# The Anatomy of Index Rebalancings: Evidence from Transaction Data

**Mariana Escobar** [1] **Lorenzo Pandolfi** [2]
**Alvaro Pedraza** [3] **Tomas Williams** [4]

[1] Banco de la Republica de Colombia

[2] University of Naples Federico II and CSEF

[3] The World Bank

[4] George Washington University

CSEF-IGIER Symposium

# Index Rebalancings

- **Index rebalancing episodes:** changes in the composition of indexes, *e.g.* additions/deletions of stocks into/from equity (S&P 500, MSCI, etc.) or bond (J.P. Morgan GBI, Citigroup) indexes
- Appealing from an empirical perspective:
  - Entail **sudden and large demand shocks** from investors using the indexes as benchmark
- **Widely used in finance** to test different theories in asset pricing and corporate finance
  1. Inelastic Demand for Financial Assets
  2. Consequences of institutional ownership on prince informativeness, corporate financing, and governance
  3. Price comovement of commonly owned stocks

# Investor Behavior

- Existing literature focuses mostly on the **price effects** of rebalancings
- There is very **little evidence on actual investor behavior**
  - High-frequency data on investors' portfolios is often unavailable
  - Low-frequency data only covers subsets of investors
- This lack of data leaves **many unanswered yet important questions** about these episodes
  - Which investors rebalance into (out of) affected stocks?
  - Are these portfolio rebalancings permanent?
  - When does the rebalancing occur?

# Demand Elasticity for Stocks

- Lack of traded quantities data is particularly problematic when estimating the **demand elasticity for stocks**
  - Key parameter of interest in asset pricing models with limits to arbitrage (Koijen and Yogo, 2019)
  - Having no data on quantities, previous studies need to:
    - Use **assets under management (AUM)** of funds benchmarked against the relevant index
    - Make assumptions on the degree of passivism of these funds
  - As a result **estimates vary widely** (both across and even within studies)
    - Chang et al. (2015) estimate an elasticity in the range [-0.4; -1.5]

# Our contribution

- **Shed novel light** on the actual behavior of investors during index rebalancing episodes
  - Use detailed **transaction-level data** from Colombian stock market
    - All stock purchases and sales with a time-stamp from the secondary market
    - We observe the **individual/institution** involved in the transaction
  - Combine it with **additions/deletions** of Colombian stocks from **MSCI indexes**
- Provide a **complete picture on index rebalancing episodes:**
  a. Effect on Prices
  b. Effect on quantities, by investor type
  c. Estimate stock demand elasticity

# Main Findings

- MSCI inclusions entail a **median CAR of 5.5%** from announcement to implementation
- This effect is a result of a **large increase in the demand by foreign investors** (both passive and non-passive investors) which is not absorbed by arbitrageurs
- The median **elasticity of demand for stocks is -0.34**
  - A **1% increase** in the demand for a stock leads to an **increase of 2.94%** in the price

# MSCI Indexes

- MSCI indexes are the **most widely used international benchmarks**
- Used by institutional investors and asset managers to compare relative performance
- Portfolio weights have been shown to track benchmark weights closely (Cremers et al., 2017; Raddatz et al., 2017)
- Importantly, used **mostly by international investors**
  - Indexes have different countries in their composition so avoided by local-only investors and funds

# MSCI Rebalancing Events

- Exploit additions/deletions of Colombian stocks to MSCI Standard Indexes
- ▸ 18 rebalancing events for which we have:
  - The stocks **included/excluded** from different indexes (MSCI ACWI, MSCI EM, MSCI EM Latin America, etc.)
  - The dates when rebalancing is **announced** and made **effective** (from 11 to 17 days between each other)
  - Information on the **benchmark weight** before and after the inclusion (exclusion) into (from) each index
  - The **Assets under management** (AUM) (total and passive) tracking the different MSCI indexes, which we use to estimate the elasticity of demand with more 'standard' methdologies

# The Colombian Stock Exchange

- Data from whole Colombia's stock market from 2006-2016
- Every transaction with information on:
  - The exact date (and time)
  - The parties involved
  - Quantity and price of shares bought (sold)
- As for the parties involved in the transaction we know:
  - The investor's name
  - Whether it is foreign or domestic
  - Its type (individual, corporation, mutual fund, pension funds, ETF, banks, etc.)

# Investors in Our Sample

| | 2006-2011 | 2012-2017 |
|---|---|---|
| **Panel A. Traded volume by investor group (% of total volume)** | | |
| Domestic Investors | 91.9 | 76.3 |
| Brokers | 11.0 | 18.6 |
| Corporations | 16.3 | 12.9 |
| Domestic individuals | 41.3 | 19.2 |
| Mutual funds | 5.5 | 4.8 |
| Pension funds | 11.8 | 12.7 |
| Others | 5.9 | 8.0 |
| Foreign Investors | 8.1 | 23.7 |
| Active mutual funds | 1.1 | 5.0 |
| Passive mutual funds | 1.7 | 2.8 |
| Exchange Traded Fund | 2.0 | 3.5 |
| Pension funds | 0.4 | 1.8 |
| Government funds | 0.4 | 2.8 |
| Hedge funds | 0.1 | 0.3 |
| Investment banks | 0.8 | 5.2 |
| Others | 1.5 | 2.4 |

# Stocks in Our Sample

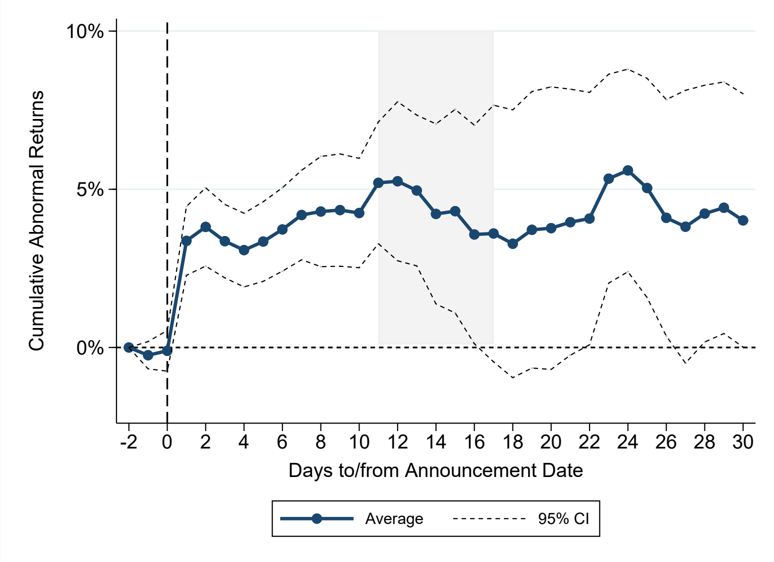
| | 2006-2011 | 2012-2017 |
|---|---|---|
| Panel B. Event stocks vs. other stocks (million USD) | | |
| Stock with addition/deletion events | | |
| Average Market Capitalization | 12,130 | 14,653 |
| Median Market Capitalization | 4,970 | 7,482 |
| Average yearly traded value | 1,841 | 1,638 |
| Median yearly traded value | 1,005 | 1,143 |
| Other stocks | | |
| Average Market Capitalization | 1,842 | 2,509 |
| Median Market Capitalization | 684 | 838 |
| Average yearly traded value | 222 | 245 |
| Median yearly traded value | 3 | 6 |

- Event stocks **similar to ten largest companies in Russell 2000** in terms of market cap

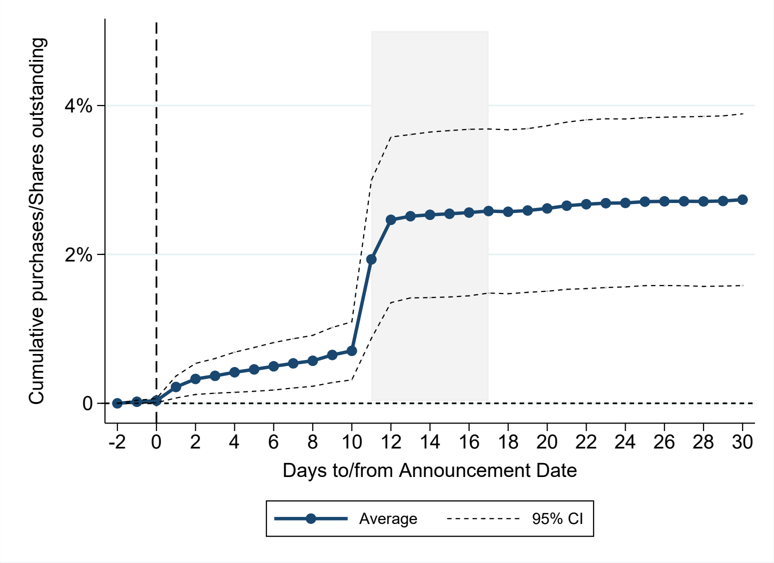
# Prices and quantities

- We first look at the price dynamics of stocks entering (or leaving) MSCI indexes
- Calculate abnormal returns with a market model $R_{st} - \hat{\beta}_s R_t^{D/s}$
  - $\hat{\beta}_s$ estimated using daily stock returns in the year prior to the rebalancing event
  - $R_t^{D/s}$ is the return of the COLCAP (local domestic index)
  - $R_{st}$ are return in pesos in excess of the domestic deposit rate
- We normalize deletions to be additions (multiplying them by -1)
- Then, we look at investors' behavior around the rebalancings

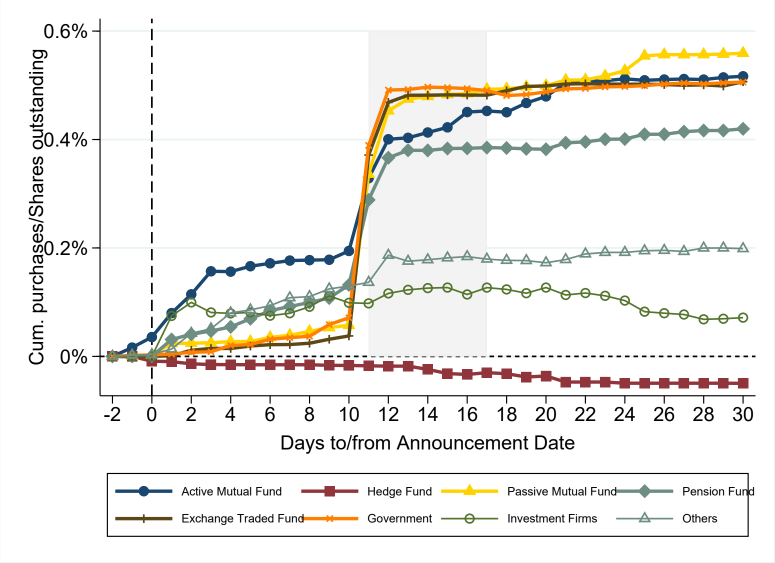
# Cumulative Abnormal Returns



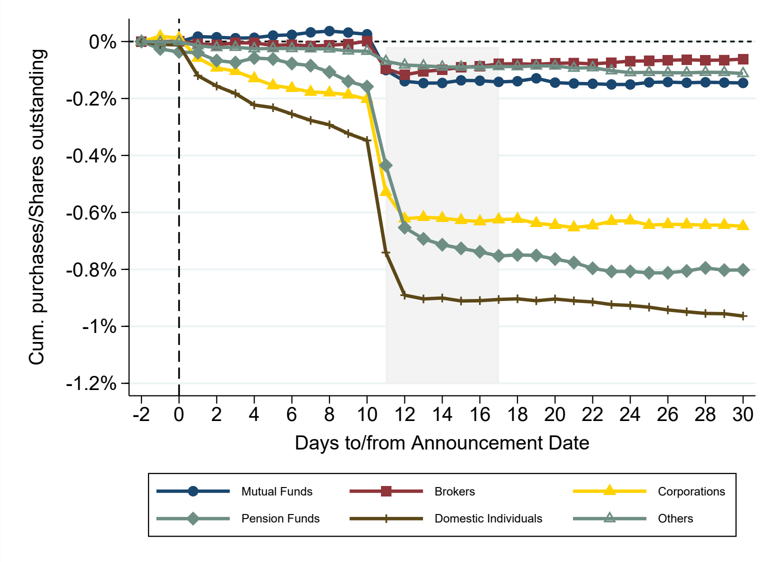
# Investor Behavior: Aggregate Foreign Purchases



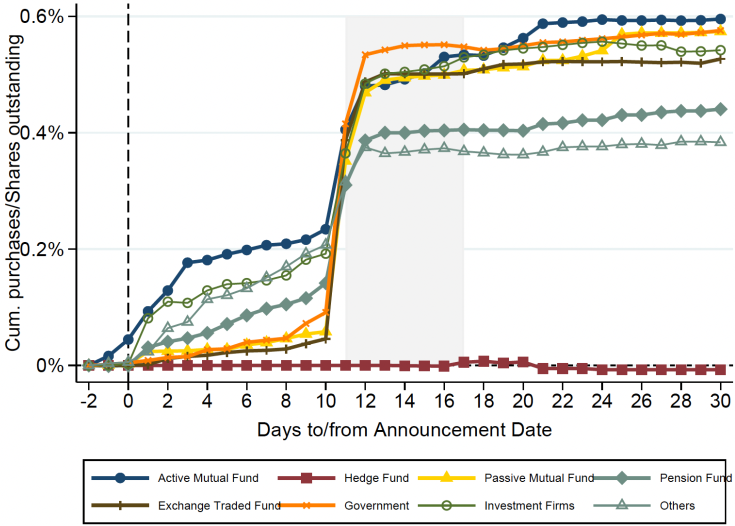
# Investor Behavior: Foreign Investors Breakdown



# Investor Behavior: Domestic Investors Breakdown



# Investor Behavior: Foreign Investors - Implementation



# Prices and Investor Behavior: Quantitative Details

| | (1) $\Delta P/P$ | (2) Foreign $[0,T]$ | (3) Foreign $[T]$ | (4) All investors $[T]$ | (5) MSCI all | (6) MSCI passive |
|---|---|---|---|---|---|---|
| Panel A. Change in prices ($\Delta P/P$) and quantities ($\Delta Q/Q$) | | | | | | |
| Mean | 6.65 | 3.21 | 2.37 | 2.51 | 24.24 | 1.23 |
| Std. errors | [1.24] | 0.64 | [0.49] | [0.5] | [3.5] | [0.2] |
| Median | 5.45 | 2.74 | 2.00 | 2.13 | 16.88 | 0.94 |
| Min | 0.87 | 0.04 | 0.04 | 0.07 | 3.46 | 0.09 |
| p25 | 3.10 | 1.08 | 0.68 | 0.69 | 15.66 | 0.64 |
| p75 | 8.10 | 4.40 | 3.29 | 3.40 | 30.46 | 1.93 |
| Max | 22.32 | 10.63 | 7.76 | 8.05 | 52.58 | 3.16 |
| No. Obs. | 18 | 18 | 18 | 18 | 18 | 18 |

# Conventional Methodology to Estimate Demand Shock

- For each rebalancing episode for stock $i$ we also compute

$$\frac{\Delta Q}{Q}^{Conventional}_{i,k} = \frac{\sum_j AUM_j^k w_j^i}{MCAP_i}$$

- $j$ indicates the index the stock is being included/excluded into/from
- Two estimates as in the literature
  - All funds rebalance to mimic the index ($k$ = *Total*)
  - Only passive funds rebalance ($k$ = *Passive*)

# Investor Behavior: Quantitative Comparison

| | (1) $\Delta P/P$ | (2) Foreign $[0, T]$ | (3) Foreign $[T]$ | (4) All investors $[T]$ | (5) MSCI all | (6) MSCI passive |
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# Investor Behavior: Quantitative Comparison

- Using **all AUM as passive largely overestimates** demand shocks
- Using **only AUM of passive funds** estimated inflows are closer to the actual ones (still ~ 50% of them)
- Why?
    - Not all non-passive funds rebalance their portfolio
    - Active AUM are still larger than passive ones
    - In our sample **non-passive flows are 1.73 times larger than passive flows**
    - Yet, **AUM of non-passive funds are 17 times larger than those of passive funds**

# Framework: Gabaix and Koijen (2021)

- Since Shleifer (1986) index rebalancing episodes are used frequently to estimate "micro" demand elasticities
  - The **slope of stock demand curves**
- Theoretical framework in Gabaix and Koijen (2021) useful to think about how to estimate these
- Their setup is for "macro" elasticities (flows from bond to equity markets)
- **Main assumptions**
  i. Bond and equity funds have implicit mandates and cannot move to other asset class
  ii. Arbitrageurs are small or constrained to fully arbitrage demand shocks away

# Framework: Gabaix and Koijen (2021)

- We modify assumption (i) and consider only equity funds with benchmarks as implicit mandates
- In this way, both assumptions find support in our data
- Key equation for **price effect** of expected inflows

$$p_t = \frac{1}{(1+\rho)^{T-t}} \frac{f_T}{\xi}$$

- $p_t$ is the price effect at time $t$ of an inflow that will happen at time $T > t$ and is announced at $t = 0$
- $\rho$ is the effective discount rate
- $\xi$ is the demand elasticity for the stock

# From Framework to Empirics

- Overall **price impact from announcement to implementation**

$$p_T \equiv \frac{\Delta P}{P} = \frac{f_T}{\xi}$$

- $\frac{\Delta P}{P}$ is our estimated CAR
- $f_T$ are the rebalancing-driven inflows on the implementation date
- We measure $f_T$ as the quantity of shares purchased (sold) by foreigners on the effective inclusion (exclusion) date
- We use several alternative measures as robustness checks

# Estimated Demand Elasticity

| | (1) $\Delta P/P$ | (2) Foreign $[0,T]$ | (3) Foreign $[T]$ | (4) All investors $[T]$ | (5) MSCI all | (6) MSCI passive |
|---|---|---|---|---|---|---|
| Panel B. Elasticities | | | | | | |
| Mean | | -0.84 | -0.63 | -0.67 | -6.67 | -0.34 |
| Std. errors | | [0.23] | [0.19] | [0.2] | [1.91] | [0.12] |
| Median | | -0.47 | -0.34 | -0.39 | -4.10 | -0.21 |
| Min | | -3.91 | -3.27 | -3.35 | -35.12 | -2.29 |
| p25 | | -1.01 | -0.63 | -0.65 | -7.84 | -0.37 |
| p75 | | -0.24 | -0.19 | -0.20 | -2.51 | -0.11 |
| Max | | 0.00 | 0.00 | -0.01 | -0.31 | -0.01 |
| No. Obs. | | 18 | 18 | 18 | 18 | 18 |

# Our Estimates versus Conventional Estimates

- Demand for stocks highly inelastic
  - A 1% increase in flows to the stock leads to an increase in price of almost 3%
- How does it **compare to conventional estimates?**
  - Assuming all AUM are passive overestimates importantly the elasticity using actual flows
  - Much more than using only passive AUM tends to underestimate it

# A Comparison with US Studies

- Hard to generalize our results to the US (different setups)
- Back-of-the-envelope calculation to provide sharper elasticities from previous US studies
- **Chang et al. (2015)** RDD using Russell 1000/2000
  - Elasticities between -0.46 (only passive funds rebalance) to -1.5 (all funds are passive)
- Our elasticity is 1.62 times larger than when using the assumption that only passive funds rebalance
- Multiplying the lower bound estimate in Chang et al by 1.62, one gets an elasticity of -0.7
- This is remarkably close to the estimate in Pavlova and Sikorskaya (2020) that estimate the actual number of active funds that behave as passive in the US

# Discussion and Additional Results

- Heterogeneity Across Stocks
- External Validity
- Other Potential Channels:
  - Information
  - Investor Recognition
  - Liquidity
- Which Elasticity of Demand?

# Final Remarks

- **Shed novel light** on the actual behavior of investors during index rebalancing episodes
- 3 Main takeaways
    1. **Broad range of investors** (beyond passive funds and ETFs) that **have 'implicit' mandates** to closely track the composition of the indexes they follow
    2. **Hedge funds** and other supposed arbitrageurs **are too small** to soften the price impact of demand shocks
    3. The **demand for stocks is highly inelastic**
- All 3 are consistent with **recent demand system asset pricing models** with limits to arbitrage (Koijen and Yogo, 2019; Gabaix and Koijen, 2021)

# Some Policy Comments

- Our estimates have **especial importance for policy makers in EM**
  - COVID-19 crisis was their first experiment with **QE for several EMs** (in bond markets)
  - Some developed markets also experimented with QE in stock markets (Japan)
  - Future crisis might lead some EMs to experiment with similar QEs
  - We provide sharp estimates of how purchases of stocks in these markets could affect prices
    - A **1% increase in flows** to the stock leads to an **increase in price of almost 3%**

# The End

**Thank You!!**

# List Events

| Company | Symbol | Type | Event | Announcement date |
|---|---|---|---|---|
| Grupo de Inversiones Suramericana | GRUPOSURA | Common | Addition | 11/7/2007 |
| Grupo Nutresa SA | NUTRESA | Common | Deletion | 5/7/2008 |
| Almacenes Exito SA | EXITO | Common | Addition | 11/12/2009 |
| Corporacion Financiera Colombiana SA | CORFICOLCF | Common | Addition | 11/11/2010 |
| Grupo Aval Acciones y Valores SA | PFAVAL | Preferred | Addition | 11/16/2011 |
| Banco Davivienda SA | PFDAVVNDA | Preferred | Addition | 5/16/2012 |
| Grupo de Inversiones Suramericana | PFGRUPSURA | Preferred | Addition | 5/16/2012 |
| Isagen SA | ISAGEN | Common | Addition | 5/16/2012 |
| Cemex Latam Holdings SA | CLH | Common | Addition | 5/16/2013 |
| Bancolombia SA | BCOLOMBIA | Common | Deletion | 5/15/2014 |
| Cemex Latam Holdings SA | CLH | Common | Deletion | 5/13/2015 |
| Grupo Argos SA | PFGRUPOARG | Preferred | Deletion | 5/13/2015 |
| Almacenes Exito SA | EXITO | Common | Deletion | 11/13/2015 |
| Banco Davivienda SA | PFDAVVNDA | Preferred | Deletion | 11/13/2015 |
| Isagen SA | ISAGEN | Common | Deletion | 11/13/2015 |
| Corporacion Financiera Colombiana SA | CORFICOLCF | Common | Deletion | 5/16/2017 |
| Bancolombia SA | BCOLOMBIA | Common | Addition | 6/16/2017 |

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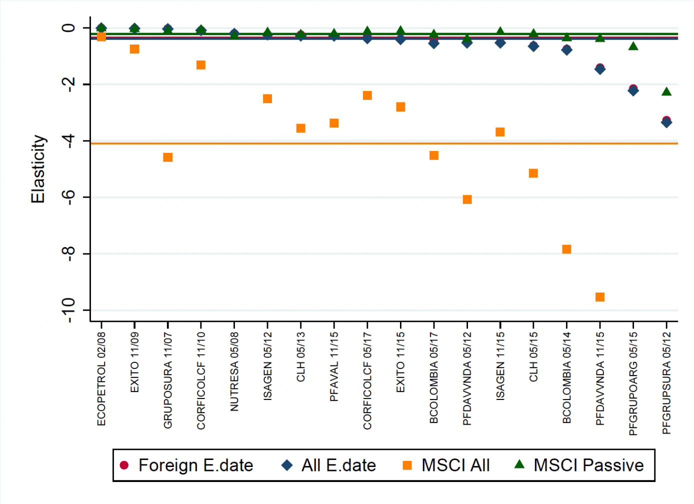
# Demand Elasticity for Stocks: Heterogeneity

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# External Validity

- Colombia is comparable to many emerging markets in terms of market capitalization and stock market development
- Stocks comparable to smaller Russell 1000 and largest Russell 2000 stocks in terms of size
- Our demand elasticity results can be useful to back out from any market a more precise demand elasticity
- This method works pretty well when compared to US studies trying to obtain more precise demand elasticities for stocks

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# Information Hypothesis

- Two pieces of evidence suggesting limited role for an information channel
    1. Clear separation (in terms of trades) between domestic and foreign investors
        - Hard to think that MSCI announcement would create such a separation in terms of information
    2. Even if possible the timing of trades is hardly consistent with this hypothesis (with 75% of them happening in the implementation date)

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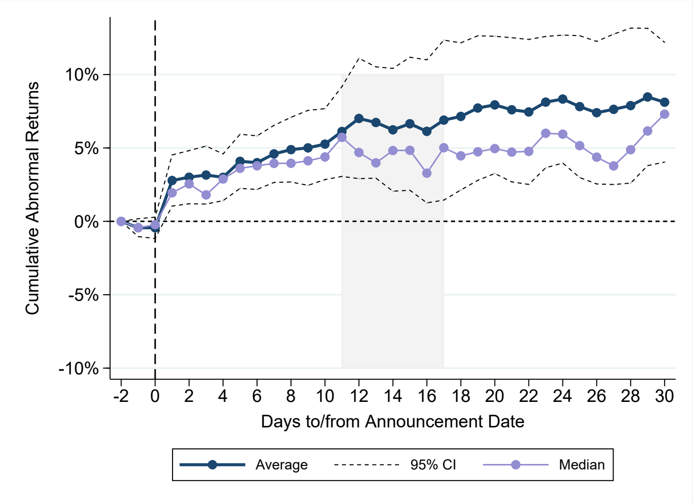
# Investor Recognition Hypothesis - Additions

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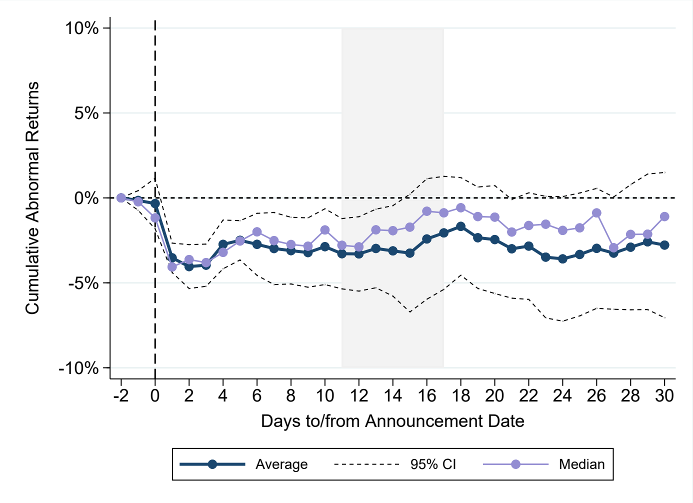
# Investor Recognition Hypothesis - Deletions

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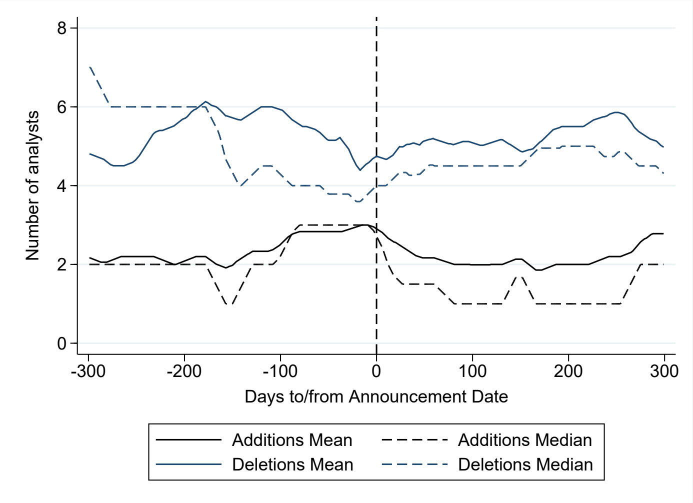
# Investor Recognition Hypothesis - Analysts Coverage

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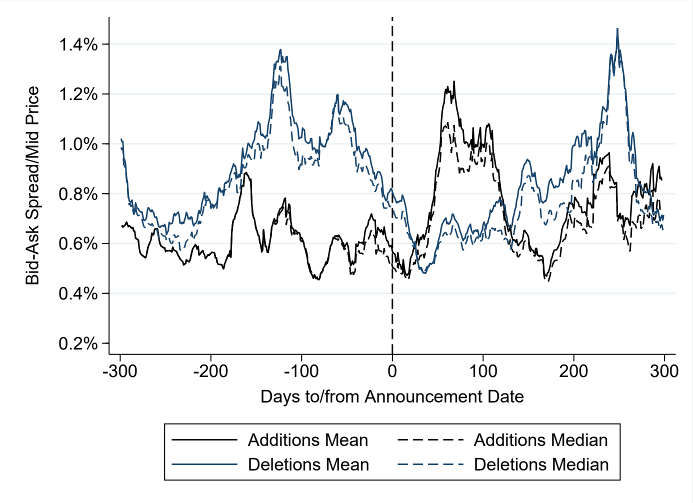
# Liquidity Hypothesis

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# Which Elasticity of Demand?

- Two issues worth thinking related to which demand elasticity we are estimating
  1. **Whose elasticity?**
     - As Pavlova and Sikorskaya (2020) argue is that of the residual market
     - In our setup the residual market are domestic investors
     - Does not change our results much to divide by the holdings of these investors only
  2. **Short or Medium run elasticity?**
     - So far we estimate a short-run elasticity
     - However, median elasticity is -0.53 when considering 60 trading days after rebalancing

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