In Search of the Origins of Financial Fluctuations

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Please go to the 2 min survey at https://tinyurl.com/y8ome4rt
Thank you!

Why are financial markets so volatile?

- Key question: Why are financial markets so volatile?
- Modern asset pricing theories:
  - Time-varying risk aversion, macro-economic risks, changing beliefs.

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- Key question: Why are financial markets so volatile?
- Modern asset pricing theories:
  - Time-varying risk aversion, macro-economic risks, changing beliefs.
- Common feature across behavioral and rational models:
  - Markets are macro elastic: Buying 1% of the market moves prices by much less than 0.1% in most models.

The inelastic markets hypothesis

- We propose an alternative, complementary view:
  - Markets are macro inelastic.
- Small shocks to capital flows can be greatly amplified.
- We refer to this as the inelastic markets hypothesis (IMH): An aggregate elasticity well below one.

THE INELASTIC MARKETS HYPOTHESIS

- We propose an alternative, complementary view:
  - Markets are macro inelastic.
- Small shocks to capital flows can be greatly amplified.
- We refer to this as the inelastic markets hypothesis (IMH): An aggregate elasticity well below one.
- This raises two questions
  1. Are there a priori reasons to explore the IMH?
  2. Suppose the IMH is true, then why do we care?

A priori evidence that the IMH may hold

- Four motivating pieces of evidence:

1. Many funds are constrained:
   - e.g. they're 100% in equity: so they provide 0 elasticity
   - or e.g. 70% in equities: still very constrained.
2. Who would be the macro-elastic arbitrageurs?
   - Hedge funds? They are small (5% of market), + tend to reduce their allocations in bad times (e.g., outflows or risk constraints: Ben David et al. '12).
3. Flows across investor sectors are very small ($\sim 0.5\%$ per quarter).
   - For instance, buying \$100bn in today's \$30tn market (i.e., 0.3%) would be very large.
4. Evidence from identified micro-elasticities (index inclusion lit.)
   - Latest estimates of the micro elasticity put it around 1.
   - Macro elasticity should be $<$ micro elasticity, in most models. Hence, elasticities below 1 are plausible, or event to be expected.

Suppose the IMH is true, then why do we care?

- As a result, flows are very impactful:
  - Over 30% of stock market fluctuations are driven by flows.
- Replacing the dark matter of asset pricing with tangible flows and demand shocks of different investors:
  - We also trace the time-variation in the market's volatility back to flows and demand shocks.
- Several questions that are irrelevant or uninteresting in traditional models become interesting:
  - Government interventions.
  - Impact on firms as arbitrageurs on the market (buybacks, issuances).
- Other shocks, such as beliefs or preference shocks, can be smaller or have a small pass-through to actions.

How macro elastic is the stock market?

- IV strategy drawing on "Granular IV" (Gabaix Koijen 2020)
  - Idiosyncratic shocks of different investors and sectors can be used as instruments.
  - Estimates based on the Flow of Funds and 13F data.
- Buying 1% of the market increases the market by 5-12%
  - These are preliminary estimates.
  - We'll say "10%" in the theory part
  - I.e. Buying \$1 of shares makes the market increase by \$10
  - The effect is "permanent": at least, no mean-reversion over 1 year
- Large literatures estimate risk aversion coefficients and the elasticity of inter-temporal substitution, but not the macro elasticity.

What we do in this paper

- Develop a theoretical framework that gives rise to the IMH.
  - Simple model first
  - General equilibrium, providing a calibratable enrichment of / alternative to consumption- and production-based asset pricing models.
- Develop a conceptual framework to guide the empirical analysis.
  - E.g., how do you measure flows into the market (as for every buyer there's a seller).
- Provide first estimates of the macro elasticity and explore some of the empirical implications for:
  - Stochastic volatility.
  - Why markets move.

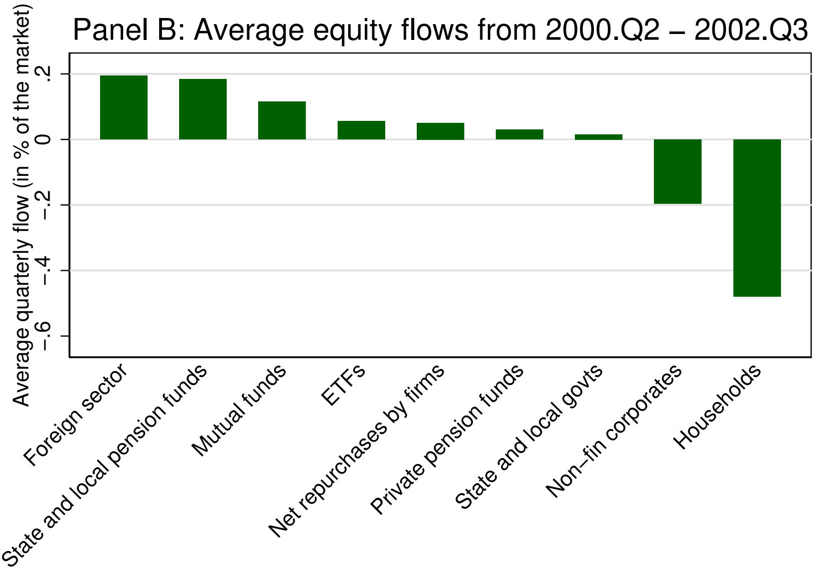
Literature review

- 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: Baker Wurgler '04, Greenwood Hanson '13, Greenwood Vayanos '14, Greenwood Hanson Stein '16, + Sunderam '19, Avdjiev, Du, Koch, Shin '20
- Previous papers with flows in markets
  - Chien, Cole, Lustig '12, Bacchetta and Van Wincoop '10, Gabaix Maggiori '15, Cavallino '19
  - No direct mapping to observables or measurement of macro elasticity
- Institutions: He Krishnamurty '13, Brunnermeier Sannikov '14
- Behavioral finance: e.g. Shleifer '00, Calvet et al. '09, Barberis, Greenwood, Jin, Shleifer '15, Barberis '19

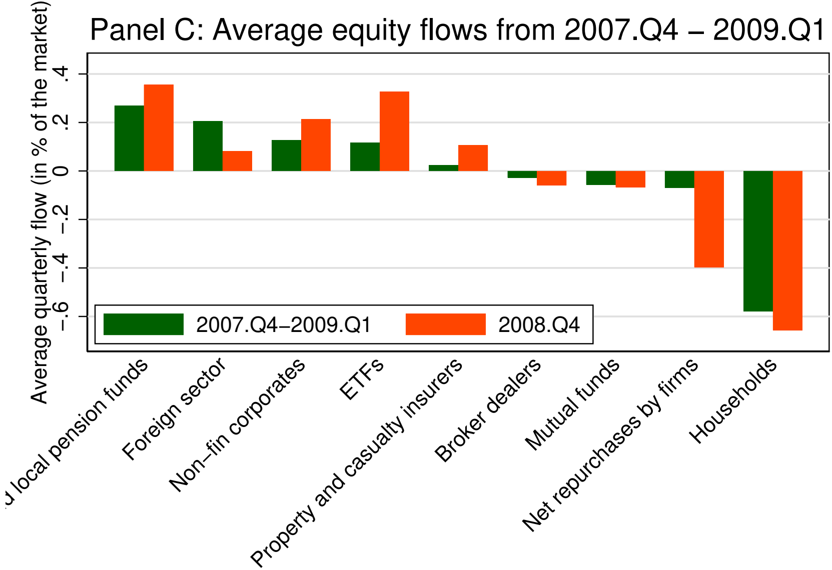
Outline of talk

1. Some facts that motivate the inelastic markets hypothesis
2. Basic force: how flows impact prices in macro-inelastic markets
   2.1 Two-period and infinite horizon
3. Empirical investigation
   3.1 What's the macro-elasticity of the a stock market
   3.2 How much do flows explain returns?
4. Macro-elasticity (this paper) vs micro-elasticity of the stock market (other papers)
5. How tenets of finance chance if the IMH is true
6. In the paper:
   6.1 Macro-finance with inelastic markets
      6.1.1 Alternative to CCAPM
      6.1.2 Model with production
   6.2 Policy

WHO REBALANCES DURING EQUITY DOWNTURNS?



WHO REBALANCES DURING EQUITY DOWNTURNS?



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.
- Two funds (or, 2 masses of competitive funds):
  - One "pure bond fund": just holds bonds
  - One "balanced fund". Demand for stocks Q^D mandated as:

    $$PQ^D = \theta W e^{\eta \hat{\pi}},$$

    where $\pi = \frac{\bar{D}}{P} - 1 - r$ is the risk premium, $\bar{\pi}$ its average, and $\hat{\pi} := \pi - \bar{\pi}$
    - E.g. if $\eta = 0$, the mandate is a fixed equity share θ
- If the consumer was rational, the fund's mandate wouldn't matter: the consumer could "undo" the mandate by adjusting flows

Total impact: The market as a flow multiplier

- At time 0^-, fund is worth W_0 and holds shares and $\hat{\pi} = 0$
- At $t = 0$, there's an inflow ΔF dollars in the fund, so $f = \frac{\Delta F}{W}\%$ flow
- Notations: $\Delta P = P - P_0$, $\Delta W = W - W_0$ et cetera and

$$p = \frac{\Delta P}{P_0}, \qquad w = \frac{\Delta W}{W_0}, \qquad d = \frac{\Delta \bar{D}}{\bar{D}_0}, \qquad f = \frac{\Delta F}{W_0}$$

- **Proposition**: The demand change is

$$q^D = f - \zeta p$$

where ζ is the macro-elasticity of demand

$$\zeta = 1 - \theta + \eta \delta^D$$

Proof

- Before the shock, the mixed fund had:

$$W_0 = P_0 Q + B_0^M, \qquad P_0 Q = \theta W_0$$

- After shock, $\Delta W = (\Delta P)\, Q + \Delta F$

$$w = \frac{\Delta W}{W_0} = \frac{(\Delta P)\, Q}{W_0} + \frac{\Delta F}{W_0} = \frac{P_0 Q}{W_0} \times \frac{(\Delta P)}{P_0} + f = \theta \times p + f$$

$$w = \theta p + f$$

- *Case* $\eta = 0$. As $Q^D = \theta W / P$, take logs, differentiate:

$$q^D = w - p = \theta p + f - p = -(1-\theta)\, p + f = -\zeta p + f$$

with $\zeta = 1 - \theta$

Total impact: The market as a flow multiplier

- Recall, change desired number of shares is: $q^D = f - \zeta p$.
- In equilibrium, $q^D = 0$ (total number of shares hasn't changed).
- So, $p = \frac{f}{\zeta}$
- **Proposition**: The price reaction to flows is $\frac{\Delta P}{P} = \frac{1}{\zeta} \frac{\Delta F}{W_0}$, i.e.

$$p = \frac{f}{\zeta}$$

- Calibration + estimation: $\zeta = 1 - \theta + \eta \delta^D \simeq 0.1$. (preliminary: in $[0.05, 0.15]$ range).
- This means that a flow $f = 1\%$ of the market cap increases total market value by 10%
- \$1 bought in the market increases total market cap by \$10

Undergraduate example

- Balanced fund has $\theta = 0.9$, $\eta = 0$, so that $\zeta = 1 - \theta + \eta\delta^D = 0.1$.
- Supply: $Q = 90$ shares, B units of the bond. Initial price of stock is \$1
- So balanced fund holds \$90 in stocks, \$10 in bonds.
- The pure bond fund holds $B - \$10$ bonds.
- Suppose an investor sells \$1 of bonds from pure bond fund, and invests this \$1 in the balanced fund. So $f = 1\%$.

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- Suppose an investor sells \$1 of bonds from pure bond fund, and invests this \$1 in the balanced fund. So $f = 1\%$.
- Final outcome:
  - Pure bond fund holds $B - \$11$
  - The balanced fund has:
    - \$11 in bonds
    - \$99 in stocks (the fund keeps the 9:1 ratio of stocks to bonds; and still has all 90 shares)
  - $P = \$1.1$: Stock price has increased by 10%: multiplier of 10.
- Only \$0.9 was "directly" invested in equities, yet the value of the equity market increased by \$9, again a multiplier of 10.

News about future dividends

- Suppose that expected time-1 dividends go up by $d = \frac{\Delta D}{D_0}$. Then, risk premium moves by (with $\delta^D = D/P$)

$$\hat{\pi} = \delta^D (d - p)$$

- Demand is

$$q^D = -\zeta p + f + \eta \delta^D d$$

- Equilibrium price is

$$p = \frac{f}{\zeta} + M^D d, \qquad M^D = \frac{\eta \delta^D}{1 - \theta + \eta \delta_D} \in [0, 1]$$

- So price has *overreaction* to current flows f, *underreaction* to future dividends d

Infinite horizon: Demand curve

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

$$P_t Q^D = \theta W_t e^{\eta \hat{\pi}_t + \nu_t}$$

- $\bar{P}_t$,$\bar{W}_t$,$\bar{D}_t$ baseline values (without flow shocks, dividend shocks), $d_t^e = \mathbb{E}_t d_{t+1}$

$$p_t = \frac{P_t}{\bar{P}_t} - 1, \qquad d_t = \frac{D_t}{\bar{D}_t} - 1$$

- Cumulative flow

$$f_t = \sum_{s=0}^{t} \frac{\Delta F_s}{\bar{W}_s}$$

Infinite horizon: Price as PV of dividends and flows

- **Proposition**: With $M^D = \frac{\eta\delta^D}{1-\theta+\eta\delta^D} \in [0,1]$

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

where ρ is the "macro market effective discount factor,"

$$\rho = \frac{\zeta}{\eta} = \delta^D + \frac{1-\theta}{\eta}$$

- Again, sensitivity $\frac{1}{\zeta}$ to flows, muted response to dividends
- High flows create a high price and lower the risk premium
- Permanent inflow ΔF_0 creates $f_t = f_0$ for $t \geq 0$

$$\Delta p_0 = \frac{f_0}{\zeta}, \qquad \Delta\pi = -\delta^D \Delta p_0$$

AGGREGATING HETEROGENEOUS INVESTORS

- Aggregation with heterogeneous funds, indexed by i
- $f_i = \frac{F_i}{W_i}$ into fund i gives, with $\zeta_i = 1 - \theta_i + \eta_i \delta^D$

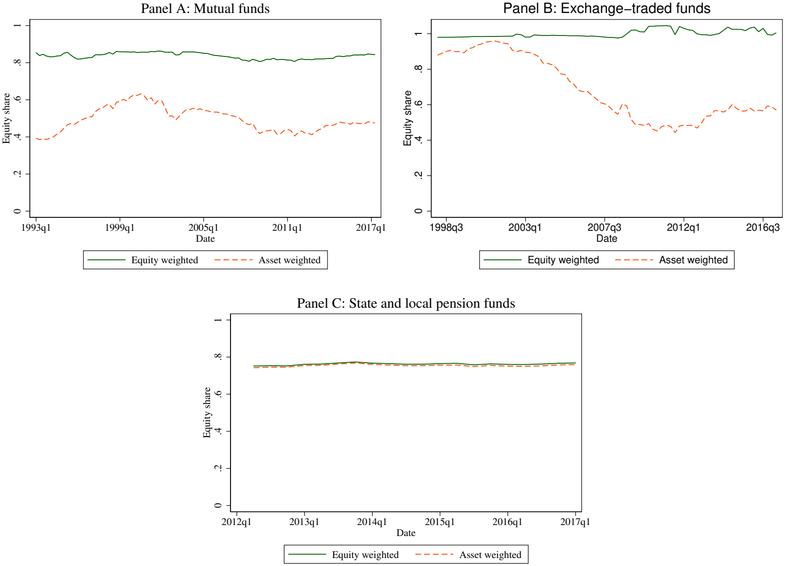
$$q_i^D = -\zeta_i p + \eta_i \delta^D d + f_i$$

- With $\mathcal{E}_i =$ the equity holdings (in dollars) of fund i, $\mathcal{E}_i = Q_i P = \theta_i W_i$, and $S_i = \frac{\mathcal{E}_i}{\sum_k \mathcal{E}_k}$ is the share of total equities held by fund i
- Total demand for stocks is: $Q = \sum_i Q_i \left(1 + q_i^D\right)$, so $q = \mathbb{E}_S \left[q_i^D\right]$

$$\mathbb{E}_S \left[q_i^D\right] = -\mathbb{E}_S \left[\zeta_i\right] p + \mathbb{E}_S \left[\eta_i\right] \delta^D d + \mathbb{E}_S \left[f_i\right],$$

  as in the basic model, $q^D = -\zeta p + \eta \delta^D d + f$, with $\theta = \mathbb{E}_S \left[\theta_i\right], \zeta = \mathbb{E}_S \left[\zeta_i\right], f = \mathbb{E}_S \left[f_i\right]$ et cetera
- Note: $\mathbb{E}_S \left[\theta_i\right] \geq \mathbb{E}_W \left[\theta_i\right]$, while empirically we often measure the latter

EQUITY- AND ASSET-WEIGHTED EQUITY SHARES



FRICTIONLESS MODELS PREDICT A HIGHER ζ

- Economy with endowment Y_t, $Y_t = G_t Y_{t-1}$, G_t i.i.d., utility $\sum_t e^{-\rho t} \frac{c_t^{1-\gamma}}{1-\gamma}$
- Equity dividend $D_t = \psi Y_t$, rest is labor income $D_t^L = (1-\psi) Y_t$
- Suppose that the price of equity is $P_t = P_t^* (1+p)$, with p a permanent deviation: what's the flow into equities?
- **Proposition**: with rational agents and log-normal G_t, then the elasticity of demand for equities is:

$$\zeta^r = \frac{1}{\pi} \frac{C}{W^{\mathcal{E}}}$$

- Calibration: $C = 0.8 \times \text{GDP}$, $W^{\mathcal{E}} = 1 \times \text{GDP}$, $\pi = 4\%$, so:

$$\zeta^r = 20$$

- Our estimates imply $\zeta^{macro} \simeq 0.1$: Rational and most behavioral models are too elastic, by $200\times$.
- The literature finds micro-elasticities of $\zeta^{micro} \simeq 1-2$

How to generate low macro-elasticities η, ζ?

1. Inertia: many investors are "buy and hold", so $\zeta = \eta = 0$
2. Mandates: or "keep a fixed allocation 80/20" or "don't react much": so $\zeta = 0.2$, $\eta = 0$
3. Investors with leverage constraints have $\zeta, \eta < 0$ (as $QP = \frac{W}{\sigma}$, and σ rises when P falls)
4. "Trend followers" have $\zeta, \eta < 0$
5. Models of behavioral inattention deliver this easily (Gabaix '14, '19). More refined:
6. When $\hat{\pi}_t$ moves, the subjective perception of $\hat{\pi}_t^s$ does not
   - $\hat{\pi}_t$ hard to estimate, so investors shrink to "no predictability"
   - People might think that others are informed: so that the price moved, but they don't think that the equity premium moved
7. Low pass-through from beliefs $\hat{\pi}_t^s$ to actions q^D
   - Perhaps because people know they don't really know$\hat{\pi}_t^s$
   - Giglio et al. '19 provide evidence for this
8. Model uncertainty, e.g. persistence of flow shocks is unclear to market participants

A simple calibration with inertia

- We have $\theta = \mathbb{E}_S[\theta_i] \simeq 0.85$ for mutual funds, $\theta = \mathbb{E}_S[\theta_i] \simeq 0.95$ for ETFs
- Take e.g. a pension fund with "buy and hold" strategy: average θ is 0.6, but its elasticity is 0
- So, if fraction $1 - m_p$ have "buy and hold" strategy. Then we get:

$$\zeta = m_p (1 - \theta) + \eta \delta^D$$

- "Inertia" coefficient $m_p = 0.5$, $\theta = 0.85$, $\eta \simeq 0.8$

$$\zeta = m_p (1 - \theta) + \eta \delta^D = 0.5 \times 0.15 + 0.8 \times 0.04 \simeq 0.1$$

Volatility coming from flows

- We observe (annualizing)

$$\sigma_{\Delta f} \simeq 1\%$$

- So volatility coming from flows (recall $\Delta p = \frac{\Delta f}{\zeta}$):

$$\sigma_r = \frac{1}{\zeta}\sigma_{\Delta f} \simeq 10 \times 1\% = 10\%$$

Two additional issues of measurement

- **Adding firms buybacks and net issuances**. Suppose extra demand of shares f^F by firms

$$f^F = \frac{\text{Net share buybacks (in value)}}{\text{Total equity value}} = -\frac{\text{Net issuances (in value)}}{\text{Total equity value}}$$

  then add f^F to the total flow.
  - Total demand is: $f = \mathbb{E}_S\left[f_i\right] + f^F$
- **Total flows instead of only equity flows** To measure flows correctly, we need the total flow, including fixed income.
  - If we just sum equity flows, they mechanically sum to zero ("for every buyer there is a seller")
  - We clarify how to measure flows into the stock market, but it comes with additional data requirements

Outline of the empirical analysis

- A large literature in macro and finance has focused on two parameters
  - The coefficient of relative risk aversion
  - The elasticity of intertemporal substitution
- Our model suggests that another parameter plays a key role, namely the demand elasticity of the aggregate stock market: ζ
- We use *Granular Instrumental Variables (GIV)* to provide a first estimate
- In addition, we estimate
  - How important are flows to explain price variation?
  - How much of the time-variation in return volatility can be traced back to heteroscedasticity in flows?

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.
- Census ASPP (annual, 2012-2018) and QSPP (quarterly):
  - State and local pension funds.
- CRSP and Compustat (quarterly):
  - Firm-level prices and characteristics.
- 13F data (quarterly, 1999-2017):
  - FactSet

An introduction to GIV (from G.-K. 2020)

- Notation $X_{St} := \sum_i S_i X_{it}$, $X_{Et} := \sum_i \frac{1}{N} X_{it}$ (with $\sum_i S_i = 1$)

$$q_{it} = -\zeta p_t + \lambda_i \eta_t + u_{it}$$

- As $0 = q_{St} = -\zeta p_t + \lambda_S \eta_t + u_{St}$,

$$\zeta p_t = u_{St} + \lambda_S \eta_t$$

- Take first case $\lambda_i = \lambda$. Then, form

$$z_t := q_{\Gamma t} = q_{St} - q_{Et}$$

- As $q_{St} = -\zeta p_t + \lambda \eta_t + u_{St}$ and $q_{Et} = -\zeta p_t + \lambda \eta_t + u_{Et}$,

$$z_t = u_{St} - u_{Et} =: u_{\Gamma t}$$

  and z_t is uncorrelated with η_t. It's also (calculations) uncorrelated with u_{Et}
- Key: z_t is constructed with observable idiosyncratic shocks of large funds or groups of funds

An introduction to GIV

- Recall

$$z_t := q_{\Gamma t} := q_{St} - q_{Et} \Rightarrow z_t = u_{\Gamma t} := u_{St} - u_{Et}$$

So,

$$\zeta p_t = u_{St} + \lambda_S \eta_t = u_{\Gamma t} + u_{Et} + \lambda_S \eta_t = z_t + \zeta e_t$$

with $e_t = \frac{u_{Et} + \lambda_S \eta_t}{\zeta}$ is uncorrelated with z_t

- Run the OLS to estimate $1/\zeta$:

$$p_t = \frac{1}{\zeta} z_t + e_t,$$

which identifies $\frac{1}{\zeta}$ by GIV

- More generally, if λ_i heterogeneous, run a factor model for

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

and extract η_t and use them as controls and run the OLS

$$p_t = \frac{1}{\zeta} z_t + \beta \eta_t + e_t$$

GIV applied to our setting

- In our model, we have
$$\Delta q_{jt} = -\zeta \Delta p_t + f_{jt} + \nu_{jt},$$
with f_{jt} flows and ν_{jt} demand shocks
- If we have clean data on flows (recall, we need total flows), we extract idiosyncratic shocks to flows
$$f_{jt} = \lambda_j' \eta_t^f + u_{jt}^f,$$
and use $z_t^f = u_{St}^f$ as an instrument
- Without data on flows, we use idiosyncratic shocks to $f_{jt}^{\nu} = f_{jt} + \nu_{jt}$
$$f_{jt}^{\nu} = \lambda_j' \eta_t^{f^{\nu}} + u_{jt}^{f^{\nu}},$$
and use $z_t^{f^{\nu}} = u_{St}^{f^{\nu}}$ as an instrument. This only requires data on equity holdings
- We use the latter approach and construct z_t from either the Flow of Funds or 13F filings

GIV APPLIED TO OUR SETTING

- We start from the basic model

$$\Delta q_{jt} = -\zeta_j \Delta p_t + \lambda_j' \eta_t + u_{jt},$$

  where we assume

$$\zeta = X\dot{\zeta},$$

  with $\dim\left(\dot{\zeta}\right) < N$.

- Elasticity of the corporate sector (net buybacks)

$$\Delta q_{Ct} = -\zeta_C \Delta p_t + \lambda_C' \eta_t + u_{Ct},$$

  and we index the corporate sector with $j = 0$

- The size weights, as a result, add up to two, $\sum_{j=0}^{N} S_j = 2$
- This model implies

$$\Delta p_t = \frac{\lambda_S' \eta_t + u_{St}}{\zeta_S + \zeta_C}$$

GIV PROCEDURE

1. Define $V_u = D[\tilde{\sigma}^2]$, with $\tilde{\sigma}_j = \max\{\sigma_j, 0.75\times\text{median}(\sigma_i)\}$ and $\sigma_j = \sigma(\Delta q_{jt})$.
2. Construct $\Delta\check{q}_{jt} = Q^{X,V_u^{-1}}\Delta q_{jt}$, where $Q^{H,W} = I - HR^{H,W}$ and $R^{H,W} = (H'WH)^{-1} HW$.
3. Extract PCs, $\Delta q_t^* = V_u^{-1/2}\Delta\check{q}_t = V_u^{-1/2}\Lambda\eta_t + V_u^{-1/2}u_t$.
4. Collect the residuals $\check{u}_t = V_u^{1/2}\left(\Delta q_t^* - V_u^{-1/2}\Lambda\eta_t\right)$ and define $z_t = S'_{t-1}\check{u}_t$.
5. Estimate the multiplier M

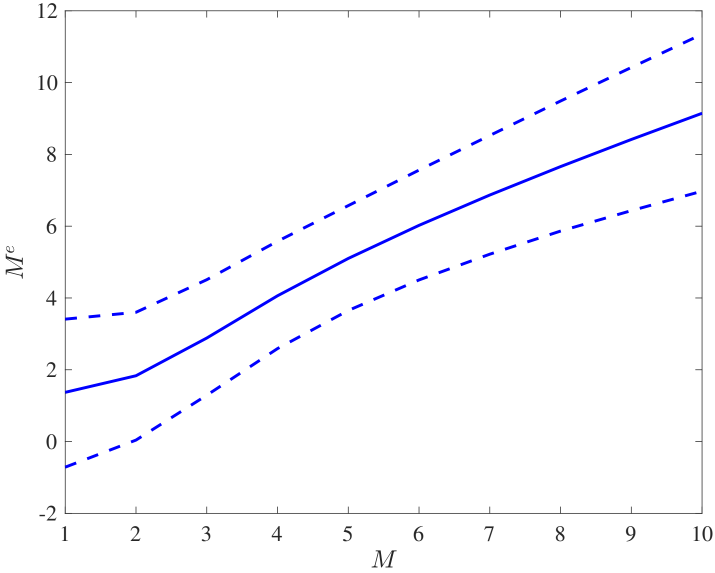
$$\Delta p_t = a + Mz_t + \epsilon_t.$$

6. Estimate $\dot{\zeta}$ via the moment conditions,

$$\mathbb{E}\left[\left(\Delta\dot{q}_t + \dot{\zeta}\Delta p_t\right) z_t\right] = 0.$$

   with $\Delta\dot{q}_t = R^{X,V_u^{-1}}\Delta q_t$.
7. Compute standard errors using the bootstrap method.

Precision of the GIV estimator: Simulations



GIV ESTIMATES OF THE MACRO ELASTICITY

M	6.21	7.09	5.40	9.06
s.e.	(1.68)	(2.12)	(1.76)	(1.71)
ζ_0	0.20	0.17	0.23	0.11
s.e.	(0.07)	(0.09)	(0.08)	(0.04)
ζ_1	0.01	0.01		0.04
s.e.	(0.06)	(0.08)		(0.04)
M with lagged z_t	6.57	7.25	5.32	10.02
s.e.	(1.76)	(2.17)	(1.79)	(1.79)
Number of PCs	1	2	1	1
Winsorize (at 5% and 95%)	No	No	No	Yes
Heterogeneous elasticities	Yes	Yes	No	Yes

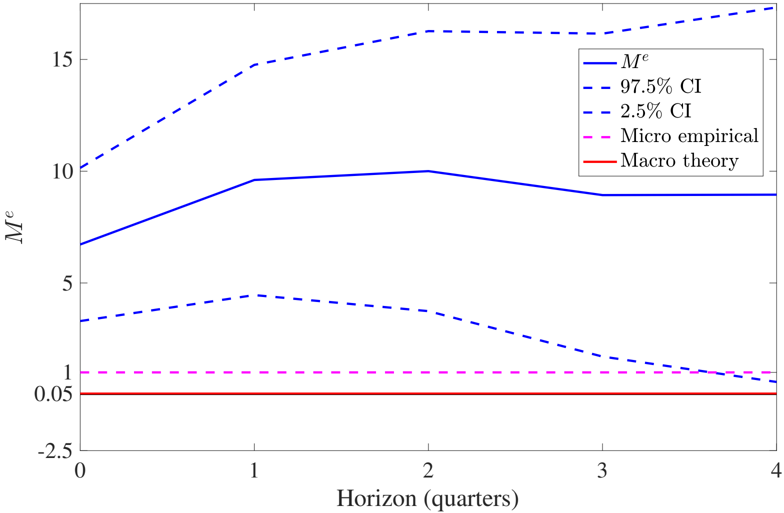
Multi-horizon multiplier estimates

- Consider the regression

$$p_{t+h} - p_{t-1} = a_h + M_h Z_t + c_h \eta_t^e + \epsilon_{t+h},$$

  for $h = 0, 1, \ldots, 4$ and where $Z_t = S'_{t-1} \Delta \check{q}_t$. η_t^e is the principal component extracted in the GIV procedure.
- Bootstrap the data in blocks of five quarters – the current quarter plus the next four quarters – to compute standard errors.
  - This preserves the temporal structure of the data.

Multi-horizon multiplier estimates

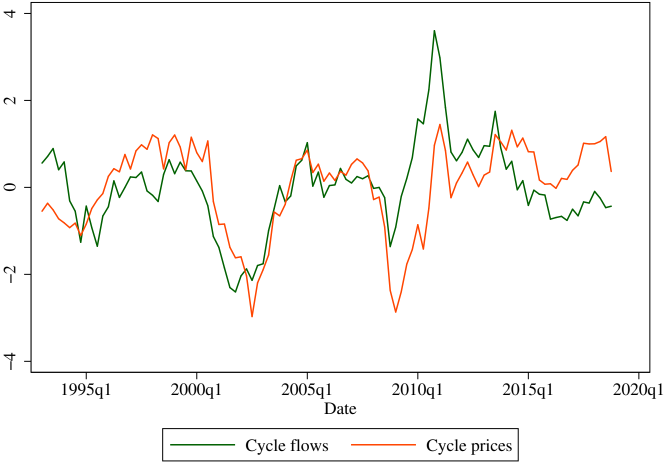


CALIBRATION: IMPACT OF q FLOWS ON VOLATILITY

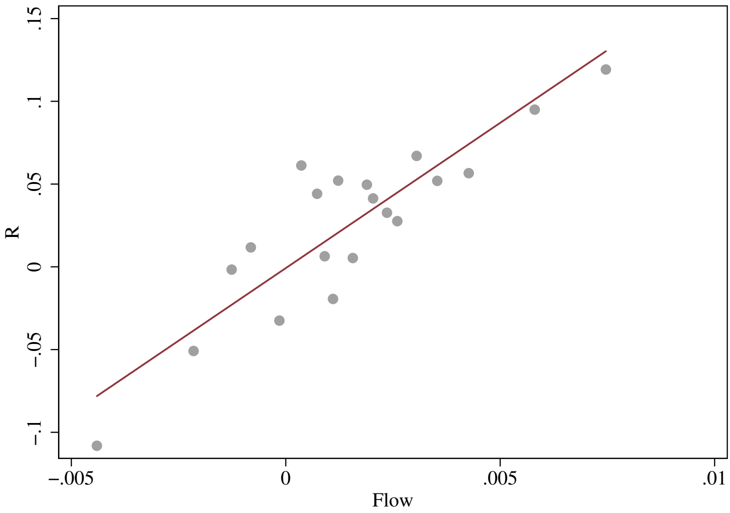
- Consider $q_{it} = -\zeta p_t + f_{it}^{\nu}$, with $f_{it}^{\nu} = f_{it} + \nu_{it}$, so $-\zeta p_t + f_{St}^{\nu} = 0$,
$$q_{it} = f_{it}^{\nu} - f_{St}^{\nu} \simeq f_{it}^{\nu}$$
- If all shocks are idiosyncratic,
$$\sigma^2\left(f_{St}^{\nu}\right) = var\left(\sum_i S_i f_{it}^{\nu}\right) = \sum_i S_i^2 \sigma_{f_{it}^{\nu}}^2 \simeq \sum_i S_i^2 \sigma_{q_{it}}^2$$
We find (with yearly values)
$$\sigma_{f_S^{\nu}} \simeq 1.4\%$$
- Now, with $p_t = \frac{1}{\zeta} f_{St}^{\nu}$, $\Delta p_t = \frac{1}{\zeta} \Delta f_{St}^{\nu}$, so volatility coming from flows and f_{St}^{ν} is:
$$\sigma_{p_t} = \frac{1}{\zeta} \sigma_{f_{St}^{\nu}} \simeq 10 \times 1.4\% = 14\%$$
comparable to stock market volatility
- Out of that, half is pure flows, half if "demand shocks" (which can capture expectations)

Cyclical component of flows, prices

- Extract the cyclical component of prices and cumulative flows following Hamilton (2018).

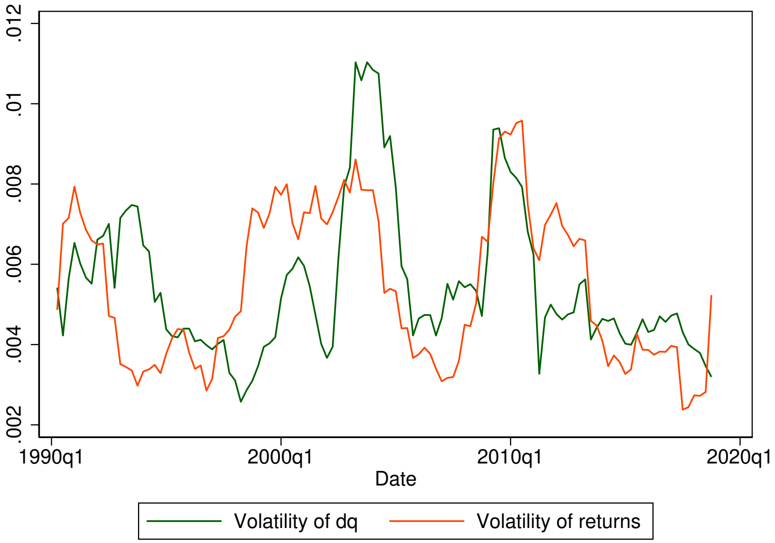


The correlation between flows and returns



(Binned scatter plot)

Volatility of flows vs volatility of returns



MICRO VS MACRO ELASTICITY

- We said "the microelasticity" is greater than the macro elasticity: let's clarify
- With ω_a= relative market cap of stock a, and aggregate is $p = \sum_a \omega_a p_a$,

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

- Demand for individual stock a: demand: Q_a^D

$$Q_a^D = Q^D \frac{\theta_a^{\mathcal{E}}}{P_a} e^{\eta^{\perp} \hat{\pi}_a^{\perp} + \nu_a^{\perp} + \theta^{\perp} p_a^{\perp}}$$

which gives

$$q_a^{D,\perp} = -\zeta^{\perp} p_a^{\perp} + \eta^{\perp} d_a^{e,\perp} + \nu_a^{\perp}$$

with the micro-elasticity

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

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:

$$\zeta^\perp = 1 - \theta^\perp + \eta^\perp \delta^D$$

- Contrast with the macro elasticity, $\zeta = 1 - \theta + \eta \delta^D$
- Empirically, $\zeta^\perp \simeq 1$ to 10 (Shleifer '86, Wurgler Zhuravskaya '02, Chang Hong Liskovich '15, Koijen Yogo '19), while we find $\zeta \simeq 0.1$.
    - (index deletions: demand falls by 6%, price falls by 6%)
- 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: 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 dynamic model, we get the same expression as for the aggregate market, but in $\perp$ space:

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

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

Revisiting Macro-Financial Tenets

- "Prices are the discounted present value of expected future dividends, perhaps with a rationally time-varying discount rate, or with time-varying behavioral expectations of future dividends"
  - Here prices are instead the discounted value of both future dividends and future flows

$$p_t = \mathbb{E}_t \sum_{\tau=t}^{\infty} \frac{\rho}{(1+\rho)^{\tau-t+1}} \left(\frac{f_\tau + \nu_\tau}{\zeta} + M^D d^e_\tau \right)$$

- "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 \$10 (keeping $\zeta = 0.1$).

Revisiting Macro-Financial Tenets

- "Saying 'Prices went up due to buying pressure' shows financial illiteracy, as For every buyer there is a seller"
  - 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 $p = \frac{f}{\zeta}$.
  - The "impulse to buy" is visible in flows f, and in $f + \nu$.
- "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).
- "The permanent impact of a trade must reflect information"
  - A one-time inflow permanently changes prices (as in $\Delta p_0 = \frac{\Delta f_0}{\zeta}$), even if it contains no information whatsoever. [Assuming a non-mean-reverting inflow]

Revisiting Macro-Financial Tenets

- "The market often looks impressively efficient in the short turn, so it must be quite macro-efficient"
  - The discount rate is $\rho = \frac{\zeta}{\eta}$, so high "short-term predictability efficient" means low $\frac{\zeta}{\eta}$
  - With low ζ (inelastic market), but low $\frac{\zeta}{\eta}$, market is inelastic but time-efficiency is high
  - E.g. in calibration, $\zeta = 0.1$, $\eta = 0.8$, $\rho = 13\%/\text{yr}$. If an event happens in 1 week, $(1+\rho)^{-1/52} = 99.8\%$ is incorporated today.
  - Generally hard to know whether the market moved by the right amount. Event studies with no drift before and after the event are not conclusive
- "Fast and smart investors (perhaps hedge funds) will provide elasticity to the market"
  - Hedge funds are small (hold 5% of equity), and they have low elasticity also.
  - They probability provide far-sightedness to the market (η) but not long-run elasticity ζ

Additional material in the paper

- A Lucas-style GE model
- Policy implications

Conclusion

- Markets are inelastic, contra Lucas and successors (habits, long run risks, disasters) and most behavioral models
- Implications: Macro-finance on tangible basis
  - Replacing the dark matter of asset pricing with tangible flows and demand shocks of different investors:
    - We also trace the time-variation in the market's volatility back to flows and demand shocks.
  - This offers a way to investigate perennial questions:
    - Who moved the market? (and then perhaps why did they move?)
    - Sources of market volatility
  - Several questions that are irrelevant or uninteresting in traditional models become interesting:
    - Government interventions.
    - Impact on firms as arbitrageurs on the market
- Next steps in progress
  - Bond market and investment: then, how flows in the bond market decrease rates and increase investment
  - Full GE with realistic financial markets and sources of fluctuations
  - Cross-section

Potential policy: government intervention of stock market?

- Suppose that the government buys f^G percent of the market, and keeps it forever. Then, market increased by

$$p = \frac{f^G}{\zeta} \simeq 10 f^G$$

- So, buy 1% of market, (about 1% of GDP), then market goes up by 10%
- If the government buys it for just T periods, impact is

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

- This may be a potential policy?

Potential policy: government intervention of stock market?

- This may be a potential policy?
- 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."
- (Charoenwong et al. estimate micro, not macro elasticities in Japan)
- Chinese "national team" owns 6% of Chinese stock market (since 2015 crash)
- Cf central banks of Switzerland / Israel prevented bought $\sim$40% GDP worth of foreign currency to prevent FX appreciation (perhaps of ~20%)