When flows matter for asset prices: Evidence from adoption of ETF creation in Israel

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Abstract

We study a 2012 reform in Israel where all exchange-traded products listed on the Tel Aviv Stock Exchange (TASE) adopted the Exchange Traded Fund (ETF) creation mechanism wherein designated market makers arbitrage between the index price and the net asset value of its benchmark. The reform greatly decreased the cost of this arbitrage activity and improved the liquidity of the ETN. We document that in response there was a significant increase in demand for ETN. Next, we find that the effect was stronger for illiquid indices containing smaller stocks. We utilize this heterogeneity to estimate the causal effect of inflows into the ETN on the price of the benchmark securities. A 1 p.p. increase in ETN ownership as a percent of market capitalization leads to an 11.7% increase in the price of stocks, revealing highly inelastic demand for equities. Our findings provide new evidence on how passive inflows can change the distribution of capital across indices, and in turn impact price and real efficiency.

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1. Introduction

The key feature of Exchange-traded funds (ETF) that underlies their increasing popularity around the world is that they offer investors an inexpensive and liquid way to gain exposure to baskets of assets. First, ETF are open-ended funds; they are listed on a stock exchange and traded. But this is not enough. The ETF "creation mechanism" is also needed to keep the transaction costs of passively tracking a basket of securities low, specifically for baskets of illiquid assets. This was dramatically illustrated in Israel in 2012, when the average bid-ask spreads on ETN securities, a close cousin of the ETF that is also an open-ended fund, reached above 100 basis points. The Israel Securities Authority (ISA), the regulator of the Tel Aviv Stock Exchange (TASE), mandated that the ETN must adopt the ETF creation mechanism. We study the effects of this reform on the underlying stocks.

The introduction of the creation mechanism directly decreased the cost of passively tracking the benchmark indices of the ETN. It did so by creating the role of the Authorized Participant (AP), which create or redeem ETF securities directly with the fund at a cost advantage. This cost reduction should increase the demand for ETN, which will mechanically translate into more inflows to the underlying stocks. Moreover, the introduction of the AP introduces a new source of market making and intermediation in the index stocks.

The main challenge of studying these effects directly is twofold. First, the allocation of capital into ETF is a long-term, slow-moving trend documented in stock indices, and other asset classes, around the world. Over long horizons, it is difficult to isolate the effect of the creation mechanism from other equilibrium effects of passive investing. Moreover, the allocation of capital into ETF affects all stocks in tracked indices at the same time. The lack of a discrete shock driving these flows makes it difficult to run precise tests. And yet, the question becomes increasingly important as the ETF market continues to grow.

In this paper, we use a unique setting in Israel where there was a large and rapid growth of passive ownership because of the introduction of the ETF creation mechanism. In 2012, the primary way to track indices on the TASE was by investing in an exchange-traded note (ETN), which is also a type of open-ended fund listed on an exchange.[1] However, the price of the ETN were deviating significantly and regularly from the net asset value (NAV) of the

[1]ETN were invented in Israel in 2000. It is an unsecured debt liability traded on an exchange and designed to deliver the return of predefined benchmark index minus expenses at a predetermined maturity date. ETN did not use the creation mechanism prior to the reform but otherwise followed the same passive investing strategy as a typical ETF.

indices that they tracked, mainly because of the high cost of arbitraging away the difference in the secondary market. The Israel Securities Authority (ISA) responded by mandating that all ETN must adopt the exchange-traded fund (ETF) creation mechanism. Specifically, all ETN issuers must contract with designated institutional investors, called Authorized Participants (AP). Only AP are allowed to purchase shares directly from the ETN in the primary market, and only in large blocks. Other potential arbitragers are restricted to secondary market trading and to trading in large blocks. Moreover, the AP were obliged to operate as market makers in ETN shares. In addition, the ISA mandated that the size of the redemption unit blocks be lowered for all investors to make the arbitrage profitable at narrower spreads.

The result was a dramatic narrowing of the tracking error and the bid-ask spreads of ETN listed on the TASE, effectively lowering the cost of passive investing. Between July 2012 and December 2013, the average bid-ask spreads of ETNs on local equity indices dropped by 36 basis points. The result of this reduction in the cost of investing in ETN, and the renewed confidence in the ability of the security to track its mandated benchmark, was significant capital allocation to ETNs. Between July 2012 and December 2013, the total investment outstanding in ETNs increased by 89%. As a result, passive ownership grew by over three percentage points for the average stock. Such a fast and intense inflow is, to our knowledge, unique in the literature studying the effect of the growth of passive ownership on indexed stocks.[2]

The reform affected all tracked indices, but it did not affect all equally. The ETN tracking indices with small, illiquid stocks had larger transaction costs before the reform, both in terms of their bid-ask spreads and the spreads between their price and that of the index NAV, than those tracking large, liquid stocks. The small float of these stocks, and the wide bid-ask spreads of the ETN tracking them, resulted in large transaction costs on the arbitrage trade that was inversely related to stock size. Thus, while the cost of arbitrage activity decreased for all indices following the adoption of the creation mechanism, the the link between passive inflows and demand for the underlying assets was strengthened mainly for equities listed in

[2] The literature has looked at the effect of mutual fund flows on underlying stocks due to quasi-exogenous events such as forced fire-sales. While related, the question of the effect of inflows from passive funds and instruments is independently important. These flows are different both in motivation and impact. Evidence includes that (1) they are less performance-sensitive and more cost-sensitive than flows into active funds (Anadu et al. (2020)), and (2) that the issuer market is much more concentrated, and this is true both in Israel specifically and around the world. For active funds, in contrast, a point arrives when size hurts performance (Berk and Green (2004)). More generally, the mixed evidence on the effect of a growth of passive ownership at the stock level, which we review below, is a clear indication that we have not pinned down the drivers and effects of either type of inflow.

the small stock market index. Accordingly, the growth of passive ownership in small stocks was larger as a proportion of their float. Between July 2012 and December 2013, stocks in the large-, medium-, and small-cap indices sustained 1.4, 3.5, and 4.8, growth of passive ownership, respectively.

We use the disproportionate effect on stocks with small market capitalization to isolate the effect of the growth of passive ownership from the strengthening of the arbitrage channel using both the cross-sectional variation around the cut-offs between the TASE market capitalization indices and the time-series variation around the reform. Because the connection between the price of the ETN and the NAV of the underlying, and between ETN inflows and inflows into the underlying stocks in the tracked index, is at the index level, our observation that small were more affected than large maps into a discontinuity at each cutoff between the market indices. We utilize these institutional details to design a difference-in-discontinuities empirical strategy where we compare firms in the smaller index to the right to firms in the larger index to the left of each of the two cutoffs, between the large and medium and between the medium and small market indices, after versus before the reform. This design allows us to compare otherwise similar firms—matched by average market capitalization at bi-annual index reconstitution events and displaying parallel trends prior to the reform—that receive different intensities of treatment only because of the index they happen to end up in.[3]

We find that the TASE stock market climbed 19% as a result of the large allocation towards ETN. The widespread and rapid investments in indices increased the demand for the underlying stocks and pushed up their price. This is consistent with the idea that passive investors, which are obligated to adjust their portfolios when facing in- or outflows, and in response to index changes, induce buying or selling pressure on the stocks because the supply cannot immediately and without cost adjust to the demand shock in the short run.

Using our difference-in-discontinuities design, we find that the cumulative returns of stocks just to the right of the index cutoffs increased by 34.6% more than for the firms just to the left and within estimation bandwidths. At the same time those stocks gained higher growth of passive ownership—Passive ownership, as a percent of market capitalization, increased by approximately 3 p.p. more for equities just to the right of the index cutoffs than for equities just to the left. This represents a sizeable shift of capital toward the lower end of the firm-size distribution.

[3] Note that we are not identifying off of switchers. Rather, we are using a the ex ante quasi-randomness in a stock's position relative to the index cutoffs as a way to define treatment and control. Essentially, we are using a regression discontinuity as a special case of selection on observables (Heckman, LaLonde and Smith (1999))

There are several implications of these findings for the effects of passive investing via exchange-traded investments more generally. First, growth in passive investing exerts long-lasting price pressure on the index securities, even when there are no accompanying changes in governance, regulatory or analyst scrutiny. Second, it is also clear that the mechanism by which passive funds are invested matters. The market index equities were being passively tracked before and after the reform. What drove the effect we document was the intensification of the link between the primary and secondary markets for ETN caused by the introduction of the the creation mechanism. Third, this price impact has one set of consequences for firms, whose cost of of equity capital decreases, and another for passive investors. Since returns are generally calculated versus an index, investors in passive funds do not generally regard the price impact of the passive funds as a cost of investing. But, especially for exchange-traded instruments where investors can enter and exit their investment continuously, as opposed to the typical picture of the buy-and-hold index investor, we show that the cost of this price impact can be considerable.

This paper contributes to the literature on the effect of the growth of passive investing on the price of underlying securities, and of the creation mechanism in particular (Pontiff (1996); Malamud (2016); Ben-David, Franzoni and Moussawi (2018); Glosten, Nallareddy and Zou (2020); Anadu et al. (2020)). We also contribute to a behavioural finance literature on the price elasticity of demand for equities. The empirical literature focuses primarily on the "inclusion effect," which exploits shifts in passive demand due to changes in index membership to test the existence of downward-sloping demand curves for stocks (see, e.g., Shleifer, 1986; Harris and Gurel, 1986; Wurgler and Zhuravskaya, 2002; Chang, Hong and Liskovich, 2014; Pavlova and Sikorskaya, 2020). The majority of this literature reports an elasticity of around -1. A recent empirical literature explicitly measures asset demand elasticities to understand changes in asset prices (see Koijen and Yogo, 2019; Gabaix and Koijen, 2020*b*). The takeaway is that changes in asset demand can cause substantial price effects due to financial frictions (see also the model of Vayanos and Woolley, 2013). Unlike the inclusion literature, we quantify the effects of the increasing shift of capital toward index investing on the underlying stocks. Specifically, we identify the effects of a structural shift in the demand for index investments and the disproportionate exposure of stocks that fall in more affected indices.[4] This agenda is related to that of Gabaix and Koijen (2020*b*), who find that flows in and out of the U.S. stock market exert a large impact on equity prices because aggregate demand by institutional investors, especially mutual funds, is price

[4] Another difference is that index inclusion is usually associated with increased firm disclosures, analyst following, and news coverage which might increase investors' attention (e.g., Boone and White 2015).

inelastic. They estimate that the aggregate price multiplier is approximately 5, i.e., a $1 additional investment in the stock market increases the aggregate value of the market by about $5. We find a price multiplier of about 11, reflecting the larger frictions in the TASE setting.

Finally, we contribute to the literature at the intersection of market microstructure and financial development (Bekaert, Harvey and Lundblad (2001); Bekaert and Harvey (2003); Bekaert, Harvey and Lundblad (2007) Lagoarde-Segot (2009); Baker and Kiymaz (2013)) and effects of market making on market quality more generally (Grossman and Miller (1988); Eldor et al. (2006)). We separately quantify the effect of the creation mechanism by using a unique shock where the innovation is introduced to a market for the first time, sharply increasing the link between passive investing and the underlying. In principle arbitrage should hold in the secondary market even in the absence of market making by authorized participants. Yet we find that in practice transaction costs can be prohibitive, allowing large spreads to persist.

2. Setting and Data

In December 2012, the Israel Securities Authority (ISA) implemented a series of regulations to improve the performance of exchange-traded notes (ETN) on the Tel Aviv Stock Exchange (TASE) ("the ETN reform"). The reform introduced the creation mechanism to the Israeli market, reduced the cost of arbitraging between the ETN securities and their indices, and centralized disclosure of the daily NAV of the indices. The reform sharply increased investor demand for these index investments. We summarize the central institutional details of the ETN Reform and its immediate consequences.

2.1. The ETN reform

ETN are similar to ETF in that they trade on a stock exchange and track a benchmark index. However, an ETN is a senior, unsecured debt security. Because they are unsecured, and unlike an ETF, the ETN issuer typically does not physically replicate the index it tracks by holding the underlying assets, which are the basis for ETF price. Instead, the return of an ETN is linked to a market index or other benchmark by contract—the ETN promises to pay at maturity the full value of the index, minus the management fee. We observe that before the reform most ETN issuers held some of the stocks of their benchmarks, generally the most liquid ones, and then hedged the rest of their position via futures, options, stock swaps, and other instruments to approximate the benchmark index return.

ETNs were first designed in 2000 in Israel, and before 2018 ETNs were the primary product for tracking indices on the TASE. For example, there were no ETF listed on the TASE at the time of the reform. By the end of 2012, there were 464 TASE-listed ETN with a float-adjusted market capitalization of 68.9 billion new Israeli shekels (ILS), and around 66% of outstanding ETN shares were held by retail investors, according to the Israel Securities Authority (ISA). There were several advantages of ETNs that underlay their popularity. Because ETN did not hold the underlying securities, institutional investors could increase their exposure to the underlying stocks through ETNs beyond the regulatory restrictions on the percent of the portfolio they could invest in a single stock. Moreover, ETNs offered a cheaper and easier way for retail investors to invest in illiquid assets because they eliminated the associated transaction, holding, and tax costs (there are no dividend or interest rate payments for ETN). Moreover, the ETN issuer promises to pay the full value of the index minus the expense ratio at the maturity date, eliminating tracking error for investors that hold the ETN until maturity.

On the other hand, ETNs are typically less liquid than ETFs, and the performance of ETNs over long periods can differ markedly from the performance of the underlying basket, especially for illiquid securities. On the TASE, the bid-ask spreads were disproportionately high for ETNs on those indices for which arbitrage activity in the secondary market was harder to sustain. For example, in late 2011, the average bid-ask spreads for ETNs on a small market capitalization index, the SME-50, exceeded 150 basis points, substantially reducing the profit from arbitrage activity on those securities. This difference between the effect on small and large-cap indices was exacerbated because ETN units could be redeemed only in large batches of the underlying securities. In 2012 the batch size was 500 thousand ILS. This trade is often profitable in the most liquid securities. However, for indices tracking illiquid securities investors would have had to gain substantial ownership in the underlying stocks, which would impose a high price impact and expose them to inventory risk.[5] The issue came to the forefront of public debate in 2011, when investors, in particular banks, who were responsible for approximately 80% of the total retail investments in the TASE, raised concerns that many ETNs had low liquidity and that their price in the secondary

[5]For example, in December 2011, the total benchmarked capital in SME-50, the index track the largest 50 stocks in the small-capitalization index, was 600 million ILS. Therefore, to be eligible for ETN redemption, arbitrageurs had to buy 0.8% of the respective ETNs.

market did not closely track the value of underlying securities. Retail investors in particular who sold their ETN investments before maturity were surprised by differences between the realized return on their investments and the implicit return they would have realized had they invested in the underlying benchmark. Moreover, significant price differences between ETN and the underlying benchmarks called into question the fiduciary duty of financial advisers who advocated investment in those ETN to their clients. This resulted in several class-action lawsuits.

In addition to worries about mispricing in the ETN market, the ISA concluded from a round of stress tests in 2011 that the ETN represented a significant downside tail risk to the market as a whole. The issuer market for ETN was concentrated; there were only seven issuers, all of whom were also large and systemically important Israeli banks. Since ETN are unsecured debt obligations, investors are exposed to the issuer's default risk. ETF, on the other hand, do not expose investors to credit risk because they hold the underlying assets of the index that they track and there is no firm commitment obligation in the ETF contract. As flows into the ETN market increased, ISA risk modelling suggested that even if one issuer collapsed the ETN market would amplify the impact on the wider market and economy.[6] To address what they termed the "stability and systemic risk implicit in ETNs," the ISA mapped out a series of reforms with the eventual aim of converting all ETN securities to ETF securities, which they accomplished in 2019.

The first step in the reform was decided in June 2012, publicly announced in December 2012 and was fully implemented by March 2013. ETN issuers were required to hold the underlying securities in their benchmark and adopt the ETF creation process. Specifically, the ETF issuers must contract with an intermediaries called authorized participants (AP), institutional investors authorized to create or redeem ETF shares in the primary market directly with the issuer by exchanging them for a specified number of shares in the tracked index (the creation unit). AP are not obligated to make this trade, but because they are the only ones that can create and redeem with the issuer, they have much lower transaction costs relative to non-AP arbitrageurs, making it more profitable to eliminate any differences between the price of the ETN and the NAV of its underlying benchmark.[7] AP increase the

[6]The question was not merely hypothetical. US financial institution Lehman Brothers had an investment-grade rating when it collapsed in late 2009. Their ETN securities stopped trading and when they defaulted and investors recovered just 9% of their value. Investors in Bear Stearns' ETNs only avoided a similar loss because JPMorgan Chase, which purchased Bear Stearns, honoured all of its debt obligations.

[7]When there is a shortage of ETF shares in the market, authorized participants create more. Succinctly, the AP puts in an order to the ETF sponsor for a block of new ETF shares, dubbed creation units. In return, it transfers an equally-valued bundle of securities from the index the ETF is tracking to the sponsor, usually according to the market capitalization weights of the index constituents. The AP can then sell the

transparency of markets by keeping ETF tracking error low, i.e., AP ensure that premiums and discounts never get too large in the ETF market.Without the authorized participants in the market, ETFs would become more like closed-end funds, which we see in the case of the ETN securities in Israel where prices drifted far from NAV. This encourages trading by other investors. When most investors buy an ETF, they want to make a bet on a particular asset class, e.g., that the stock market will go up. Typical investors do not want to investigate whether funds are trading above or below their NAV.

Moreover, ETN issuers were to reduce the minimum levels for ETN redemption from 500 thousand to 150 thousand ILS, which reduced the cost of arbitraging any price difference between ETN and the underlying benchmarks.[8] Finally, the reform enhanced the transparency of the daily Net Asset Value (NAV) of ETN, which had previously been available only in PDF form via an ETN-by-ETN lookup tool. Specifically, from July 2012, the ISA instituted a daily electronic reporting requirement for all ETN issuers that provided investors with the NAV and other key parameters needed to evaluate the end-of-day value of the ETN securities, including the expense ratio and dividend reinvestment policy, in a centralized location and common format.[9] This was to help investors become aware of any gaps between the ETN values on the secondary market and the underlying securities quickly. The reform thus decreased the cost of arbitrage in both the primary and secondary markets—any changes in the value of the ETN relative to the underlying securities could be closed by additional creation or redemption by the APs or by arbitrage activity in the secondary market, with AP as key liquidity providers.

The effect on ETN tracking error and liquidity was large and immediate. Between July 2012 and December 2013, the average bid-ask spreads of ETN on local equity indices dropped by 36 basis points. Figure 1 reports the average bid-ask spread of ETN listed on the TASE.[10] From January 2013 we see a sharp improvement in liquidity and reduction in transaction

new ETF shares in the secondary market for a profit. Conversely, authorized participants will reduce ETF shares in circulation when the price of the ETF is lower than the price of the underlying shares. They do so by selling ETF shares to the sponsor, receiving in return an equally-valued bundle of index securities known as the redemption basket. In this way, the AP provide a large portion of the liquidity in the ETF market while keeping the price of the ETF aligned with the net asset value (NAV) of the index it tracks.

[8]A description of those adjustments was published by the ISA on January 22, 2013 (`http://www.isa.gov.il/%D7%94%D7%95%D7%93%D7%A2%D7%95%D7%AA%20%D7%95%D7%A4%D7%A8%D7%A1%D7%95%D7%9E%D7%99%D7%9D/175/2013/Pages/TheNextStep_ETFSockExchangeTrade.aspx`).

[9]The information is presented in the form "124טופס ת" (i.e., Form 124). Investors are able to access this information on Maya Corporate Actions (hereafter, Maya Corp.) or by subscription through third-party vendors including Praedicta. Maya Corp. operates as a central source of public information for listed companies.

[10]Bid ask spreads are the gap between the prices demanded by prospective sellers and those offered by potential buyers. We report them as a percent of the ask.

costs from the increase in market making following the introduction of AP, an effect which persists through the end of the sample. This is also reflected in dramatically lower tracking error in the prices of the ETNs relative to the NAV of their benchmark indices, which we observe in Panel B of Figure 1.

[Place Figure 1 here.]

The reform clearly achieved its stated intent: To reduce the tracking error and improve the liquidity in the primary and secondary market for ETN securities. But what of the effect on the markets for the benchmark securities those ETN track? The reform greatly strengthened the link between flows into ETN and flows into equities from ETN demand, an effect clearly observable in Figure 2. This was driven both by the new requirement that ETN hold the underlying securities and by the new source of creation, redemption, and trading afforded by the AP, which mechanically increased market making activity in the markets for the underlying securities. Moreover, another effect of the reform was a large increase in investor demand for ETN securities as financial advisors responded to the perceived reduction in litigation and regulatory risk after the reform. The bottom (blue) line in Figure 2 reports cumulative net flows into ETN securities, which corresponds to the total value of ETN shares issued by ETN to investors (represented in the figure as a negative flow). Between July 2012, when it was agreed that ETN issuers would adopt the creation mechanism, and December 2013 the total investment outstanding in ETN increased by 89%. The top (green) line in Figure 2 represents the corresponding accumulation of the stocks in their underlying benchmarks by the ETN issuers by the ETN issuers. The line is even steeper than the inflows into ETN would suggest, reflecting that the reform also entailed physical replication of the index. The average stock experienced over three percentage points growth of passive ownership.

[Place Figure 2 here]

2.2. Data

Our primary data are security-level information about returns, stock prices, outstanding shares, float-rate, and distributions for equities and ETN securities listed on the Tel Aviv Stock Exchange (TASE). The information is publicly available on the website of the TASE for all traded securities through a security-by-security lookup tool, though we accessed it via an administrative dataset at the ISA. This data are at a daily frequency. Our regression sample covers the period from December 2010 to June 2015, an approximately two-year window centred on the implementation of the ISA reform in December 2012.[11] We combine this data with information on the index membership and weights of the market index securities at the daily level.

When we study the impact of the reform on the security issuers, we use data from firm balance sheets and income statements which we obtain from the Compustat Global database, which we map to by stock ticker. This data are available at a a firm-quarter frequency. We use data on firm total assets, net sales, cash and cash equivalents, debt, dividends, earnings (EBITDA), capital expenditures, and research and development expense. This data are also publicly available on the website of the TASE and Maya for all incorporated firms through a company-by-company lookup tool. We additionally use firm characteristics such as primary industry membership.

We measure inflows into ETN securities and ETN purchases in the underlying securities using confidential trade account-transaction level data from the TASE transaction book. This data covers all the trading activity in stocks and stock ETN over our sample period. Each trade has an associated (anonymous) identifier that identifies that account over time and across trades. A categorical variable identifies the trading account as an ETN issuer, an Authorized Participant, a non-affiliated institutional investor, a hedge fund, or a retail account. Two indicators identify accounts traded by a computer algorithm and accounts registered with a high-frequency trader (HFT); the latter are a entirely subsumed subset of the latter category. In addition we observe the identification number of the traded security, the sign of the trade, the number of units traded, and the ILS value of the transactions. We combine the trading data with account-level information and then we aggregate transactions to a daily frequency. Next, we construct daily links between ETN accounts and the underlying stocks in their benchmarks to measure demand shocks driven by inflows into ETN securities. Specifically, we match each ETN security with its benchmark index, index constituent stocks, and their respective weights. All but four ETN track only one index benchmark; for these four we allocate flows based on their portfolio weights. Appendix Table A2 describes the trading account data.

We restrict the sample of securities to the 69 ETN that track the market indices, and the securities included in the market indices—those listed on the Large (TA-25), Medium (TA-

[11]Note that there was a complete re-organization of the market indices in Israel in 2016. Therefore, we end all analyses in June 2015 to avoid contamination from this re-organization.

75), or the Small (TA-GROW) indices. The market-index-tracking ETN account for 99% of the capital allocated to ETN on domestic equity indices, excluding ETN tracking the TA-BANK5 index.[12]

There are 366 securities listed on the market indices, out of 645 total unique securities listed on the TASE between December 2010 and June 2015. Since each firm in our sample has only one security listed on a market exchange, our sample also covers 366 unique firms. We construct our sample of stocks according to the index assignments on the ranking days of the semi-annual index reconstitution events. For example, if a stock is removed from a market index after a given end-of-November ranking, it will exit our sample the next trading day.

[Place Table 1 here]

Table 1 reports summary statistics over the period December 2010 to June 2015. Data in Panel A are at the security-monthly level. The average (median) stock has a market value of 1.2 billion ILS (2.6 million ILS).[13] The average (median) free float, or percentage of fully diluted shares outstanding available to trade on the secondary market was 45% (39%), reflecting the highly concentrated ownership of Israeli firms in this period. ETN hold an average (median) of 7.2% (6.9%) percent of a security's market value. Panel B of Table 1 reports firm-quarter level summary statistics for the firms with equity listed in the market indices from December 2010 to June 2015. The average (median) firm has total assets of 22.8 billion (631.7 million) ILS. The average (median) firm has a return on assets of 0.02 (0.01) and is not highly levered, with a mean (median) ratio of total debt to total assets of only 0.20 (0.14). About 7% of firms paid dividends in a given quarter and about 3% announced the intention to acquire an unrelated firm.

Finally, our treatment is defined by index membership and ranking within the index. Therefore, we need to account for reconstitution events. The TASE determines membership in the market indices twice a year based on average firm market capitalization rankings.[14] The TASE minimizes turnover by using a banding method. Appendix A1 gives more details while Appendix Table A1 reports the frequency of switchers by reconstitution event from December 2010 to June 2015. To account for the fact that treatment is not stable across our

[12] TA-BANK5 tracks the securities of the five largest banks in Israel and accounts for 30%, of the capital allocated to ETN on local equity indices between July 2012 and December 2013.

[13] The currency is the Israeli new shekel (ILS). The average spot rates over the sample period was 3.67 ILS/USD and 4.90 ILS/EUR.

[14] The ranking takes place on the last calendar day of each May and November. Index reconstitution

sample period we include controls for the market cap rating in the regressions, which update treatment status and ranking after each re-constitution.

3. Empirical Specification

3.1. Defining Treatment

The reform affected all equities in the TASE index universe. At the time of the ETN reform there were 14 indices that included equities listed on the TASE.[15] Five of them were market indices with a similar structure to the Russell indices in the US context in that they segmented the market by ranking stocks on market capitalization.[16] The large-cap index (TA-25) tracked the top 25 stocks by market capitalization; the medium-cap index (TA-75) traced the following 75 largest stocks by market capitalization (these two indices together comprise the TA-100 index); and the TA-GROW tracked the rest of the stocks listed in the index universe, comprising the small-cap stocks. The fifth market index was the SME-50, which included the 50 largest stocks in the TA-GROW index.[17] As of June 2012, investment in the ETN tracking the market indices accounted for approximately 85% of all the investment outstanding in ETN on local equity indices.

What was the effect of this large increase in passive demand on the prices of the benchmark stocks? Figure 3 reports that cumulative returns of all of the market indices increased following the reform. However, we can see that it increased by significantly more for stocks in the small-capitalization index than in the large- or medium-capitalization indices.

[Place Figure 3 here]

The stronger treatment effect on the small-capitalization index is intuitive given the details of

occurs on the 15th of June and December, respectively.

[15]This was the structure of market indices in Israel July 2010 and July 2017.

[16]The other indices were seven industry indices, an index of dividend-paying stocks, and an index that weighted Israeli companies based on their annual Environmental, Social, and Governance (ESG) ratings.

[17]Tamar Equity Indices Universe (`https://info.tase.co.il/Eng/knowledge_center/indices/Pages/indexuniverse.aspx`) determines the list of all shares that meet basic threshold criteria for inclusion in the TASE tracking indices, and consists of over 300 stocks traded on the exchange. The universe serves as the foundation for all the benchmark indices in our sample. TASE updates the list of shares included in the Index Universe semiannually. Essential threshold criteria for inclusion in the index universe are generally

the setting that we discuss above. The arbitrage trade requires buying up significant holdings in the underlying index securities, particularly before the reform. We therefore expect the introduction of AP and reduction of the size of the creation units to affect the smaller, less liquid indices more than the large indices, as the stocks in the latter were already liquid enough to make arbitrage trading profitable in the pre-period. Moreover, because creation and redemption occurs at the security basket level, we expect discontinuities in the effects of the reform between indices but not within indices.

3.2. Discontinuous growth of passive demand

The evidence so far is consistent with a significant increase in ETN holdings of the benchmark securities and of increased trading by the ETN and AP, especially in the small-cap index, following the reform. We now provide evidence supporting the claim that the reason that small-capitalization indices are more strongly affected by the reform is that the introduction of the AP causes a large increase in trading intensity in the small-capitalization stocks while having a more modest effect on larger-capitalization stocks that were already traded actively before the reform. Table 2 reports the growth of passive ownership for the large-, medium-, and small-cap indices separately. In the year following the reform, stocks in the large-, medium-, and small-cap indices sustained 1.4, 3.5 and 4.8 percent growth of passive ownership, respectively, relative to the level of passive ownership just before the details of the reform was finalized by the ISA in July 2012.

[Place Table 2 here]

From Table 2 we can see that between December 2012 and December 2013, the large-, medium- and small-capitalization indices received 2.6, 1.5, and 0.3, billion ILS from investments in ETNs, respectively. Hence, indices for larger-capitalization stocks received larger total inflows while indices for smaller-capitalization stocks received larger inflows as a proportion of their size.

However, around the index cutoffs inflows from ETN and AP into the underlying stocks is higher for stocks just to the right of the index cutoffs in both value terms and proportionally.

To see why disproportionate growth of passive ownership in small stocks following the ETN

more stringent than those of already existing constituents. The three major threshold criteria for inclusion reform translates into discontinuous demand for the underlying stocks to the right of the index cutoffs, consider the way that inflows from increased demand for ETN is allocated across the index cutoffs:

$$\Delta Demand_{r,R,t,t+1} - \Delta Demand_{l,L,t,t+1} = \omega_{r,R,t}\Delta Passive_{R,t,t+1} - \omega_{l,L,t}\Delta Passive_{L,t,t+1} \quad (1)$$

Where l and r denote rank relative to the index cutoff (left or right) within index L or R and t to $t+1$ is the time period in which the ETN experiences inflows (a demand shock). ω are the index weights, where, because the market indices are value-weighted, $\omega_{0,R} > \omega_{0,L}$. $\Delta Demand_{r,R,t,t+1}$ is the implied increase in demand for the stock of rank r in index R between t and t+1. $\Delta Passive_{R,t,t+1}$ is the total increase in investment outstanding in index R. Then by definition of the weights:

$$\Delta Demand_{r,R,t,t+1} - \Delta Demand_{l,L,t,t+1} = \frac{ME_{r,R,t}}{\sum_R ME_{r,R,t}}\Delta Passive_{R,t,t+1} - \frac{ME_{l,L,t}}{\sum_L ME_{l,L,t}}\Delta Passive_{L,t,t+1} \quad (2)$$

Where ME is the market equity of the index stocks, on the basis of which the weights are constructed. Consider the security of rank zero, at the cutoff. It has $ME_{0,L,t} = ME_{0,R,t}$. Therefore,

$$\frac{\Delta Demand_{0,R,t,t+1}}{ME_{0,R,t}} - \frac{\Delta Demand_{0,L,t,t+1}}{ME_{0,L,t}} = \frac{\Delta Passive_{R,t,t+1}}{\sum_R ME_{r,R,t}} - \frac{\Delta Passive_{L,t,t+1}}{\sum_L ME_{l,L,t}} \quad (3)$$

Note that there is nothing stock-specific on the right-hand side of Equation 3. This illustrates that at the cutoff, the increase in demand is driven by only the reform. The weights matter, represented on the left-hand side, because they determine the proportion of the demand shock at the index level that is allocated to the individual stock.

Figure 4 reports these large discontinuities in the value of capital flows that stocks just above and below the index cutoffs received through investments in ETNs following the reform. The top panel of Figure 4 represents the discontinuity around the boundary between the large- and medium-market indices and the bottom figures the discontinuity between the medium-

are (i) minimum 'free-float rate;' (ii) minimum 'average free-float value;' and (iii) minimum 'average price.'

and small-market indices.

[Place Figure 4 here]

Because the market indices are value-weighted and capital within each index is distributed in proportion to the index weights, the growth of passive ownership within each index is similar across all stocks in the same index. Also, stocks that fall just above and below the index cutoffs have similar market capitalization. Therefore, the disproportionate growth of passive ownership among indices of smaller stocks translates to discontinuous growth of passive demand for the stocks that fall just below relative to those just above the index cutoffs.

What is the source of this higher intensity of treatment just to the right of the index cutoffs? Figure 5 reports the discontinuity in the weights of stocks across the index cutoffs against their ranks. It clearly demonstrates the discontinuity in index weights around the index cutoffs, which implies the greater growth of passive demand for stocks at the top of medium- and small-capitalization indices compared to stocks at the bottom of large- and medium-capitalization indices that we observed in Figure 4. Specifically, for the stocks directly to the right of the large- to medium-cap cutoff the average weight is 4.1%, while for the average for the weights of stocks directly to the left of the cutoffs is 1.4%. Similarly, for the stocks directly to the right of the medium- to small-capitalization index cutoff the average weight is 4.4% while for the stocks directly to the left of the cutoffs the weight is 0.6%, on average. Therefore, the weights of the stocks to the right of the index cutoffs are three-to-seven times larger than those of stocks falling just to the left of the cutoffs.

[Place Figure 5 here]

The discontinuity in weights occurs both before and after the reform, mechanically by the construction of the indices. However the discontinuity in flows is a consequence of the reform because the ETN were not required to replicate their benchmark physically and because, particularly for the small market index the cost of buying up the index was high before the reform. We observe all trading on the TASE over the period, so we can directly test for a change in the intensity of those flows around the reform due to the adoption of the creation mechanism. Table 3 reports the correlation at the security-day level between inflows into ETN and ETN trading in the underlying. Here, "Large" denotes stocks in both the large and medium market indices while “Small” includes only stocks listed in the small-capitalization market index. We can see that there is no significant difference in the correlation for stocks in the large and medium market indices. But for the small market index there is a 14% increase in the coefficient; indeed, in the post-reform period the correlation is one! The R^2 statistic also increases for the small but not large or medium market indices. This indicates both that the ETN increased the intensity and speed with which they traded in the underlying in response to inflows and that this response was concentrated in the less liquid index.

[Place Table **??** here]

This is a unique setting. While there have been large inflows from passive investing in other markets worldwide, they occurred as a continuous and cumulative process over decades. In contrast, here we have a large discrete change in passive ownership of stocks directly connected to the introduction of the creation mechanism. Thus, the 2013 reform is an ideal setting to test the impact of the creation mechanism on the underlying securities tracked by a growing passive investment sector.

3.3. Empirical Strategy

Because the connection between the price of the ETN and the NAV of the underlying, and between ETN inflows and inflows into the underlying stocks in the tracked index, is at the index level, our observation that small were more affected than large maps into a discontinuity at each cutoff between the market indices. his suggests using a regression discontinuity design to define a plausible control group.[18] This will pin down the effect of the flows following the reform but not the differential effect of introducing the AP because we would not be utilizing the time-series variation around the reform. We instead use both sources of variation by implementing a difference-in-discontinuities strategy. Effectively, we estimate a difference-in-differences design while utilizing the discontinuities around the cutoffs in the post period to defined treated and control who are otherwise similar but receive different intensities of treatment (Heckman, LaLonde and Smith (1999)).[19] In other words, we compare firms in the smaller index to the right to firms in the larger index to the left of

[18]The discontinuity is sharp, i.e., every security to the right of the cutoff is in the treatment group while those to the left of the cutoff are all in the control group.

[19]This is equivalent to the difference-in-discontinuity strategy of Grembi, Nannicini and Troiano (2016) and to the matched difference-in-differences design of Casas-Arce and Saiz (2015). This strategy has several advantages over the standard matching-on-observables procedure. Lee and Lemieux (2010) show that the

each of the two cutoffs, between the large and medium and between the medium and small indices, after versus before the reform.

Specifically, for security i, cutoff $c \in [0,1]$ and month t:

$$\begin{aligned} Y_{i,c,t} =& \alpha_0 + \alpha_1 f(r_{i,c,t}) + D_{i,c,t}(\delta_0 + \delta_1 f(r_{i,c,t})) + \\ & T_t[\gamma_0 + \gamma_1 f(r_{i,c,t}) + D_{i,c,t}(\beta_0 + \beta_1 f(r_{i,c,t}))] + \theta_c + \theta_t + \epsilon_{i,c,t} \end{aligned} \tag{4}$$

Where Y is the outcome of interest, e.g., mean bid-ask-spreads; $f(r)$ is a flexibly defined function of the security's ranking in month t relative to the cutoff. In the main specifications it is linear and estimated within a bandwidth of 52 and 13 around the cutoffs between the large and medium and between the median and small cutoffs, respectively. We normalize the ranking by subtracting from it the cutoff rankings so that all cutoffs are at zero and rankings relative to zero. D is an indicator that takes the value of 1 if security i has a ranking to the right of the cutoff c in month t and is zero otherwise. T is an indicator that takes the value of 1 from December 2012, the date the reform was announced in its finalized form and is zero otherwise. θ_c takes the value of 1 for the cutoff between the medium and small indices and is zero otherwise. We apply a triangular kernel that weights firms with market capitalization rankings close to the cutoff more highly and decreases the weight of firms with market capitalization far from the cutoff. Standard errors are clustered at the issuing firm level. β_0 identifies the local average treatment effect (LATE) for securities around the market boundaries where those to the right experience a higher intensity of treatment than those to the left.

We are not just interested in this overall average treatment effect but also in recovering the elasticity with respect to the passive inflows. Since we observe the trades of the ETN and AP directly, by regressing outcomes directly on the change in ETN holdings of the underlying stocks and instrumenting that change with the discontinuity. For intuition, we can conceptualize this in the two-stage framework where the estimating equation is:

$$\Delta y_{i,c,t} = \beta_0 + \beta_1 \Delta ETNHoldings_{i,c,t} + \lambda X_{i,c,t} + \gamma_c + \gamma_t + \varepsilon_{i,c,t}. \tag{5}$$

Where $\Delta ETNHoldings_{i,c,t}$ is the growth of passive ownership for stock i after the reform relative to before.

standard matching model's untestable assumption of no selection on unobservable variables is satisfied with the regression discontinuity model, provided the RD model assumptions are met. The reason is that a valid discontinuity, i.e., one where there is a strong discontinuity, position relative to the discontinuity cannot be

The first stage is a sharp regression discontinuity estimation that isolates exogenous variation in the growth of passive ownership for stocks around the market index cutoffs following the reform. The first-stage regression is represented as:

$$\Delta ETNHoldings_{i,c,t} = \lambda_0 + \lambda_1 f(r_{i,c,t}) + D_{i\tau}[\lambda_{0r} + \lambda_{1r} f(r_{i,c,t})] + \gamma_c + \gamma_t + \zeta_{i,c,t} \tag{6}$$

Note that X in Equation 5 includes $f(r)$ and $D \times f(r)$ as controls. And, as before, we apply a triangular kernel to up-weight firms closer to the cutoff and down-weight those further away. β_1, The coefficient on the instrumented change in passive ownership is now our coefficient of interest. It identifies a slightly different quantity: The percent increase in the outcome caused by a percent increase in passive ownership in firms just to the right of the market index cutoffs relative to those just to the left.

3.4. Identification Assumptions

Following Lee and Lemieux (2010); Lee and Rui (2007), we assume that index membership does not not affect the stocks' outcomes other than through its index assignment and location within the index. Specifically, our identification assumptions are (1) that there are local parallel trends of observations around the cutoff. Equivalently, all potential outcomes $E[Y_{i,t}|rank_{i,t} = r, t \geq t_0]$ and $E[Y_{i,t}|rank_{it} = r, t < t_0]$ are continuous in r at r_c. And (2) that there is no manipulation of $rank_{i,t}$ at any t. We find no evidence that our identification assumptions are violated. In Figure 6 we see no evidence of manipulation around either cutoff. We cannot reject the null hypothesis of continuity of the running variable density function around either cutoff.[20] Note that, without the banding technology of the TASE, we would expect to see smooth declining lines of the average market capitalization across one vertical line (e.g., Chang, Hong and Liskovich, 2014). However, the banding technology employed by the TASE creates two membership cutoffs, which divide the stocks between every two consecutive indices conditional on the stocks' index membership in the previous constitution period.

[Place Figure 6 here]

perfectly manipulated, and where potential outcomes in the absence of the discontinuity are smooth, induce quasi-random treatment assignment around the cutoff.

[20] We run formal manipulation tests using the Cattaneo and Jansson (2020) update on the McCrary (2008) industry standard tests. The t-statistic for the test around the cutoff between the large- and medium-capitalization indices is 0.2402 with a p-value of 0.8101. That for the test around the cutoff between the

Next, we test for discontinuities in pre-determined covariates in December 2011, one year in advance of the announcement of the ETN reform. If we saw any discontinuities it would call into question our assumption that our treatment and control groups were otherwise similar before the reform. In common with all quasi-experimental settings, these tests do not guarantee that our identification assumptions hold, but it does increase our confidence that any violations are not first-order and that we are recovering an asymptotically un-biased estimator of the LATE of the reform. Finally, we test for evidence of violation of continuity of potential outcomes around the cutoff below, by examining pre-trends and testing for discontinuities before the reform. We find no evidence of jumps or diverging trends prior to the reform for equities within the bandwidths.

4. Effects of Inflows into Index Investments for Equity in Small Versus Large Market Indices

We have seen that the 2012 ETN reform that introduced AP led to an overall increase in price; the market indices climbed 19% overall, and that bid-ask spreads of both the ETN and the average for the stocks in the market indices fell. We also know that there is a relatively greater intensity of treatment on indices with smaller stocks than those with larger ones, and indeed we find two discontinuities in the effect of the reform on passive inflows—one at the cutoff between the large and medium market indices and another at the cutoff between the medium and small market indices. For both cutoffs, there is a larger intensity of treatment to the right of the cutoff than the left.

4.1. Price Effects

The top panel of Figure 7 reports the cumulative returns on investment in the treated and control groups separately. Returns are cumulative from December 2010. The treated are those equities within a bandwidth of 13 and 52 market capitalization rankings to the right of the large-medium and medium-small market index cutoffs, respectively. The control group is defined symmetrically to the left of the market index cutoffs. Data are defined at the equity-month-cutoff level. Index cutoffs are pooled and the average market capitalization rankings

medium- and small-capitalization indices is -1.1499 with a p-value of 0.2502. See Appendix Figure A2 for evidence for each reconstitution separately.

are normalized by subtracting off the relevant index cutoff ranking. All specifications include cutoff fixed effects and triangular kernel weights, and standard errors are clustered at the equity level.

Before December 2012, the returns on the two indices showed parallel trends in stock prices. Note how the price effect for both treated and control groups, in parallel, increase sharply after the negotiations between the ISA and the ETN issuers on the form of the new regulation conclude, in July 2012. This was when we see passive inflows increase as brokers again are allowed to offer ETN investments to retail investors (see Figure 2). However, the relatively larger treatment effect for treated firms only begins at the implementation of the reform, i.e., when the AP contracts begin and the costs of arbitraging between the price of ETN securities and the NAV of the indices they track drops. This is also precisely when we see the bid-ask spreads narrow for the ETN securities, reported in Figure 1. This difference in the timing of the reaction of the overall market to the reform and the differential effect of the reform on treated and control groups is the key to our ability to distinguish between the effect of inflows into the market as a whole following the resolution of uncertainty due to the reform and the effect of the introduction of the creation mechanism and the subsequent drop in arbitrage costs.

[Place Figure 7 here]

The bottom panel Figure 7 reports coefficients from the difference-in-discontinuities regression interacted with monthly dummies and where treated and control are defined within the same bandwidths as the top figure. We visually confirm parallel trends before the reform, represented by the line at December 2012.

The corresponding coefficients are reported in Table 4. Model (1) reports the result of the difference-in-discontinuities (DiRD) model, represented by Equation 4, applied to the growth of passive ownership around the cutoffs. Treated firms to the right of the market index cutoffs experienced around 3 percentage points higher growth in passive ownership as a percent of their market value than control firms to the left. This is our "first stage" evidence in the sense that it supports our assertion that the proportion of passive ownership differs across the market index boundaries. This corresponds to the evidence presented in Figure 4. We will return to this observation when discussing the mechanisms of the price effect below.

[Place Table 4 here]

Model (2) reports the DiRD coefficient in cumulative returns, corresponding to the bottom panel of Figure 7. Prices for treated equities increase by 34.6% more than for control firms. This translates into an implied elasticity of 11.715, i.e., a 1 p.p. increase in passive ownership as a percent of market capitalization leads to an 11.7% increase in the price of stocks.

Models (3) and (4) break down this difference-in-discontinuities into the pre- and post-discontinuities, respectively. We can see from Model (3), that there is no discontinuity in the prices of around the index cutoffs before the reform. That there is no discontinuity around the market thresholds in anticipation of differential passive inflows is further evidence in support of our identification assumptions.

4.2. Robustness

How robust are these results to our choice of bandwidth and specification? The main results change little when we vary the bandwidths. The top panel of Figure 8 plots the coefficients on the coefficient of interest from Equation 4, on the y-axis, against a percent of the baseline bandwidths of 13 and 52 for the large-medium and the medium-small index boundaries, respectively. Specifically, the proportion of the baseline bandwidth used ranges from 10 to 200%. We can see that, while the 95 percent confidence intervals predictably widen as we narrow the estimation window around the cutoffs, the point estimates are remarkably stable around 35%.

[Place Figure 8 here]

The bottom panel of Figure 8 also plots the main coefficient of interest from estimating Equation 4, this time within the baseline bandwidths, as in Table 4. What varies is the polynomial expansion of the running variable, i.e., of the security ranking within the market indices relative to the cutoff. This is represented on the ex-axis. The point estimate is also fairly stable across the specifications, though a bit larger for higher polynomial expansions. We conclude from this evidence that the reform had a large and sustained price impact overall, and an even larger impact on the the price of equities in less liquid indices. In other words, even when we properly control for stock characteristics by using the cutoff discontinuities, we see a differential impact because the ex-ante differences in the cost of both replicating the less liquid indices and arbitraging the value of those indices relative to the ETN tracking them resulted in a relatively larger change in the demand for the stocks in illiquid indices after the reform.

4.3. Mechanism: Price Pressure from Passive Flows

We have demonstrated that prices meaningfully increase following the reform, both overall and in the cross-section for stocks ranked at the top of their market index relative to those ranked at the bottom of their index. The effect that we estimated combines the direct effects of the reform, most notably the introduction of the AP and the decreased cost of arbitraging between the price of the ETN securities and the NAV of the indices that they track, with indirect price effects. The indirect effects include price pressure resulting from inflows into the ETN investments in response to the reform, which necessitate the ETN sponsors to purchase the benchmark stocks. In this section, we leverage our transaction-level database to estimate the elasticity of a stock's cumulative returns with respect to the change in ETN holdings in that stock around the reform. Our aim is to understand how much of the price increase is due to inflows versus the direct effects of the reform.

We can identify ETN holdings from our transaction data, aggregated to the daily level, under the maintained assumption that the ETN invest according to a completely pre-determined index allocation with no discretion. We then instrument our proxy for the change in ETN holdings by the regression discontinuity at the market index cutoffs. Model (1) of Table 5 reports the reduced-form effect of having an average market capitalization ranking to the right of the market index cutoffs using all data. This differs from the results reported in Models (2) through (4) in Table 4 in that it the RD specification (right versus left) estimated in the post period without applying any bandwidths and using daily data. We see that prices for treated equities increase by a statistically- and economically-significant 24.1% more than for control firms.

[Place Table 5 here]

Model (2) of Table 5 reports estimates from the first stage equation, which is:

$$\Delta Passive_{i\tau} = \gamma_{0l} + \gamma_{1l}(r_{i\tau} - c) + D_{i\tau}[\gamma_{0r} + \gamma_{1r}(r_{i\tau} - c)] + \theta_c + \theta_t + \varepsilon_{it}, \tag{7}$$

$\Delta Passive_{i\tau}$ is the average daily net investments in market indices of all trading accounts classified as belonging to ETN sponsors. From Table 3 we know that passive inflows into ETN securities and ETN trading in the underlying market indices are highly correlated, which supports our intention of estimating the price elasticity of inflows caused by the increase in passive investment following the reform. $D_{i\tau}$ is an indicator variable that takes the value of one if the stock's ex ante average market capitalization ranking ($r_{i\tau}$) is to the right of the market index cutoffs (c) between the large- and medium-capitalization index or between the medium- and small-capitalization index, and zero otherwise. We see that treated stocks to the right of the market index thresholds experience 1.8 percentage points higher ETN inflows than control firms to the left of the cutoffs. The magnitude is similar to the discontinuity in the growth of passive ownership as a percent of market capitalization, shown in Model (1) of Table 4.

Finally, Model (3) of Table 5 reports the estimates of the instrumental variable specification. This second-stage is represented as:

$$Ret_{it,t+k} = \alpha_{0l} + \alpha_{1l}(r_{i\tau} - c) + \Delta\widehat{Passive}_{i\tau}[\alpha_{0r} + \alpha_{1r}(r_{i\tau} - c)] + \theta_c + \varepsilon_{it}, \tag{8}$$

where the outcome, $Ret_{it,t+k}$, are cumulative returns of stock i at time t to horizon $t+k$ and $\Delta\widehat{Passive}_{i\tau}$ is the change in passive inflows around the reform instrumented by D, the indicator for ex-ante ranking position around the market thresholds. A 1 p.p. increase in inflows into stock i as a result of passive inflows into an ETN that tracks that stock's index results in a 13.6% increase in the stock's equity price relative to the price increase for control firms.

We can now compare the instrumental variable specification to our baseline DiRD model and consider what the IV specification tells us about what is driving the effect of the reform on prices. First, note that the 13.6% elasticity estimate from the IV model is close to the implied elasticity of 11.71 from the DiRD specification. Second, by isolating the effect of ETN sponsor purchases on price, we conclude that the main driver of the price effect of the reform are the reallocation of capital to the passive indices, i.e., the indirect effects of the reform.

A causal interpretation of the IV result rests on the identification assumptions that (1) the instrument is relevant and (2) that ex ante stock rankings relative to the index thresholds are related to cumulative returns only through their effect on the differential inflows from ETN sponsors. Assumption (1), the relevance assumption, is supported by the evidence from Model (1). If a stock is ranked to the right of the market index cutoffs it experiences statistically and economically higher passive inflows. The first-stage F-statistic is higher than the Stock and Yogo critical value of 11.52 to bound bias to be no more than 10% (Stock, Yogo et al. (2005)). Thus, we fail to reject the hypothesis that the instrument is not weak.

It is easy to think up stories that would invalidate assumption (2), the exclusion restriction.

We have already noted that there are likely direct effects of the reform on prices apart from the effect via passive flows. Moreover, the anticipation of differential ETN sponsor purchases of the underlying could independently influence the cumulative returns of stocks ranked to the right of the index thresholds relative to those to the left. This is less of a concern in the main DiRD specification since (a) estimates off of the inability of the stock issuers to perfectly influence their market index assignment and we observe the distribution of ranking is smooth around the cutoff, (b) there is no evidence of a violation of the parallel trends assumption within the estimation bandwidths (7) and (c) we observe no anticipatory discontinuity in prices around the index thresholds before the reform. That the 2SLS estimates are so close to those implied by the DiRD specification suggests that any bias in the 2SLS estimation is of second-order importance and that the price effect is primarily due to the effect of passive inflows on the underlying stocks.

4.4. Price elasticity of flows

The failure of markets to arbitrage away price changes driven by capital allocation to index investments suggests that the demand curves' for stocks have a negative slope. However, quantifying the causal price effects of the growth of index investments has proven difficult. Shleifer (1986); Wurgler and Zhuravskaya (2002) and Chang, Hong and Liskovich (2014) consider the question in the context of forced buys from index inclusion/exclusion. The idea is that passive investors who are forced to adjust their portfolios to index changes induce buying pressure on the stocks to be added and selling pressure on the stocks to be deleted. The failure of markets to arbitrage away price changes associated with these forced trades uncovers the demand curves' negative slope for stocks.

In principle, capital allocation to index investments works similarly: To the extent that investors have downward-sloping demand curves for stocks, widespread investments in indices increase the demand for the underlying stocks and can have the effect of pushing up their price. However, quantifying the price effects of the growth of index investments has proven difficult as that growth has manifested as a persistent, slow-moving change in capital allocation towards investments passively tracking baskets of securities.

Our price estimates suggest the existence of inelastic demand curves for stocks compared to what has been documented by the index inclusion literature estimated in the context of the US market indices. Price elasticity is given by the negative inverse of the price effects, and it measures the slope of the demand curves for stocks among non-passive investors. Our estimates suggest that the price elasticity of non-passive investors is –0.07. This estimate is quite close to the implied elasticity of –0.09 that we derive from the DiRD specification. As a point of comparison, Chang, Hong and Liskovich (2014), who quantify the price effects of index additions and deletions in the Russell Indexes setting, document that 7.3% increase in passive demand, from membership in the Russell 2000, causes 5% price increase. Their results imply that the elasticity of the demand curves for stocks is -1.46.

Our elasticity is closer to the estimates of Gabaix and Koijen (2020*b*) using U.S. mutual fund data. They estimate an elasticity of 0.2 using an instrumental variable method developed in Gabaix and Koijen (2020*a*) based on the observation that institutional investors, notably mutual funds, are not free to fully respond to equity price movements because they are constrained by investment mandates. The implication is that flows can then have large effects on asset prices, which is consistent with our results. It makes sense that demand is even more inelastic on the TASE because, in addition to being tied by mandates, would-be traders are constrained in their ability to respond to market prices by relatively small free float for the average stock. Listed companies in Israel, in common with many other markets worldwide (Japan, Germany, South Korea, India, etc.), firms have large cross-holdings, restricting the size of the float available to investors.

4.5. Alternative Stories

We have concluded from the evidence presented thus far that the price effects of the reform were large and persistent. We found that effects were stronger for securities in smaller-capitalization indices, specifically those in a bandwidth around the market index boundaries, than otherwise similar firms included in larger-capitalization indices. We attribute these effects to the effect of the reform on passive inflows. Specifically, the introduction of the AP reduced the cost of investing in the ETN and there was a large increase in demand for these investments. This translated into strong buying pressure on the underlying stocks, pushing up their prices. The implication is that the growth in passive ownership in response to the reform decreased price efficiency by increasing prices dramatically for reasons with no obvious connection to firm fundamentals, as in the framework of Gabaix and Koijen (2020*b*). But our treatment is not merely a large demand shock. The introduction of the AP increased arbitrage trading between the price of the ETNs and the NAV of the indices that they tracked, which had a direct effect on the cost of investing in ETN, and thus on demand, but may also have had indirect effects, such as on the liquidity of the underlying stocks.

De Simone, Dovman and Gildin (2021) also use the 2012 reform to estimate the effect of the creation mechanism on liquidity. They find a large and permanent narrowing of the bid-ask spreads and in increase in turnover for the entire index universe following the reform, and that the effect is larger for the small-capitalization index than for the large- or medium-capitalization indices. Illiquid assets, and assets with high transaction costs, trade at low prices relative to their expected cash flows. An improvement in liquidity makes investment less risky by allowing investors to acquire and sell assets rapidly without affecting stock prices, thereby decreasing risk premia and the cost of capital to firms (Amihud, Mendelson and Pedersen (2006) find evidence for this hypothesis in the U.S. context and Bekaert, Harvey and Lundblad (2007) using EME data). Could the improvement in liquidity following the reform be the true explanation of the price effects we have documented in this paper?

Table 6 reports the effect of the reform on the liquidity, as measured by the bid-ask spreads, of the basket securities.[21] Model (1) confirms the evidence of De Simone, Dovman and Gildin (2021) that there is a strong differential effect around the cutoff with maximally-defined bandwidths—a more than 100% larger narrowing for treated firms to the right of the market index cutoffs relative to the control to the left. However, in Model (2) we can see that the difference is not significant within the baseline bandwidths. In Models (3) and (4) we see there was is not a discontinuity around the bandwidths either before or after the reform. Thus, while liquidity and price are inherently related in equilibrium, and so we cannot entirely separate these effects, we conclude that our difference-in-discontinuities strategy is controlling for this effect when we condition on the market capitalization rankings. This suggests that the differential price and liquidity effects are in large part separate phenomenon, with the price effects being driven by demand pressure.

[Place Table 6 here]

Next, when we see substantial differential price effects for firms just to the right of the index cutoffs relative to those just to the left, it is natural to ask if there were any ex ante discontinuities in any firm-level covariates relevant to stock price before the reform around the index cutoffs. In other words, the differential price effects may be driven by other ex-ante differences in the fundamentals of the issuing firms that were then reflected in their prices, for example through differential demand to hold that index. This is also a test of our identification assumptions. To test this, we merge in issuer-level data from Compustat Global. Table 7 tests for discontinuities in firm-level variables whose securities are ranked

[21] bid-ask spreads are calculated as the ratio between the bid less the ask and the ask.

just to the right of the market index boundaries relative to those firms with securities ranked just to the left. We see that there are no significant differences before the reform. It is thus unlikely that our results are driven by ex-ante discontinuities in firm-level fundamentals.

[Place Table 7 here]

It is also informative to test for any differential response of issuing firms around the cutoff after the reform. The differential price effect is large and sustained so we may expect firms to respond. On the other hand, it may not have been clear at the time that the price effect would be sustained. Table 7 reports the estimates around the market index boundaries for the post period, as well as the difference-in-discontinuities esimates. In the post-reform period, we see that firms just to the right of the market indices issue 0.015% more stock, measured by cumulative issuance in each 5 months after a re-constitution event (Model 1). However, we do not see that cash as a percent of total assets increases (Model 2) nor that debt as a percentage of total assets decreases (Model 4) significantly in the post period. Firms with equities to the right of the index cutoffs are not, on average, increasing their dividends (Model 3, as a percent of total assets) nor investing in physical assets (Model 5, as a percent of total assets) differentially relative to firms with equities just to the left of the market index cutoffs. However, we do see that their profitability is higher than firms with equities just to the right of the index cutoffs after the reform, both as measured by the ratio of earnings before interest and taxes (EBIT) to operating revenue (Model 6) and by return on assets (ROA), computed as the ratio of net income and total assets (Model 7). And we also see that firms that experienced a relatively higher price effect because their equities were ranked just to the right of the ranking cutoff were more likely to announce the intention of acquiring at least 50% of an unrelated firm's shares. These results are consistent with a story where the price effects are not caused by differential changes in issuing firm fundamentals prior to the reform. They also suggest that firms are not responding to the price effects as if they were signaling changing investor expectations about the future cash flows of firms, for example, it does not appear to affect firm investment. These results differ from evidence presented in other papers that passive demand can impact issuing firm investment and that new projects are, on average, of poorer quality (Zou (2019)).

5. Conclusion

We utilize a 2012 reform in Israel where all ETN listed on the TASE adopted the ETF creation mechanism to show that growth in passive investing exerts long-lasting price pressure on the index securities that the ETN tracked, even when there are no accompanying changes in governance, regulatory or analyst scrutiny. This is especially true for indices of illiquid securities. Our findings provide new evidence on how passive inflows can change the distribution of capital across indices, and in turn impact price efficiency.

Thus, we document the extent to which flows can induce price inefficiency as a function of ex-ante index liquidity. This is a significant contribution for two reasons. First, existing evidence is based off index inclusion events. These are precipitated by a stock-specific reason for inclusion or exclusion, making finding a good counterfactual benchmark challenging (see e.g., Pavlova and Sikorskaya (2020), which suggests that significant flows are active). Moreover, in the US but not the Israeli context, where ETN do not vote their shares, index inclusion or exclusion are accompanied by many changes in addition to passive flows, such as monitoring intensity and governance incentives. In contrast we observe a market-wide shift in passive demand where governance and information effects are second-order and where we can define a clean counterfactual. Second, existing evidence focuses on the U.S. context, while stock markets around the world are interested in the effect of increasingly popular ETF markets on the health and functioning of their markets. Many of these exchanges look much more like the TASE in Israel than the S&P 500 or Russell universe in the US. Indeed, much more evidence is needed from a wider variety of settings, and we help fill this knowledge gap.

Finally, we also show that when considering the effect of a growth in passive investing, the mechanism by which passive funds are invested matters. In Israel, the market index equities were being passively tracked before and after the reform. What drove the effect we document was the intensification of the link between the primary and secondary markets for ETN caused by the introduction of the the creation mechanism. This implies that setting up the regulatory structure to support passive investing via exchange-traded instruments, including the creation mechanism, could help policymakers seeking to develop and deepen their capital markets around the world.

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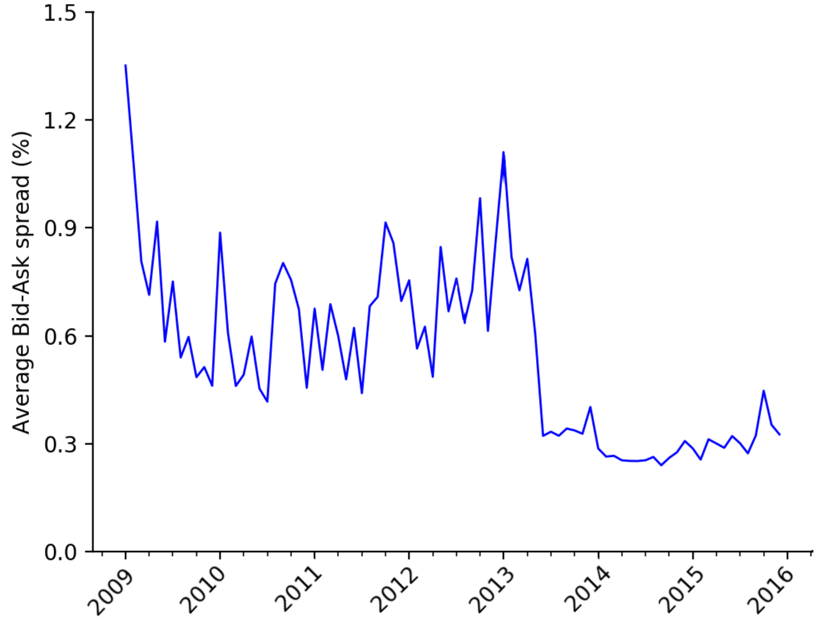


6. Figures

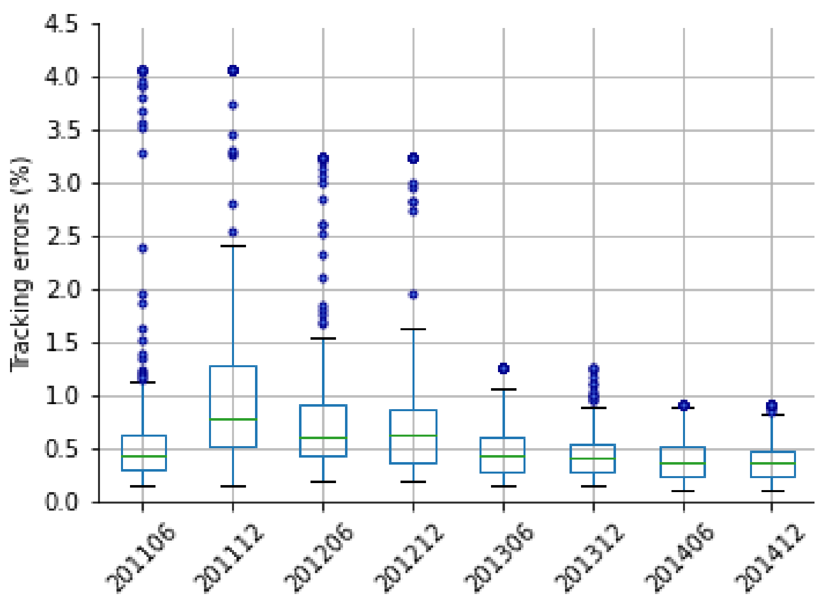


Figure 1: Effect of Reform on Average Bid-Ask Spreads and the Tracking Error of ETNs. The top figure plots the average bid-ask spreads of ETNs on local equity indices from January 2009 through December 2015. Bid-ask spreads are measured in percent (calculated as (bid - ask)/ask). The first vertical line represents July 2012, when the reform was finalized. The second vertical line represents January 2013, when the reform was announced and implemented. The bottom figure reports the semiannual distribution of monthly tracking errors on investment in ETNs from January 2011 through December 2014. Monthly tracking errors are calculated based on the differences between the daily returns of the ETN relative to those of its respective benchmark. The figure displays box plots for each semiannual distribution of tracking errors. The dots represent the outliers of the distribution. Tracking errors are measured in percent.

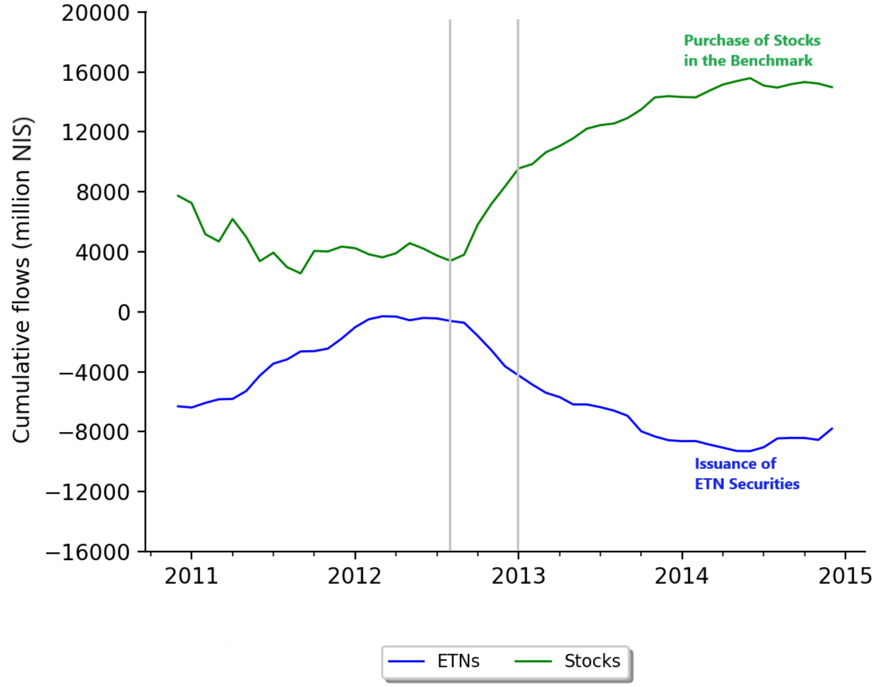


Figure 2: The effect of the reform on ETN demand for the securities in the market indices. The figure plots cumulative net flows, in billions of ILS, from 2011 to 2015. The blue dashed line represents the value of ETN shares that were created, i.e., the flow into ETN securities. The green solid line represents the value of ETN issuer holdings of the equities listed on the market indices of the TASE. The leftmost vertical line represents July 2012, when the reform was finalized. The rightmost vertical line represents January 2013, when the reform was announced.

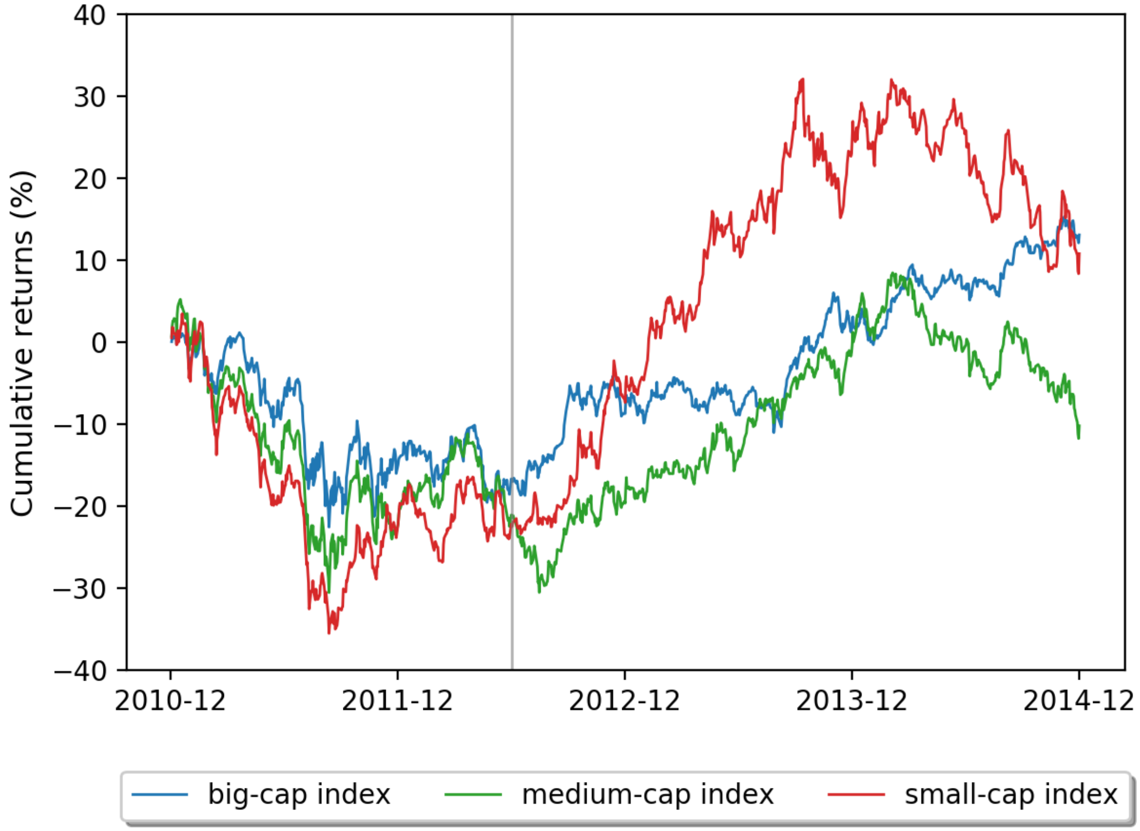


Figure 3: Average Cumulative Returns of Stocks by Market Index. The figures plot the average cumulative returns of the small-capitalization market index (TA-GROW; red line), medium-capitalization (TA-74; green line) and large-capitalization (TA-25, blue line) market indices from December 2010 through December 2014.

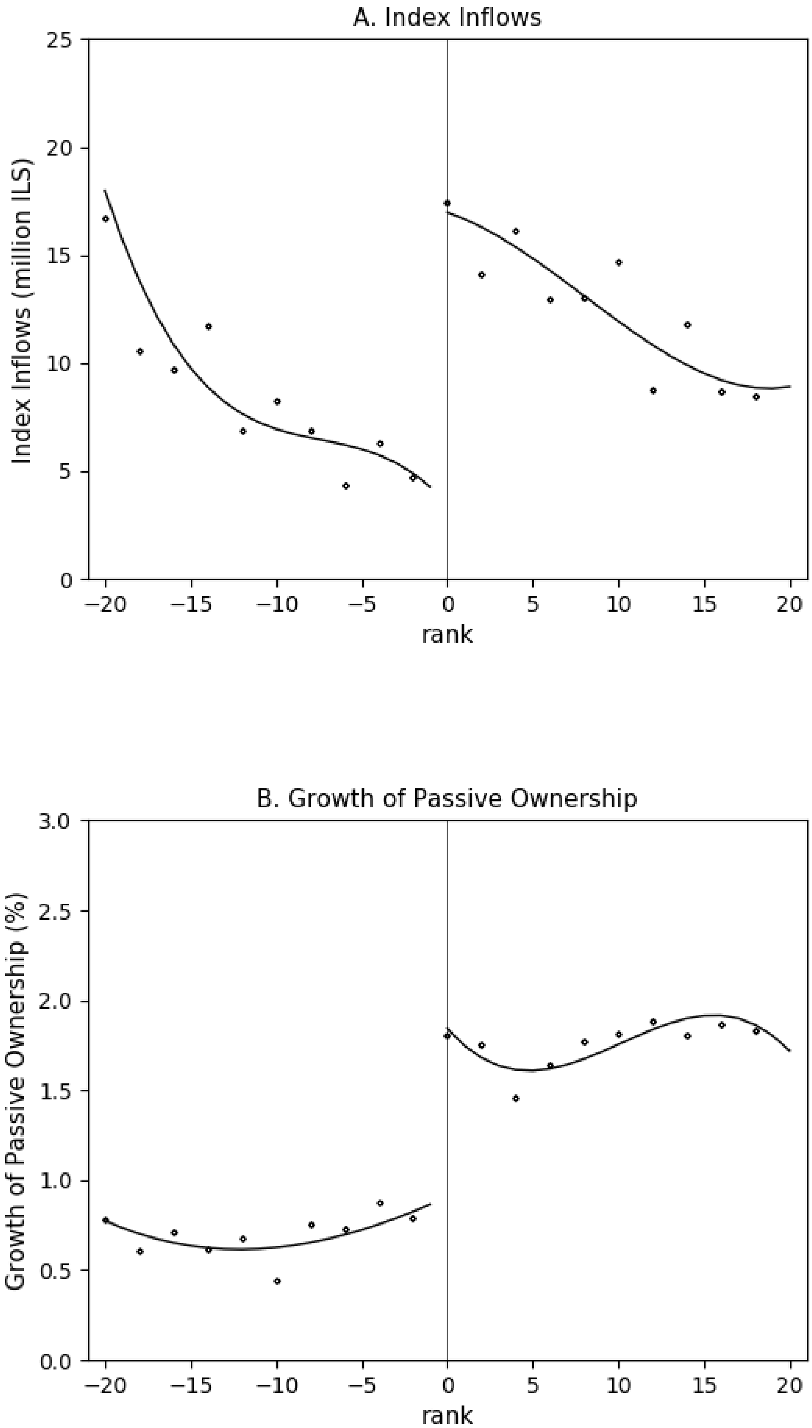


Figure 4: Discontinuous Index Inflows and Ownership around the Index Cutoffs. The figure plots the growth of passive demand and the growth of passive ownership against the average market capitalization ranks on the ranking day. Panel A plots the growth of passive demand. Growth of passive demand is measured in millions of Israeli Shekel. It is calculated as the total value of net inflows from ETN investments multiplied by the firms' index weight on the ranking day. Panel B plots the growth of passive ownership, which is measured in percent. It is calculated as the growth of inflows into ETN divided by the firms' market value on the ranking day. Both are measured between month one through month five following the ranking day. Index cutoffs are pooled and normalized to be zero. The lines fit polynomial functions of market capitalization ranks on either side of the cutoff. Every point represents averages over bin width equal to 2. The sample period is from December 2012 through June 2015.

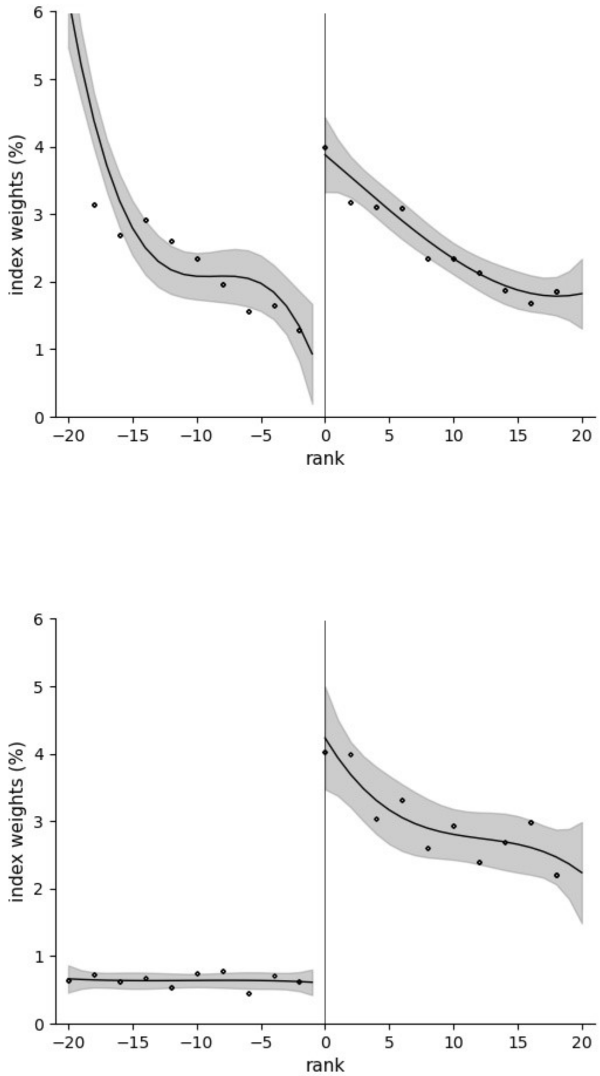
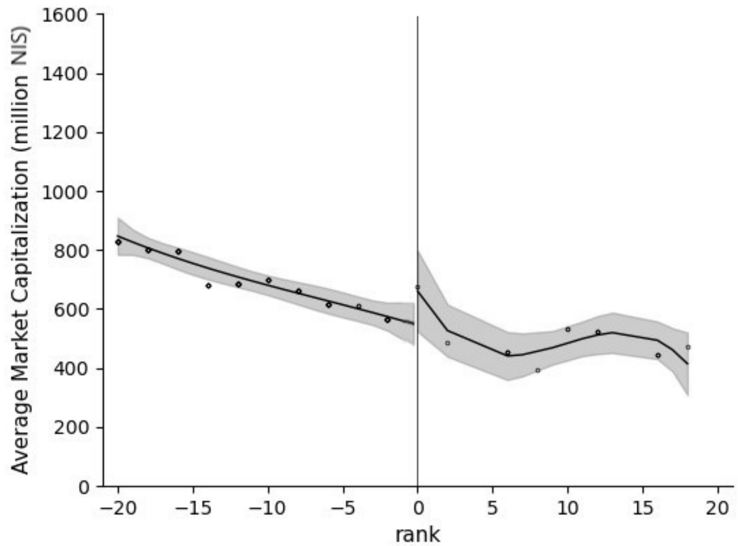
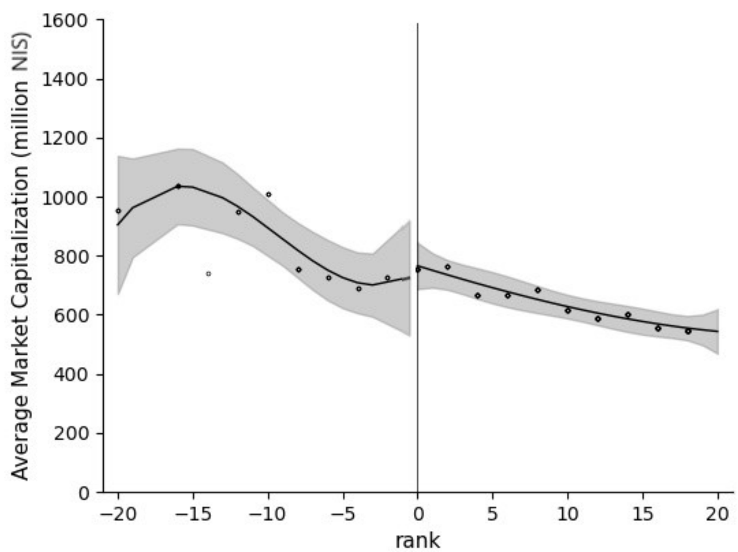


Figure 5: Discontinuous Index Weights around Index Cutoffs. The figure plots index weights against the average market capitalization ranks on the ranking day, along with 95-percent confidence intervals (the shaded area). Index weights are measured in percent of index on the ranking day. Panel A plots the weighs around the upper cutoff. Panel B plots the weighs around the lower cutoff. The firms that end up at the bottom of large- and medium-cap indices are on the left-hand side of the cutoff. Those that end up at the top of medium- and small-cap indices are on the right-hand side of the cutoff. The lines drawn fit polynomial functions of rank on either side of the cutoff. Every point represents averages over bin width equal to 2. The sample period is from 2011 through 2014.

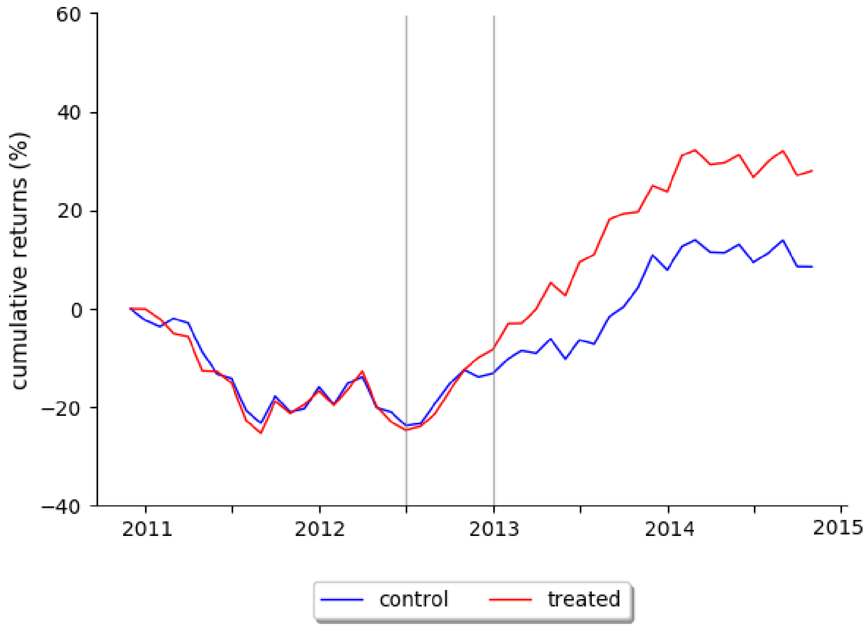


A. Cutoff between Large (left) & Medium (right)



B. Cutoff between Medium (left) & Small (right)

Figure 6: Continuity in Average Market Capitalization Around Index Cutoffs, 2011 through 2014 The figure plots the average market capitalization against the average market capitalization ranks, along with 95-percent confidence intervals (the shaded area). Every point represents averages over all constitution periods. See Appendix Figure A2 for evidence for each reconstitution separately. Panel A plots the density function of the average market capitalization running variable around the cutoff between the large- and medium- and Panel B around the cutoff between the medium- and small-capitalization cutoff. We fit polynomial functions of the running variable on either side of the cutoff. The t-statistic for a test of the null hypothesis of continuity in the density across the cutoff between the large- and medium-capitalization indices is 0.2402 with a p-value of 0.8101. That for the test around the cutoff between the medium- and small-capitalization indices is -1.1499 with a p-value of 0.2502.



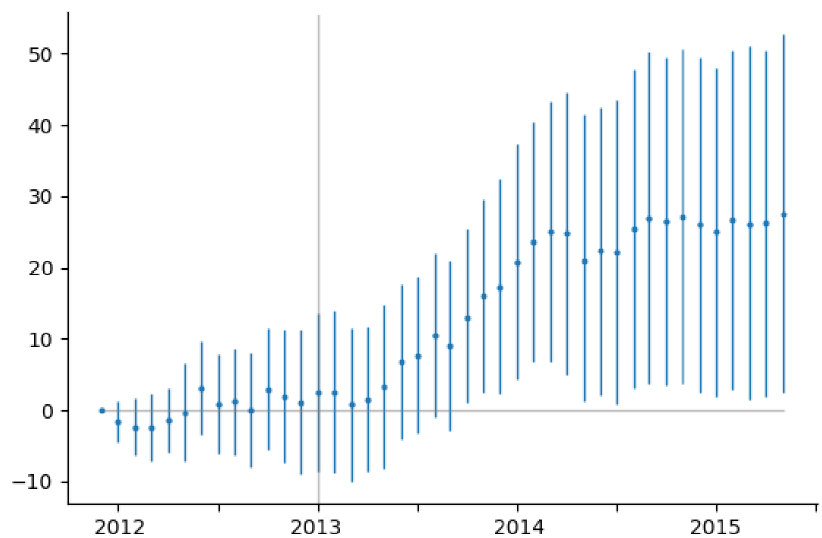
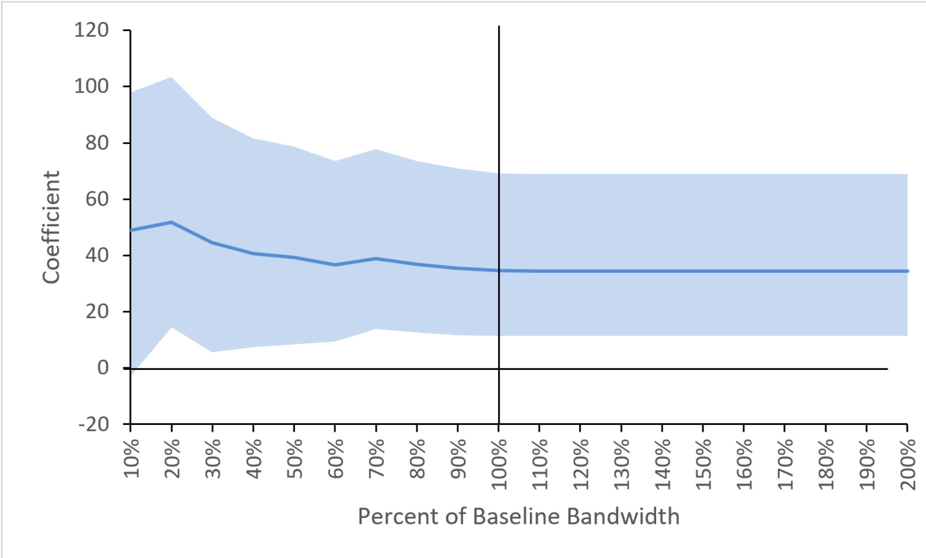


Figure 7: Treated Stock Prices Around the Reform Relative to Control. The top figure plots cumulative returns on investment in treated and control groups. The bottom figure plots coefficients from the difference-in-discontinuities regression (Equation 4) interacted with monthly dummies. The treated groups are those equities within a bandwidth of 13 and 52 market capitalization rankings to the right of the large-medium and medium-small market index cutoffs, respectively. The control groups consists of equities within a bandwidth of 13 and 52 to the left of the market index cutoffs. Cumulative returns are measured in percent from January 2011. The vertical line represents January 2013, when the reform was announced and implemented. The sample period is January 2011 through December 2015.



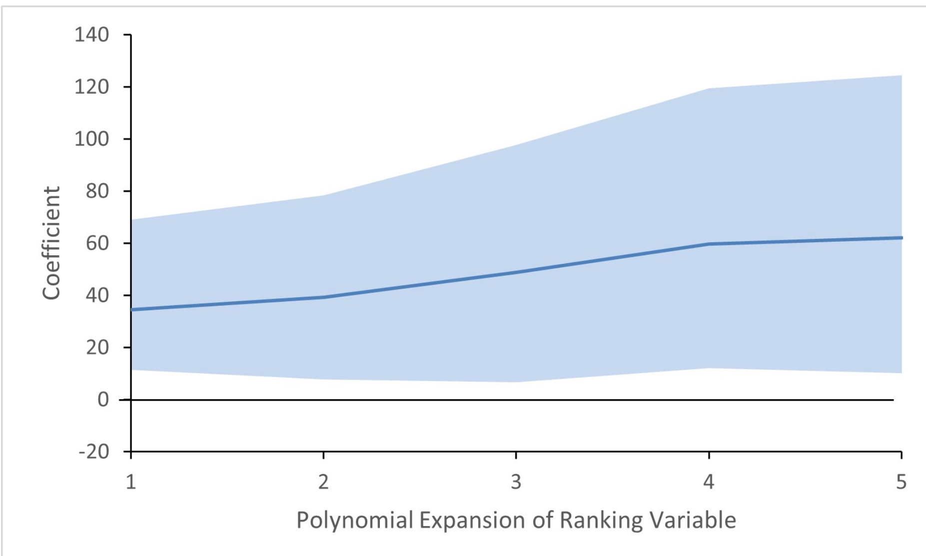


Figure 8: Price Effect of Reform Robust To Varying Bandwidth and Specification. Figures plot the coefficients from the difference-in-discontinuities regression (Equation 4) on the y-axis. The top figure varies the estimation bandwidth around the index cutoffs as a percent of the baseline bandwidth (the x-axis), which is 13 and 52 market capitalization ranks for the index boundaries between the large-medium and the medium-large indices, respectively. The vertical line represents the coefficient at the baseline bandwidth. The bottom figure estimates within the baseline bandwidth but varies the polynomial expansion of the running variable, i.e., the ranking of the securities within the market indices. Cumulative returns are measured in percent from January 2011. The sample period is January 2011 through December 2015. Standard errors are clustered at the security level.

7. Tables

Panel A: Equity-Month Summary Statistics						
Variables	Observations	Mean	Std. Dev.	Median	Min.	Max.
Market Value (Millions ILS)	24,103	1,167.2	8,213.6	188.7	2.6	223,178.2
Free Float Percentage	24,103	0.452	0.192	0.392	0.102	1.000
Passive (ETN) Ownership (%)	24,054	0.072	0.043	0.069	0.013	0.196
Bid-Ask Spread (%)	24,074	1.735	2.240	0.968	0.082	14.082

Panel B: Issuer Firm-Quarter Summary Statistics						
Variables	Observations	Mean	Std. Dev.	Median	Min.	Max.
Total Assets (Millions ILS)	7,436	22,830.5	44,017.1	631.7	8.4	127,300
Market to Book Ratio	7,422	1.20	3.96	0.08	-0.83	29.16
EBIT (Millions ILS)	7,436	336.25	606.24	50.66	-265.65	1,995
Return on Assets	7,422	0.016	0.101	0.010	-0.121	1.945
Sales Growth	5,601	0.022	0.476	0.002	-3.059	3.030
Cash/Total Assets	7,422	0.240	0.168	0.202	0.000	0.858
Total Debt/Total Assets	7,422	0.199	0.232	0.135	0.000	1.677
CAPEX/Total Assets	7,422	0.129	0.169	0.051	0.000	0.760
Dividends/Total Assets	7,422	0.006	0.043	0.000	0.000	0.517
1(Pay a Dividend)	7,436	0.069	0.253	0.000	0.000	1.000
1(M&A)	7,436	0.031	0.175	0.000	0.000	1.000
1(M&A, Full Control)	7,436	0.026	0.161	0.000	0.000	1.000

Table 1: Summary statistics This table presents summary statistics for December 2010 to June 2015, aggregated to the security-month (Panel A) or firm-quarter (Panel B) level. All variables denominated in currency are in millions of Israeli new Shekel (ILS) and are winsorized at the 1% and 99% levels. Equity Market Value is the stock price multiplied by the number of floating shares, or the number of shares outstanding that trade freely. The Free Float is the percentage of shares outstanding that trade freely. Passive ownership is ETN benchmark capital in the stock divided by its total equity market value. The Bid-Ask Spread is the difference between the mean ask and the mean bid as a percent of the mean ask. The Market to Book Ratio is calculated as the ratio of equity market value to the book value of equity. EBIT is earnings before interest and taxes. Return on Assets (ROA) is the ratio of EBIT to total assets. Sales Growth is the log change in quarterly sales. Cash is cash plus tradable securities. CAPEX is net capital expenditures, defined as funds used to acquire fixed assets other than those associated with acquisitions. 1(Pay a Dividend) is one if the firm paid a cash dividend in the quarter and zero otherwise. 1(M&A) is one if the firm announces the intention to purchase any amount of the stock of an unrelated firm, and zero otherwise. 1(M&A, Full Control) is one if the firm announces the intention to acquire at least 50% of the target's stock in an unrelated firm, and zero otherwise.

Panel A. Benchmarked Capital (Billion ILS)

	large-Cap Index	Medium-Cap Index	Small-Cap Index
2011-06	12.1	3.9	0.8
2011-12	11.0	3.3	0.6
2012-06	10.5	3.4	0.3
2012-12	12.8	4.0	0.4
2013-06	13.0	5.3	0.7
2013-12	16.2	7.2	0.9
2014-06	16.9	8.1	1.0
2014-12	16.9	7.5	0.8

Panel B. Passive Ownership (%)

	large-Cap Index	Medium-Cap Index	Small-Cap Index
2011-06	3.9	7.1	6.7
2011-12	3.9	7.6	6.8
2012-06	3.7	7.9	3.8
2012-12	4.6	8.6	4.7
2013-06	4.9	10.2	7.5
2013-12	5.1	11.4	8.6
2014-06	4.7	12.8	8.1
2014-12	4.0	13.2	7.4

Table 2: Passive Ownership across Market Indices. This table presents the total benchmarked capital (BC, Panel A), and the passive ownership (RPO, Panel B) across the three size-based market indices in Israel. BC, measured in billions of Israeli Shekel (ILS), is the total investment outstanding in member stocks of each the market indices through ETNs. Passive ownership is the benchmarked capital divided by market value. Market value of each stock is calculated as the stock' price multiplied by the number of floating shares. The names large-, Medium-, and Small-cap index refer to TA-25, TA-75, and TA-SME50, respectively. All the numbers measured at the end of each June and December from 2011 through 2014.

Outcome: Passive Inflows into Index Securities; Standard errors in parentheses.

	Large		Small		All	
	Pre-Reform	Post-Reform	Pre-Reform	Post-Reform	Pre-Reform	Post-Reform
Passive Ownership Growth	0.8972	0.8838	0.8818	1.0082	0.8885	0.9470
	(0.0058)	(0.0045)	(0.0036)	(0.0038)	(0.0031)	(0.0030)
Intercept	0.0013	0.0017	0.0003	0.0002	0.0007	0.0008
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0000)
R^2	0.3312	0.3843	0.4821	0.5014	0.4202	0.4429
Observations	48,924	61,176	64,857	68,333	113,781	129,509

Table 3: Correlation Between inflows into ETN and ETN trading in the Underlying Market Indices. This table reports the correlation at the security-day level between inflows into ETN and ETN trading in the underlying market indices that they track. "Large" denotes stocks in both the large and medium market indices while "Small" includes only stocks listed in the small-capitalization market index.

	Growth Passive Ownership	Cumulative Return		
		DiRD	RD Pre	RD Post
	(1)	(2)	(3)	(4)
D × Post	2.950***	34.558***		
	(4.80)	(2.93)		
D	-1.065***	1.564	1.564	36.122***
	(-4.86)	(0.40)	(0.40)	(2.96)
Post	1.995***	1.977		
	(5.42)	(0.24)		
Intercept	0.254*	-10.532***	-10.532***	-8.555
	(1.91)	(-2.64)	(-2.64)	(-0.95)
N	4,332	4,334	1,383	2,951
R^2	0.34	0.13	0	0.07
F-stat	634	75.2	0.7	15
Cutoff, Period FE	Yes	Yes	Yes	Yes
Triangular Kernel Weights	Yes	Yes	Yes	Yes
MSE-Optimal, Bias-Corrected BW	Yes	Yes	Yes	Yes

Table 4: Differential Price Effect of Reform Estimated Via DiRD Specification

This table reports estimates of regression model 4 for outcomes (1) growth in passive ownership in equity i as a percent of its market capitalization, and (2) cumulative stock return for sample period December 2010 through June 2015. Data are at the security-month level. D is one if an equity is treated and zero otherwise. Treated are equities within a bandwidth of 13 and 52 market capitalization rankings to the right of the large-medium and medium-small market index cutoffs, respectively. The control groups are defined symmetrically to the left of the index cutoffs. T-statistics are reported in parentheses. Post is one after December 2012 and zero otherwise. Index cutoffs are pooled and the average market capitalization rankings are normalized by subtracting off the relevant index cutoff ranking. All specifications include cutoff and month fixed effects, triangular kernel weights, and standard errors are clustered at the equity level. *, **, and *** represent significance at the p¡0.1, p¡0.05, and p¡0.01 level, respectively.

Independent var.	Cumulative Returns (Reduced-Form) (1)	Δ Passive (First Stage) (2)	Cumulative Returns (IV) (3)
$\Delta\widehat{Passive}$			13.569***
			(2.63)
D	24.074***	1.774**	
	(2.59)	(2.46)	
Intercept	32.121***	3.493***	-15.273
	(4.68)	(6.11)	(-0.59)
N	59,532	59,532	59,532
R^2	0.03	0.04	0.40
F-stat		19.9	
Cutoff, Period FE	Yes	Yes	Yes
Triangular Kernel Weights	Yes	Yes	Yes
MSE-Optimal, Bias-Corrected BW	Yes	Yes	Yes

Table 5: Differential Price Effect of Reform Estimated Via 2SLS Specification

Model (1) is the relationship between D, an indicator that is one if a stock is to the right of the market index cutoffs and zero otherwise, and cumulative stock returns (the reduced-form relationship). Returns are cumulated from December 2010. Model (2) estimates the first-stage, represented by Equation **??**, relating a stock's position relative to the index cutoffs, D, to the relative change in passive ownership at the security-day level, $\Delta Passive$. Model (3) presents the instrumental variables model, where $\Delta Passive$ is instrumented by the discontinuity and the index cutoffs represented by D. Data are at the security-day level. Treated are equities within a bandwidth of 13 and 52 market capitalization rankings to the right of the large-medium and medium-small market index cutoffs, respectively. The control groups are defined symmetrically to the left of the index cutoffs. T-statistics are reported in parentheses. Index cutoffs are pooled and the average market capitalization rankings are normalized by subtracting off the relevant index cutoff ranking. All specifications include cutoff and month fixed effects, triangular kernel weights, and standard errors are clustered at the equity level. *, **, and *** represent significance at the p¡0.1, p¡0.05, and p¡0.01 level, respectively.

	DiRD	DiRD	RD Pre	RD Post
	(1)	(2)	(3)	(4)
D × Post	-1.077***	0.001		
	(-8.52)	(0.01)		
D	2.313***	0.005	0.005	0.006
	(14.08)	(0.03)	(0.03)	(0.05)
Post	-0.168***	-0.058		
	(-6.31)	(-0.88)		
Intercept	0.555***	0.269***	0.269***	0.210***
	(14.17)	(3.64)	(3.64)	(3.37)
N	19,136	4,332	1,383	2,949
R^2	0.15	0.25	0.25	0.24
Cutoff, Period FE	Yes	Yes	Yes	Yes
Triangular Kernel Weights	Yes	Yes	Yes	Yes
MSE-Optimal, Bias-Corrected BW	No	Yes	Yes	Yes

Table 6: Differential Liquidity Effect of Reform Estimated Via DiRD Specification

Estimates for regression model 4 on outcome equity bid-ask spreads for sample period December 2011 through June 2015. Bid-ask spreads are defined as the ratio of the bid less the ask to the ask. Data are at the security-month level. D is one if an equity is treated and zero otherwise. For Models (2) through (4), Treated are equities within a bandwidth of 13 and 52 market capitalization rankings to the right of the large-medium and medium-small market index cutoffs, respectively. The control groups are defined symmetrically to the left of the index cutoffs. T-statistics are reported in parentheses. Post is one after December 2012 and zero otherwise. Index cutoffs are pooled and the average market capitalization rankings are normalized by subtracting off the relevant index cutoff ranking. All specifications include cutoff and month fixed effects and standard errors are clustered at the equity level. *, **, and *** represent significance at the p¡0.1, p¡0.05, and p¡0.01 level, respectively.

	Cumulative Issuance (5M)	Cash	Cash Dividends	Debt	CapEx	Profitability	ROA	1(M&A)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Pre	0.003	0.082	-0.001	-0.036	-0.058	-0.044	-0.007	0.087
	(1.00)	(1.15)	(-0.19)	(-0.58)	(-0.89)	(-0.97)	(-0.85)	(1.06)
Post	0.015**	0.032	-0.0	0.072	-0.056	0.118**	0.015*	0.027**
	(2.08)	(0.88)	(-0.05)	(0.63)	(-0.87)	(2.55)	(1.89)	(2.05)
DiRD	0.012	-0.051	0.001	0.108	0.002	0.161**	0.022	-0.06
	(1.52)	(-0.93)	(0.17)	(1.12)	(0.03)	(2.43)	(1.5)	(-1.27)
N	932	932	932	932	932	932	932	932
R^2	0.08	0.04	0.02	0.04	0.03	0.03	0.04	0.02
Cutoff, Period FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Triangular Kernel Weights	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bandwidth	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 7: Difference-in-Discontinuities Specification for Firm-Level Variables.

This table reports estimates of regression model 4 for sample period December 2010 through June 2015 using issuer-quarter data. Outcomes are defined as (1) cumulative issuance of equities as a percent of the free float; (2) total cash and cash equivalents scaled by total assets; (3) total cash dividends paid that quarter, scaled by total assets; (4) total debt scaled by total assets; (5) capital expenditures scaled by total assets; (6) profitability, defined as earnings before interest and taxes (EBIT) scaled by total operating revenue; (7) return on assets (ROA), defined as net income scaled by total assets; and (8) an indicator that is one if the firm announced the intention to acquire at least 50% of an unrelated firm's shares in that quarter, and zero otherwise. Pre represents the sharp regression discontinuity coefficient estimated in the period before the reform, i.e., from 2010Q4 to 2012Q3, and Post estimates to the same model but for the post-reform period from 2012Q4 to 2015Q2. Treated are equities within a bandwidth of 13 and 52 market capitalization rankings to the right of the large-medium and medium-small market index cutoffs, respectively. The control groups are defined symmetrically to the left of the index cutoffs. T-statistics are reported in parentheses. Index cutoffs are pooled and the average market capitalization rankings are normalized by subtracting off the relevant index cutoff ranking. All specifications include cutoff and month fixed effects, triangular kernel weights, and standard errors are clustered at the equity level. *, **, and *** represent significance at the p¡0.1, p¡0.05, and p¡0.01 level, respectively.

A1. Reconstitution Events on the TASE from December 2010 to June 2015

The rule for index membership uses the average market capitalization of the stocks over the ranking period, the two calendar weeks before the ranking day. At the end of the ranking period, the TASE assigns eligible stocks to market indices based on (i) the stock's average market capitalization rank, and (ii) the stock's previous membership status. Specifically, the TASE determines the index membership of the big-cap index first, following which the TASE determines the membership of the medium-cap and small-cap sequentially. The eligible stocks for each ranking are all the available stocks in the index universe that were not assigned to one of the preceding market indices.[22]

The TASE starts with the big-cap index, which includes 25 shares. Eligible stocks are ranked based on their average market capitalization. Stocks ranked $1-20$ are included in the big-cap index, and stocks with a rank above 30 excluded from the big-cap index unconditional to their previous membership status. For stocks ranked $20-30$, the TASE employs a banding policy to mitigate index turnover. In this ranking range, the TASE grants priority to stocks that had been members of the big-cap index in the previous membership period.

Next, the TASE determines the constitution of the medium-cap index in a similar way. The medium-cap index includes 75 stocks. Stocks in the Index Universe that were not included in the big-cap index and ranked based on their average market capitalization. Stocks ranked $1-60$ are included in the medium-cap index, and stocks with a rank above 90 excluded from the medium-cap index unconditional to their previous membership status. For stocks ranked $60-90$, the TASE gives priority to stocks that were members of the medium-cap index in the previous membership period. The member stocks of the big- and medium-cap indices also enter the TA-100 index, which comprises all the stocks of the two indices.

The next 50 largest stocks, which did not enter the medium-cap index, enter the small-cap index. Similar to the preceding rankings, the TASE employs a banding policy according to which it gives priority to stocks that were members of the small-cap index in the previous membership period. The banding range for assignment to small-cap index is ranks $35-65$. The rest of the stocks in the Index Universe enter TA-GROW, which comprises all the stocks that did not enter TA-100.

[22] As exception, the universe of eligible stocks for the big-cap index (TA-25) includes only the stocks that have floating rate 20% or above.

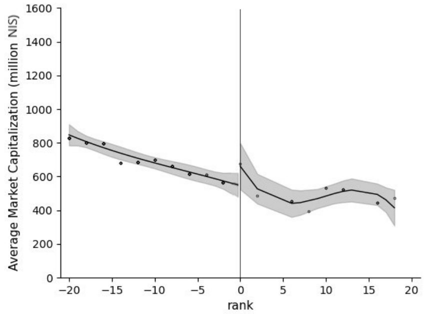
By following the TASE methodology, we were able to achieve sharp discontinuity in index assignment and recreate the exact ranks for determining membership in market indices.[23] We used daily prices and number of outstanding shares as the main inputs for calculating the average market capitalization of each stock over the ranking period. Next, we used daily adjustment factor to correct prices for distributions. We also hand-collected detailed information about firms' distributions from Maya Corp. and followed the TASE methodology for adjusting outstanding shares to distributions around the ranking period. After calculating the average market capitalization of each stock over the ranking period, we followed the TASE methodology to assign stocks in the market indices as described above. At the end of the procedure we achieved an exact match with the membership in market indices.

Re-Constitution	Switching Securities
201012	8
201106	6
201112	3
201206	2
201212	4
201306	2
201312	3
201406	5
201412	4
201506	6
Total	43

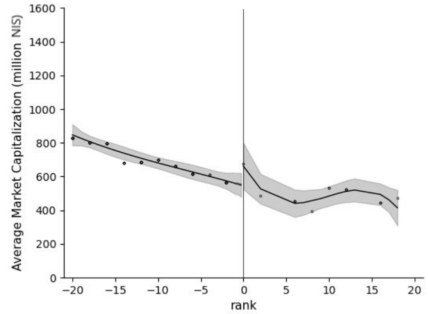
Table A1: Frequency of Switchers by Reconstitution Date. This table presents the total number of equities that are moved into a different index each re-constitution event from December 2010 to June 2015. The TASE determines membership in the market indices twice a year based on average firm market capitalization rankings.

[23] We thank Amit Rahmani, Head of Indices Unit at TASE, for his help. The TASE provides a transparent and publicly available description of its methodology for determining index membership. A complete description of the TASE method is available in Hebrew on the Maya Corp. website.

A2. Additional Robustness Tests and Summary Statistics



Large & Medium, Dec. 2011 (t-stat: ; p-value:)



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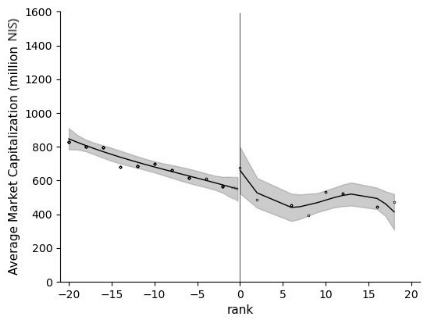

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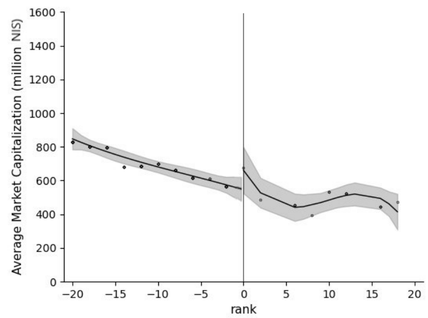

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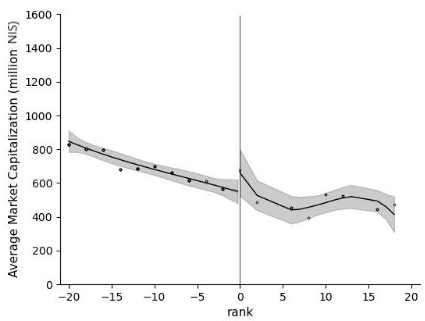

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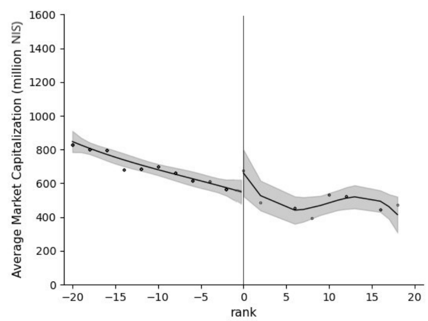

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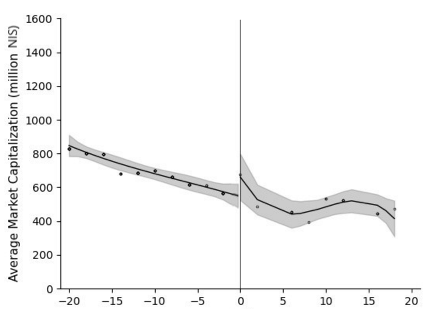

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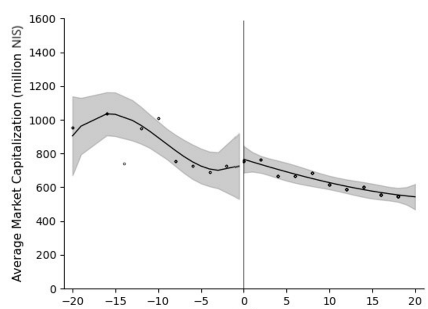

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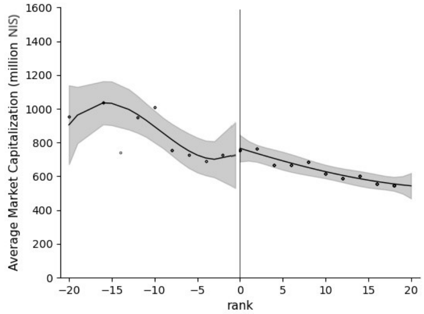

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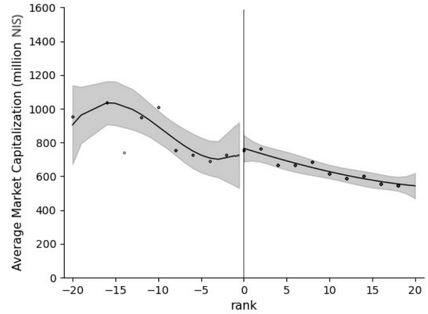

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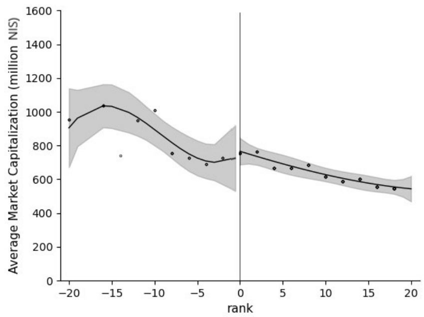

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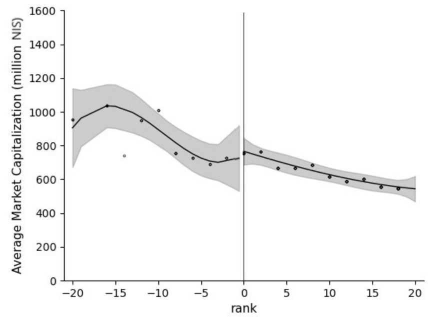

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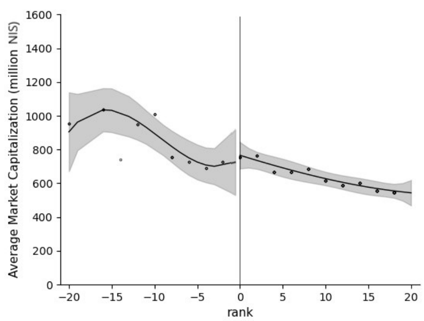

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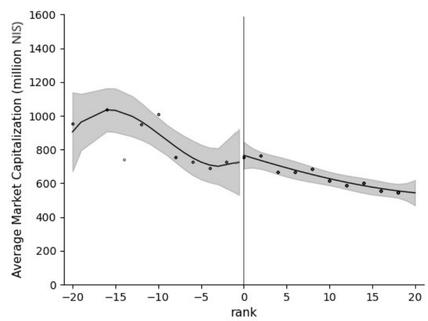

Medium & Small, Dec. 2014 (t-stat: ; p-value:)

Figure A2: Continuity in Average Market Capitalization Around Index Cutoffs, 2011 through 2014 The figure plots the average market capitalization against the average market capitalization ranks, along with 95-percent confidence intervals (the shaded area). Every point represents averages over all constitution periods. We fit polynomial functions of the running variable on either side of the cutoff.

Variable	Investor group	All	ETNs	Stocks
A. Trading Accounts	All	533,569	208,214	456,297
	ETN Sponsors	374	267	234
	Institutional	2,953	1,966	2,722
	Retail	524,961	203,738	448,202
	Algorithmic Traders	5,281	2,243	5,139
B. Traded Securities	All	366	69	297
	ETN Sponsors	366	69	297
	Institutional	363	66	297
	Retail	366	69	297
	Algorithmic Traders	366	69	297
C. Observations (Trades)	All	15.68	1.26	14.42
	ETN Sponsors	1.16	0.07	1.09
	Institutional	0.69	0.08	0.61
	Retail	9.58	0.91	8.67
	Algorithmic Traders	4.25	0.20	4.05
D. Buys	All	768.51	110.69	657.82
	ETN Sponsors	86.02	39.39	46.63
	Institutional	51.41	11.07	40.34
	Retail	225.55	24.85	200.70
	Algorithmic Traders	405.52	35.38	370.14
E. Sells	All	768.51	110.69	657.82
	ETN Sponsors	80.09	43.69	36.40
	Institutional	50.74	8.68	42.07
	Retail	242.12	24.01	218.11
	Algorithmic Traders	395.55	34.31	361.24

Table A2: Summary of Trading Data for Securities Listed on the TASE Market Indices and the ETN Tracking Them from 2011 to 2015. This table describes the trading accounts (Panel A), the equities traded (Panel B), total observations , i.e., trades (Panel C) and total buys and sells (Panels D and E, respectively) for securities listed on the TASE market indices and the trading accounts dealing in those securities. Each category is further broken down into the investor groups associated with each trading account and whether the observations are associated with trading in ETN securities or in the stocks listed on the market indices. Data are from December 2010 to June 2015.