Wurgler Zhuravskaya '02, Duffie '11, Chang Hong Liskovich '15.
  - Mutual fund flows and aggregate returns: Warther '95.
  - Demand system approach (cross section): Koijen Yogo '19, Koijen Richmond Yogo '20.
- Demand and supply pressure, response to incentives esp. in bonds: Baker Wurgler '04, Gabaix Krishnamurthy Vigneron '04, Garleanu Pedersen '09, Greenwood Hanson '13, Greenwood Vayanos '14, Greenwood Hanson Stein '16, + Sunderam '21, Vayanos Vila '21
- Flows in markets: Froot Ramadorai '05, Chien, Cole, Lustig '12, Bacchetta and Van Wincoop '10, '21, Gabaix Maggiori '15, Cavallino '19.
- Quantitative easing in bond markets: Krisnamurthy and Vissing-Jorgensen '11, Koijen Koulicher et al. '21
- Macro-finance: Gertler Karadi '12, He Krishnamurthy '13, Brunnermeier Sannikov '14, Caballero Simsek '20, '21
- Behavioral finance: e.g. Shleifer '00, Calvet et al. '09, Barberis, Greenwood, Jin, Shleifer '15, Barberis '19.

Outline of the remainder of the talk

1. The basic economics of flows and prices in macro-inelastic markets:
    1.1 Two-period
    1.2 Infinite horizon
2. Empirical investigation.
    2.1 Macro-elasticity of the US stock market.
    2.2 Measuring capital flows into the aggregate market.
3. Macro-finance with inelastic markets.
    3.1 Alternative to CCAPM.
    3.2 Model with production.
4. Time permitting:
    4.1 Policy
    4.2 Micro vs Macro elasticity
    4.3 How tenets of finance chance if the Inelastic Markets Hypothesis is true.

Aggregate stock market: 2-period model

- Initially, we fix the interest rate and average risk premium (we'll endogenize those later)
- Two assets
  - One aggregate stock in supply of Q^S shares and with price P.
  - One bond in supply B^S, with price fixed at 1.

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  - One aggregate stock in supply of Q^S shares and with price P.
  - One bond in supply B^S, with price fixed at 1.
- Two funds (i.e. 2 masses of competitive funds):
  - One "pure bond fund": Just holds bonds.
  - One "balanced fund" Demand for stocks Q^D mandated as:

$$\frac{PQ^D}{W} = \theta e^{\kappa(\pi - \bar{\pi})},$$

  where $\pi = \frac{\bar{D}}{P} - 1 - r_f$ is the risk premium, $\bar{\pi}$ its average.
    - E.g. if $\kappa = 0$, the mandate is a fixed equity share θ.
- With rational consumers, the fund's mandate wouldn't matter: consumers would offset the mandate by adjusting flows.

TOTAL IMPACT: THE MARKET AS A FLOW MULTIPLIER

- At time 0^-, balanced fund is worth $\bar{W}$ and holds shares and $\pi = \bar{\pi}$. Initial $\delta = \overline{D/P}$.
- At $t = 0$, there's an inflow ΔF dollars in the balanced fund, so $f = \frac{\Delta F}{\bar{W}}$% flow.

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- **Proposition**: The equity price reaction to flows is

$$\frac{\Delta P}{P} = \frac{f}{\zeta}$$

where ζ is the macro-elasticity of demand

$$\zeta = 1 - \theta + \kappa\delta$$

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- Calibration + estimation: $\zeta = 1 - \theta + \kappa \times \delta \simeq 1 - 0.85 + \kappa \times \delta = 0.2$.
- \$1 bought in the market increases total market cap by \$5.

Implications for κ

- Empirically, we calibrate $\kappa \simeq 1$. (see also Dahlquist and Ibert '24)

Equity share	κ
15	55.5
25	35.0
35	21.6
45	11.5
50	7.3
55	3.5
60	0.0
65	-3.2
70	-6.2
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- Rational / Merton model predicts: $\kappa = \frac{\ln \theta}{d\pi} = \frac{1}{\pi} = 25$ (as $\theta = \frac{\pi}{\gamma\sigma^2}$)

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- Recall $\zeta = 1 - \theta + \kappa\delta$.
- $\kappa < 0$: The paper has an extension with inertia.

Undergraduate example

- Balanced fund has $\theta = 0.8$, $\kappa = 0$: $\zeta = 1 - \theta + \kappa\delta = 0.2$.
- Supply: $Q = 80$ shares, B units of the bond.
- Initial stock price is \$1 and initial holdings:
  - Balanced fund: \$80 in stocks + \$20 in bonds = \$100 total.
  - Bond fund: $\$B - \$20$ bonds.

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- So price is $P = \frac{\$84}{80} = \$1.05$, price increase of 5% $\Rightarrow$ Multiplier = 5.
- Equity flow

$$f_S = \frac{\sum_i \theta_i \Delta F_i}{W} = \frac{0.8 \times 1}{0.8 \times 100} = 1\%.$$

Aggregating heterogeneous investors

- Linearized demand of fund i, with $q_i^D = \frac{\Delta Q_i}{Q_i}$, $p = \frac{\Delta P}{P}$, $\zeta_i = 1 - \theta_i + \kappa_i \delta$

$$q_i^D = -\zeta_i p + f_i$$

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- Aggregate demand: with $S_i = \frac{Q_i}{Q}$ = share of equities owned by fund i, with $X_S = \sum_i S_i X_i$
$$q_S^D = -\zeta_S p + f_S$$

- In general, everything remains the same as with the "representative mixed fund", but using equity-weighted averages, not asset-under-management-weighted averages.

What's an "aggregate flow into equities"?

- How do we measure flows into the market given that "for every buyer there is a seller"

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WHAT'S AN "AGGREGATE FLOW INTO EQUITIES"?

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- Recall aggregate demand: with $S_i = \frac{Q_i}{Q}$ = share of equities owned by fund i, with $X_S = \sum_i S_i X_i$

$$q_S^D = -\zeta_S p + f_S$$

- The correct flow into the market is (W= value of equities)

$$f_S = \frac{\sum_i \theta_i \Delta F_i}{W^{\mathcal{E}}} = \frac{\sum_i \theta_i \Delta F_i}{\sum_i \theta_i W_i} = \frac{\sum_i \theta_i \Delta F_i}{\text{Value of Equities}}.$$

- Ideal data: Flows at the fund level into stocks and bonds (ΔF_i) and corresponding equity shares (θ_i).

Infinite horizon: Demand curve

- The 2-period model generalizes well to an infinite horizon
- Mandate of representative fund, with ν_t demand shocks:

$$\frac{P_t Q_t^D}{W_t} = \theta e^{\kappa(\pi_t - \bar{\pi}) + \nu_t}$$

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- Notations (simplified here: more elaborate in paper)
  - $\bar{P}_t, \bar{W}_t, \bar{D}_t$ baseline values (without flow shocks),
  - Deviations from baseline values:

$$p_t = \frac{P_t}{\bar{P}_t} - 1, \qquad d_t = \frac{D_t}{\bar{D}_t} - 1, \qquad d_t^e = \mathbb{E}_t d_{t+1}.$$

  - Cumulative flow:

$$f_t = \frac{F_t - \bar{F}_t}{\bar{W}_t}.$$

Infinite horizon: Price as PV of dividends and flows

- **Proposition**: Price deviations are given by

$$p_t = \mathbb{E}_t \sum_{\tau=t}^{\infty} \frac{\rho}{(1+\rho)^{\tau-t+1}} \left(\frac{f_\tau}{\zeta} + \delta d_\tau^e \right),$$

with ρ is the "effective discount factor,"

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- If flows mean-revert at rate ϕ ($\mathbb{E} f_t = (1-\phi)^t f_0$):

$$\Delta p_0 = \frac{f_0}{\zeta + \kappa\phi}, \qquad \Delta \pi_0 = -(\delta + \phi) \Delta p_0$$

Empirical investigation

- A primer on estimating macro elasticities and the multiplier.
- Granular instrumental variables.
- Connection to existing identification strategies.
- Two implementations:
    1. Mutual fund flows and 13F data.
    2. Flow of funds.
- In ongoing work, we also implement the GIV at the stock level to estimate the micro elasticity.

Estimating elasticities and the multiplier

- Notation $X_{St} := \sum_i S_i X_{it}$, $X_{Et} := \sum_i \frac{1}{N} X_{it}$ (with $\sum_i S_i = 1$).
- $\Delta q_{it} = \frac{Q_{it} - Q_{i,t-1}}{Q_{i,t-1}}$: fractional changes in investors' equity holdings.
- To develop ideas, we model

$$\Delta q_{it} = -\zeta_i \Delta p_t + f_{it}^{\nu},$$

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  - η_t: Aggregate shocks.
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  where
  - η_t: Aggregate shocks.
  - u_{it} : Idiosyncratic or investor-specific shocks.
- Key identifying assumption:

$$\mathbb{E}\left[u_{it} \eta_t\right] = 0.$$

Estimating elasticities and the multiplier

$$\Delta q_{it} = -\zeta_i \Delta p_t + \lambda_i' \eta_t + u_{it},$$

- Market clearing implies $\Delta q_{St} = 0$ and hence, with $M = \frac{1}{\zeta_S}$.

$$\Delta p_t = M \left(\lambda_S' \eta_t + u_{St} \right)$$

- The core idea in GIV is to use u_{it} in to estimate aggregate elasticities and multipliers.

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- The core idea in GIV is to use u_{it} in to estimate aggregate elasticities and multipliers.
- Simplest argument: Take $\zeta_i = \zeta$, $\check{X}_i = X_i - X_E$:

$$\Delta q_{it} - \Delta q_{Et} = \check{\lambda}_i' \eta_t + \check{u}_{it}$$

- So you run a factor model on $\Delta q_{it} - \Delta q_{Et}$, collect $\check{u}_{it}^e$, η_t^e, and form GIV:

$$z_t := \sum_i S_{i,t-1} \check{u}_{it}^e$$

- The OLS gives a consistent estimator of M:

$$\Delta p_t = M z_t + \beta \eta_t^e + \varepsilon_t$$

Granular instrumental variables (GIV)

- In G-K GIV ('24), we:
  - Show how to use factor models to estimate idiosyncratic shocks, u^e_{it}.
  - Provide conditions under which the estimated idiosyncratic shocks can be used efficiently by forming $z_t := \sum_i S_{i,t-1}\check{u}^e_{it}$ as the GIV.
  - Show how to extend to different ζ_i (use the shocks u_{jt} for $j \neq i$).
  - Implement examples (e.g., oil markets; sovereign spillovers) where the residuals of the factor model can be matched to labeled shocks.
    - This is unfortunately not feasible in this case.

GIV: Requirements and threats to identification

- When does GIV result in precise multiplier estimates?
  - Investor sectors are concentrated.
  - Volatile idiosyncratic shocks.
- Threat to identification:
  - Not properly controlling for a common factor with loadings that are correlated with size ($\lambda_S - \lambda_E \neq 0$).
  - To obviate that concern:
    - Add factors, see if estimate changes significantly
    - Use over-identification tests: e.g., form the GIV on the $z_{kt} = \sum_{i \in I_k} S_{i,t-1} \check{u}^e_{it}$ for different subset I_k of large investor groups, and see if the z_{kt} give the statistically similar estimates.

Connection to existing identification strategies

- The existing literature is a special case of GIVs where we have labeled shocks:
  - Index inclusion is a u_{it} of benchmark-restricted investors.
  - Shocks to Morningstar ratings is a u_{it} to the mutual fund sector's demand.
  - ...

The GIV is more generally useful in macro-finance

- Foreign inflows and their impact on the exchange rates (Camanho, Hau Rey '22) / on GDP...
  - ... and then impact of exchange rates on trade (GIV with idiosyncratic demand shocks by large investment funds)
- What's the impact of an increase concentration (via GIV on Herfindahl) on wages, employment? (Schubert and Stansbury '22)
- If there is an export boom, what's the impact on the exchange rate, and the rest of the economy? (Use export shocks to large firms)
- Do firm-specific hiring and investment spill over to peer firms operating in the same product market?
- Impact of 100 "China shocks": there are lots of idiosyncratic foreign export shocks, look at their impact, generalizing Autor et al. '03
- GIV in networks (Chodorow-Reich, G. K. '23): domestic and international

Data sources

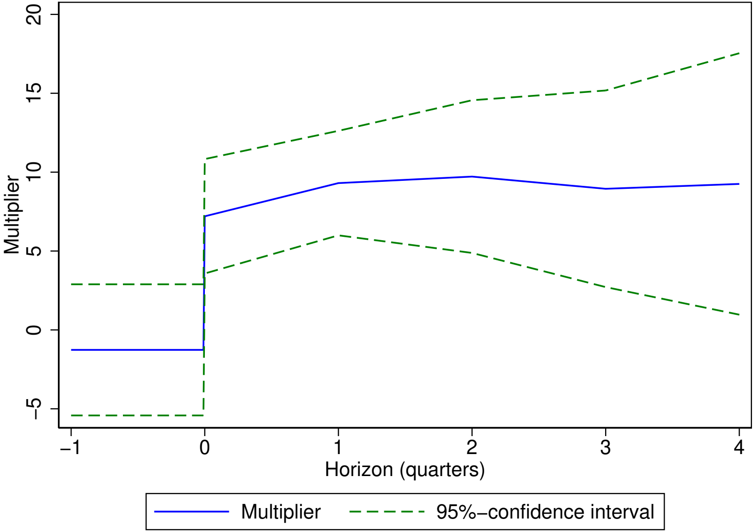
- Flow of funds (quarterly, 1993-2018):
  - Sector-level data on levels and flows of stocks and bonds.
  - Bonds: Treasury securities and corporate bonds.
  - We adjust the levels and flows for holdings of assets outside of the U.S.
- Morningstar (monthly, 1993-2018):
  - Disaggregated data on mutual funds and ETFs.
- 13F data (quarterly, 1999-2019):
  - FactSet

Details of GIV procedure

GIV applied Flow of Funds: $M \simeq 5$ to 7

	Δp	Δp	Δq_E	Δq_E	Δq_C	Δq_C	Δp
Z	7.08	5.28					
	(1.86)	(1.10)					
Δp			-0.13	-0.17	-0.01	-0.01	
			(0.04)	(0.05)	(0.01)	(0.02)	
GDP growth	5.99	5.97	0.56	0.85	0.22	0.23	5.93
	(0.69)	(0.67)	(0.27)	(0.33)	(0.13)	(0.16)	(0.91)
η_1	21.06	23.72	3.98	5.49	-0.72	-0.64	31.50
	(13.58)	(12.79)	(2.08)	(2.07)	(0.69)	(0.81)	(15.57)
η_2		29.95		5.62		0.29	
		(6.54)		(2.15)		(0.67)	
Constant	-0.01	-0.01	0.00	0.00	-0.00	-0.00	-0.01
	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
Observations	104	104	104	104	104	104	104
R^2	0.436	0.515					0.279

Those flows impact the price over a long horizon



GIV applied to disaggregated data

- As alternative way to estimate the multiplier, we use:
  - Disaggregated 13F data (outside of mutual funds) to estimate common factors.
  - Disaggregated mutual fund flows to isolate idiosyncratic shocks.
- Sample from 2000.Q1 - 2019.Q4.
- This approach allows for heterogeneous elasticities.

GIV applied to disaggregated data: Details

- Extract common factors η_t from disaggregated demands in 13F filings outside mutual funds

$$\Delta q_{jt} = -\zeta_{j,t-1}\Delta p_t + \lambda'_{j,t-1}\eta_t + u_{jt}.$$

- With Δf_t the % inflow into mutual funds, estimate (monthly)

$$\Delta f_t = \sum_{l\geq 1} a_l \Delta f_{t-l} + ct + \epsilon^f_{mt},$$

  so the new demand from mutual funds is:

$$Z_t = S^{MF}_{t-1}\frac{\epsilon^f_t}{1-\sum_l a_l}.$$

- Estimate M in:

$$\Delta p_t = MZ_t + \lambda'\eta_t + m'C_t + a + e_t$$

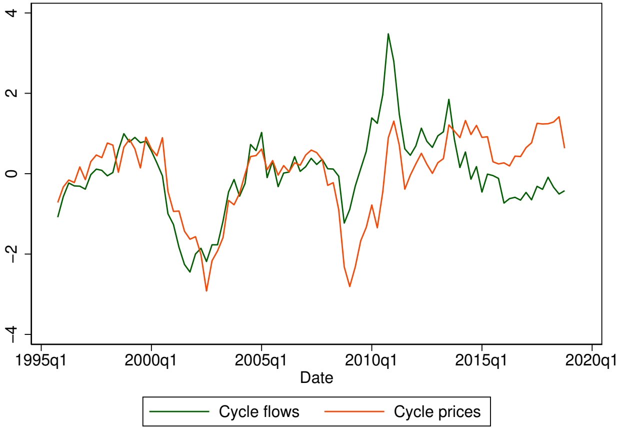
- Compared to mutual fund literature (Warther '95, Goetzmann and Massa '03) we:
  - Control for common factors η_t extracted from funds outside mutual funds.
  - Adjust for total present value of inflows via K.

GIV using mutual fund flows: $M \simeq 7$ to 8

	Δp	Δp	Δp	Δp	Δp	Δp
Z	11.05	10.96	8.67	7.85	7.84	7.73
	(2.63)	(2.76)	(2.50)	(2.31)	(2.32)	(1.91)
GDP growth	4.16	4.18	4.90	4.96	4.96	3.40
	(1.29)	(1.27)	(1.01)	(1.18)	(1.18)	(1.19)
η_1		-0.88	-0.91	-0.92	-0.92	0.08
		(0.73)	(0.53)	(0.62)	(0.62)	(0.60)
η_2			-2.96	-3.04	-3.04	-0.81
			(0.62)	(0.48)	(0.48)	(0.37)
η_3				-0.84	-0.84	-1.22
				(0.55)	(0.55)	(0.41)
η_4					0.05	-0.26
					(0.34)	(0.38)
$\Delta\sigma$						-0.10
						(0.01)
Observations	80	80	80	80	80	80
R^2	0.434	0.445	0.561	0.570	0.570	0.702

A new measure of capital flows into the stock market

- Guided by the theory, we construct a new measure of capital flows into the US stock market.
- We construct the cumulative flow and extract the cyclical component.



Capital flows, beliefs, macro-variables, and prices

- Correlations between capital flows, prices, macroeconomic variables, and survey expectations of returns (Greenwood and Shleifer '14).

	Flow	Flow	Flow	Return	Return	Return	Return
Gallup	0.48		0.46		0.61		0.33
	(0.10)		(0.11)		(0.09)		(0.09)
GDP growth		0.21	0.06			0.41	0.21
		(0.11)	(0.11)			(0.10)	(0.08)
Flow				0.65			0.45
				(0.09)			(0.09)
Constant	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.10)	(0.11)	(0.10)	(0.09)	(0.09)	(0.10)	(0.07)
Observations	79	79	79	79	79	79	79
R^2	0.233	0.046	0.237	0.426	0.376	0.171	0.582

Macro GE: Endowments and Funds

- Traditional CRRA utility $\sum \beta^t c_t^{1-\gamma} / (1-\gamma)$.
- For now, endowment $Y_t = Y_{t-1} G_t$, with G_t lognormal, $\mathbb{E}[G] = e^g$.
- Later, we'll do a production economy
- Divide output: $Y_t = \mathcal{D}_t + \Omega_t$ with $\mathcal{D}_t = G_t^D \mathcal{D}_{t-1}$, and Ω_t "residual" (combination of wages, etc)
- The whole tree is priced as

$$P_t = \frac{D_t}{\delta} e^{p_t},$$

- Two funds: 1) pure bond 2) mixed fund with equity share

$$\theta_t = \theta \exp\left(-\kappa^D p_t + \kappa \mathbb{E}_t \left[\Delta p_{t+1}\right]\right)$$

Consumer

- Household has 2 members: rational consumer, behavioral investor
- Rational consumer chooses consumption, trades bond: so Euler equation *for bonds* holds,

$$\mathbb{E}_t \left[\beta \left(\frac{C_{t+1}}{C_t} \right)^{-\gamma} R_{ft} \right] = 1$$

- Behavioral investor invests in the two funds. Seeks to maximize with "narrow framing"

$$\mathbb{E}_t \left[V^p \left(w_{t+1} \right) \right], \qquad V^p \left(w \right) = \frac{w^{1-\gamma}}{1-\gamma}$$

Behavioral investor

- There's a "behavioral disturbance" b_t: stand in for noise in institutions, beliefs, tastes, fears, etc. It's an AR(1).
- When $b_t = 0$, wants,

  $$\bar{\theta}^M = \underset{\theta^M}{\operatorname{argmax}} \mathbb{E}\left[V^p\left(\left(1-\theta^M\right)R_{ft} + \theta^M R_{M,t+1}\right)|b_t = 0\right]$$

  which leads to flow into mixed fund:

  $$\Delta\bar{F}_t = \frac{1-\theta}{\theta\delta}\Delta\mathcal{D}_t.$$

- However, his policy is perturbed: invests in pure bond fund

  $$\Delta F_t = \Delta\bar{F}_t + \frac{1}{\delta}\Delta\left(b_t\mathcal{D}_t\right)$$

- Allocation is optimal on average, not date by date
- Model endogenizes b_t as coming from belief shocks, $b_t = k\mathbb{E}_t^{\text{subj}}\left[\hat{\pi}_{t+1}\right]$, matching Giglio et al. ('21) evidence on the pass-through between volatile beliefs and small flows.

Equilibrium definition

- State vector: $Z_t = (Y^t, \mathcal{D}_t, \mathcal{D}_{t-1}, b_t)$: fundamentals + behavioral disturbance.
- **Definition**: An equilibrium comprises functions: the stock-price $P(Z)$, the interest rate $R_f(Z)$, and the consumption and asset allocation $c^r(Z)$, $B^r(Z)$, such that the mixed fund's allocation $\theta(P, Z)$ follows its mandate, and

1. The consumer follows the consumption policy $c^r(Z)$, which maximizes utility subject to the above constraints.
2. The investor follows the behavioral policy above.
3. The consumption market clears, $c^r(Z) = Y(Z)$.
4. The equity market clears: the mixed fund holds all the equity $(Q^D(Z) = Q^S)$.

Solution: Flows

- Given what's above, the flow is:

$$f_t = \theta b_t$$

  where $d_t = \sum_{s=1}^{t} \frac{\Delta Y_t}{Y_{t-1}}$ is the cumulative growth rate in the dividend.
- Specialize to $f_t = (1 - \phi_f)\, f_t + \varepsilon_t^f$
  - Stand in for e.g. random beliefs / risk aversion / fad shocks

Solution: Whole endowment economy

- **Proposition**: whole economy is solved as $\zeta = 1 - \theta + \kappa^D$, $\rho = \frac{\zeta}{\kappa}$. Stock price is:

$$P_t = \frac{D_t}{\delta} e^{p_t},$$

where deviation is:

$$p_t = b_f^p f_t, \qquad b_f^p = \frac{1}{\zeta + \kappa \phi_f}.$$

Variance of stock returns:

$$\sigma_r^2 = var\left(\varepsilon_t^D + b_f^p \varepsilon_t^f\right).$$

Equity premium depends on flows, which depend on the behavioral deviation:

$$\pi_t = \bar{\pi} + b_f^\pi f_t, \qquad \bar{\pi} = \gamma \sigma_r^2, \qquad b_f^\pi = -\left(\delta + \phi_f\right) b_f^p.$$

- Finally, the interest rate is $r_f = -\ln \beta + \gamma g - \gamma\left(\gamma + 1\right) \frac{\sigma_y^2}{2}$ and $\delta = r_f + \bar{\pi} - g$.
- Here, flows affect prices and returns.

BASIC EQUATIONS OF MACRO-FINANCE WITH FLOWS

- Pricing of stocks and bonds with SDF $\mathcal{M}_{t+1} \neq \beta \left(\frac{C_{t+1}}{C_t} \right)^{-\gamma}$

$$\mathcal{M}_{t+1} = \exp(-r_{ft} - \pi_t \frac{\varepsilon_{t+1}^D}{\sigma_D^2} + \xi_t), \qquad \pi_t = \bar{\pi} + b_f^{\pi} \tilde{f}_t$$

- Flows and prices responses are the primitives, and the SDF just records of those.
- The SDF is a symptom, not a cause.
- Consumption does not price equities (though prices bonds)

$$\mathbb{E}_t \left[\beta \left(\frac{C_{t+1}}{C_t} \right)^{-\gamma} R_{M,t+1} \right] \neq 1$$

- Investment, labor demand (with $\kappa =$cost of investment)

$$\begin{aligned} V(K_t, Z_t) &= \max_{I_t, L_t} \{ F(K_t, L_t, Z_t) - w(Z_t) L_t - I_t - \kappa(I_t, K_t, Z_t) \\ &\quad + \mathbb{E}_t [\mathcal{M}_{t+1} V((1-\delta) K_t + I_t, Z_{t+1})] \} \end{aligned}$$

Calibration: Postulates

Variable	Value
Growth rate of endowment and dividend	$g = 2\%$
Std. dev. of endowment growth	$\sigma_y = 0.8\%$
Std. dev. of dividend growth	$\sigma_D = 5\%$
Mixed fund's equity share	$\theta = 0.85$
Mixed fund's sensitivity to risk premium	$\kappa = 1$
Active fraction of funds	$m_p = 0.84$
Mean reversion rate of behavioral disturbance	$\phi_b = 4\%$
Std. dev. of innovations to behavioral disturbance	$\sigma_b = 3.3\%$
Time preference	$\beta = 1.03$
Risk aversion	$\gamma = 2$

Variables generated by the calibration

Variable	Value
Macro elasticity	$\zeta = 0.16$
Macro elasticity with mean-reverting flow	$\zeta^M = 0.2$
Macro market effective discount factor, $\rho = \zeta/\kappa$	$\rho = 16\%$
Risk free rate	$r_f = 1\%$
Average equity premium	$\bar{\pi} = 4.4\%$
Average dividend-price ratio	$\delta = 3.4\%$
Std. dev. of stock returns	$\sigma_r = 15\%$
Share of variance of stock returns due to flows	89%
Share of variance of stock returns due to fundamentals	11%
Mean reversion rate of cumulative flow and log D/P	$\phi_f = 4\%$
Std. dev. of innovation to cumulative flow	$\sigma_{\tilde{f}} = 2.8\%$
Slope of log price deviation to flow	$b_f^p = 5$
Slope of equity premium to flow	$b_f^\pi = -0.37$

Some stock market moments

	Data	Model
Std. dev. of excess stock returns	0.17	0.15
Mean P/D	37	33
Std. dev. of log P/D	0.42	0.5

	Data			Model			
Horizon	Slope	S.E.	R^2	Slope	95% CI	S.E.	R^2
1 yr	0.11	(0.034)	0.07	0.14	[0.04, 0.32]	(0.048)	0.09
4 yr	0.36	(0.14)	0.18	0.61	[0.18, 1.19]	(0.17)	0.28
8 yr	1.00	(0.34)	0.40	1.34	[0.39, 2.50]	(0.31)	0.43

Predictive regression: $R_{t\to t+T} = \alpha_T + \beta_T \log\left(\frac{D_t}{P_t}\right)$

Payoffs from having such a macro model

- Can see how disturbances in asset markets (coming from flows) impact on real economy
- Inflow shocks $\Rightarrow$ risk premium $\searrow \Rightarrow$ Investment, GDP $\nearrow$
- Can discipline model with not just with *price* data from asset markets, but also with *quantity* data from asset holdings
- Potentially, will be a useful way to do have a realistic finance
- Extension in paper: long term bonds.

Potential policy: government intervention of stock market?

- Take $\frac{1}{\zeta} = 5$.
- Suppose that the government buys f^G percent of the market, and keeps it forever. Then, market increased by

$$p = \frac{f^G}{\zeta} \simeq 5 f^G$$

- So, buy 1% of market, (about 1% of GDP), then market goes up by 5%

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- If the government buys it for just T periods, impact is

$$p = \left(1 - \frac{1}{(1+\rho)^T}\right)\frac{f^G}{\zeta}$$

Potential policy: government intervention of stock market?

- This may be a potential policy?
- In Aug. 1998, the Hong Kong government (under speculative attack) bought 6% of the HK stock market: 24% abnormal return, not reversed in the next eight weeks. (Caballero '99)
- The BoJ now holds 5% of Japanese stock market. Bloomberg "The Bank of Japan, sometimes dubbed the Tokyo whale for its huge influence on the country's stock market, [...] is taking up too much of the pool."
- (Papers have estimated micro, not macro elasticities in Japan: Barbon Gianinazzi '19, Charoenwong et al. '19 estimate)
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Revisiting Macro-Financial Tenets

- "The market often looks impressively efficient in the short turn, so it must be quite macro-efficient"
  - Remember $p_t = \mathbb{E}_t \sum_{\tau=t}^{\infty} \frac{\rho}{(1+\rho)^{\tau-t+1}} \left(\frac{f_\tau + \nu_\tau}{\zeta} + \delta d_\tau^e \right)$
  - The discount rate is $\rho = \frac{\zeta}{\kappa}$, so high "short-term predictability efficient" means low $\frac{\zeta}{\kappa}$
  - With low ζ (inelastic market), but low $\frac{\zeta}{\kappa}$, market is inelastic but time-efficiency is high

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- "Trading volume is very high, so the equity market must be very elastic"
  - Most volume is share-to-share (100% turnover). Actually share to bonds volume is very small about $\mathbb{E}\left[|f_i|\right] = 1.9\%$ per year).

Revisiting Macro-Financial Tenets

- "Saying 'Prices went up due to buying pressure' shows financial illiteracy, as 'For every buyer there is a seller'."
  - Correct measure of flows: $f_S = \frac{\sum_i \theta_i \Delta F_i}{W^{\mathcal{E}}}$
  - Remember $q^D = -\zeta p + f \equiv 0$. The "buyer side" is f, the "seller side" is $-\zeta p$. In equilibrium Net Buys $= 0$, so $p = \frac{f}{\zeta}$.
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- "If markets are inelastic, the Sharpe ratios of timing strategies are extraordinarily high."
  - Persistent flows can have a large impact on price and a small impact on expected returns, if flows mean-revert slowly or not at all (low ϕ) $\Delta\pi_0 = -\left(\delta + \phi\right)\Delta p_0 \simeq -0.04\Delta p_0$.

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- "Share buybacks do not affect equity returns, as proved by the Modigliani-Miller theorem"
  - In the traditional model, the price impact of a share buyback should be 0.
  - Here, if firms buy back \$1 worth of equity, that increases aggregate value by about \$1 (when taking into account consumers' response)

Micro vs macro elasticity

- The model can be extended to the cross section of returns.
- With ω_a= relative market cap of stock a, and aggregate is $p = \sum_a \omega_a p_a$,

$$p_a = p + p_a^{\perp}, \qquad q_a = q^D + q_a^{D,\perp}, \qquad \pi_a = \beta_a \pi + \hat{\pi}_a^{\perp}$$

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- Fraction of portfolio in stock a:

$$\frac{P_{at} Q_{at}^D}{P_t Q_t^D} = \theta_a^{\mathcal{E}} e^{\kappa^{\perp} \hat{\pi}_{at}^{\perp} + \theta^{\perp} p_a^{\perp}}$$

where $\theta^{\perp} = 0$ corresponds to fixed fractions and $\theta^{\perp} = 1$ to a fixed number of shares (e.g., benchmarking).

- This gives

$$q_{at}^{D,\perp} = -\zeta^{\perp} p_{at}^{\perp} + \kappa^{\perp} \delta d_{at}^{e,\perp} + \kappa^{\perp} \mathbb{E}_t \left[\Delta p_{a,t+1}^{\perp} \right]$$

with the micro-elasticity

$$\zeta^{\perp} = 1 - \theta^{\perp} + \kappa^{\perp} \delta$$

Micro vs macro elasticity

- So, the impact of a flow $f_a = f + f_a^{\perp}$ is

$$p_a^{\perp} = \frac{f_a^{\perp}}{\zeta^{\perp}},$$

where the micro-elasticity of demand is:

$$\zeta^{\perp} = 1 - \theta^{\perp} + \kappa^{\perp}\delta$$

- Contrast with the macro elasticity, $\zeta = 1 - \theta + \kappa\delta$

Micro vs macro elasticity

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$$p_a^{\perp} = \frac{f_a^{\perp}}{\zeta^{\perp}},$$

  where the micro-elasticity of demand is:

$$\zeta^{\perp} = 1 - \theta^{\perp} + \kappa^{\perp}\delta$$

- Contrast with the macro elasticity, $\zeta = 1 - \theta + \kappa\delta$
- We will estimate both ζ and $\zeta^{\perp}$ using GIV.
  - As a large literature estimates $\zeta^{\perp}$, it provides a validation of the GIV procedure in this context.
- Cf Samuelson, the market is quite "micro efficient" but not "macro efficient": the price impact is much smaller in the cross-section than in the aggregate ($\frac{1}{\zeta^{\perp}} \ll \frac{1}{\zeta}$)

Micro vs macro elasticity

- Calibrate $\frac{1}{\zeta^{\perp}} = 1$.
- If an investor decides to buy \$1 worth of Apple shares, while selling \$1 worth of Google shares.
  - Then, market cap of Apple goes up by \$1, market cap of Google falls by \$1.
  - Aggregate value of market doesn't change.
- If someone buys \$1 of Apple, selling \$1 of bonds.
  - Aggregate market goes up by \$5.
  - Apple goes up by \$1.
  - So, other (non-Apple) stocks go up by \$4 in aggregate.

Micro vs macro elasticity: Impact of buying an individual stock

- Stock a, which accounts for ω_a of total market cap.
- Flow f_a into a has aggregate impact:

$$f = \omega_a f_a$$

so specific asset flow:

$$f_a^{\perp} = f_a - f = (1 - \omega_a) f_a$$

- Total impact is $p_a = p_a^{\perp} + p$,i.e.:

$$p_a = \left(\frac{1 - \omega_a}{\zeta^{\perp}} + \frac{\omega_a}{\zeta} \right) f_a. \tag{1}$$

- For the other stocks $b \neq a$, we have $f_b^{\perp} = -f = -\omega_a f_a$, so:

$$p_b = \left(\frac{1}{\zeta} - \frac{1}{\zeta^{\perp}} \right) \omega_a f_a, \qquad b \neq a \tag{2}$$

Micro vs macro elasticity: Infinite horizon

- In a dynamic model, we get the same expression as for the aggregate market, but in $\perp$ space:

$$\rho^{\perp} = \frac{\zeta^{\perp}}{\kappa^{\perp}} = \frac{1-\theta^{\perp}}{\kappa^{\perp}} + \delta, \qquad M^{D,\perp} = \frac{\delta}{\rho^{\perp}} \in [0,1]$$

$$p_{a,t}^{\perp} = \mathbb{E}_t \sum_{\tau=t}^{\infty} \frac{\rho^{\perp}}{(1+\rho^{\perp})^{\tau-t+1}} \left(\frac{f_{a\tau}^{\perp} + \nu_{a\tau}^{\perp}}{\zeta^{\perp}} + M^{D,\perp} d_{a\tau}^{\perp e} \right).$$

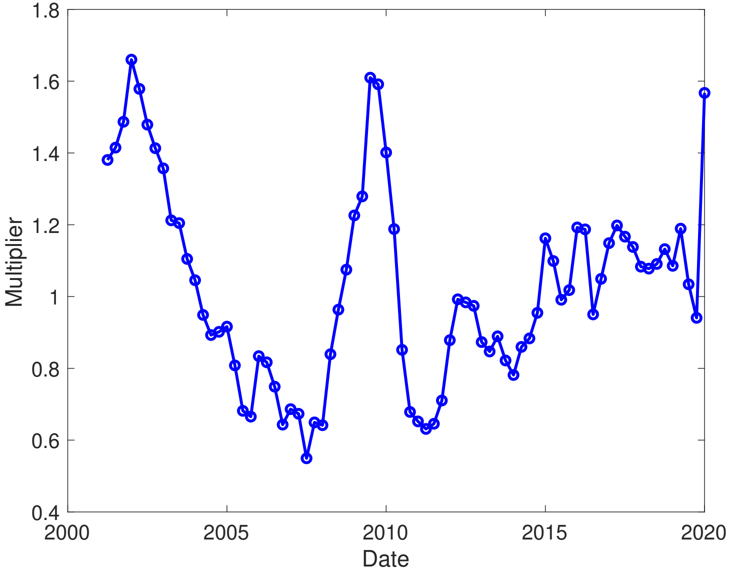
MICRO MULTIPLIERS USING GIV (ONGOING WORK)

- Stock level demand:

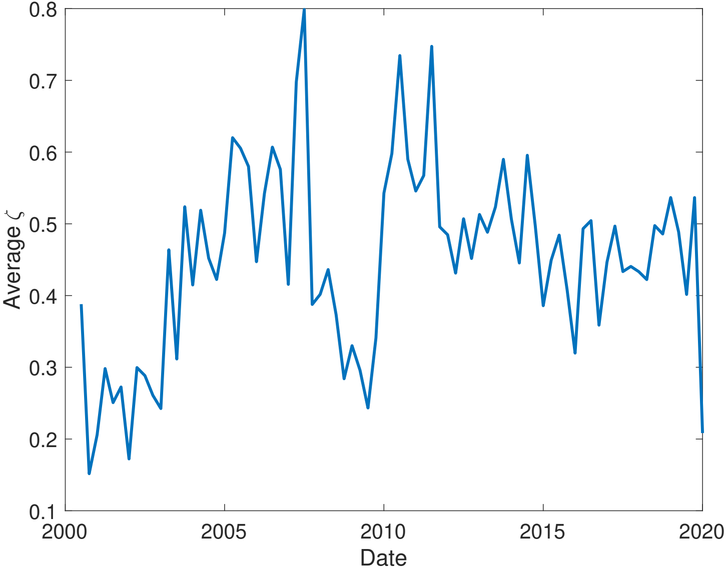
$$\Delta q_{iat}^{\perp} = -\zeta_{it}^{\perp} \Delta p_{at}^{\perp} + \lambda_{it}' \eta_{at} + u_{iat}.$$

  - We allow for investor-specific and time-varying elasticities.
  - The model can be extended to include changes in fundamentals.

Micro multipliers using GIV



MICRO ELASTICITIES OF LARGE INVESTORS USING GIV



Conclusion

- A framework to connect prices, fundamentals, and portfolio flows and holdings to understand prices and expected returns across markets and asset classes.
- Markets appear to be inelastic, contra Lucas and successors (habits, long run risks, disasters) and most behavioral models

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- One can investigate much of macro-finance with inelastic markets.
  - Lots of open questions (why the low elasticity? what's the response by firms? what determines flows in major episodes?), for both empirics and theory.
  - We're working on those. More soon hopefully!