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University of Naples Federico II

University of Salerno

Bocconi University, Milan

CSEF - Centre for Studies in Economics and Finance
DEPARTMENT OF ECONOMICS – UNIVERSITY OF NAPLES
80126 NAPLES - ITALY
Tel. and fax +39 081 675372 – e-mail: csef@unina.it
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The Anatomy of Index Rebalancings: Evidence from Transaction Data

Mariana Escobar [*], **Lorenzo Pandolfi**[†], **Alvaro Pedraza** [‡], **and Tomas Williams**[§]

Abstract
We exploit novel transaction-level data from Colombia to analyze episodes of additions to and deletions from MSCI equity indexes. We fnd additions and deletions to have large price effects (5.5%). We show that these effects are due to large demand shocks by different classes of international investors - beyond passive funds and ETFs - which are not absorbed by arbitrageurs. Consistent with asset pricing models with limits to arbitrage, stock demand curves are very inelastic: the median elasticity in our sample is -0.34, implying that a 1% increase in the demand for a stock increases its price by 2.9%.

JEL Classification: F32, G11, G15

Keywords: index rebalancings; institutional investors; stocks demand elasticity; passive funds; arbitrage

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[*] Banco de la Republica de Colombia. E-mail: mariana.esc13@hotmail.com

[†] Università di Napoli Federico II and CSEF. E-mail: lorenzo.pandolfi@unina.it

[‡] The World Bank. E-mail: apedrazamorales@worldbank.org

[§] George Washington University. E-mail: tomaswilliams@gwu.edu

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1 Introduction

Index rebalancing episodes have been widely exploited to study several topics in financial economics. For instance, they have been used to measure the effects of large demand shocks on stock prices and estimate the slope of stock demand curves (e.g., Shleifer, 1986; Harris and Gurel, 1986; Kaul et al., 2000; Chang et al., 2014)[1], as well as to study the consequences of institutional ownership on price informativeness, corporate financing, and governance (Boone and White, 2015; Appel et al., 2016; Crane et al., 2016; Bena et al., 2017), and the price comovements of commonly owned stocks (Barberis et al., 2005; Greenwood, 2008; Claessens and Yafeh, 2012). Index rebalancings are appealing from an empirical perspective since they entail sudden and large shocks in the demand of affected securities by investors – mostly large institutions – benchmarked against the indexes. To the extent that (at least some of) these shocks are unrelated to fundamentals, their quasi-experimental nature makes them an ideal laboratory to test several asset pricing and corporate finance theories.

Despite the extensive use in the literature and the vast evidence on the price effects of index rebalancings, little is known about the actual behavior of the population of investors in response to these events. This is because traded quantities are usually hard to observe. High-frequency data on investors' portfolios is often unavailable, and low-frequency (quarterly) data typically covers a subset of investors. This lack of data leaves many unanswered yet important questions about index rebalancings. For instance: which types of investors rebalance into (out of) affected stocks? Are these portfolio rebalancings permanent? Do investors trade when rebalancings are announced, when they are made effective, or in the interim period between these two dates? Moreover, lacking data on actual traded quantities is particularly problematic when using index inclusions and deletions to estimate the demand elasticity for stocks, which is a key parameter of interest for financial economists and policy makers.[2] Researchers estimating such elasticity usually infer the demand shocks implied by the rebalancings from the assets under management (AUM) of funds benchmarked against the indexes and make assumptions on the degree of *passivism* of such funds. Depending on these assumptions, estimates can vary widely.[3]

[1] Similar studies have been conducted in exchange rate and sovereign debt markets (Hau et al., 2010; Pandolfi and Williams, 2019).

[2] In fact, this elasticity is at the heart of a new class of asset pricing models – such as those developed by Koijen and Yogo (2019) and Gabaix and Koijen (2020) – which are used to study key policy issues, such as the impact of asset purchase programs on asset prices.

[3] Wurgler and Zhuravskaya (2002) review studies estimating the demand elasticity for

Our main contribution in this paper is to shed novel light on index rebalancings – and especially on the behavior of investors – by combining transaction-level data from the Colombian stock market with episodes of additions into and deletions of Colombian stocks from MSCI indexes. Our dataset contains all the stock purchases and sales from the secondary market where these stocks are traded. Additionally, we observe the individuals/institutions involved in each transaction. To our knowledge, this is the first attempt to provide a complete picture on index rebalancing episodes by analyzing not only price changes, but also the actual trading behavior of the universe of investors in response to these episodes. Furthermore, our dataset allows us to measure the demand elasticity for stocks using actual traded quantities, without having to make assumptions on funds' behavior.

We find that inclusion into an international equity index leads to a median cumulative abnormal return, from the announcement to the implementation date, of 5.5%, which is line with recent studies of equity additions and deletions (Chang et al., 2014). We show that the price effect results from a large increase in the demand by foreign investors.[4] This group buys (sells) about 2.7% of the outstanding shares of stocks included into (removed from) the indexes. Importantly, most trades (74%) take place on the effective day of the index recomposition rather than on the announcement day. Such portfolio rebalancings do not revert, at least in the month following the index redefinition. In addition to passive mutual funds and ETFs, most foreign investors – including active mutual funds, pension funds, investment firms, government agencies and sovereign wealth funds – also rebalance their portfolios in the direction of the index. The demand shock from such non-passive investors is 1.7 times larger than the demand from purely passive funds. Foreign hedge funds, instead, tend to trade in the opposite direction of the index recomposition, possibly to speculate on the events. Yet, their trades are very small compared to those of the rest of foreign investors.

stocks and note that it can range between -1 and -37. Even when looking at the very same event, estimates can vary depending on the assumptions made to infer quantities. For instance, Chang et al. (2014), in their RDD study on the impact of stock inclusions into the Russell 1000 index, and contemporaneous exclusion from the Russell 2000, provide an estimated elasticity between -1.5 and -0.4, which implies that a 1% increase in the quantity demanded of a given stock leads to an increase in its price ranging from 0.67% to 2.5%. The latter is estimated assuming that only passive funds tracking both indexes rebalance their portfolios accordingly. The former is instead obtained under the assumption that all investors (passive and active) benchmarked against these indexes do so.

[4]In emerging markets, MSCI indexes are mostly tracked by foreign investors rather than domestic ones, as they have international focus and often include stocks from different countries. In fact, we show in Section 3 that domestic investors sell stocks when these are included in international indexes and buy them when they get removed. This is consistent with the evidence in Bena et al. (2017).

After this, we combine our results on prices and traded quantities and estimate a median elasticity of demand for stocks of -0.34. Thus, for the median stock in our sample, a 1% increase in the quantity demanded of shares (relative to the number of shares outstanding) leads to an increase in its price of 2.94%. This estimate is obtained looking at the quantity of shares purchased (sold) by foreign investors on the effective inclusion (exclusion) date. These are indeed the trades that can most reasonably be attributed to be a direct consequence of the index change. Yet, we show that the median elasticity is similar if we consider trades between announcement and implementation.[5]

Although our empirical analysis focuses on a sample of large Colombian stocks, our results can shed light on the elasticity of demand in other equity markets as well. First, the Colombian stock market is similar in size to equity markets in other developing countries, such as Argentina, Peru, and Vietnam. Second, because MSCI indices typically focus on the biggest firms in the countries they follow, our sample of Colombian stocks are very close in terms of market capitalization to the smallest US stocks in the Russell 1000 and the largest in the Russell 2000, which are the object of several recent studies on the effects of index redefinitions (e.g., Chang et al., 2014; Boone and White, 2015; Appel et al., 2016; Pavlova and Sikorskaya, 2020). Furthermore, our measured elasticity using transaction data can be combined with information on AUM to perform back-of-the-envelope calculation to obtain more precise estimates of the stock demand elasticities in contexts/markets where only AUM data is available.[6]

An implicit assumption of our empirical exercise is that index additions and deletions only affect prices through a demand shock; a common assumption in studies that use index redefinitions to measure the demand elasticity for stocks. However, these price effects might also be explained by at least three alternative channels. First, if index providers have superior information about firms, announcements of index additions and deletions may convey information to market participants who therefore revise their expectations about firm fundamentals. Second, price effects might arise due to changes in investor recognition (Chen et al., 2004) if stocks become more or less salient to investors after a rebalancing. Third, index redefinitions could impact the liquidity of affected securities (Hegde and McDermott, 2003; Pandolfi and Williams, 2019) and, in turn, stock returns if investors require a liquidity premium. In our setting, these alternative channels

[5]Additionally, we also show that the elasticity is very similar when we take into account also purchases (sales) by domestic investors who buy (sell) newly included (excluded) stocks on the implementation date.

[6]In Section 4 we show that a back-of-the-envelope calculation that combines our estimated elasticity with AUM data leads to an estimated elasticity for US stocks which is consistent with previous studies.

do not appear to be driving the results. For example, if index rebalancings were conveying information about firm fundamentals, one should observe active foreign investors and possibly domestic investors trading at or close to the announcement date. Instead, the majority of flows are from foreign investors and take place on the implementation date. Importantly, MSCI additions and deletions decisions are based on public information – such as company size, market capitalization, liquidity, and others – which is typically available to investors. As for the investor recognition hypothesis, changes in investor awareness are unlikely to be driving our results, as: i) the price effects of additions and deletions are similar in absolute value (one would expect additions to have much larger effect under this alternative hypothesis) and the number of analysts covering affected stocks do not change significantly around the rebalancing episodes. Finally, we show that the bid-ask spread on these stocks do not change permanently in response to the episodes, thus ruling out the liquidity channel as well.

To sum up, three main takeaways emerge from our analysis, all of which are consistent with theories of limits to arbitrage, including those recently developed by Koijen and Yogo (2019) and Gabaix and Koijen (2020). First, there is a broad range of investors (beyond passive funds and ETFs) that have 'implicit' mandates to closely track the composition of the indexes they follow so as to deviate very little from benchmark returns.[7] Second, hedge funds and other investors, that are supposed to act as arbitrageurs in financial markets, are too small to soften the price impact of demand shocks generated by investors with such 'implicit' mandates. Third, consistent with the other two results, the demand for stocks is highly inelastic, contrary to what is typically predicted in canonical asset pricing models.

2 Data and Institutional Framework

To study rebalancing events, we exploit episodes of additions to and deletions of Colombian stocks from MSCI international equity indexes, together with transaction-level data from the Colombian stock exchange, *i.e.*, the *Bolsa de Valores de Colombia* (BVC, henceforth). In this section, we describe these episodes and discuss the main features of the BVC and the proprietary transaction data.

[7] This behavior is consistent with benchmark indexes being the preferred habitat for many different investors. See for instance Pavlova and Sikorskaya (2020) and Kashyap et al. (2021).

2.1 MSCI Additions and Deletions

MSCI indexes are the most widely tracked international benchmarks for institutional investors in equity markets. Importantly, many of their flagship indexes contain stocks from different countries, and are thus followed mostly by large international investors. In our analysis, we exploit additions to and deletions of stocks from MSCI Standard Indexes, which are the largest in terms of the AUM benchmarked against these indexes.[8] Starting from the MSCI quarterly reports for the Standard Indexes, we identify 18 episodes of additions and deletions of Colombian stocks in the 2006-2017 period.[9] We retrieve from the reports the announcement date, which usually happens around mid-month, and the date when the rebalancing is made effective, which is the last trading day of the month, and thus occurs 11 to 17 days after the announcement. Also, the MSCI quarterly reports provide information on the benchmark weight (the relative weight) of each stock in each index.

To compute elasticity estimates with the conventional methods used in the literature, we collect from the MSCI website information about the AUM tracking the MSCI Emerging Markets Index (MSCI EM) and the MSCI All Country World Index (MSCI ACWI). Since these data are provided in the MSCI website only for June 2015 and November 2016, we complement them with data from the EPFR Global Fund Flows database. This database covers a subsample of the population of mutual funds and ETFs and provides information on the benchmark indexes they track. For both indexes, we compute the ratio of the AUM reported by MSCI relative to those resulting from EPFR in each of the two periods for which we have data from both sources. Then, we compute the median coverage ratio for each index and multiply it by the AUM in EPFR to infer the total AUM benchmarked against the indexes.[10] Finally, to measure the AUM of passive funds and ETFs benchmarked against the indexes, we rely on EPFR data only, which has an excellent coverage of the population of such funds. At the end of 2016, the Investment Company Institute (ICI) reported total assets for ETFs worldwide of 3.5 trillion dollars, which is also the total assets under management for ETFs in the EPFR database.

[8] MSCI also provides other indexes, such as Small Caps, Value, and Growth indexes, that might differ in their composition from the Standard Indexes.

[9] Colombia is part of the MSCI All Country World Index, the MSCI Emerging Markets Index, and the MSCI EM Latin America, among other indexes. When a Colombian stock is announced to be included into or excluded from the Standard Indexes, this recomposition affects all of these indexes. Our sample includes 10 additions and 8 deletions. Stock ticker symbols and announcement dates for each episode are given in Appendix Table OA1.

[10] We apply the ratio for the MSCI Emerging Markets Index also to the MSCI EM Latin America Index and the MSCI EM Colombia Index.

2.2 The Colombian Stock Exchange

The BVC runs like a standard electronic central limit order book. Trades are submitted via authorized broker-dealers registered at the exchange and buy and sell orders meet via an automated trading system. In contrast to fragmented markets in the United States and Europe, the BVC is the sole authorized trading venue for Colombian stocks, which means that we can observe the universe of transaction of Colombian stocks and avoid biases from incomplete reporting (e.g., from multiple trading venues such as multilateral trading facilities, dark pools, or from rival exchanges). Also, at the time of each addition/deletion, none of the stocks in our sample had dual listings, nor were they traded through global depositary receipts. Thus, all the transactions around rebalancing events, and hence, any change in ownership for stocks in our sample are reported in the BVC trading records.

The BVC proprietary data consist of all the transactions in Colombian stocks during the 2006-2017 period. The data contain detailed execution information, including a time stamp (to the second), price, direction, quantity, and the broker routing the trade.[11] Each transaction record has a unique investor identification number. In addition, the BVC classifies investors into three broad groups – domestic individuals, domestic institutions, and foreign investors.[12] The stock exchange further classifies domestic institutions into mutual funds, pension funds, non-financial corporations, brokers trading on their own accounts, and other institutions.

To obtain a more detailed classification of foreign investors we proceed as follows. For the exclusive purpose of this project, the BVC discloses the name of foreign institutions involved in the transactions. We search manually on the web and cross-reference the names with Factset Ownership – a database with extensive global coverage on institutional investors – and classify each foreign investor into one of the following groups: Active mutual funds, passive mutual funds, pension funds, exchange-traded funds (ETFs), hedge funds, government institutions (e.g., sovereign wealth funds and central banks), and investment firms. Other investors include foreign individuals, trust funds, and private endowments.

The BVC database has about 17 million records during our 12-year period. Domestic institutions represent over half of the traded value in domestic stocks.

[11] Since February 2012, the market hours are synchronized with the New York Stock Exchange trading session, with a closing batch auction during the last five minutes of each trading day.

[12] In Colombia, there are no individual or aggregate ownership limits on foreign investors. Foreign individuals and institutions are allowed to either reinvest or transfer earnings such as dividends or capital gains with little restrictions.

Consistent with international trends in cross-border portfolio investments (IMF, 2017), the presence of foreign investors in Colombia increases over time. The number of foreign investors rose from 324 in 2006 to almost 4000 at the end of 2017 and the share of total traded value by this group increased from 4.5% to 31.8%. In addition to the generalized growth of foreign flows to emerging markets after the 2008 global financial crisis, there are two key related events in Colombia in the period that contribute to explain the surge of foreign investors: (i) Colombian sovereign debt recovered its investment grade in June 2011, and (ii) in 2013, taxes on foreign investors' earnings from domestic securities were reduced from 33% to 14%. Between 2012 and 2017, foreign mutual funds accounted for 7.8% of the total traded value, while investment banks, ETFs, and government funds accounting for 5.2%, 3.5%, and 2.8% respectively (Table 1, Panel A).

According to the annual statistics of the World Federation of Exchanges (WFE, 2019), at the end of 2017, Colombia had the fourth largest stock market in Latin America by market capitalization, and the fourteenth largest among developing countries. Relative to developed countries, the Colombian stock market is small – its size relative to the total value of U.S. listed companies at the end of our sample is 0.4%. However, MSCI indices typically include the largest companies and the most actively traded stocks in each country. The average market capitalization of our sample stocks is six times larger than the average size of other listed companies in Colombia. Similarly, the yearly traded value of our sample stocks is seven times larger than that of the other listed companies (Table 1, Panel B). Moreover, in terms of market capitalization, the stocks in our analysis are similar the largest ten stocks in the Russell 2000 index.

3 Empirical Analysis and Results

We analyze three main issues related to equity index rebalancings. First, we measure the price impact of these episodes. Second, we analyze the behavior of investors in response to these episodes. Finally, we combine the information on prices and traded quantities to estimate the demand elasticity for stocks.

3.1 The price effect of index additions and deletions

We measure the price impact of index additions and deletions by looking at the price dynamics of Colombian stocks included into or removed from MSCI international equity indexes. We calculate abnormal returns as the difference between the stock returns and the implied returns from a single factor model, $R_{st} - \hat{\beta}_s R_t^{D/s}$. The stock's beta, $\hat{\beta}_s$, is estimated using daily stock returns in the year prior to the

addition/deletion event and the return of the COLCAP, a value-weighted index of the Colombian stock market. To avoid spurious correlation, we exclude the return of stock s itself from the index, $R_t^{D/s}$. Returns are measured in Colombian pesos in excess of the domestic deposit rate.[13]

Figure 1 depicts the average cumulative abnormal return (CAR) of stocks in our sample from 3 trading days before the announcement date onwards. Deletions are normalized to be additions by multiplying the CAR of removed stocks by -1.[14] CARs immediately increase after the announcement date, and they drift slightly upwards until the implementation date (since the implementation day varies across events, this is represented as a shaded area in the figure). We report detailed statistics about the price effect of the rebalancings in the first column of Table 2. In this case, CARs are computed from the day prior to the announcement date to the day of the actual index recomposition.[15] CARs range between 0.87% and 22.32%. The median CAR is 5.45%, while the average is 6.65% and is statistically different than 0 at the 1% significance level.[16]

The average price impact of our 18 events is broadly in line with those found in previous studies. For example, Chang et al. (2014) find that inclusions into and deletions from the Russell 2000 have an average price effect of about 5%. This is particularly interesting as the market capitalization of stocks in our sample is close in magnitude to those in the sample by Chang et al. (2014). In a sample of almost 200 stock additions to the S&P 500, Wurgler and Zhuravskaya (2002) instead find

[13]We use the 90-day DTF rate, an interest rate composite, calculated as the weighted average of the interest rates on 90-day Certificates of Deposits offered by Colombian banks and financial institutions.

[14]As shown in Chang et al. (2014), index additions and deletions have comparable price effects. Throughout the rest of the analysis we follow this approach and describe our results as if all events were additions.

[15]Since the number of days between the announcement and the implementation dates differ across episodes, the average CAR in Table 2 is slightly different than the one in Figure 1 (where we report the average CAR for each day after the announcement date).

[16]It is possible that the right asset pricing model differs across stocks in our analysis. As an alternative, we estimate abnormal returns using an international factor model with two factors following Bekaert et al. (2014) – a global factor and a domestic factor $[R_t^G, R_t^{D/s}]$. The two factors are value-weighted market indexes, so that the model potentially embeds a global CAPM, a domestic CAPM, and the mixed case when both global and domestic markets affect the pricing of a particular stock. In this case, returns are measured in U.S. dollars in excess of the three-month U.S. T-Bill rate. The median and mean CAR of stocks in our sample computed using the mixed model are 5.21% and 6.28% respectively. Thus they are very close to the estimates we get with our baseline domestic, one-factor model. In Appendix Table OA2, we report all of our results obtained using the mixed two-factor model.

the average CAR to be around 3%, which goes up to 5% when focusing on above-median demand shocks, that is, additions which are predicted to be associated with larger inflows because of the size of index funds tracking the index.

3.2 Investor behavior and traded quantities

We now analyze the behavior of investors in response to the rebalancings in the MSCI Standard Indexes. As in the previous section, we pool together additions and deletions by considering sales as purchases, and vice versa, in case of deletions. Since MSCI indexes are mostly tracked by international investors, we start our analysis by looking at the behavior of foreigners in response to the rebalancings. Figure 2 provides a first graphical representation of these results. Specifically, it reports the cumulated fraction of outstanding shares bought by foreigners starting from 3 trading days before the announcement onwards, averaged across episodes. After the announcement date, there is a slight increase in foreign holdings, but most flows into affected stocks occur on the day when the rebalancing is made effective.

The granularity of our dataset allows us to dig even deeper into the behavior of investors, by looking separately at the behavior of different classes of both foreign and domestic investors around the rebalancing period. Figure 3, Panel A, depicts the total fraction of outstanding shares bought by different classes of foreign investors. All classes of foreign investors, except for hedge funds, purchase shares of stocks added to MSCI indexes. The main difference across investor types is the timing of their portfolio adjustments. Not surprisingly, passive mutual funds and ETFs are those who buy more shares on the actual implementation date and trade very little between the announcement and the implementation. Active mutual funds tend to start adjusting their portfolios already when the rebalancing of the index is announced, possibly to minimize the price impact of their orders. Perhaps more surprisingly, there are different types of investors besides passive funds and ETFs that trade significantly on the implementation date, suggesting 'implicit' mandates to follow their benchmark indexes. Panel B, instead depicts the behavior of domestic investors in response to the rebalancings. What is remarkable in this case is that all domestic investor types take aggregate opposite positions with respect to foreigners after the rebalancing, thus essentially absorbing their demand (supply) of newly included (deleted) stocks. Interestingly, domestic brokers that could also act as arbitrageur, do not take particularly large positions on the opposite direction of foreign investors.

We next look specifically at the trades that are driven by the willingness of foreigners to mimic the indexes, *i.e.*, the rebalancing-driven demand shocks, which we will use also to compute elasticities in the following section. In fact, not all

foreign investor trades may necessarily be due to the index rebalancing *per se*. Some of them could be due to speculative reasons: for instance, while overall all investor classes rebalance in the direction of the indexes, some investors within each class might also trade in the opposite direction. Thus, in order to measure the specific trades of foreign investors replicating the index, we first look only at the subsample of those who increase their holdings of newly included stocks in the period that goes from the announcement to the implementation – Figure 3, Panel C – and then on those who only do so on the implementation date – Figure 3, Panel E. The latter, in particular, are the investors who most likely trade for purely passive motives.[17] The figure that emerges in both cases is very similar to that in Panel A, except for two groups: investment firms and investors classified as Others (i.e., foreign individuals, trust funds, and private endowments). It seems that while some investors in these groups passively mimic the indexes, others take the opposite position, possibly to speculate on the events.

Quantitative details about investors' demand shocks are presented in Table 2, Panel B, columns 2 through 4. Specifically, we report the total shares purchased by investors tracking the index relative to the total number of outstanding shares, *i.e.*, $\Delta Q/Q$, computed in different ways. Column 2 presents descriptive statistics for the total purchases of shares between the announcement and implementation date by all foreign investors trading in the direction of the index. On average, foreign investors that trade in the direction of the index buy 3.21% of the outstanding shares of the stock, with a median of about 2.7%. Column 3 reports the foreign purchases on the implementation date only. These are precisely the trades that are most likely due to investors' willingness to replicate the index composition. Foreign investors trading in the direction of the index during the implementation date purchase on average 2.37% of the shares outstanding, the median being 2.0%. That is, 74% of foreigners' net flows take place precisely on the implementation day of the index rebalancing. In Column 4, we also include domestic investors who trade in the direction of the index on the implementation date. Estimates are very similar to those obtained considering only foreign investors. This piece of evidence is particularly important as it corroborates the view that MSCI indexes are mostly followed by international investors.

We also want to quantitatively compare the actual rebalancing of foreign investors to those one would obtain following the conventional methodologies used in the index rebalancing literature – those that exploit the AUM of funds benchmarked against the indexes. For this, we compute:

[17] In Figure 3, Panels D and F, we complement this evidence by focusing on domestic investors who sell (buy) newly added (deleted) stocks from the announcement to the implementation date, and on the implementation date, respectively.

$$\frac{\Delta Q}{Q}^{Conventional}_{i,k} = \frac{\sum_j AUM_j^k w_j^i}{MCAP_i} \tag{1}$$

where j indicates the index the stock is being included into (removed from), $MCAP_i$ is the market capitalization of the stock i, w_j^i is the benchmark weight (the relative importance of stock i in index j) after being included into the index, and AUM_j indicates the AUM benchmarked against index j. Consistent with previous studies, we make two assumptions to compute these estimated inflows. We assume that either all funds tracking the indexes rebalance their portfolios accordingly ($k = Total$), or that only passive funds do so ($k = Passive$), and present summary statistics for these inflows in columns 5 and 6 of Table 2, Panel A, respectively. The assumption that all funds rebalance leads to a median estimated inflow (relative to market capitalization) of 16.9%, while using only passive funds implies an inflow of 0.94%. Overall, using all AUM benchmarked against the indexes largely overestimate inflows. Using passive AUM on the other hand, generates closer estimates to the actual flows in our sample. Yet, these estimates are still less than 50% than the actual observed flows.

There are several reasons that might explain why using all AUM benchmarked against the indexes systematically overestimate the inflows. An important one is that while many active investors rebalance their portfolio following index redefinitions, not all of them do so. More importantly, active AUM are typically much larger than passive AUM. In our sample, among foreigners trading in the direction of the index on the implementation day, passive funds and ETFs purchase 0.87% of the outstanding shares of newly included stocks, while other investors purchase 1.50% of them. Thus, the inflows from non-passive investors are 1.73 times those from other investor classes, while those estimated using the AUM would imply 'active' inflows to be 17 times larger than the 'passive' ones.

3.3 The price elasticity of demand for stocks

Because of their features, index rebalancing episodes offer an ideal framework to estimate the slope of stock demand curves, as we do in this section. We start with the theoretical framework developed by Gabaix and Koijen (2020) to flesh out how we estimate this elasticity. Even though their analysis focuses on macro-elasticities – on the effects of flows from bond to equity markets and vice versa – the main insights from their model can be applied to our setting. The key assumptions that generate large price impacts of inflows in Gabaix and Koijen (2020) are: i) bond/stock funds have strict mandates which prevent them from freely adjusting their portfolios into other asset classes; ii) hedge funds are too small to arbitrage

demand shocks. We can apply this framework to our setup by considering instead of bond/equity funds, a framework with equity funds that track different benchmark indexes.[18] Under this small change, both assumptions seem to find support in our data. First, different investors seem to mimic index composition by rebalancing their portfolio accordingly. Moreover, they mostly do so on the implementation date rather than when inclusions or deletions are announced. Second, hedge funds (and domestic brokers) appear to take the opposite position with respect to other international investors, but their positions are small especially if compared to those taken by the rest of investors.

The model by Gabaix and Koijen (2020) fits very well our empirical setting for another key reason: in their model, expected exogenous inflows generate immediate price impacts, even when actual inflows are expected to materialize later in time, exactly as we observe in our data. In their model, the price effect of expected future inflows is given by the following expression:

$$p_t = \frac{1}{(1+\rho)^{T-t}} \frac{f_T}{\xi} \tag{2}$$

where ρ is the effective discount rate, f_T is the inflow (relative to the size of the market) that is expected to happen at time T and ξ is the demand elasticity for the stock.[19] Under this framework, a permanent and anticipated inflow – such as those implied by index additions (or deletions) on the implementation date – generates an increase in the price on the date the inflow is expected – the announcement date, in our setting – and a drift from the announcement to the implementation date, consistent with our findings. Furthermore, Gabaix and Koijen (2020) predict the price change to be permanent, which is also something that appears to be true in our context. The overall price impact of the expected inflow, from the announcement until the implementation, is therefore given by $p_T \equiv \frac{\Delta P}{P} = \frac{f_T}{\xi}$. Thus, bringing this setting to our data, one could measure the elasticity of demand for the included/excluded stocks, ξ, from the price impact and the expected inflows.

Of course, we do not observe 'expected inflows' but rather the realized ones. Yet, we can reasonably proxy for expected rebalancing-driven inflows by taking

[18] While it is true that stocks are more likely to have closer substitutes, and therefore micro-elasticities should in principle be smaller than macro-elasticities, we argue that, consistent with the evidence we provide in the previous section, several equity funds face 'implicit' mandates on their portfolio composition similar to those of bond and equity funds.

[19] p_t refers to the price impact at time t relative to a baseline price before any shock is announced. In our empirical setup, we consider this baseline to be the stock price before the announcement date.

the quantity of shares purchased (sold) by foreigners on the effective inclusion (exclusion) date. These are indeed the trades that are most likely entirely due to funds being replicating the index composition – different than those occurring in the days between the announcement and the implementation, which may be due to speculative reasons as well – and can be anticipated by market participants. More specifically, we compute f_T as $\Delta Q/Q$ from Table 2, Panel B, column 3.[20]

Then, we calculate the change in stock prices between the day preceding the announcement and the closing price of the implementation day. The elasticity is calculated dividing f_T by $\frac{\Delta P}{P}$. Results from these estimates are given in Figure 4 for each event and summarized in Table 2, Panel B, Column 3. The elasticity of demand for stocks in our sample ranges between -3.27 and -0.01, with a median of -0.34. The average elasticity is -0.67 – larger in absolute value than the median because of few stocks whose demand is much more elastic than the rest of the sample (as displayed in Figure 4). When considering the purchases occurring between the announcement and the implementation date (Column 2 in Panel B), the estimated elasticity becomes larger (in absolute value) but still close to the baseline value in Column 3. That is because most inflows materialize on the implementation date. Similarly, estimates do not change much when including also purchases by domestic investors, as very few domestic investors rebalance their portfolios in the direction of the indexes (Column 4 in Panel B).

All in all, the results from our empirical analysis show that the demand for stocks in our sample is particularly inelastic, contrary to the prediction of traditional asset pricing models, such as the CAPM.

4 Discussions

4.1 External validity

While our results are based on a sample of Colombian stocks that are included into (excluded from) MSCI international indexes, they can be used to think about other countries and contexts as well. First, although smaller than equity markets in developed countries, the Colombian stock exchange is comparable to many equity markets in developing countries. At the end of 2017 – that is, at the end of our sample period –, the total market capitalization of the Colombian

[20]It is worth remarking that, in principle, the Q to be used in the denominator of this formula should be the quantity of shares held by investors whose trades are not entirely due to replication motives. Yet, as we explain in detail in Section 4, in our setting purely passive investors – mostly foreigners – hold a negligible fraction of outstanding shares before the rebalancings, which is the reason why we can simply use total outstanding shares in the computation.

stock market was of about 120 Billion US dollars, close to equity markets in other emerging economies such as Vietnam (125 Billion US dollars), Qatar (130 Billion US dollars), Argentina (109 Billion US dollars), and Peru (100 Billion US dollars), and even comparable to developed economies such as Austria (150 Billion US dollars), Ireland (145 Billion US Dollars), and Portugal (75 Billions US Dollars).[21] Thus, the Colombian stock market can be reasonably seen as representative of at least a subsample of emerging economies.

Furthermore, as already mentioned, stocks in our sample are the largest in terms of market capitalization among Colombian listed companies and are similar in size to the smallest US stocks included in the Russell 1000 and the largest stocks in the Russell 2000. Such stocks have been extensively used in the literature in RDD studies exploiting the cutoff rules of these two indexes to examine precisely the effects of index additions and deletions and measure the demand elasticity of stocks (e.g., Chang et al., 2014; Boone and White, 2015; Appel et al., 2016), as we do in our study.

Additionally, our results on the demand elasticity computed using the actual flows, combined with the AUM of funds can shed further light on the actual elasticities in other markets, including the US. In Section 3, we calculate the changes in quantities using both the total AUM benchmarked against the indexes, and the AUM of passive funds only (as formalized in Equation 1, with *i.e.*, with $k = \{Passive, Total\}$), as is typically done in most of the previous studies. Here we combine these inferred changes in quantities with the change in prices to obtain a range of inferred elasticities to which we can compare our baseline elasticity computed looking at the actual traded quantities. Results from this comparison are reported in Figure 4 and Table 2, Panel B, columns 5 and 6. The key result is that our baseline elasticity – computed using actual transaction data – is much closer to the elasticity obtained under the assumption that only passive funds rebalance their portfolios in response to index recompositions. Using all AUM benchmarked against a given index tends to overestimate (in absolute value) the elasticity of stock demand curves, much more than using only passively managed assets seems to underestimate this elasticity.[22]

[21] World Bank Data

[22] Of course our estimate of the demand elasticity also relies on some assumptions. That is, we focus on foreign flows on the effective date and price changes from announcement to implementation. We replicate the estimation using the change in shares bought by all investors from the announcement to the implementation – considering both foreigners trading in the index direction and domestic investors doing so and obtain a median elasticity of -0.56. We also re-estimate our baseline elasticity but using the change in price only at the announcement date and obtain a median elasticity also of -0.56. This number increases (in absolute value) to -0.59, when we consider the change in shares by all

This exercise allows us to say something also about the elasticity in more developed economies. For instance, looking at US stocks close to the threshold between the Russell 1000 and the Russell 2000, Chang et al. (2014) report an average elasticity ranging from -1.5, under the assumption that all investors rebalance, and -0.46, when assuming that only passive funds rebalance. Since we find that the median elasticity in our sample is 62% larger (in absolute value) that the one obtained when using only passive AUM (see Table 2), a simple back-of-the-envelope calculation where we multiply the lower bound elasticity in Chang et al. (2014) by 1.62 gives an estimated elasticity of -0.74. This estimate is very close to the estimate in Koijen and Yogo (2019), which is around -1.

To sum up, while our estimates are from a sample of large Colombian stocks, our results not only speak to other emerging equity markets but also to developed markets, and even the US. Our estimates can be used to back out more precise measures of stock demand elasticities for different markets when data on traded quantities is unavailable and the change in quantities are inferred from the AUM of funds.

4.2 Other Potential Channels

Our empirical analysis relies on the assumption that index rebalancing episodes entail sudden demand shocks which we use to estimate the stock demand elasticity. However, there may be alternative mechanisms explaining the price response to index additions and deletions, such as: (i) an information channel whereby MSCI reveals information about the firm to the market (Dhillon and Johnson, 1991); (ii) an investor recognition channel if increases in the firm coverage by new analysts generates a premium on the stock price (Chen et al., 2004); and (iii) a liquidity channel when new investors holding the stock improve its liquidity and thus its price (Hegde and McDermott, 2003; Pandolfi and Williams, 2019). We discuss some additional evidence that is consistent with our interpretation of index additions and deletions as pure demand shocks due to investors' willingness to replicate the index composition.

Information: There are two related pieces of evidence that suggest that the information channel should not be playing an important role in our setup. First, there is a clear separation between the purchases and sales of foreign and domestic investors. In our sample of events, all groups of domestic investors are net sellers of shares. It is unlikely that the information revealed by MSCI about Colombian

investors and the change in price at the announcement date only. All in all, all of these estimates are close to our baseline one, and much smaller (in absolute value) than the estimated elasticity one would get using the total AUM of funds benchmarked against the indexes.

firms is segmented by investors' domicile, exclusively affecting the expectations of foreigners but not those of domestic investors. This evidence is instead explained by the fact that most foreign investors track their performance against MSCI indexes while domestic investors do not. Second, even in the case where MSCI rebalancings only affect the information set of foreign investors, the timing of purchases and sales is hardly consistent with the information hypothesis, as around 75% of the trades happen at implementation rather than on the announcement date, when the information is actually diclosed.

Investor recognition: To analyze the role of investor recognition we proceed as follows. First, we present the cumulative abnormal returns in separate plots for additions and deletions (Figure 5).[23] Under this hypothesis one would expect an asymmetric response between inclusions and exclusions since deleted stocks do not suddenly get unrecognized. Thus, prices of added stocks should increase, while the effect should be almost muted for deletions. Contrary to this, we find similar patterns in the CAR of stocks affected by additions and deletions. Then, we plot the mean and median number of analysts covering the affected stocks in a window of +/-300 trading days and do not find significant changes after the index rebalancings (Figure 6). Also in this case, if investor awareness changes after inclusions and exclusions, one would expect the number of analysts to be also affected by these events. Overall, these two pieces of evidence suggest that the investor recognition channel does not have a major role in our setting.

Liquidity: Finally, to rule out the possibility that the price changes following the rebalancings are due to changes in the liquidity of stocks, we analyze whether there are significant liquidity changes for the stocks in our sample. We plot the mean and median bid-ask spreads in a window of +/- 300 trading days around the announcement of the rebalancings. While there seem to be changes in this liquidity measure around the announcement date (which could be consistent with the increased trading we observe in our data) after a while these changes seem to reverse for both additions and deletions (Figure 7). As a result, our results do not appear to be driven by a potential liquidity channel either.

[23]Panel B excludes the November 13, 2015 deletion of Isagen due to a private auction for the majority of the company shares in the observation window. At the beginning of November that year, the Colombian government had a majority control in the company (57.61% of the shares outstanding). In line with other deletion events, the stock experienced a negative CAR of -4.3% between the deletion announcement on November 13 and the implementation day on November 30. In December, however, the government announced the minimum bid price for the auction at 4,130 COP and disclosed the names of three potential bidders causing the stock price to increase over 22% (`https://www.larepublica.co/economia/precio-minimo-por-accion-de-isagen-sera-de-4130-incrementando-215-2336336`).

4.3 Which demand elasticity are we measuring?

In our empirical analysis, we measure the elasticity of demand for stocks by looking at the evolution of prices and quantities in the period between the announcement and the implementation of index redefinitions. This opens up two important questions about the nature of the elasticity that we measure, which we address in this section. The first question is whose demand are we measuring in our analysis. Pavlova and Sikorskaya (2020) provide a framework that is particularly suitable to address this question. As the authors explain, the purely passive rebalancing-driven purchases and sales of stocks affected by index additions and deletions can be thought as reductions (or increases) in the available supply of stocks. In turn, this change can be used to measure the slope of the 'residual' demand curve, that is, the demand that is not due to pure index replication motives. Such residual demand not only includes the demand from investors not tracking the index but also the non-inelastic demand from active investors benchmarked against the index who do not perfectly replicate the index composition in their portfolios. Applying this framework to our setting, the change in the available supply of stocks is driven by foreign investors trading to replicate the index, and therefore the residual demand is the aggregate demand of all other investors in the market. This is the sum of the domestic investors' demand and the elastic component of foreign demand. Yet, because these stocks are mostly owned by domestic investors, our estimated elasticity is essentially the demand elasticity of domestic investors.

In theory, when computing the demand elasticity one should compute the percentage change in the quantity demanded by investors forming the residual demand. That is, $\Delta Q/Q$ should be measured using the quantity of shares held by 'residual' investors rather than the total outstanding shares. While such distinction might be crucial in other settings, for example, in cases where passive funds hold a considerable amount of existing shares, in our case the shares held by purely passive investors (foreign investors) are negligible. In other words, almost all outstanding shares are already in the hands of 'residual' investors (specifically domestic investors) before additions and deletions. For instance, the median share of domestic holdings relative to total outstanding shares is 98% in the case of additions and 91% for deletions. This implies that using the quantity of shares held by investors constituting the residual demand – whose elasticity is the one we measure empirically – would not deliver quantitatively different results.

Finally, in our baseline estimates we focus on a short time window between the announcement and the implementation of index additions and deletions. Thus, we measure a short-run elasticity of demand. In principle, if investors rebalance their portfolios slowly, this elasticity might be different from the medium- or even long-run elasticity. On top of this, arbitrageurs might be better able to smooth demand

shocks over a longer horizon. To address this issue, we replicate our estimates but considering all trades of affected stocks occurring up to 3 calendar months (a quarter) after the index rebalancings together with the change in price over that same horizon. Of course, enlarging the observation time comes at the expenses of a lower precision –estimates are more vulnerable to large demand shocks for reasons other than index additions and deletions. Figure 8 shows that extending the horizon does not deliver different results about the behavior of investors. Even the most active investors rebalance their portfolio mostly around the implementation date, and after that there are only slight and smooth changes in foreign holdings. We also re-compute the elasticities using this horizon in Table 3 and find a smaller, albeit similar elasticity. For instance, the median elasticity we obtain when we consider the foreigners purchases from announcement to implementation is -0.47 (2). When we changed the time horizon to announcement until 60 trading days after it, we obtain a median elasticity of -0.53. Therefore, the medium-run elasticity appears to be close to the baseline short-run elasticity we estimate in our sample.

5 Conclusion

In this paper, we exploit transaction-level data from the Colombian stock market together with episodes of stock additions and deletions from major international equity indexes to shed novel light on the price impact of equity index rebalancings, the behavior of investors around these events, and the elasticity of demand for stocks.

A key takeaway from our analysis is that most large international investors do rebalance their portfolios in the direction of the rebalancing of the indexes they follow. This is consistent with the view that many investors, even when formally active, have 'implicit mandates' not to deviate from their benchmark indexes. Instead, arbitrageurs, such as hedge funds, trade very little around these events. As a result, stock demand curves are very inelastic.

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Figures

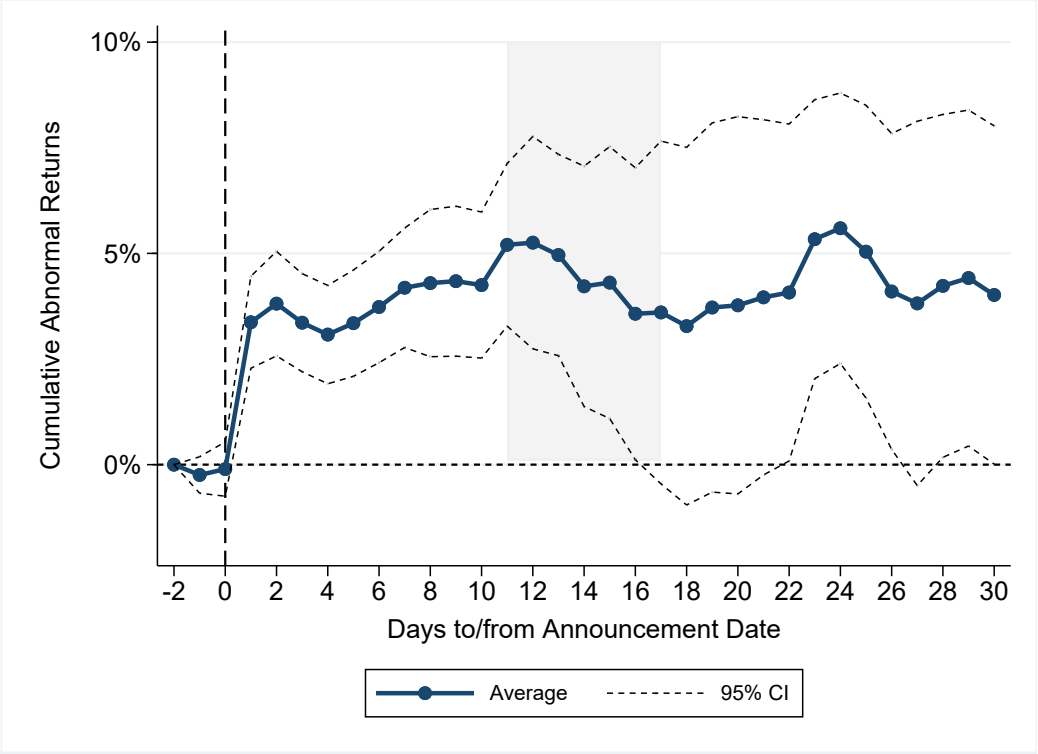


Figure 1: Cumulative Returns.

Notes: This figure presents the cumulative abnormal returns (CAR) during the event window. Abnormal returns are calculated as the difference between the stock returns and the implied returns from a single factor model: $R_{st} - \hat{\beta}_s R_t^{D/s}$. $\hat{\beta}_s$ is calculated using daily stock returns in the year prior to the addition/deletion event with respect to the COLCAP, a value-weighted index for the domestic market and excluding stock s. All returns are measured in domestic currency in excess of the local deposit rate. For deletions, CAR are multiplied by -1. CAR are calculated for each addition/deletion event and averaged across stocks (solid line). CI = Confidence Interval.

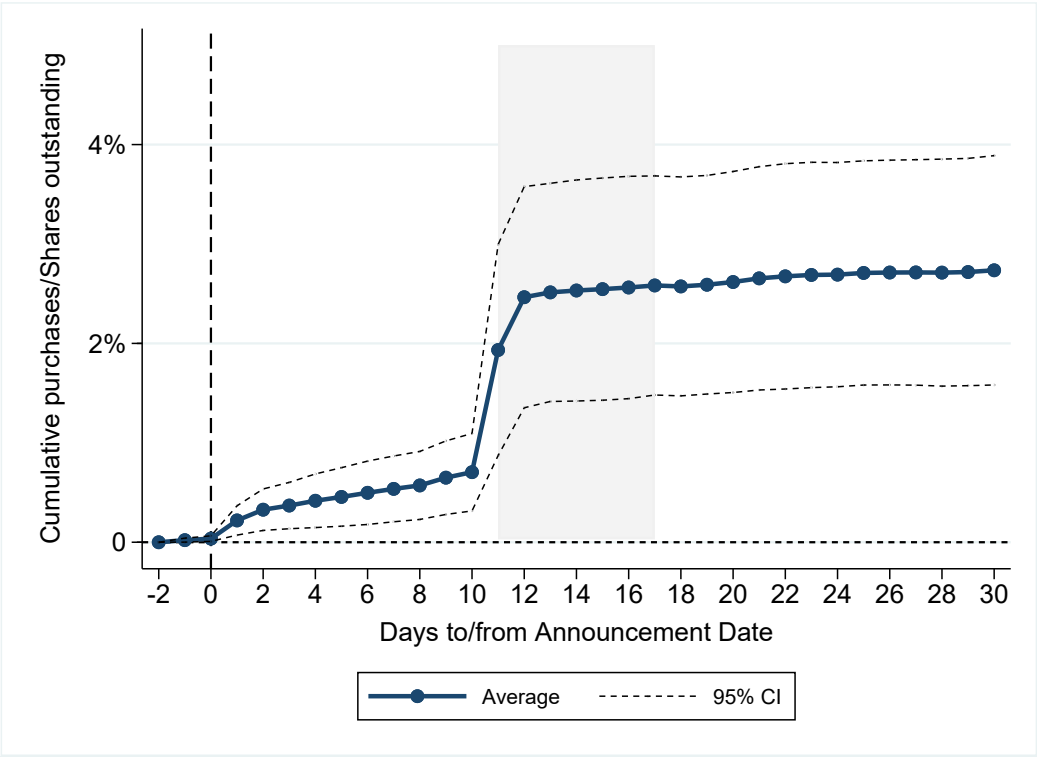
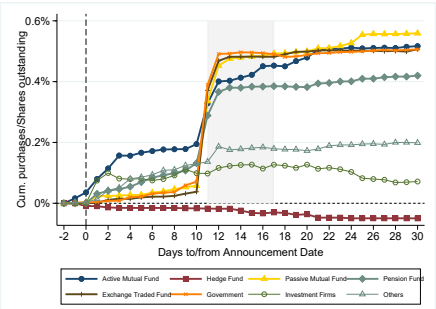


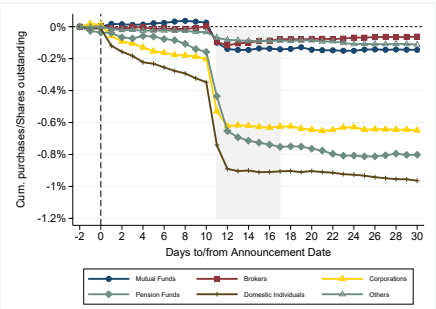
Figure 2: Evolution of Cumulative Purchases by Foreign Investors.

Notes: This figure presents the cumulative purchases of shares by foreign investors as a percentage of shares outstanding. For deletions, trades are multiplied by -1. Cumulative purchases over shares outstanding are calculated for each addition/deletion event and average across stocks (solid line). CI = Confidence Interval.

Panel A . All foreign investors

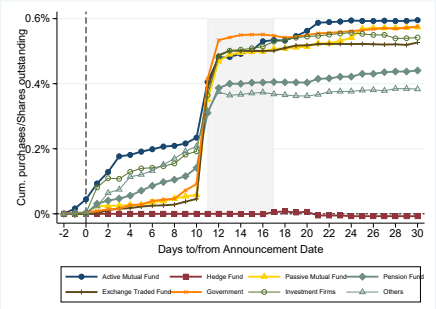


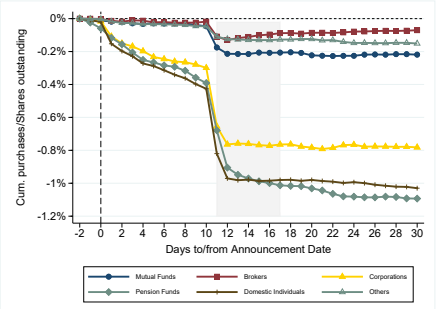
Panel B. All domestic investors



Panel C. Foreign investors buying (selling) the newly included (excluded) stock in $[0, T]$

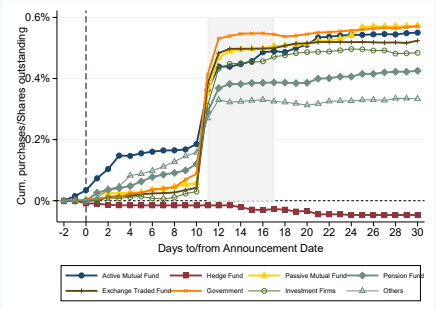
Panel D. Domestic investors selling (buying) the newly included (excluded) stock in $[0, T]$





Panel E. Foreign investors buying (selling) the newly included (excluded) stock in T

Panel F. Domestic investors buying (selling) the newly included (excluded) stock in T



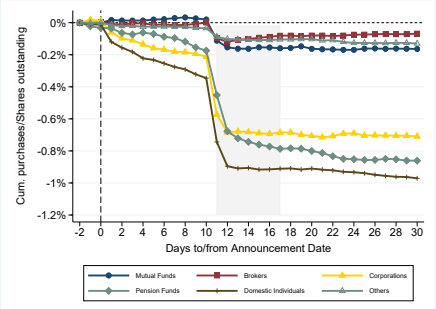


Figure 3: Flows by Investor Group.

Notes: The figure presents the cumulative purchases of shares as a percentage of shares outstanding for different investor groups. For deletions, trades are multiplied by -1.% Panels A and B display the cumulative holdings of all foreign and domestic investors respectively. Panel C restricts the sample to foreign investors with net purchases (sales) between the announcement of an addition (deletion) and the implementation date $t \in [0, T]$. Panel D restricts the sample to domestic investors with net sales (purchases) between the announcement of an addition (deletion) and the implementation date $t \in [0, T]$. Panel E restricts the sample to foreign investors with net purchases (sales) in the implementation date $t \in [T]$. Panel F restricts the sample to domestic investors with net sales (purchases) in the implementation date $t \in [T]$.

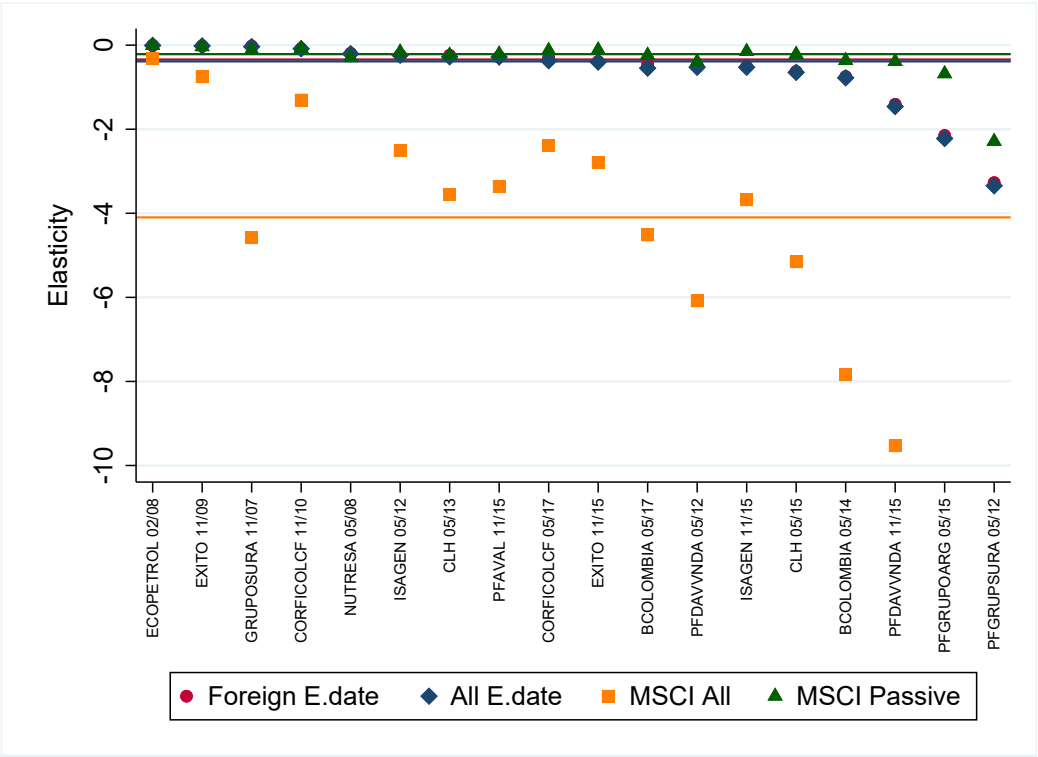
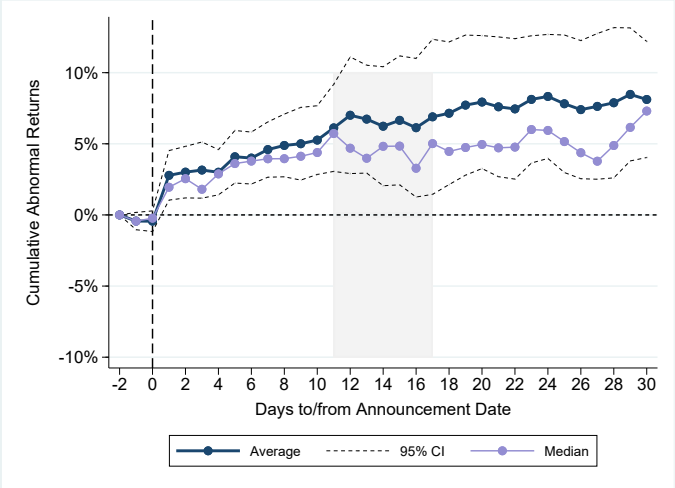


Figure 4: Event-specific Elasticities.

Notes: The figure presents the estimated elasticity for each addition/deletion event i in our sample: $\frac{\Delta Q_i}{Q_i} / \frac{\Delta P_i}{P_i}$. For each case, the relative change in price, $\Delta P_i / P_i$, is calculated as the cumulative abnormal return between the announcement and implementation day. The relative change in quantities, $\Delta Q_i / Q_i$, is calculated in four ways: (i) Flows of foreign investors with net purchases (sales) during the implementation day of additions (deletions) as a proportion of shares outstanding (circles). (ii) Flows among all investors with net purchases (sales) during the implementation day of additions (deletions) as a proportion of shares outstanding (rhombuses). (iii) Expected flows from foreign investors relative to market capitalization assuming that all funds tracking MSCI indices rebalance after an addition/deletion (squares). (iv) Expected flows from foreign investors relative to market capitalization assuming that only passive funds tracking MSCI indices rebalance (triangles). The figure presents the median measure of elasticity for each method.

Panel A. Cumulative Returns - Additions



Panel B. Cumulative Returns - Deletions

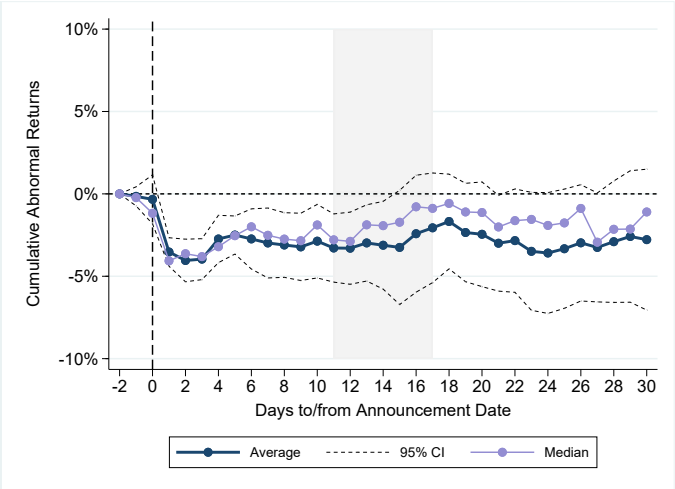


Figure 5: Evolution of Prices during Addition and Deletions

Notes: The figure presents the cumulative abnormal returns (CAR) during the event window for stock additions (Panel A) and deletions (Panel B). Abnormal returns are calculated as the difference between the stock returns and the implied returns from a single factor model: $R_{st} - \hat{\beta}_s R_t^{D/s}$. $\hat{\beta}_s$ is calculated using daily stock returns in the year prior to the addition/deletion event with respect to the COLCAP, a value-weighted index for the domestic market and excluding stock s. All returns are measured in domestic currency in excess of the local deposit rate. CAR are calculated for each event and average across stocks (solid line). CI = Confidence Interval. Panel B exclude the November 13, 2015 deletion of Isagen due to a private auction for the majority of the company shares in the observation window.

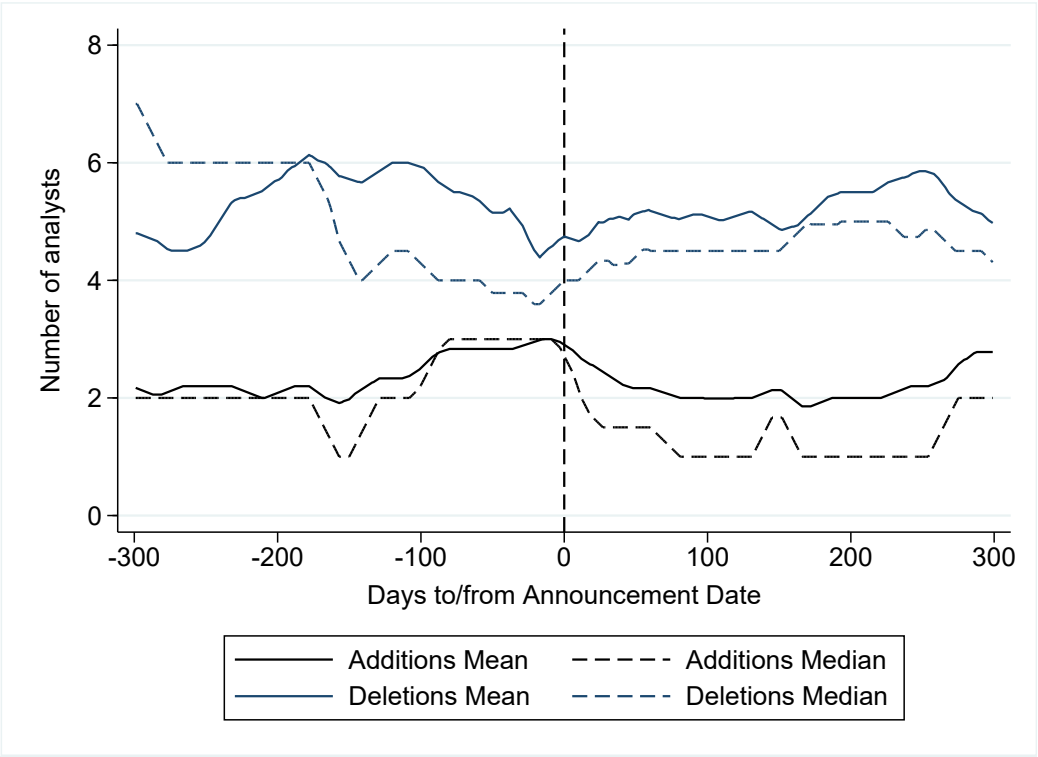


Figure 6: Analyst Coverage of Event Stocks

Notes: The figure present the mean (solid line) and median (dashed line) number of analyst covering added and deleted stocks in a +/-300 trading days window around the event. The series is smoothed with a 20 day moving average.

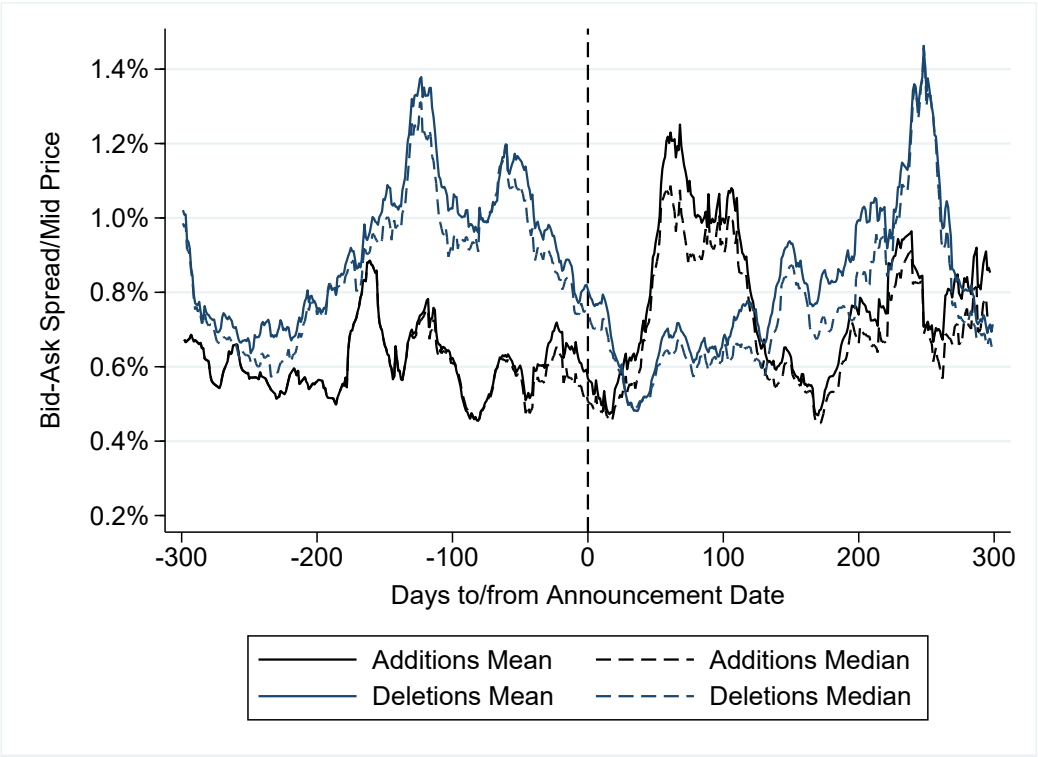
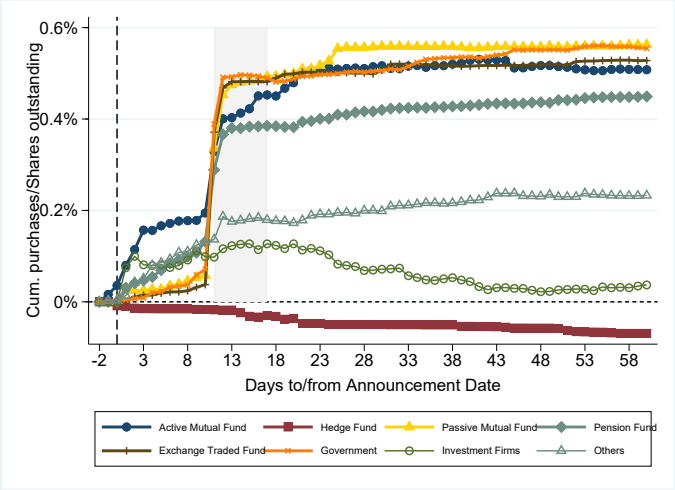


Figure 7: Bid-Ask Spread of Event Stocks

Notes: The figure presents the mean (solid line) and median (dashed line) of the bid-ask spread for added and deleted stocks in a +/-300 trading days window around the event. The bid-ask spread is normalized relative to mid price of each stock. The series is smoothed with a 20 day moving average.

Panel A. All Foreign Investors



Panel B. Foreign investors buying (selling) the newly included (excluded) stock in T

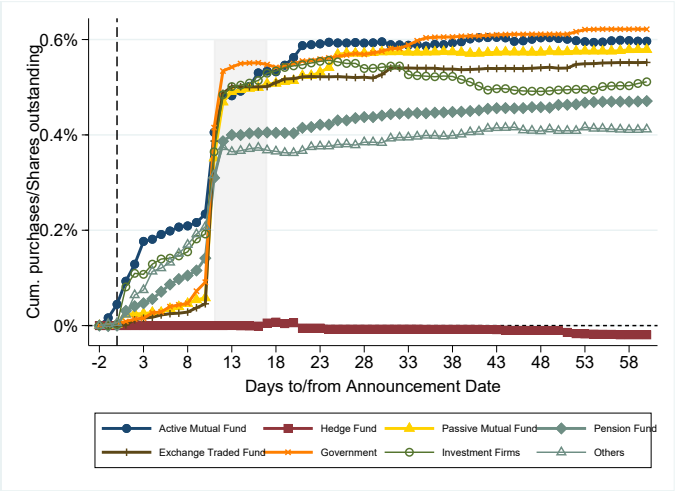


Figure 8: Flows by Investor Group

Notes: The figure presents the cumulative purchases of shares as a percentage of shares outstanding for different investor groups. For deletions, trades are multiplied by -1.% Panels A displays the cumulative holdings of all foreign and domestic investors respectively. Panel B restricts the sample to foreign investors with net purchases (sales) in the implementation date $t \in [T]$.

Tables

Table 1: Summary Statistics - Colombian Stock Market

	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
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

Notes: Panel A presents the share traded by different types of investors. Classification of domestic investor as reported by the Colombian Exchange. Foreign institutions are classified based on a manual web search of names as well as a cross-reference with Factset Ownership. The Panel B compares the market capitalization and the yearly trading value in USD of stocks with addition/deletion events and other listed companies in Colombia.

Table 2: Price Change, Investor Behavior, and Elasticities

	(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
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

Notes: Panel A presents summary statistics for the relative changes in price $\Delta P_i/P_i$ and flows $\Delta Q_i/Q_i$. $\Delta P_i/P_i$ is calculated as the cumulative abnormal return between the announcement and implementation day. The relative change in quantities, $\Delta Q_i/Q_i$, includes the flows from investors with trades in the direction of the index rebalancing (i.e., purchases during addition and sales during deletion) and is calculated in five ways: Flows of foreign investors between the announcement and implementation day as a proportion of shares outstanding (column 2). Flows of foreign investors during the implementation day (column 3). Flows among all investors on the implementation date (column 4). Assuming that all funds following MSCI indexes rebalance (column 5) or that only passive funds rebalance (column 6). Elasticities are calculated under each definition of flows in Panel B.

Table 3: Medium-run elasticities

	$\Delta P/P$		$\Delta Q/Q$	Elasticities	
	[0,T]	[0, 60]	Foreign [0,60]	(1)	(2)
Mean	6.65	3.72	3.74	-1.14	-2.28
Std. errors	[1.24]	[3.58]	[0.67]	[0.43]	[0.89]
Median	5.45	3.44	3.57	-0.60	-0.53
Min	0.87	-35.38	-0.05	-8.09	-10.91
p25	3.10	-1.69	1.37	-1.12	-2.99
p75	8.10	8.72	6.87	-0.26	-0.08
Max	22.32	41.31	9.21	0.00	1.24
No. Observations	18	18	18	18	18

Notes: The figure presents summary statistics for the relative changes in price $\Delta P_i/P_i$ calculated as the cumulative abnormal return between the announcement and implementation day (0 to T) and between the announcement and 60 business days (0 to 60). The relative change in quantities is calculated between t=0 and t=60, $\Delta Q_i/Q_i$, and includes the flows from investors with trades in the direction of the index rebalancing (i.e., purchases during addition and sales during deletion. Elasticities are calculated using the flows in the full period relative to the returns during the announcement and implementation (column 1) and relative to the returns in the 60-day window (column 2).

Online Appendix

Table OA1: Addition/Deletion events

Company	Symbol	Type	Event	Announcement date
Grupo de Inversiones Suramericana	GRUPOSURA	Common	Addition	11/7/2007
Ecopetrol SA	ECOPETROL	Common	Addition	02/14/2008
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	5/16/2017

Notes: This table presents company names, stock symbols, type of stocks, and announcement day for each event in the sample.

Table OA2: Elasticities with Cumulative Abnormal Returns from 2-factor Model

		ΔQ/Q		Elasticities			
	ΔP/P	**Foreign**	**All investors**	**Foreign**	**All investors**	**MSCI all**	**MSCI passive**
Mean	6.28	2.37	2.51	-0.37	-0.40	-3.73	-0.15
Std. errors	[1.24]	[0.49]	[0.5]	[0.19]	[0.2]	[1.79]	[0.10]
Min	-1.39	0.04	0.07	-2.35	-2.43	-17.49	-0.75
p25	2.62	0.68	0.69	-0.56	-0.61	-6.75	-0.31
Median	5.21	2.00	2.13	-0.35	-0.38	-4.23	-0.21
p75	7.94	3.29	3.40	-0.09	-0.09	-2.17	-0.10
Max	21.87	7.76	8.05	2,05	2.09	21.98	1.43
No. Observations	18	18	18	18	18	18	18

Notes: The table presents summary statistics for the relative changes in price $\Delta P_i/P_i$ and flows $\Delta Q_i/Q_i$, and the estimated demand elasticity. $\Delta P_i/P_i$ is calculated as the cumulative abnormal return between the announcement and implementation day. Abnormal returns are calculated using a two-factor international asset pricing model. The relative change in quantities, $\Delta Q_i/Q_i$, is calculated in two ways: (i) Flows of foreign investors with net purchases (sales) during the implementation day of additions (deletions) as a proportion of shares outstanding. (ii) Flows among all investors with net purchases (sales) during the implementation day of additions (deletions) as a proportion of shares outstanding. *MSCI all* refers to elasticities calculated using expected flows from foreign investors relative to market capitalization assuming that all funds tracking MSCI indices rebalance after an addition/deletion. *MSCI passive* refers to elasticities calculated assuming that only passive funds tracking MSCI indices rebalance.