Macro Finance in Inelastic Markets

Ralph S.J. Koijen

August 2022 - Macro Finance Research Program Summer Session for Young Scholars
BACKGROUND

- Based on joint work
  - New work with Xavier Gabaix and Moto Yogo
Why are financial markets so volatile?

▸ Key question: Why are financial markets so volatile?
▸ 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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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%.

Practical implications:

- Flows in financial markets do not matter,
- Differences in beliefs or tastes (e.g., about ESG) matter little quantitatively,

for prices and expected returns.
Why are financial markets so volatile?

- Key question: Why are financial markets so volatile?
- 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%.
- Practical implications:
  - Flows in financial markets do not matter,
  - Differences in beliefs or tastes (e.g., about ESG) matter little quantitatively,
  - 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).
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 (∼5% of market) and reduce allocations in bad times (outflows or risk constraints, Ben-David et al. '12).
WHY MIGHT WE EXPECT MACRO INELASTICITY?

- A larger literature estimates the micro elasticity. Some basics:
  - Multiplier $= 1 / \text{elasticity}$. 
**Why might we expect macro inelasticity?**

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WHY MIGHT WE EXPECT MACRO INELASTICITY?

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  - Multiplier $= 1 / \text{elasticity}$.
  - Theory: micro elasticity $\gg$ macro elasticity.
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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 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 $\pi = \frac{D}{P} - 1 - r_f$ is the risk premium, $\bar{\pi}$ its average.
    - E.g. if $\kappa = 0$, the mandate is a fixed equity share $\theta$.
- 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 $0^-$, fund is worth $W_0$ and holds shares and $\hat{\pi} = 0$. Initial $\delta = D/P$.
- At $t = 0$, there’s an inflow $\Delta F$ dollars in the fund, so $f = \frac{\Delta F}{W}$ % flow.
**TOTAL IMPACT: THE MARKET AS A FLOW MULTIPLIER**

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

\[
\frac{\Delta P}{P} = \frac{f}{\zeta}
\]

where $\zeta$ is the macro-elasticity of demand

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


The stock market has increased by almost 50% over the last year; medium-term corporate bonds have been pretty flat.

As a result of the high equity prices, the equity premium dropped from 5% to 2.5%.

Consider a “typical” investor with a long-term strategic stock-bond allocation of 60%-40% assuming a 5% equity premium.
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Consider a “typical” investor with a long-term strategic stock-bond allocation of 60%-40% assuming a 5% equity premium.

The portfolio drifted to 70%-30% due to the high equity returns and flat bond returns.
Calibrating $\kappa$: A thought experiment

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- As a result of the high equity prices, the equity premium dropped from 5% to 2.5%.
- Consider a “typical” investor with a long-term strategic stock-bond allocation of 60%-40% assuming a 5% equity premium.
- The portfolio drifted to 70%-30% due to the high equity returns and flat bond returns.
- What is the equity share (in %) to which you would expect a typical investor to rebalance to in practice (not in theory), again gradually?
IMPLICATIONS FOR $\kappa$

- Empirically, we estimate $\kappa \simeq 1 - 2$.

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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:
  - Bond fund: $B - $20 bonds.
  - Balanced fund: $80$ in stocks + $20$ in bonds = $100$ total.

- Investors reallocate $1$ from bond fund to balanced fund.
- Final holdings:
  - Bond fund: $B - $21 bonds.
  - Balanced fund: $21$ in bonds + $84$ in stocks = $105$ total.

- Maintains the 4:1 ratio and still has all 80 shares

\[ P = \frac{84}{80} = 1.05, \text{ price increase of 5\%} \Rightarrow \text{Multiplier} = 5. \]
UNDERGRADUATE EXAMPLE

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\[ \text{Multiplier} = \frac{P_{\text{final}}}{P_{\text{initial}}} = \frac{84}{80} = 1.05 \]

\[ \text{Equity flow } f_S = \zeta \Delta F = 0.8 \times 100 = 80 \]
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So price is $P = \frac{84}{80} = 1.05$, price increase of 5% $\Rightarrow$ Multiplier $= 5$.

Equity flow

$$f_S = \frac{\sum_i \theta_i \Delta F_i}{W} = \frac{0.8 \times 1}{0.8 \times 100} = 1\%.$$
Linearized demand of fund $i$, with $q_i^D = \frac{\Delta Q_i}{Q_i}$, $p = \frac{\Delta P}{P}$, $\zeta_i = 1 - \theta_i + \kappa_i \delta$

\[ q_i^D = -\zeta_i p + f_i \]
AGGREGATING HETEROGENEOUS INVESTORS

- Linearized demand of fund $i$, with $q_i^D = \frac{\Delta Q_i}{Q_i}$, $p = \frac{\Delta P}{P}$,
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- Aggregate demand: with $S_i = \frac{Q_i}{Q} =$ share of equities owned by fund $i$, with $X_S = \sum_i S_i X_i$

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

\[
f_S = \frac{\sum_i \theta_i \Delta F_i}{W^e} = \frac{\sum_i \theta_i \Delta F_i}{\sum_i \theta_i W_i} = \frac{\sum_i \theta_i \Delta F_i}{\text{Value of Equities}}.
\]

Ideal data: Flows at the fund level into stocks and bonds (\( \Delta F_i \)) and corresponding equity shares (\( \theta_i \)).
The 2-period model generalizes well to an infinite horizon.

Mandate of representative fund, with $\nu_t$ demand shocks:

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

Some notation:

- $\bar{P}_t, \bar{W}_t, \bar{D}_t$: baseline values (without flow shocks).
- Deviations from baseline values:
  - $p_t = P_t - P_{t-1}$,
  - $d_t = D_t - D_{t-1}$,
  - $d_e_t = E_t d_{t+1}$.

Cumulative flow:

$$f_t = F_t - \bar{F}_t$$
Infinite horizon: Demand curve

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- Some notation:
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  - Deviations from baseline values:

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

- 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 \( \rho \) is the “effective discount factor,”

\[ \rho = \frac{\zeta}{\kappa} = \delta + \frac{(1 - \theta)}{\kappa} > \delta \]
INFINITE HORIZON: PRICE AS PV OF DIVIDENDS AND FLOWS

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**Permanent inflow** \( f_0 \) creates \( \mathbb{E}f_t = f_0 \) for \( t \geq 0 \), so permanently increases price and lowers risk premium:

\[ \Delta p = \frac{f_0}{\zeta}, \quad \Delta \pi = -\delta \Delta p. \]
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**If flows mean-revert at rate** \( \phi \) \( (E_{f_t} = (1 - \phi)^t f_0) \):

\[ \Delta p_0 = \frac{f_0}{\zeta + \kappa \phi}, \quad \Delta \pi_0 = - (\delta + \phi) \Delta p_0 \]
HOW TO GENERATE LOW MACRO-ELASTICITIES $\kappa$, $\zeta$?

1. Inertia: many investors are “buy and hold”, so $\zeta = \kappa = 0$.

2. Mandates: or “keep a fixed allocation 80/20” or “don’t react much”: so $\zeta = 0.2$, $\kappa = 0$.
   - Market timing can lead to long periods of underperformance (Asness, Ilmanen, and Maloney, 2017)
     - “When others seem greedy, they may still get greedier for many years to come”
     - “Even if the investor has the patience to stay the course, boards or capital providers, seeing persistent underperformance, may not”
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     - “When others seem greedy, they may still get greedier for many years to come”
     - “Even if the investor has the patience to stay the course, boards or capital providers, seeing persistent underperformance, may not”
3. “Trend followers” and risk constraints: $\zeta, \kappa < 0$.
4. When $\hat{\pi}_t$ moves, the subjective perception of $\hat{\pi}^s_t$ does not:
   - $\hat{\pi}_t$ hard to estimate, so investors shrink to “no predictability” (could be rational, Grossman Stiglitz ’80, behavioral inattention, Gabaix ’14, complexity of extraction, Chinco Fos ’20, short sample Martin Nagel ’20; consistent with Giglio et al. 2021).
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.
Evaluating Elasticities and the Multiplier

- **Notation**
  \[ X_{st} := \sum_i S_i X_{it}, \quad X_{Et} := \sum_i \frac{1}{N} X_{it} \text{ (with } \sum_i S_i = 1) \]

- **\( \Delta q_{it} = \frac{Q_{it} - Q_{i,t-1}}{Q_{i,t-1}} \)**: time series of fractional changes in investors’ equity holdings.

- **To develop ideas, we model**
  \[
  \Delta q_{it} = -\zeta_i \Delta p_t + f_{it}^v,
  \]
  where \( \zeta_i \) is the elasticity of interest.
Estimating Elasticities and the Multiplier

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- We model the demand disturbance as

  $$f_{it}^\nu = \lambda'_i \eta_t + u_{it},$$

  where
  - $\eta_t$: Aggregate shocks.
  - $u_{it}$: Idiosyncratic or investor-specific shocks.
Estimating Elasticities and the Multiplier

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  where
  - $\eta_t$: Aggregate shocks.
  - $u_{it}$: Idiosyncratic or investor-specific shocks.
- Key identifying assumption:
  \[ \mathbb{E} [u_{it} \eta_t] = 0. \]
Market clearing implies $\Delta q_{St} = 0$ and hence

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

with $M = \frac{1}{\zeta_S}$. 

Two observations:

1. From the covariance matrix of equity demands, we can only estimate $\tilde{\lambda}_i$ and we cannot separately identify the elasticities.
2. This can be done only using $u_{i} - \tilde{u}_{i} St$, that is shocks to prices that excluded from the demand equation of investor $i$. 

Estimating elasticities and the multiplier
ESTIMATING ELASTICITIES AND THE MULTIPLIER

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with $M = \frac{1}{\zeta_S}$.

Substituting prices back into the demand equation

$$\Delta q_{it} = \tilde{\lambda}'_i \eta_t - \frac{\zeta_i}{\zeta_S} u_{St} + u_{it},$$

where $\tilde{\lambda}_i = \lambda_i - \frac{\zeta_i}{\zeta_S} \lambda_S$. 
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1. From the covariance matrix of equity demands, we can only estimate $\tilde{\lambda}_i$ and we cannot separately identify the elasticities.
2. This can be done only using $u_{St}^{-i}$, that is shocks to prices that excluded from the demand equation of investor $i$. 
Granular Instrumental Variables (GIV)

- The core idea in GIV is to use $u_{it}$ in

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

to estimate aggregate elasticities and multipliers.

- In G-K (2020), we:
  - Show how to use factor models to estimate idiosyncratic shocks, $u_{it}^e$.
  - Provide conditions under which the estimated idiosyncratic shocks can be used efficiently by forming $z_t := \sum_i S_{i,t-1} u_{it}^e$ as the GIV.
  - 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.
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.
  - ...


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 ($\lambda_S - \lambda_E \neq 0$).
DATA SOURCES

  ▶ 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
## GIV Applied Flow of Funds: $M \sim 5$ to $7$

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<th>$\Delta p$</th>
<th>$\Delta p$</th>
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<th>$\Delta q_E$</th>
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THOSE FLOWS IMPACT THE PRICE OVER A LONG HORIZON
As an 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.


This approach allows for heterogeneous elasticities.
GIV applied to disaggregated data: Details

- Extract common factors $\eta_t$ 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 $\Delta f_t$ the % inflow into mutual funds, estimate (monthly)

$$\Delta f_t = \sum_{l \geq 1} a_l \Delta f_{t-l} + ct + e_{ft}^f,$$

so the new demand from mutual funds is:

$$Z_t = S_{t-1}^{MF} \frac{e_t^f}{1 - \sum_l a_l}.$$

- 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 $\eta_t$ extracted from funds outside mutual funds.
  - Adjust for total present value of inflows via $K$. 
## GIV Using Mutual Fund Flows: $M \simeq 7$ to $8$

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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).

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<th>Return</th>
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<td>$R^2$</td>
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<td>0.376</td>
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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, $E[G] = e^g$.
- Later, we’ll do a production economy.
- Divide output: $Y_t = D_t + \Omega_t$ with $D_t = G_{t}^D D_{t-1}$, and $\Omega_t$ “residual” (combination of wages, etc)
- The whole tree is priced as
  \[ P_t = \frac{D_t}{\delta} e^{\rho_t}, \]
- Two funds: 1) pure bond 2) mixed fund with equity share
  \[ \theta_t = \theta \exp \left(-\kappa^D \rho_t + \kappa E_t [\Delta \rho_{t+1}] \right) \]
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”

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

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

which leads to flow into mixed fund:

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

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

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

Allocation is optimal on average, not date by date

Model endogenizes $b_t$ as coming from belief shocks,

$$b_t = k \mathbb{E}_{t}^{\text{subj}} [ \hat{\pi}_{t+1} ]$$

matching Giglio et al. ('21) evidence on the pass-through between volatile beliefs and small flows.
Equilibrium definition

- State vector: \( Z_t = (Y^t, D_t, D_{t-1}, b_t) \): 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 \( f_t = (1 - \phi_f) f_t + \epsilon_t^f \)

- 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:

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

where deviation is:

$$p_t = b^p f_t, \quad b^p = \frac{1}{\zeta + \kappa \phi f}.$$  

Variance of stock returns:

$$\sigma^2_r = \text{var} \left( \epsilon^D_t + b^p f_t \epsilon^f_t \right).$$

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

$$\pi_t = \bar{\pi} + b^\pi f_t, \quad \bar{\pi} = \gamma \sigma^2_r, \quad b^\pi = - (\delta + \phi f) b^p.$$  

- **Finally,** the interest rate is $r_f = - \ln \beta + \gamma g - \gamma (\gamma + 1) \frac{\sigma^2_y}{2}$ 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 $M_{t+1} \neq \beta \left( \frac{C_{t+1}}{C_t} \right)^{-\gamma}$

  $$M_{t+1} = \exp(-r_{ft} - \pi_t \frac{\varepsilon_{t+1}^D}{\sigma_D^2} + \zeta_t), \quad \pi_t = \bar{\pi} + b_f \tilde{f}_t$$

- 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)

  $$V(K_t, Z_t) = \max_{l_t, L_t} \{ F(K_t, L_t, Z_t) - w(Z_t) L_t - l_t - \kappa (l_t, K_t, Z_t)$$

  $$+ \mathbb{E}_t [M_{t+1} V((1 - \delta) K_t + l_t, Z_{t+1})] \}$$
## Calibration: Postulates

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<tr>
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<th>Value</th>
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<td>Growth rate of endowment and dividend</td>
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<td>Std. dev. of endowment growth</td>
<td>$\sigma_y = 0.8%$</td>
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<tr>
<td>Std. dev. of dividend growth</td>
<td>$\sigma_D = 5%$</td>
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<tr>
<td>Mixed fund’s equity share</td>
<td>$\theta = 0.85$</td>
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<td>Mixed fund’s sensitivity to risk premium</td>
<td>$\kappa = 1$</td>
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<td>Active fraction of funds</td>
<td>$m_p = 0.84$</td>
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<td>Mean reversion rate of behavioral disturbance</td>
<td>$\phi_b = 4%$</td>
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<tr>
<td>Std. dev. of innovations to behavioral disturbance</td>
<td>$\sigma_b = 3.3%$</td>
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<tr>
<td>Time preference</td>
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<td>Risk aversion</td>
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### Variables generated by the calibration

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<td>Macro elasticity with mean-reverting flow</td>
<td>$\zeta^M = 0.2$</td>
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<td>Macro market effective discount factor, $\rho = \zeta / \kappa$</td>
<td>$\rho = 16%$</td>
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<td>Risk free rate</td>
<td>$r_f = 1%$</td>
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<td>Average equity premium</td>
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<td>Average dividend-price ratio</td>
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<tr>
<td>Share of variance of stock returns due to fundamentals</td>
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<tr>
<td>Mean reversion rate of cumulative flow and log $D/P$</td>
<td>$\phi_f = 4%$</td>
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<tr>
<td>Std. dev. of innovation to cumulative flow</td>
<td>$\sigma_f = 2.8%$</td>
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<tr>
<td>Slope of log price deviation to flow</td>
<td>$b^p_f = 5$</td>
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<td>Slope of equity premium to flow</td>
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## Some Stock Market Moments

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<td>1.00</td>
<td>(0.34)</td>
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<td>[0.39, 2.50]</td>
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<td>(0.31)</td>
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<td></td>
<td>0.43</td>
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</table>

Predictive regression: $R_{t \rightarrow t+T} = \alpha_T + \beta_T \log \left( \frac{D_t}{P_t} \right)$
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 $\downarrow \Rightarrow$ Investment, GDP $\uparrow$
- 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.
Revisiting Macro-Financial Tenets

▶ “The market often looks impressively efficient in the short turn, so it must be quite macro-efficient”

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

▶ The discount rate is $\rho = \frac{\zeta}{\kappa}$, so high “short-term predictability efficient” means low $\frac{\zeta}{\kappa}$

▶ With low $\zeta$ (inelastic market), but low $\frac{\zeta}{\kappa}$, market is inelastic but time-efficiency is high
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- 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]
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  [Assuming a non-mean-reverting inflow]

- “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 $\mathbb{E} [|f_i|] = 1.9\%$ 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: \( f_S = \frac{\sum_i \theta_i \Delta F_i}{W} \)
- 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 \( f + \nu \).
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▶ The “impulse to buy” is visible in flows \( f \), and in \( f + \nu \).
▶ “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 \( \phi \)) \( \Delta \pi_0 = - (\delta + \phi) \Delta p_0 \simeq -0.04 \Delta p_0 \).
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

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

- So, buy 1% of market, (about 1% of GDP), then market goes up by 5%
POTENTIAL POLICY: GOVERNMENT INTERVENTION OF STOCK MARKET?

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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.
- 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)
- Chinese “national team” owns 6% of Chinese stock market (since 2015 crash)
Potential policy: Q.E. in other asset classes

- Similar Q.E. in other asset classes:
- Cf central banks of Switzerland / Israel bought ~ 40% GDP worth of foreign currency to prevent FX appreciation (perhaps of ~ 20%) [Caveat: this is not well identified]
- So perhaps large scale interventions matter (modelling in Gabaix Maggiori '14)
- Q.E. for bonds: there, the multiplier is about 0.3, not 5. (Krishnamurthy and Vissing-Jorgensen '12, Koijen et al. '21)
  - This is likely because when doing QE for bonds, the central bank exchanges one long term bond for one short-term bonds — two very substitute assets
The model can be extended to the cross section of returns. With $\omega_a =$ relative market cap of stock $a$, and aggregate is $p = \sum_a \omega_a p_a$,

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

Fraction of portfolio in stock $a$:

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

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

This gives

$$ q_a^{D, \perp} = -\zeta^\perp p_a^\perp + \kappa^\perp \delta d_{at}^{e, \perp} + \kappa^\perp E_t \left[ \Delta p_{a,t+1}^\perp \right] $$

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, $\zeta = 1 - \theta + \kappa \delta$
So, the impact of a flow $f_a = f + f_a^\perp$ is

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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 $\zeta$ 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: Impact of buying an individual stock

- Stock $a$, which accounts for $\omega_a$ 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.:

$$p_a = \left(\frac{1 - \omega_a}{\zeta_{\perp}} + \frac{\omega_a}{\zeta}\right) f_a \quad (1)$$

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

$$p_b = \left(\frac{1}{\zeta} - \frac{1}{\zeta_{\perp}}\right) \omega_a f_a, \quad b \neq a \quad (2)$$
Micro vs Macro Elasticity: Numerical example

- We calibrate $\zeta^\perp = 1$ and $\zeta = 0.2$.
- Suppose for GM, $\omega_{GM} = 0.5\%$.
- Consider two trades:
  - If an investor buys $1$ of GM selling $1$ of Google, the price of GM increases by $1$ and the price of Google drops by $1$. No impact on the market.
  - If the investor buys $1$ of GM using cash, then GM increases by
    \[
    \frac{1 - \omega_a}{\zeta^\perp} + \frac{\omega_a}{\zeta} = \frac{0.995}{1} + \frac{0.005}{0.2} = \$1.02.
    \]
    The price of all other stocks increases by
    \[
    (1 - \omega_a) \left( \frac{1}{\zeta} - \frac{1}{\zeta^\perp} \right) = \$3.98.
    \]
    The total market thus increases by $\$5$. 

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

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

$$p^\perp_{a,t} = E_t \sum_{\tau=t}^{\infty} \frac{\rho^\perp}{(1 + \rho^\perp)^{\tau-t+1}} \left( \frac{f_{a\tau} + v_{a\tau}}{\zeta^\perp} + M^{D,\perp} d_{a\tau} \right).$$
Micro multipliers using GIV (GKY, 2022)

- Stock level demand: \( \Delta q_{jat}^\perp = -\zeta_{it} \Delta p_{at}^\perp + \lambda'_{it} \eta_{at} + u_{iat} \).
  - We allow for investor-specific and time-varying elasticities.
  - The model can be extended to include changes in fundamentals.

- To construct the instrument, we select the largest 200 managers in a quarter in terms of dollar volume traded.
Procedure, starting with a candidate $\zeta_{it}$:

- $d_{iat} := \Delta q_{iat} + \zeta_{it} \Delta p_{at} = \lambda'_{it} \eta_{at} + u_{iat}$.
- Run PCA on $d_{iat}$ and estimate the residuals, $u_{iat}^e$.
- Form the (investor-specific) instruments

$$z_{iat} = \sum_{j \neq i} S^a_{jt} u^e_{jat}. $$

Parameter estimation:

- First stage

$$\Delta p_{at} = a_{it} + M_{it} z_{iat} + e_{iat}. $$

- Second stage, with $\Delta \hat{p}_{at} = a_{it} + M_{it} z_{iat}$,

$$\Delta q_{iat} = b_{it} - \zeta_{it} \Delta \hat{p}_{at} + e_{iat}^*. $$

- Loop over $\zeta_{it}$ until convergence.
MICRO MULTIPLIERS USING GIV

Date

Multiplier


0.4
0.6
0.8
1
1.2
1.4
1.6
1.8

Date


0.4
0.6
0.8
1
1.2
1.4
1.6
1.8

Multiplier
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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  - Replacing the dark matter of asset pricing with tangible flows and demand shocks of different investors:
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CONCLUSION

▶ A framework to connect prices, fundamentals, and portfolio flows and holdings to understand prices and expected returns across markets and asset classes.

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▶ This offers a way to investigate perennial questions:
    ▶ Who moved the market? (and then perhaps why did they move?)
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▶ One can rethink / investigate empirically much of 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.