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THE EFFECTS OF STOCK OWNERSHIP BY EXCHANGE-TRADED FUNDS ON CORPORATE INVESTMENT

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Abstract

We study the effects of stock ownership by exchange-traded funds (ETFs) on the levels of firm-level corporate investment. We use Russell 2000 index membership as an instrument to capture exogenous variation in ETF ownership and perform sequential mediation analyses to identify specific channels of ETFs' influence on investment. We find that ETFs expand the set of firms' investment opportunities and increase the levels of investment, while exerting no significant influence on firms' corporate governance. The increase in investment opportunities is attributable to the positive effect of ETFs on firms' future cash flows and cost of capital, as well as to a rise in valuations as a result of an increased demand for stocks. The largest part of the increase in the cost of capital comes as a result of ETFs' positive effect on forward equity beta. We attribute part of this effect to the increased comovement between the price of a stock and Russell indices caused by the increase in ETF ownership. In light of the recent proliferation of passive investing, the study makes an important contribution to the literature by identifying the market effects of the new prevailing style of asset management and complements existing evidence on the corporate governance effects of exchange-traded funds.

Keywords: exchange-traded funds, corporate investment, investment opportunity set, comovement, passive investing

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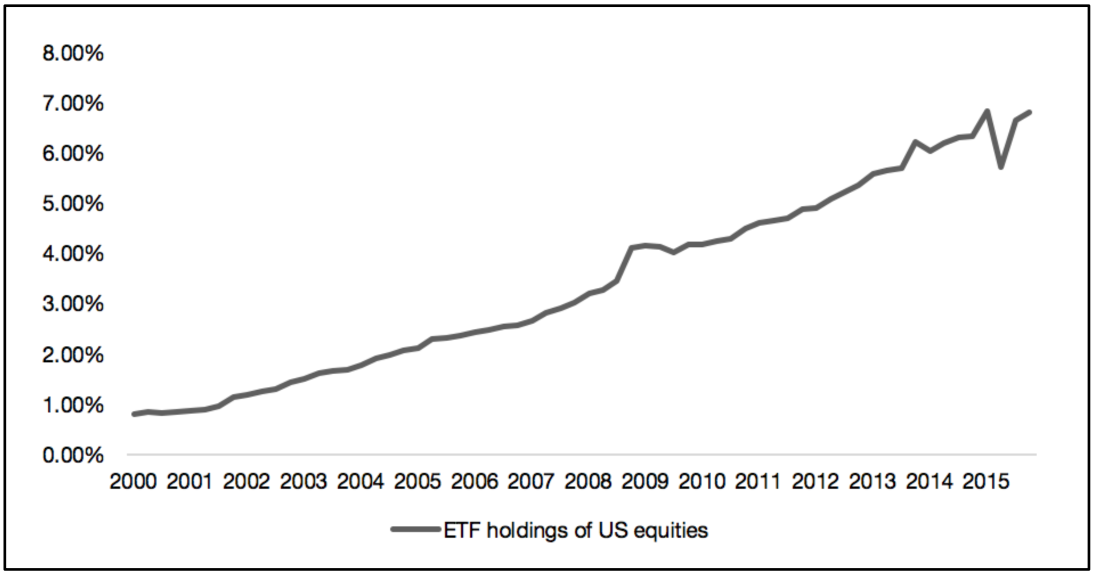
1. Introduction

We study the effects of stock ownership by exchange-traded funds (ETF) on the investment policies of individual companies. By instrumenting ETF ownership with Russell 2000 index membership, we show that ETFs expand the set of investment opportunities (IOS) available to corporate managers, leading to an increase in corporate investment. We find that app. 60% of the rise in the investment opportunity set of a firm as a result of an increase in ETF ownership is attributable to ETFs' effect on that firm's cost of capital and future cash flows.

Over the last decade, investors have demonstrated a strong and growing preference for passive fund management. Driven by the contention that active asset managers fail to outperform the market net of fees, this trend has contributed to the stellar growth of ETFs, investment vehicles that track the performance of an index (e.g. S&P 500) and can be bought and sold like ordinary stocks. ETFs have made it possible for investors to profit from the growth of an index without having to purchase all its constituents separately. This, together with extremely low expense ratios in comparison to active funds, has provided market access to investors who had not been able to afford a diversified asset management solution before and improved broader risk sharing capabilities of the market (De Winne, Gresse & Platten, 2014). In fact, the industry has become so successful that ETFs accounted for app. 6.8% of the stock market capitalization in 2015, up from only 0.7% in 2001 (Figure 1). Since most of the growth in passive investment has taken place through ETFs, we use this investment vehicle as a proxy for the rising importance of passive investing. Index mutual funds (or passive mutual funds) are another source of passive investment management. However, ETFs have proven to be more attractive for investors since they appear to be cheaper, more liquid, and still well diversified. ETFs are a somewhat better proxy for growth in passive investment than index funds since the former account for a larger part of growth in assets invested in index-based vehicles over the last 15 years.

Sound investment is an important predictor of future firm performance. Firms that are not constrained in their decisions to invest in profitable projects exhibit higher levels of growth in the future and are more competitive than their peers (Desai, Wright, Chung & Charoenwong, 2003). Even more importantly, investment determines growth on the macroeconomic level. A number of seminal models in economics show that investment leads to the accumulation of capital, higher productivity, and improved growth (e.g. Solow, 1956). Corporate investment is defined by both available investment opportunities (market factors) and the firm's ability to exercise these opportunities (governance factors). Previous literature has documented the improvement in corporate governance following an increase in passive ownership. Appel, Gormley & Keim (2016) show that firms with passive ownership exercise investment opportunities more efficiently. Little research has been made into the market effects of passive investors i.e. the ways in which passive investors change the investment opportunity set of firms.

Figure 1. ETF holdings of US equities (%)



Source: CRSP, Compustat, Markit

In relation to market factors, Baker, Stein & Wurgler (2003) claim that the presence of capital constraints makes investment dependent on the firm's stock price. Similarly, Kallapur & Trombley (2001) state that price is the most important factor defining the investment opportunity set of a firm, which is the pool of available profitable investment projects. The importance assigned to price in the literature is dictated by the fact that a high price is, other thing equal, equivalent to a low cost of capital. Cheap capital, in turn, leads to the availability of a larger number of profitable projects. If ETFs affect the price of the securities they own, they can alter the IOS of individual firms and their investment decisions. Previous literature documents that ETFs can have an effect on the IOS both through changing the firm's cost of capital and the IOS-implied future cash flows. More specifically, an increase in passive ownership could be associated with an increase in the firm's equity beta without a corresponding increase in business risk (Ben-David, Franzoni &

Moussawi, 2014; Goetzmann & Massa, 1999; Barberis, Shleifer, Wrugler, 2005), an increase in short selling (Grullon, Michenaud & Weston, 2011), and a controversial effect on the liquidity of the stock (Hamm, 2014; Bae, Kang & Wang, 2012). All these factors, in turn, will lead to a change in the cost of capital and the firm's IOS. At the same time, an increase in passive ownership could also result in a reduction in corporate short-termism since passive investors track their respective indices and do not prioritize short-term returns. This is likely to increase the set of investment opportunities available to managers by extending the duration of acceptable investment projects (Cremers, Pareek & Sautner, 2016). While it is possible to make predictions about the sign of the individual effects of passive owners on the IOS, the net effect of these changes on investment should be determined empirically. The recent shift towards passive investment through ETFs represents a major change in the prevailing style of asset management. An examination of its effects on corporate investment policies could further the long-standing debate on the effects of financial markets on real growth.

We define our research questions as:

RQ1: How does the ownership of a stock by ETFs affect corporate investment?

RQ2: What are the channels through which this effect occurs?

The remainder of this paper is structured as follows. Section 2 presents a review of relevant literature and an empirical framework. Section 3 describes the methodology of the study, while Section 4 provides a description of the data types and sources. Section 5 presents the results of the study and their interpretation. Section 6 concludes.

2. Literature Review and Hypotheses

The review of literature starts with a description of the documented effects of ETF ownership on individual companies. We show that ETFs influence both the efficiency of the market for companies' stocks and their governance policies. We then go on to demonstrate that corporate investment is a product of investment opportunities (market) and the efficiency of their utilization (governance). When ETFs invest in a company, they might affect investment through both of these channels. We focus our attention on the market channel and conclude this section with a detailed examination of the ways ETFs change the set of investment opportunities.

2.1 Effects of ETFs on the market for individual securities

Recent years have witnessed a lot of academic debate over the impact ETFs have on the equity market. For example, Da & Shive (2016), Ben-David, Franzoni & Moussawi (2014), Israeli, Lee & Sridharan (2016) argue that an increase in the ETF ownership of a stock results in a more pronounced comovement of stock returns with the returns of the index and thus reduces pricing efficiency for individual securities. Putting the issue in the context of the industry, a recent article by Sanford C. Bernstein & Co. (2016) claims that if passive investing continues to grow in size, capital allocation will eventually be impossible since passive funds buy the whole index without much consideration for its constituents. Ye (2012) proves this assertion in a more rigorous manner.

On a different note, Bae, Kang & Wang (2012) find that when ETFs increase their holdings of a particular stock, this stock is shorted more often since ETF sponsors have an incentive to lend it to short-sellers so as to partly compensate for their low management fees. More short selling generally has an adverse effect on firm value. Madura & Do (2008) show that since ETFs can be shorted as a separate instrument (unlike mutual funds), they cause additional indirect short selling of stocks. The authors demonstrate that the short interest of ETFs is on average 10 times that of underlying securities. The level of ETF short interest is, in turn, a strong predictor of a bearish sentiment (Madura & Do, 2008). At the same time, Bae et al (2012) show that an increase in the proportion of a company’s stock owned by ETFs leads to increased liquidity of the underlying stocks largely as a result of short-selling. Malamud (2015) arrives at the same conclusion in his dynamic equilibrium model of ETFs. On the other hand, Hamm (2014) argues that uninformed traders tend to migrate from individual stocks to ETFs in order to avoid being exploited by informed traders and thus decrease stock liquidity.

Finally, there is a multitude of other documented channels through which ETFs influence both the efficiency of the market for individual securities and corporate policies. These range from the effects of ETFs on a stock’s beta with the market to corporate governance (e.g. Barberis et al, 2005; Appel, Gormley & Keim, 2016; Fichtner, Heemskerk & Garcia-Bernardo, 2016). Both are strongly correlated with the investment opportunity set of the firm (IOS), which eventually defines corporate investment. We explore these channels in more detail.

2.2 Determinants of firm-level investment policy

At the highest level of analysis, a firm's investment policy is a product of the interaction between its investment opportunities and the way it exploits those opportunities. The effect of the first term is more straightforward and unequivocal: the more positive-NPV projects a company has at its disposal, the more projects it will take up and the higher investment volume it will generate. The second term is less unambiguous and requires some elaboration. In most cases, it is in the interest of the shareholders of a company to take up all available positive-NPV projects. However, shareholders typically cannot fully control the policies and decisions their firms undertake, because of e.g. the high cost of monitoring under dispersed ownership (a free-rider issue), asymmetric information, and managerial agency costs. In maximizing their own utility, company managers may have a number of reasons to under- or over-invest. They may decide to underinvest so as to lower the volatility of company cash flows and increase the security of their employment. They may also overinvest (i.e. pursuing negative-NPV projects) so as to engage in empire-building. Similarly, they may take up projects that are too risky relative to the preference of company owners if the managers' compensation packages include option-like instruments whose value is positively related to the volatility of cash flows (leading to perverse incentives). Also, in certain cases even shareholders themselves may find it optimal to deviate from their preferred policy of maximum positive-NPV projects. The owners of firms that are heavily laden with debt may decide to engage in risk-shifting, or taking up risky, possibly negative-NPV projects, to exploit the option-like nature of equity at the expense of debt-holders. At the same time, they may decide to forego positive-NPV projects whose costs will be borne by the equity-holders but benefits (if any) will primarily accrue to the debt-holders.

Thus, both managers and shareholders can exert a substantial influence on the investment policy of a firm, holding its investment opportunity set constant. We refer to this channel of influence as the corporate governance channel. A new set of shareholders at a company may either lead to a change in managerial agency costs (e.g. either eliminate them or allow them to rise even further) or lead to changes in investment policies through a change in their own behavior. For instance, while the old set of shareholders may have been less vigilant or more tending to overinvest, the new shareholders may invest more effort in monitoring their managers and may pursue a more balanced investment policy. Thus, such changes may be expected to alter a firm's investment policy holding the IOS constant. Finally, the incentives of individual stakeholders (and hence the corresponding agency costs) are not exogenous but depend on other aspects of a firm's operations. If a new set of investors into a company decides to alter e.g. the level of its financial leverage, then these shareholders may become interested in risk-shifting and the other debt-equity-holder conflicts mentioned above. This leads to a potential omitted variable bias and implies that one should be cautious in drawing conclusions about the behavioral propensities of investors relying only on the observable change in investments, without appropriately controlling for the other factors affecting investor behavior.

Passive investing might influence both investment opportunities and the governance channel. On the one hand, passive investors have an effect on managerial decisions. Appel, Gormley & Keim (2016) (hereafter AGK) look at the impact of passive investors on corporate governance and find that the impact is positive. They use index funds as a proxy for passive investors and show that these funds engage with the mangers by proxy voting and are concerned about the long-term performance of the firm. This direct intervention appears to be the only way of influencing governance since index funds cannot sell the shares because of their commitment to tracking the index. The paper however does not test the latter channel of influence, a change in investment opportunities. AGK claim, and we agree, that in their design, investment opportunities may not be affected by passive investors *at the point of a change in their investment position*. However, there are several channels through which investment opportunities may be influenced by passive investors and in particular ETFs fairly quickly (detailed below), and hence ETFs can have an economically significant impact on investment opportunities already in the short run. In turn, investments may be affected not only by a change in governance but also by a change in investment opportunities induced by passive investors. ETFs may determine investment opportunities in several ways.

2.3 Theoretical link between ETFs and investment opportunities

A firm's opportunities for investment are usually defined by the literature as an investment opportunity set, which is the ability of a firm to invest in projects with a positive net present value (Myers, 1977; Smith & Watts, 1992; Kallapur & Trombley, 2001). Previous literature suggests that various price-related variables capture most of the variation in the IOS (Kallapur & Trombley, 2001). Price-based measures rely on the idea that future value-adding growth is at least to some extent reflected in the current price of the stock (Kallapur & Trombley, 2001). The market will value firms with a large IOS higher than those with a low or negative one. This assumption led to the emergence of such IOS proxies as the price-to-book value of equity (PBV) and assets (Tobin's Q), and the price-to-earnings ratio (P/E).

However, in order to capture the effect of ETFs on corporate investment that stems from the IOS channel, it is necessary to consider the determinants of the IOS that can be affected by changes in ETF ownership. If we accept that price-based measures capture changes in the IOS, it is possible to derive such determinants from various models of discount pricing. These models suggest that the IOS of a firm is broadly determined by a firm's future cash flows and cost of capital. A company's future cash flows are the sum of the cash flows from its existing and future projects. In what follows, we construct a simple theoretical framework to illustrate the various channels through which ETFs might affect future cash flows and the cost of capital.

Passive investors can change the IOS-implied cash flows of a firm by reducing the duration of the projects that the firm chooses to take up. ETFs and passive investors in general do not seek short-term returns as opposed to e.g. active mutual funds or hedge funds, and can be regarded as long-term investors. We conjecture that when a large fraction of a firm's market capitalization is held by ETFs, the investment activities of that firm will exhibit a reduction in short-termism i.e. a larger part of R&D and capital expenditures will go into long-term projects. We identify at least two reasons why this relationship should hold. First, unlike active managers, passive managers cannot exit an underperforming investment (or an investment that they believe will underperform). This implies that active investors have an incentive to induce companies to exhibit short-termism, boosting their valuations in the short run and reaping short-term profits while depressing firm value in the longer term. By contrast, for a passive manager such a strategy presents a zero-sum game over time. Second, passive managers certainly do have an incentive to post a better short-term performance, as doing so will likely lead to extra fund inflows and higher revenues from management fees. However, because the trend of such short-termism-induced profitability will reverse in the future and because passive managers cannot normally participate in profit-sharing, their aggregate revenue will again remain unchanged over time. By contrast, active managers often enjoy notoriously asymmetric payoffs, laying a claim to a significant share of portfolio profits but fencing themselves off from most of its losses. In such a setting, active managers again have stronger incentives to exhibit short-termism and force their portfolio companies to do the same. Asker, Farre-Mensa & Ljungqvist (2014) and Cremers, Pareek & Sautner (2016) document that short-term investors pressure firms to lower the R&D spending and boost short-term earnings. In line with these findings, a reduction in the short-termism of the shareholders serves to increase the set of investment opportunities available to managers by allowing them to invest in profitable projects that would otherwise be disregarded due to the timing of their cash flows. A larger IOS will in turn result in more investment. A possible measure of short-termism is asset durability proposed by Souder & Bromiley (2012). Asset durability captures the horizon of new investments by calculating the expected useful life of new investments. Shorter useful life implies that a larger proportion of asset value is depreciated each year. A ratio of capital expenditures to *their* depreciation is then defined as asset durability (Souder & Bromiley, 2012). Thus, a higher durability of assets in firms where ETF ownership is substantial would imply that ETFs have a positive effect on the IOS through this channel.

Previous literature suggests that ETFs change firms' expected returns by increasing the comovement of stock returns with the index tracked by ETFs (Da & Shive, 2016) and increasing the non-fundamental volatility of stocks in the index (Ben-David, Franzoni & Moussawi, 2014). Barberis et al (2005) show that stock inclusions in the S&P 500 result in a non-fundamental increase in the betas of the included stocks. It is unlikely that an index inclusion per se increases the systematic risk of a company that would justify such an increase in the comovement between the returns of the stock and the index. Hence, another explanation for the increase is a more synchronized investors' trade flow (provided that the demand curve for stocks is not flat). In support of this hypothesis, Goetzmann & Massa (1999) document high correlation between index fund inflows and index returns. To the extent that this result is driven by passive investors, an increase in ETF ownership should increase stocks' betas and result in a higher cost of capital. This, in turn, could reduce the IOS of respective firms and lead to a reduction in the levels of investment. On the other hand, the effect of a higher cost of capital on the IOS could be positive given that cost of capital measures usually incorporate future growth opportunities of a firm (Da, Guo, & Jagannathan, 2012; Frank & Shen, 2015). A high cost of capital, in this case, signals investors that the firm has more investment opportunities at its disposal and facilitates capital-raising. This bias could then artificially inflate IOS proxies.

Short-selling constraints introduce a negative premium to a firm's cost of capital in that they allow share prices to depart from fundamental levels (Gilchrist, Himmelberg & Huberman, 2004). A reduction in these constraints should allow short-sellers to eliminate this mispricing or even push the price of the stock below the fundamental level. In any case, short-sellers reduce the negative premium of short-selling constraints on the cost of capital (Gilchrist, Himmelberg & Huberman, 2004). Baker et al (2003) claim that there is a positive relationship between stock prices and investment due to the presence of capital constraints. Managers are keener on raising capital for investment when equity is overpriced. Thus, we conjecture that a decrease in price commanded by ETF-induced short selling will make funds more expensive, reduce the firm's IOS, and curtail investment. In connection to this argument, Grullon, Michenaud, and Weston (2011) find that an exogenous increase in short selling leads to a decrease in firm investment.

Lastly, there is a large body of literature that documents the effect of stock liquidity on firms' cost of capital (e.g. Amihud & Mendelson, 1986; Amihud, Mendelson, & Pedersen, 2005; Bae, Kang & Wang, 2012). Amihud & Mendelson (1986) show that a decrease in bid-ask spreads (a proxy for higher liquidity) results in a statistically and economically significant reduction in the cost of capital. If ETFs make individual stocks less liquid because uninformed traders move away from these stocks into ETFs (e.g. Hamm, 2014), we should expect an increase in cost of capital for these companies and a deterioration in their IOS and investment. If, on the other hand, ETFs increase the liquidity of underlying securities as a result of more short-selling (e.g. Bae, Kang & Wang, 2012), the effect should be reversed.

In sum, we expect that ETFs should have an effect on investment through the IOS channel. The magnitude and sign of this effect will depend on the strength of the four determinants of the IOS identified above. We define six corresponding hypotheses.

Hypothesis 1: An increase in ETF ownership leads to an increase in firms' investment opportunity set and levels of investment.

Hypothesis 2: An increase in ETF ownership leads to an increase in firms' asset durability and an increase in the IOS.

Hypothesis 3: An increase in ETF ownership leads to an increase in firms' cost of capital and a decrease in the IOS.

Hypothesis 4: An increase in ETF ownership leads to an increase in a firm's equity beta.

Hypothesis 5: An increase in ETF ownership increases the short selling of a firm's stock.

Hypothesis 6: An increase in ETF ownership reduces the liquidity of a firm's stock.

Unlike previous literature, which focuses on the effects of passive institutional ownership on firm performance through corporate governance, we take a different perspective and examine how the proliferation of ETFs affects investment through changing the investment opportunity set. Documenting this link could result in strong implications for both policymakers and corporate directors and further our understanding of the welfare effects of ETFs. The key contribution of this paper is the identification of a new channel through which ETFs affect corporate investment decisions. While acknowledging the existence of a corporate governance channel, we show that ETF ownership has an effect on a firm’s investment policy through altering the universe of available investment projects.

3. Methodology

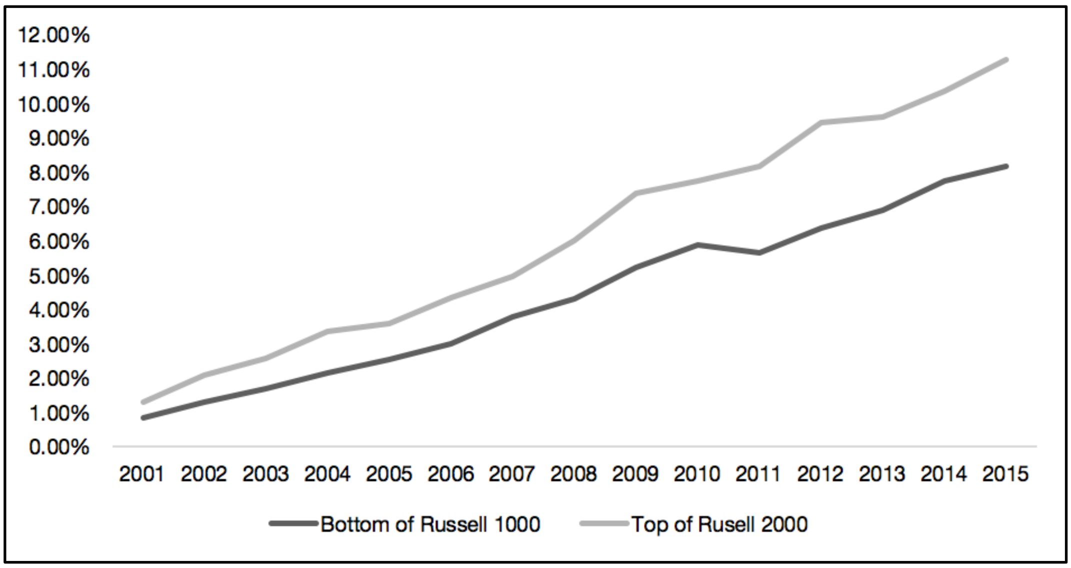
3.1 Determining the effects of ETF ownership

Testing the impact of passive investors’ ownership on company policies or performance presents an empirical challenge. The challenge lies in proving the causal character of the relationship between these two sets of variables. Because rational investors are forward-looking and profit-maximizing, they commit resources to identifying companies that are expected to outperform in the future. Hence, that they take larger positions in stocks that subsequently outperform might merely be either a testimony to their superior skill relative to the market or the return that they earn as a reward for acquiring costly information (Grossman & Stiglitz, 1980). If more corporate investment is a sign of future outperformance (e.g. if a company is prone to underinvest but an ETF manager expects this issue to attenuate in the future), the relationship between ETF ownership and investment might suffer from a reverse causality bias, wherein ETFs will select companies whose investments (and value) are expected to rise but they will not necessarily cause them to rise.

Apart from reverse causality, there might be an issue of omitted variable bias that will undermine the reliability of the causal link. Passive managers’ ownership of stocks of certain companies might be correlated with a range of other variables, such as active managers’ positions in the same stock (AGK). For these reasons, a natural way of establishing a reliable causal link between passive ownership and corporate policies is to generate a plausibly exogenous variation in passive investors’ holdings of stocks and to use this variation to draw statistical inferences.

To generate such variation, we adopt the design proposed by AGK that utilizes the gap in passive ownership of certain stocks in two US stock indices: Russell 1000 and 2000. These two indices are run by FTSE Russell and are parts of the Russell 3000 index that aggregates 3000 largest US companies. The Russell 1000 index is comprised of the top 1000 stocks of the broader index, whilst Russell 2000 is comprised of the shares of the remaining companies. The latter index is the most commonly used index to represent small capitalization stocks. Stocks within both indices are ordered according to their free-float market capitalization. AGK notice that

Figure 2. ETF ownerships of sample companies by index membership (%)



Source: CRSP, Compustat, Markit

stocks at the bottom of the Russell 1000 index have much lower percentage holdings by passive managers than those at the top of Russell 2000. The reason for this effect is that a small fraction of every dollar invested in Russell 1000 goes to its smallest stocks because their weight in the index is the lowest. On the contrary, a relatively large fraction of a dollar invested into Russell 2000 goes to its top constituents, as their weights are the largest by construction. Even though the absolute dollar amount invested in Russell 1000 (the index's market cap) is more than 11 times greater than that for Russell 2000, the wide gap between the weights of the bottom and top stocks in the indices leads to a noticeable "jump" in ownership by passive investors (Figure 2).

Moreover, this break in passive ownership is plausibly exogenous in the context of reverse causality and omitted variables. The stocks at the bottom of Russell 1000 and the top of Russell 2000 are similar in size and other characteristics, except for passive ownership. Moreover, since passive, index-tracking investors are committed to replicating an underlying index, they will have to hold all stocks within the index in the specified proportions, without regard to their appraisal of the stocks' future performance potential. Likewise, such variation in ownership should not be correlated with other variables that could potentially influence the variables of interest of this research. Hence, using the difference in passive ownership estimated with this design allows us to mitigate the endogeneity issues that would otherwise confound the robustness of the statistical link that this study aims to test.

Table 1. Instrumenting

$$ETF_{it} = \beta_0 + \beta_1 \cdot Russell\ 2000_{it} + +\beta_{2\ (1;2)} \cdot \ln(Mktcap)_{it}^{\ 1;2} + \varepsilon_{it}$$

ETF (%) is a percentage of a firm's total market capitalization held by exchange-traded funds at the end of Q3 of year t. Russell 2000 is a dummy variable taking the value of 1 if the stock belongs to Russell 2000 in year t and 0 otherwise. Mkt Cap is a firm's dollar market capitalization at the end of May in year t.

	(1) ETF	
Russell 2000	2.346***	*(28.52)*
log(Mkt Cap)	4.599***	*(3.19)*
log(Mkt Cap)^2	-0.183*	*(-1.86)*
Constant	-20.04***	*(-3.80)*
R-squared	0.153	
F-statistic	348	
Observations	7499	

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Following the example of AGK, we select a 250-company bandwidth for our sample (i.e. the bottom and top 250 stocks from the respective indices). We set the sample period to be between 2001 and 2015, rebalancing the sample annually after index reconstitutions. Finally, we instrument ETF ownership using Russell 2000 membership as an exogenous instrument and controlling for end-of-May market capitalization. This way, for each sample company we capture only the part of ETF ownership that is driven by a company's index membership and size (that determines index membership). The results of the estimation are reported in Table 1. The working variable in all subsequent analyses is $\widehat{ETF}$, or instrumented ETF ownership.

3.2 The impact of ETFs on corporate investment

Corporate investment is a complex, high-level variable that is jointly determined by a large number of external and internal factors. The ownership structure of a company may affect its investment policy not directly but through a variety of different channels. Such channels may be identified by carefully scrutinizing the theoretical determinants of corporate investments and by selecting those determinants that may be affected, directly or indirectly, by a specific group of company owners (in our case, ETFs). To test the presence and potency of the channels that we have identified, we employ a *4-step mediation framework proposed* by Baron & Kenny (1986). A recursive application of the framework allows us to test for the presence of a causal link between ETFs and corporate investment and crucially to establish the channels through which this effect takes place. Figure 3 presents a visual overview of the mediation analyses we perform.

All mediation analyses that we undertake follow the same 4-step procedure. To establish that a certain independent variable X affects its corresponding dependent variable Y through a mediator Z, we first show that there is a direct impact of X on Y by directly regressing the latter variable on the former one. Then, we separately regress Y on Z and Z on X to show that the suspect mediator is a determinant of the dependent variable Y and is determined by the independent variable X. Finally, we regress Y on both Z and X. We expect the coefficient on Z to remain significant and that on X to lose its statistical power and diminish in magnitude (absolute value). If the coefficient on X turns insignificant, we conclude that there is a *pure* mediation relationship between X and Y through Z. If the coefficient on X falls in magnitude and significance but still remains significant at the conventional levels, the mediation relationship is thought to be *impure* but is present nonetheless. Finally, including more than one potential mediator is a straightforward extension of the procedure outlined above. Such a framework has now become standard in academic literature and has found a wide variety of applications within and outside social sciences (notably is psychology).

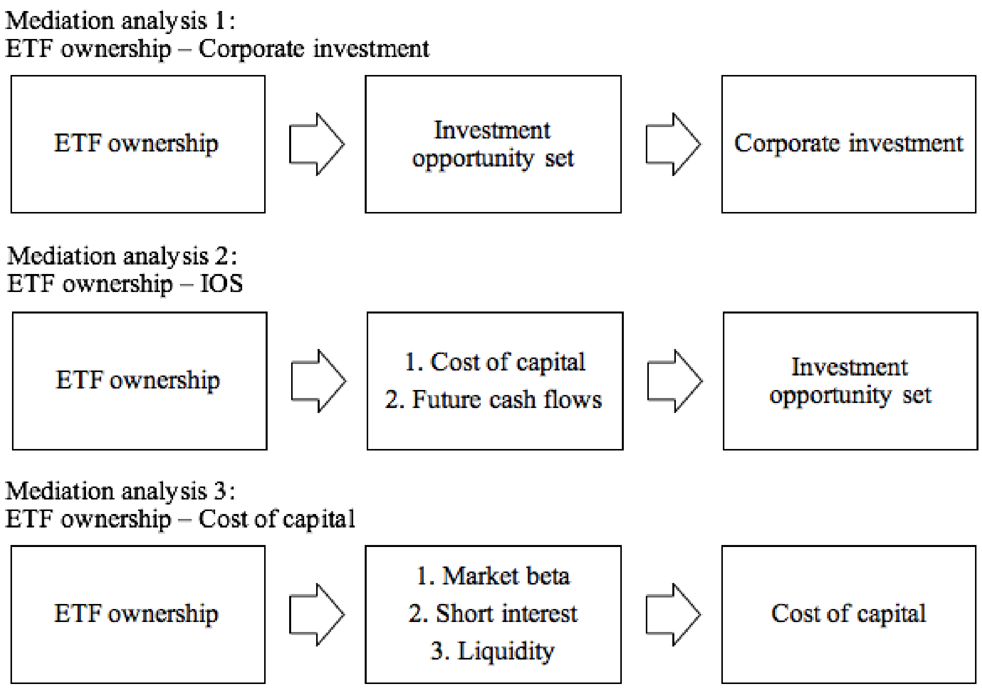
However neat Barron & Kenny's mediation framework may be, its more than three-decade tenure in social sciences has seen it garner a fair amount of constructive criticism. In enumerating some of these criticisms, we turn to a reasonably recent and comprehensive review of the method by Zhao, Lynch & Chen (2010). The authors identify the circumstances under which the 4-step procedure of Baron & Kenny may yield results that researchers may over-interpret (i.e. claim mediation when there is none, a form of a "false positive"), as well as those that researchers tend to under-interpret (a "false negative"). In particular, the authors shed more light on the issue of competitive and complementary mediation by noticing that the absence of a significant coefficient in the first step of Baron & Kenny's procedure need not signal the absence of mediation in and of itself. Indeed, if we assume that for a certain set of variables X, Z, and Y the direct effect has a positive (negative) sign and the indirect affect a negative (positive) one of a similar magnitude, the overall effect (of X on Y) is likely to be insignificantly different from zero (exemplifying a competitive mediation). If a researcher follows the steps suggested by Baron & Kenny, the mediation analysis will yield a (possibly) false negative in its very roots. Thus, Zhao et al (2010) suggest that all 4 steps ought to be carried out regardless of the outcome of each individual specification.

In a similar vein, Glynn (2012) notices that the absence of a significant relationship in the second step of mediation (a supposedly significant association between Z on X) is also likely to result in a false negative. Indeed, if half of the observations of X affect Z positively (negatively) and the other half negatively (positively), the overall observed effect may be insignificant. If, however, the first half of the observations further affect Y positively (negatively) *and* the second half negatively (positively), the overall effect of X on Y may range between "very" negative and "very" positive, including no effect at all. Hence, terminating the mediation analysis upon discovering the absence of a significant association between X and Z may also lead to false negatives.

Lastly, even significance tests, namely the Patel test now ubiquitous in the mediation literature, suffer from potentially serious shortcomings as illustrated by Zhao et al (2010). To partially address these criticisms, we employ a bootstrap procedure for all our mediation analyses. This way, we run a lower risk of committing the error of false positives and circumvent the need to conduct the Patel test by employing a more robust test relying on numerous consecutive resamplings by the means of the bootstrap method. The results of bootstrap estimations are reported in Appendix B. In all cases, they are supportive of statistically significant mediation at all principal stages of this study.

By way of testing the robustness of mediation analyses, we also use the *mediation* package in Stata that computes standard errors and confidence intervals of the observed direct and indirect effects. Finally, for the sake of brevity, we present all equations of the estimated regressions only in the first stage (out of three stages in total) of mediation. The remaining two tests follow the same pattern. The specifications and outputs of key stages of the mediation are reported for all three analyses and are included in the results description section. The estimations of remaining interim specifications are presented in Appendix C.

Figure 3. Mediation analysis summary



Source: Created by the authors

3.2.1 Mediation analysis 1: ETF ownership – Corporate investment

As the first step, we estimate the following regression to establish a *direct* link between ETFs ($\widehat{ETF}_{it}$) and corporate investment (INV_{it}):

$$INV_{it} = \beta_0 + \beta_1 \cdot \widehat{ETF}_{it} + \beta_{2(1;2)} \cdot \ln(Mktcap)_{it}^{1;2} + GICS_{it} + \delta_t + \varepsilon_{it} \quad (1)$$

where $\ln(Mktcap)_{it}^{1;2}$ stands for the first and second power of log market capitalization, while GICS and δ_t denote industry- and time-fixed effects respectively.

Further, we view investment policies as a function of investment opportunities. We define the investment opportunity set (IOS) as a pool of positive-NPV investment projects available to and recognized by the company at a particular point in time. (If we want to decompose investments into the IOS and governance components, we have to assume that managers' recognizing of an investment opportunity is a precondition for its inclusion in the IOS). Guided by the existing literature on the topic, we consider a number of proxies and measures for the IOS. In specification (2), we use Tobin's Q as a proxy for the IOS. As a second step of the mediation framework, we regress the dependent variable on the supposed mediator. Naturally, we expect the relation between investment opportunities and investments to be highly significant (economically and statistically) and positive.

$$INV_{it} = \beta_0 + \beta_1 \cdot IOS_{it} + \beta_{2(1;2)} \cdot \ln(Mktcap)_{it}^{\;1;2} + \beta_3 \cdot GICS_{it} + \delta_t + \varepsilon_{it} \tag{2}$$

In order to be of relevance to investments, ETFs have to either affect investment opportunities or the function that maps investment opportunities to investments. Such a function shows how managers "convert" investment opportunities into investments. We argue that, other things equal, this function should be monotonically increasing, although it may possibly be concave in the short term because of capital markets rigidities. To account for the effect of investment opportunities on investments (4), we add a proxy of investment opportunities to regression (1). Additionally, we add an interaction term between ETF ownership and investment opportunities to see if the former affects the way the latter one influences investments (i.e. if ETFs affect the mapping function described above). If this is so, we interpret such an effect as ETF ownership having an impact on corporate governance, which we believe to be the most important determinant of the mapping function.

Finally, investment is measured for a period of 12 months starting one quarter after index reconstitution. ETF ownership and the IOS proxy are taken at the end of the first of quarter after index reconstitution. In such a way, ETFs have one quarter to enter their positions and affect the IOS of companies, and then the companies' investments over the subsequent 12 months are drawn for the changed IOS. Note that if we were to measure both ETF ownership and the IOS at the point of index reconstitution, we would expect to observe no relationship between the two by construction.

$$IOS_{it} = \beta_0 + \beta_1 \cdot \widehat{ETF}_{it} + \beta_{2(1;2)} \cdot \ln(Mktcap)_{it}^{1;2} + \beta_3 \cdot GICS_{it} + \delta_t + \varepsilon_{it} \tag{3}$$

$$INV_{it} = \beta_0 + \beta_1 \cdot \widehat{ETF}_{it} + \beta_2 \cdot IOS_{it} + \beta_3 \cdot ETF_{it} \cdot IOS_{it} + \beta_{4(1;2)} \cdot \ln(Mktcap)_{it}^{1;2} + \beta_5 \cdot GICS_{it} + \delta_t + \varepsilon_{it} \tag{4}$$

3.2.2 Mediation analysis 2: ETF ownership – IOS

Our next task is to establish the channels through which ETF ownership affects the IOS. In line with the reasoning provided in the literature review, we conjecture that there is a mediation-type relationship between ETFs and the IOS, with the cost of capital and cash flows. Prior to performing the mediation analysis, we provide some motivation for the variables for the IOS, the cost of capital, and cash flows of our choice.

We select Tobin's Q as the only measure of the IOS. The reason we do so is because Tobin's Q is the only proxy that reflects investment opportunities available to a firm by considering the valuation of its total assets and not just their equity component (unlike PBV and P/E). Thus, if we choose Tobin's Q as the left-hand-side variable in a regression of IOS on the cost of capital and cash flows, we may take the cost of capital and cash flow variables pertaining to the entire firm, not their equity-related counterparts (the operating cash flow to equity and the return on equity, respectively). Since we focus on the effect of ETFs on the total cost of capital of firms, and not just their cost of equity capital, this property of Tobin's Q is highly desirable for our analysis.

Measuring the cost of capital is a contentious practical and academic issue. In the traditional framework, a company's WACC is a combination of the costs of equity and the after-tax cost of debt weighted according to the company's capital structure. The costs of debt and equity in turn depend on the company's business risk and capital structure. Business risk in this context is usually defined in terms of the CAPM beta (or using various extensions of the CAPM). Hence, holding the other determinants of the WACC fixed, a firm's WACC only depends on the covariance between its cash flows and the market. While under the standard assumptions of the CAPM-based asset pricing models, such an approach should provide the correct expected return for individual investment projects, it may fail to do so for stocks (Da, Guo & Jagannathan, 2012). The reason for this is that these models cannot incorporate the option-like nature of future investment projects. In addition to projects-in-place, companies have the option to take up new investment projects in the future, an option that clearly has value but may not be priced looking at the realized trailing returns.

In the light of these considerations, the empirical relation between the WACC and IOS might be, perhaps somewhat counterintuitively, positive. This comes as a result of the fact that, as explained above, the CAPM-based WACC fails to capture the value of the implied growth options that investors recognize and price. Since strong growth options are often associated with higher risk (due to a higher company-specific risk with no lower market correlations), an expansion of the firm's investment opportunities pool could be associated with both a *higher market beta* and *higher expected cash flows*. Moreover, it is likely that the growth of expected cash flows is greater in magnitude than that of the market beta, causing investment opportunities to rise despite the higher WACC. (In terms of regression analysis, this can be thought of as an issue of omitted variable bias that would lead the coefficient on the WACC to be biased upwards and eventually to become positive). Frank & Shen (2015) document this effect for their sample of companies.

For the curious reader not convinced by the paucity of closed-form explanations or structural models for the positive association between the WACC and investment opportunities, we replicate the analysis commonly presented in the (meagre) existing literature on this topic and estimate the implied cost of capital (ICC) alongside the weighted-average cost of capital. Whilst the WACC seeks to gauge the cost of capital by using the riskiness of a company's projects-in-place as a starting point, ICC is a market-implied proxy for the cost of capital derived from the current projections of future earnings and current market valuation (Appendix A). To the extent that market prices are efficient, such an approach helps to overcome some of the fallacies of the WACC, such as its oversight of the option-like nature of future investment projects of a company. At the same time, whenever there is a departure from efficient pricing, in particular a one-off change in prices without a protracted change in the size or volatility of future cash flows, ICC will mechanically reflect such a change whilst the WACC will not.

Because the ICC is not predicated upon a structural model but is derived from market prices and requires numerous assumptions to lend itself to intuitive predictions, we do not test its association with ETF ownership but merely use it to show that the cost of capital proxied using ICC is (intuitively) inversely related to investment opportunities and investments. We show that our results with respect to the association between the cost of capital and investment opportunities are consistent with the mainstream view of Frank & Shen (2015) for both the WACC (a positive association) and ICC (a negative association).

As a proxy for future cash flows, we choose cash flows from operations (Johnson & Lee, 1994). We normalize this variable by the total balance sheet assets, using them as a reasonable proxy for the replacement value of assets in the denominator of Tobin's Q. We also conjecture that ETFs affect the cash flows from future investment projects by changing the investment horizons of companies they invest in. Such a change, if any, will be reflected in an increased asset durability. Hence, we also add a specification in which asset durability is regressed on ETF ownership. Since we find no reliable link between these two variables, we omit asset durability in all the other steps of the mediation analysis.

$$IOS_{it} = \beta_0 + \beta_1 \cdot ETF_{it} + \beta_2 \cdot CF_{it} + \beta_3 \cdot WACC_{it} + \beta_{4(1;2)} \cdot \ln(Mktcap)_{it}^{1;2} + \beta_5 \cdot GICS_{it} + \delta_t + \varepsilon_{it} \quad (5)$$

3.2.3 Mediation analysis 3: ETF ownership – Cost of capital

With our next step, we seek to establish our final mediation relationship between ETFs and the cost of capital. Holding taxes and capital structure constant, the impact of ETFs on the cost of capital can occur through the following channels: a change in market betas, a change in the premium related to short-selling constraints, and a change in the premium related to illiquidity. We estimate a number of regressions of these variables on ETF ownership. In our main specifications, we select the market beta as a proxy for the change in market risk, the sum of short interest and indirect short interest (short interest arising from the shorting of ETFs holding a particular stock) as a proxy for the change in short-selling, and the bid-ask spread as a proxy for the change in illiquidity. We also control for the market debt-to-equity ratio that influences the WACC and might be affected by ETF ownership.

Both ETF ownership and each of our variables of interest are considered as of the end of the first quarter after index reconstitution (the end of Q3). This is so because ETFs will be unable to instantaneously adjust their portfolios but will need some time to do so. Admittedly, the time required for the adjustment is shorter than one quarter, but the available data do not allow us to consider shorter time intervals. The initial steps of mediation analyses follow the same logic as in the analyses above. The main regression of the dependent variable on the mediators and the independent one is estimated in the following form:

$$WACC_{it} = \beta_0 + \beta_1 \cdot \widehat{ETF}_{it} + \beta_2 \cdot Beta_{it} + \beta_3 \cdot SI_{it} + \beta_4 \cdot BA_{it} + \beta_5 \cdot DE_{it} + \beta_{6(1;2)} \cdot \ln(Mktcap)_{it}{}^{1;2} + \beta_7 \cdot GICS_{it} + \delta_t + \varepsilon_{it} \quad (6)$$

4. Data and sample description

We use a mix of secondary sources to obtain the data necessary for conducting this study. Crucially, we rely on a dataset compiled by Dr. Talis Putniņš that contains the data on ETF and mutual fund ownership for app. 15,000 US public companies (roughly representing the entire US equity market) for the period between 2001 and 2015 inclusive on a quarterly basis. This dataset also provides several ETF-specific variables such as indirect short interest. The dataset was compiled using the following databases: CRSP, Compustat, Thomson Reuters Mutual Fund Holdings, and Markit. Further, the time-series data on Russell indices reconstitutions and compositions are backed out of membership changes in iShares Russell 1000 ETF and iShares Russell 2000 ETF, the oldest and largest ETFs tracking these indices. We use these data to estimate the first-stage regressions and instrument ETF ownership. Knowing the companies of our interest (the 250-company bandwidth between Russell 1000 and 2000), the timing of reconstitutions, and ETF ownership, we retrieve a range of company-level variables from Bloomberg Professional. These variables include market capitalization, capital expenditures and R&D expenses, cost of capital- and cash flow-related measures and others.

Our final sample includes 7500 firm-level observations spread over a 15year period. Table 1 presents summary statistics for the variables used in the study. All variables are winsorized at the 1% level.

1. *INV.* Our proxy for corporate investment is calculated by scaling the sum of next twelve months' (NTM) CAPEX and R&D of the companies in our sample by their total assets at the end of Q3 of year t. On average, companies in our sample invest 8.24% of their assets per year.
2. *ETF.* ETF ownership is the proportion of a company's market capitalization owned by exchange-traded funds at the end of Q3 of year t. On average, 5.26% of the outstanding market capitalization of each company in the sample is owned by ETFs.

3. *Mkt Cap*. Market capitalization is measured in millions of US dollars and ranges from \$349.29m to \$5670.17m. We control for the logarithm of market capitalization to discern between the effect of ETFs and of company size on its investment policies. Smaller firms have a higher chance of being included in the Russell 2000 index and thus of having a greater percentage ownership by ETFs, while at the same time tending to invest less or more because of the correlation between firm size and liquidity or governance. We allow for non-linearity in the relationship between company size and investment by using a polynomial of the degree two (higher degrees of polynomials did not markedly improve explanatory power in unreported regressions).
4. *Tobin's Q*. We use Tobin's Q as the proxy for the investment opportunity set. The variable is calculated as the market value of a firm's assets scaled by their book value at the end of Q3 of year t.*CFO/TA*. The measure of future cash flows is calculated as NTM operating cash flows of a firm scaled by its total assets at the end of Q3 of year t. Observations with a negative value of the variable are excluded from the sample.
5. *WACC*. A firm's cost of capital is proxied by the weighted average cost of capital. We calculate it at the end of Q3 of year t using 1-year forward beta with the S&P 500 Index as a proxy for the market portfolio.
6. *ICC*. Denotes a firm's implied cost of capital at the end of Q3 of year t calculated as per Appendix A.
7. *AD*. Asset durability is the ratio of the current year's CAPEX to its depreciation during the year. This measure gauges the pace at which a company depreciates its capital expenditures, by dividing CAPEX by the part of depreciation accrued on that CAPEX (i.e. excluding the depreciation of PPE outstanding at the beginning of the period assuming that its rate stays unchanged). AD is measured for a period of 12 months starting at the end of the first of quarter after index reconstitution. The variable is calculated as $AD_{it} = \frac{Capex_{it}}{Depreciation_{it} - (Gross\ PPE_{it} - Capex_{it}) \cdot Depreciation\ rate_{i,t-1}}$
8. *Beta (E)*. Companies' systematic risk is measured by their 1-year forward levered (equity) betas against the S&P 500 Index at the end of Q3 of year t. Forward estimates are used to capture the effect of changes in companies' riskiness *introduced* by ETFs.

9. *SI*. Short interest represents the percentage value of a stock's market capitalization sold short at the end of Q3 of year t. The variable captures both direct short-selling and short-selling caused by ETF lending of shares to short-sellers.
10. *B/A*. Bid-ask spread is used as a stock liquidity proxy. The spread is calculated as the difference between the average ask and bid prices measured over 1 month before the end of Q3 scaled by the average mid-quote over the same period.
11. *D/E*. The ratio represents a company's market debt-to-equity ratio at the end of Q3 of year t.

Table 2. Summary Statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
INV, %	6984	8.2357	9.7983	0	55.1360
ETF, %	7499	5.2551	3.4358	0.2882	14.9350
Mkt Cap, $m	7499	2018.222	971.5383	349.2882	5670.172
Tobin's Q	6935	2.0231	1.4134	0.8441	8.6774
CFO/TA	4227	0.0964	0.0729	0.0002386	0.3943
WACC, %	6557	7.6427	2.0356	1.5972	17.2606
ICC, %	1465	8.8076	2.9072	1.0480	23.5426
AD	3266	2.2094	65.6751	-333.4072	334.9169
Beta(E)	6740	1.1222	0.4373	0.1068	2.4494
SI, %	7499	5.9109	5.4019	0	27.1622
B/A, %	6729	1.5019	3.1794	0.01868	18.0156
D/E	6593	0.4269	0.6357	0	4.1673

5. Results and discussion

In line with Section 3, we establish the effect of ETFs of firm-level investment and subsequently apply mediation to determine the channels through which ETF ownership affects companies in our sample. In order to gain a source of exogenous variation in ETF ownership, we instrument ETF holdings of a stock with Russell 2000 index membership and two powers of log market capitalization (Table 1). We then regress our investment proxy on instrumented ETF ownership while controlling for the size of the company as well as time- and industry-fixed effects. Table 3 shows the results of specification (1). In line with our expectations, we find that a 1 percentage point (pp) increase in the proportion of a company's market capitalization owned by ETFs leads to a 0.699 pp increase in the proportion of CAPEX and R&D relative to assets. The coefficient is statistically significant at the 1% level. Industry membership appears to be a statistically and economically significant determinant of investment and explains part of the positive effect of ETF ownership. However, even after controlling for industry-fixed effects, ETFs continue to influence our investment proxy, implying the presence of other channels of impact than size, time, and industry factors.

We next set out to establish the channels through which ETFs affect investment. As we argued earlier, corporate investment is a product of a company's investment opportunities and

Table 3. ETFs and Investment proxy

$$INV_{it} = \beta_0 + \beta_1 \cdot \widehat{ETF}_{it} + \beta_{2(1;2)} \cdot ln(Mktcap)_{it}^{1;2} + GICS_{it} + \delta_t + \varepsilon_{it}$$

INV is a proxy for a firm's investment activity and is calculated by dividing the sum of NTM Capex and R&D by the total assets at the end of Q3 of year t. $\widehat{ETF}$ (%) is a percentage of a firm's total market capitalization held by exchange-traded funds at the end of Q3 of year instrumented with Russell 2000 membership. Mkt Cap is a firm's market capitalization at the end of May in year t. GICS and Date denote industry- and time-fixed effects respectively.

	(1) *INV*	
$\widehat{ETF}$	0.699***	*(6.46)*
log(Mkt Cap)	-6.297	*(-1.62)*
log(Mkt Cap)^2	0.456*	*(1.73)*
GICS	-	-
Date	-	-
Constant	38.85***	*(2.72)*
R-squared	0.261	
F-statistic	125.6	
Observations	5638	

t statistics in parentheses
* p<0.1, **p<0.05, *** p<0.01

the way it exercises those opportunities, or maps them to investments. Previous literature documented the importance of the governance channel, but did not attempt to establish the role of the investment opportunity set (AGK). We use the method suggested by Baron & Kenny (1986) to test whether the IOS serves as a reliable mediator between ETFs and corporate investment. In order for investment opportunities to be a mediator, ETFs have to significantly affect our IOS proxy, and the proxy, in turn, has to diminish the effect of ETFs on investment when added to specification (1). We regress Tobin's Q, our IOS proxy, on ETFs and the standard control variables (Table 4) and find that a one standard deviation increase in ETF ownership results in a 0.1249 standard deviation increase in Tobin's Q. The coefficient is significant at the 1% level. ETF ownership has a positive and significant effect on the investment opportunity set of a firm. In unreported regressions, we also test for the effect of ETFs on other IOS proxies. We find a similar positive effect in the case of the PBV ratio and no effect in the case of the P/E ratio. The results reported in Tables 3 and 4 lend support to Hypothesis 1. Next, we return to specification (1) and modify it to incorporate the IOS proxy as well as an interaction term between the IOS and ETF ownership to account for the possible effect of changes in corporate governance. We arrive at specification (4) which resolves the mediation relationship between ETF ownership and corporate

Table 4. ETFs and IOS

$$IOS_{it} = \beta_0 + \beta_1 \cdot \widehat{ETF}_{it} + \beta_{2(1;2)} \cdot \ln(Mktcap)_{it}^{\ 1;2} + \beta_3 \cdot GICS_{it} + \delta_t + \varepsilon_{it}$$

Tobin's Q is defined as a firm's market value of assets divided by the book value of assets at the end of Q3 of year t. $\widehat{ETF}$ (%) is a percentage of a firm's total market capitalization held by exchange-traded funds at the end of Q3 of year t instrumented with Russell 2000 membership. Mkt Cap is a firm's market capitalization at the end of May in year t. GICS and Date denote industry- and time-fixed effects respectively.

	(1)	
	Tobin's Q	
$\widehat{ETF}$	0.149***	*(8.46)*
log(Mktcap)	-0.455	*(-0.66)*
log(Mkt Cap)^2	0.0487	*(1.04)*
GICS	-	-
Date	-	-
Constant	1.629	*(0.64)*
R-squared	0.189	
F-statistic	69.16	
Observations	5611	

t statistics in parentheses
* p<0.1, **p<0.05, *** p<0.01

investment and controls for the effect of both possible channels – investment opportunities and corporate governance. Table 5 reports the results. Our IOS proxy is positively related to firm-level investment and is significant at the 1% level. When we add Tobin's Q to the regression of investment on ETF ownership, the coefficient on ETF ownership drops from 0.6991 pp to 0.1149 pp and loses statistical significance. The observed reduction in magnitude and explanatory power implies the presence of a pure mediation relationship between ETF ownership and investment by the means of the investment opportunity set. At the same time, the coefficient on the interaction term is positive, but is not statistically significant, implying the absence of a meaningful change in corporate governance as a result of changes in ETF ownership.

We also perform a robustness check of our results following the causal mediation analysis method suggested by Hicks & Tingley (2011). We find that the average causal mediation effect (ACME) is 66.26% when Tobin's Q is used as the IOS proxy (Appendix B). This value can be interpreted as the proportion of ETFs' effect on corporate investment through their influence on the IOS.

We employ the same mediation methodology to decompose the IOS into a number of individual components and show which of them are affected by ETF ownership. First, we split our IOS proxy into the cost of capital and a measure of future cash flows. We expect these two

Table 5. Mediation through the IOS

$$INV_{it} = \beta_0 + \beta_1 \cdot \widehat{ETF}_{it} + \beta_2 \cdot IOS_{it} + \beta_3 \cdot ETF_{it} \cdot IOS_{it} + \beta_{4(1;2)} \cdot \ln(Mktcap)_{it}^{1;2} + \beta_5 \cdot GICS_{it} + \delta_t + \varepsilon_{it}$$

INV is a proxy for a firm's investment activity and is calculated by dividing the sum of NTM Capex and R&D by the total assets at the end Q3 of year t. $\widehat{ETF}$ (%) is a percentage of a firm's total market capitalization held by exchange-traded funds at the end of Q3 of year t instrumented with Russell 2000 membership. Tobin's Q is defined as a firm's market value of assets divided by the book value of assets at the end of Q3 of year t. Mkt Cap is a firm's market capitalization at the end of May in year t. GICS and Date denote industry- and time-fixed effects respectively.

	(1)	
	INV	
$\widehat{ETF}$	0.115	*(0.63)*
Tobin's Q	1.881***	*(3.66)*
Tobin's Q*$\widehat{ETF}$	0.104	*(1.17)*
log(Mkt Cap)	-5.247*	*(-1.77)*
log(Mkt Cap)^2	0.336*	*(1.68)*
GICS	-	
Date	-	
Constant	36.40***	*(3.31)*
R-squared	0.364	
F-statistic	126.6	
Observations	5593	

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

components to serve as mediators for the effect of ETF ownership on the investment opportunity set. We proxy the cost of capital by the weighted average cost of capital (WACC) and regress it on ETF ownership. Table 6 reports the results. We find that a 1 pp increase in the proportion of the market capitalization owned by ETFs results in a 0.2609 pp increase in the WACC. Consistent with our expectations, a higher level of ETF ownership leads to an increase in firms' cost of capital.

We also proceed with a similar estimation for the measures of future cash flows. Namely, we regress asset durability on ETF ownership. The results reported in Table 7 suggest that ETFs do not have a meaningful effect on the duration of firms' cash flows. ETF ownership appears to have no material impact on corporate short-termism in our sample and for the time frames of our choice. We therefore reject Hypothesis 2. Given that we still expect ETF ownership to influence firms' future cash flows (irrespective of and possibly not through their duration), we construct a simpler future cash flow proxy. Specifically, we scale firms' operating cash flows for the next twelve months by total assets (CFO/TA) and regress this variable on ETF ownership. We find that ETF ownership is positively related to the cash flow proxy. A one standard deviation increase in

Table 6. ETFs and Cost of Capital

$$WACC_{it} = \beta_0 + \beta_1 \cdot \widehat{ETF}_{it} + \beta_{2(1;2)} \cdot \ln(Mktcap)_{it}^{1;2} + \beta_3 \cdot GICS_{it} + \delta_t + \varepsilon_{it}$$

WACC is measured using 1-year forward beta at the end of Q3 of year t. $\widehat{ETF}$ (%) is a percentage of a firm's total market capitalization held by exchange-traded funds at the end of Q3 of year t instrumented by Russell 2000 membership. Mkt Cap is a firm's market capitalization at the end of May in year t. GICS and Date denote industry- and time-fixed effects respectively.

	(1)	
	WACC	
$\widehat{ETF}$	0.2609***	*(10.78)*
log(Mkt Cap)	-1.530**	*(-2.11)*
log(Mkt Cap)^2	0.0754	*(1.57)*
GICS	-	-
Date	-	-
Constant	14.60***	*(5.36)*
R-squared	0.295	
F-statistic	128.3	
Observations	5348	

t statistics in parentheses

* p<0.1, ** p<0.05, *** p<0.01

ETF ownership leads to a 0.1449 standard deviation increase in the ratio of operating cash flows to total assets. The coefficient is significant at the 1% level.

Given that ETFs have a statistically significant effect on both cash flows and the cost of capital, we can proceed with the last step of the mediation analysis. It is possible to claim the existence of a mediation relationship between the IOS and ETF ownership by the means of cash flows and the cost of capital only if the presence of these two components in the regression of an IOS proxy on ETF ownership reduces the significance and magnitude of the latter. Regression results are presented in Table 8. Our proxy for future cash flows is positively and significantly related to the investment opportunity set. A one standard deviation increase in the ratio of operating cash flows to total assets results in a 0.4450 standard deviation increase in Tobin's Q. A one standard deviation increase in the WACC leads to a 0.2681 standard deviation increase in Tobin's Q. Both coefficients are significant at the 1% level. We interpret the positive coefficient on the cost of capital as consistent with the fact that risky firms with a high WACC (e.g. tech companies) have more investment opportunities available to them. In line with our findings, Frank & Shen (2015) arrive at the conclusion that CAPM-based cost of capital measures (WACC) indeed have a positive and significant coefficient in regressions where an IOS measure is used as the

Table 7. ETFs and Cash Flow Measures

$$CF_{it}|AD_{it} = \beta_0 + \beta_1 \cdot \widehat{ETF}_{it} + \beta_{2(1;2)} \cdot \ln(Mktcap)_{it}^{1;2} + \beta_3 \cdot GICS_{it} + \delta_t + \varepsilon_{it}$$

Asset durability is defined as NTM CAPEX scaled by its depreciation measured at the end of Q3 of year t. CFO/TA if defined as NTM operating cash flow scaled by total assets measures at the end of Q3 of year t. $\widehat{ETF}$ (%) is a percentage of a firm's total market capitalization held by exchange-traded funds at the end of Q3 of year t instrumented by Russell 2000 membership. Mkt Cap is a firm's market capitalization at the end of May in year t. GICS and Date denote industry- and time-fixed effects respectively.

	(1)		(2)	
	Asset Durability		CFO/TA	
$\widehat{ETF}$	-0.202	*(-0.17)*	0.00932***	*(8.21)*
log(Mkt Cap)	34.36	*(0.59)*	-0.0355	*(-0.89)*
log(Mkt Cap)^2	-2.489	*(-0.64)*	0.00179	*(0.68)*
GICS	-	-	-	-
Date	-	-	-	-
Constant	-100.5	*(-0.47)*	0.303**	*(2.04)*
R-squared	0.008		0.188	
F-statistic	0.865		26.28	
Observations	2802		3569	

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

dependent variable. They argue that this result is driven by WACC's failure to properly account for the growth opportunities available to the firm. Likewise, since a relatively higher percentage of outstanding market capitalization is held by passively-managed ETFs for each Russell 2000 company than for a similar Russell 1000 stock, when a stock moves to the former index, ETFs will pile in, increasing the demand for the company's shares. Absent a fundamental change in the company's prospects and assuming *a flat demand curve for stocks*, the price of the company's shares should not change. If the demand curve, by contrast, is downward sloping (most prominently shown by Shleifer (1986), whose methodology shares the spirit of ours), even a plausibly information-free spike in buying pressure will lead to abnormal returns and a lasting increase in valuation. Shleifer (1986) uses stock inclusions in the S&P 500 index to instrument an exogenous change in demand, explicitly referring to buying pressure by index funds. These non-fundamental price effects can explain part of the observed sharp increase in the valuations of companies (proxied by e.g. Tobin's Q) in the top part of Russell 2000 (Table 8), *despite* an increase in the cost of capital (complementing the explanation about the omitted growth factor that ETFs

Table 8. IOS determinants

$$IOS_{it} = \beta_0 + \beta_1 \cdot \widehat{ETF}_{it} + \beta_2 \cdot CF_{it} + \beta_3 \cdot WACC_{it} + +\beta_{4(1;2)} \cdot \ln(Mktcap)_{it}^{1;2} + \beta_5 \cdot GICS_{it} + \delta_t + \varepsilon_{it}$$

Tobin's Q is defined as a firm's market value of assets divided by the book value of assets at the end of Q3 of year t. $\widehat{ETF}$ (%) is a percentage of a firm's total market capitalization held by exchange-traded funds at the end of Q3 of year t instrumented by Russell 2000 membership. CFO/TA if defined as NTM operating cash flow scaled by total assets measures at the end of Q3 of year t. WACC is measured using 1-year forward beta at the end of Q3 of year t. Mkt Cap is a firm's market capitalization at the end of May in year t. GICS and Date denote industry- and time-fixed effects respectively.

	(1)	
	Tobin's Q	
$\widehat{ETF}$	0.0271	*(1.57)*
CFO/TA	7.488***	*(19.61)*
WACC	0.175***	*(12.09)*
log(Mkt Cap)	-1.768**	*(-2.29)*
log(Mkt Cap)^2	0.148***	*(2.82)*
GICS	-	-
Date	-	-
Constant	3.761	*(1.33)*
R-squared	0.401	
F-statistic	48.5	
Observations	3426	

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

might affect, causing a historical measure of the cost of capital and investment opportunities to move in one direction).

Despite the rather unintuitive relationship between our IOS proxy and the WACC, the coefficient on ETFs becomes statistically insignificant and falls in magnitude from 0.1495 to

0.0271, implying the presence of pure mediation between ETF ownership and the IOS by the means of cash flows and the cost of capital. The mediation through the WACC accounts for app. 22.55% of the total effect of ETF ownership on IOS, while the same figure for operating cash flows stands at 37.92%.

In Table 9, we replicate the results presented in Table 8 using the implied cost of capital (ICC) instead of the WACC to obtain a more intuitive negative relationship between the IOS and the cost of capital. The ICC is backed out of the forecast of future earnings and current valuation for each observation in our sample (Appendix A), following the method suggested by Gebhardt, Lee & Swaminathan (2001). Consistent with our expectations, we observe a negative relationship between the ICC and IOS proxy since the implied cost of capital strips out the growth component of the WACC. A one standard deviation increase in the ICC results in a 0.2815 standard deviation decrease in Tobin's Q. Finally, we reject Hypothesis 3 given the fact that our principal cost of capital proxy (WACC), which is positively influenced by ETF ownership, is associated with an increase in companies' investment opportunity sets.

As the final step, we split the cost of capital into a number of its determinants and test for the effect of ETF ownership on these variables. We first regress firms' forward equity beta, short interest, and bid-ask spread on ETF ownership and standard controls. The results are reported in Table 10. ETF ownership has a positive and significant effect on forward equity beta. A one standard deviation increase in ETF ownership results in a 0.1306 standard deviation increase in the beta. The coefficient is significant at the 1% level. We interpret this result as a consequence of excess comovement with the Russell 2000 index that might be introduced by ETFs. A seminal paper by Barberis et al (2005) proposes three distinct theories for explaining the phenomenon of comovement. First, the company's fundamentals may become more similar to those of its peers from the index, which would justify the increase in comovement. Second, some noise traders invest in an index to express their views regarding an entire asset class or group's future. As their collective but noisy sentiment changes, they will indiscriminately and symmetrically buy or sell all securities in the index, thereby leading to a second type of comovement. Related to this is a habitat view, wherein investors' decisions depend on their liquidity, risk-aversion, and sentiment parameters. As these parameters change for all or many investors, they will buy or sell securities, causing their prices to co-move. Third, an information diffusion view posits that some groups of stocks reflect market-wide information faster than others but that reactions tend to be fairly

Table 9. ICC

$$IOS_{it} = \beta_0 + \beta_1 \cdot \widehat{ETF}_{it} + \beta_2 \cdot CF_{it} + \beta_3 \cdot ICC_{it} + \beta_{4(1;2)} \cdot \ln(Mktcap)_{it}{}^{1;2} + \beta_5 \cdot GICS_{it} + \delta_t + \varepsilon_{it}$$

Tobin's Q is defined as a firm's market value of assets divided by the book value of assets at the end of Q3 of year t. $\widehat{ETF}$ (%) is a percentage of a firm's total market capitalization held by exchange-traded funds at the end of Q3 of year t instrumented by Russell 2000 membership. CFO/TA if defined as NTM operating cash flow scaled by total assets measures at the end of Q3 of year t. ICC is calculated as per the methodology of Gebhardt, Lee & Swaminathan (2001) at the end of Q3 of year t. Mkt Cap is a firm's market capitalization at the end of May in year t. GICS and Date denote industry- and time-fixed effects respectively.

	(1)	
	Tobin's Q	
$\widehat{ETF}$	0.0412*	*(1.74)*
CFO/TA	7.405***	*(14.77)*
ICC	-0.105***	*(-8.65)*
log(Mkt Cap)	-5.743***	*(-4.05)*
log(Mkt Cap)^2	0.392***	*(4.12)*
GICS	-	-
Date	-	-
Constant	22.23***	*(4.18)*
R-squared	0.457	
F-statistic	31.9	
Observations	1361	

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

homogenous within such groups. In our case, in line with the findings of Barberis et al (2005), we find it unlikely that our company's cash flows will become more correlated with those of its new index peers (hence the fundamental channel may be assigned a lower importance). We find it very likely though that some non-fundamental ("friction-" or "sentiment-based") comovement is at play here. Other things equal, comovement should be stronger when a greater fraction of the stock's outstanding market capitalization is owned by index funds. Furthermore, the argument appears particularly potent if one bears in mind the fact that Russell 2000 is very widely used as an index tracking US small cap stocks, whilst Russell 1000 is often considered to be more broad than the other large-cap indices (rendering it a less useful tool for placing bets on specific market moves). Thus, one can intuitively expect relatively more index-level noisy trade-flow in Russell 2000, leading to a more pronounced comovement among its constituents.

Consistent with our expectations, ETF ownership has a positive and significant effect on the volume of short-selling. A 1pp increase in the proportion of market capitalization owned by ETFs leads to a 0.792 pp increase in the proportion of market capitalization sold short. The coefficient is significant at the 1% level. If the relationship is interpreted as causal, this result suggests that ETFs lend about 80% of their marginal holdings of a stock to short-sellers. It is also in line with the findings of Bansal, McKeon & Svetina (2013). At the same time, contrary to our hypothesis, ETF ownership has a negative and significant effect on companies' bid-ask spreads, suggesting an improvement in stock liquidity. While previous research reports contradictory findings in relation to ETFs' effect on stock liquidity, our results are consistent with Bae, Kang & Wang (2012) who suggest that an improvement in the liquidity of the stocks held by ETFs might come as a result of an increased short-selling activity. Having obtained these results, we fail to reject Hypotheses 4 and 5, while dismissing Hypothesis 6.

Table 10. Cost of Capital Determinants

$$Beta(E)_{it}|SI_{it}|BA_{it} = \beta_0 + \beta_1 \cdot \widehat{ETF}_{it} + \beta_{2(1;2)} \cdot \ln(Mktcap)_{it}^{1;2} + \beta_3 \cdot GICS_{it} + \delta_t + \varepsilon_{it}$$

Beta (E) is 1-year forward beta at the end of Q3 of year t. SI is the percentage of a stock's market capitalization sold short at the end of Q3 of year t. B/A is the average bid-ask spread measured over 1 month before the end of Q3 of year t. $\widehat{ETF}$ (%) is a percentage of a firm's total market capitalization held by exchange-traded funds at the end of Q3 of year t instrumented by Russell 2000 membership. Mkt Cap is a firm's market capitalization at the end of May in year t. GICS and Date denote industry- and time-fixed effects respectively.

	(1)		(2)		(3)	
	Beta(E)		SI		BA	
$\widehat{ETF}$	0.0460***	*(8.79)*	0.792***	*(12.21)*	-0.00186***	*(-5.44)*
log(Mkt Cap)	-0.470***	*(-2.78)*	3.010	*(1.32)*	-0.0246	*(-1.52)*
log(Mkt Cap)^2	0.0231**	*(2.07)*	-0.389***	*(-2.59)*	0.00178*	*(1.71)*
GICS	-	-	-	-	-	-
Date	-	-	-	-	-	-
Constant	3.130***	*(4.90)*	-3.061	*(-0.35)*	0.129**	*(2.06)*
R-squared	0.219		0.202		0.236	
F-statistic	91.8		60.11		39.41	
Observations	5486		5948		5467	

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

In order to complete the mediation, we regress WACC on ETF ownership and the channels outlined above. Additionally, we control for capital structure (leverage) to make the coefficient on equity beta reflect companies business risk and to a lesser extent their capital structure. ETFs may affect the market leverage ratio for at least two reasons. Firstly, if they affect equity valuation positively and proportionally more than the value of debt, the D/E ratio will automatically fall. Secondly, if ETFs expand firms' investment opportunities and thus prompt them to invest more, firms will naturally need funding to do so. The pecking order theory of capital structure posits that upon depleting their excess cash reserves, firms will turn to debt as a means of financing, and will only tap the equity market as the last resort. The coefficient on ETFs loses statistical significance in specification (6) presented in Table 11, implying the presence of a mediation relationship between the cost of capital and ETF ownership by the means of equity beta, short interest, and stock liquidity. It also drops in magnitude from 0.2609 in the regression without channels to 0.00156 in the presence of mediators. All coefficients on the channels are statistically significant (Table 11).

The effect of equity beta on the WACC is positive, which is consistent with the fact that companies with more systematic risk have a higher cost of capital. A one standard deviation increase in the equity beta leads to a 0.7790 standard deviation increase in the WACC. The coefficient on the bid-ask spread is negative, implying a negative effect of stock illiquidity on the IOS (since the WACC is positively related to the IOS). This result is consistent with the fact that illiquidity puts a premium on a company's cost of capital and makes financing more expensive, which, in turn, reduces the set of available investment opportunities. (Amihud & Mendelson, 1986). Short interest has a positive effect on the WACC and IOS. The result is rather surprising and contradicts existing evidence that an increase in short selling leads to lower stock prices and investment by removing the artificial discount on the cost of capital introduced by the presence of short selling constraints (Gilchrist, Himmelberg & Huberman, 2005). We attribute part of these findings to our choice of the sample. Grullon, Michenaud, & Weston (2015) find that the effect of short selling on companies' cost of capital and investment decisions depends on the size of the firm and is stronger for small companies which are more difficult to short. Given that our sample only includes companies at the bottom of Russell 1000 and at the top of Russell 2000, we believe that the effect of short-selling on the cost of capital and IOS may not be representative of the wider population of companies, because all firms in the sample are relatively large and thus likely not very difficult to short. An alternative and perhaps more important explanation of the observed relationship is a potential omitted variable (e.g. growth-related) between short interest (strongly related to index membership), the cost of capital, and investment opportunities. Finally, the coefficient on D/E is negative. The direction of the causal link is ambiguous. On the one hand, firms with more growth opportunities tend to use less leverage to attenuate potential agency conflicts that may arise when managers choose high levels of investment (Myers, 1977). On the other hand, companies with a higher level of leverage may be strained by the costs associated with the prospect of bankruptcy and will thus tend to invest less. The channels are also different in terms of their mediating power. About 54.75% of the total effect of ETFs on the WACC is attributable to the market beta. On the other hand, short interest and bid-ask spreads explain 30.04% and 7.10% of this effect respectively.

In sum, our analysis documents the existence of a mediation relationship between ETF ownership and firms' cash flows and the cost of capital. The effect of ETFs on these factors improves firms' investment opportunity set, which in turn increases investment. Our mediation model suggests that around 60% of the ETF-induced improvement in the IOS is attributable to ETF's impact on firms' cash flows and the cost of capital. Unlike previous literature on the topic, we find no statistically significant effect of ETF ownership on companies' corporate governance.

Finally, the design of this study allows us to resolve a highly important issue of reverse causality that would otherwise severely challenge the validity of our findings. This design, however, is not faultless and deserves criticism or a critical assessment on a number of fronts. A cornerstone assumption on which our design is predicated is that markets are efficient at pricing the securities in our sample. Most immediately, this implies that a change in a company's valuation should always be caused by either a change in future expected cash flows or a change in the discount rate that is applied to these cash flows. Armed with the parsimony of this simplification, we decompose the cost of capital and cash flows into their respective *fundamental* components (whenever possible) and track the impact of ETFs on these components. Upon a more careful review, our assumption of efficient pricing might be somewhat far-fetched. The issue we encounter is that by using a bandwidth of companies around the cut-off point of two major indices, we are exposed to potential *systematic* mispricings of the equity market. Namely, as we have argued before, an increase in the equity beta caused by ETFs may in part reflect a fundamental convergence in business risks across companies, an increase in the riskiness of the company's investment projects, and non-fundamental sentiment-driven comovement. Similarly, a positive association between the WACC and investment opportunities may partly reflect growth prospects and partly be a mechanical result of an increase in the investment opportunities proxy driven by a higher valuation. Corroborating the suggestion that this is indeed so is the fact that we observe a larger increase in betas for companies with lower betas, in line with Claessens & Yafeh (2012)

Table 11. Mediation through WACC determinants

$$WACC_{it} = \beta_0 + \beta_1 \cdot \widehat{ETF}_{it} + \beta_2 \cdot Beta_{it} + \beta_3 \cdot SI_{it} + \beta_4 \cdot BA_{it} + \beta_{5(1;2)} \cdot \ln(Mktcap)_{it}^{1;2} + \beta_6 \cdot DE_{it} + \beta_7 \cdot GICS_{it} + \delta_t + \varepsilon_{it}$$

WACC is measured using 1-year forward beta at the end of Q3 of year t. $\widehat{ETF}$ (%) is a percentage of a firm's total market capitalization held by exchange-traded funds at the end of Q3 of year t instrumented by Russell 2000 membership. Beta (E) is 1-year forward beta at the end of Q3 of year t. SI is the percentage of a stock's market capitalization sold short at the end of Q3 of year t. B/A is the average bid-ask spread measured over 1 month before the end of Q3 of year t. D/E is a firm's market debt-to-equity ratio at the end of Q3 of year t. Mkt Cap is a firm's market capitalization at the end of May in year t. GICS and Date denote industry- and time-fixed effects respectively.

	(1)	
	WACC	
$\widehat{ETF}$	0.00156	*(0.14)*
Beta(E)	3.774***	*(81.56)*
SI	0.00930***	*(4.06)*
B/A	1.866***	*(3.12)*
D/E	-1.524***	*(-28.72)*
log(Mkt Cap)	-0.493	*(-1.16)*
log(Mkt Cap)^2	0.0354	*(1.27)*
GICS	-	-
Date	-	-
Constant	6.597***	(4.09)
R-squared	0.861	
F-statistic	661.2	
Observations	5337	

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

who study comovement using index inclusions around the world. We believe that these market-driven non-fundamental effects complement the factors we study in this paper and might be to a large extent reflected in the results we obtain. With this, we do not attempt to provide an exhaustive analysis of the complex factors at play, but merely seek to provide a more holistic explanation for our results. We invite further studies on this topic to bridge the gap between the long-run considerations of the effects of ETFs on investments provided in this paper and the short-run analysis of the non-fundamental effects of index reconstitutions.

6. Conclusion

Our study seeks to advance the current understanding of the impact of investors on corporate policies. Moreover, it comes at a crucial time for the investment industry, as ETFs have grown rapidly over the last 15 years and appear poised to continue their quest for supremacy as a highly efficient and increasingly flexible investment vehicle. The "blanket" approach to investing in diversified baskets of stocks employed by many equity ETFs has been subject to intense criticism on the grounds that the efficiency of market prices should not be taken for granted. Systematic distortions in market prices may affect a number of real company-level variables that have a meaningful and widespread impact on the broader economy and society. The exact firm-level real variable of interest to the present study is corporate investment.

We document a positive causal relationship between ETF ownership of companies' shares and corporate investment. By generating exogenous variation in ETF ownership using a break in this variable between the Russell 1000 and 2000 indices, we show that ETFs tend to expand companies' investment opportunities while largely not affecting their corporate governance. We explore the former finding in greater detail and show that ETFs increase both future cash flows and the cost of capital. Perplexingly, the rise in the cost of capital serves to expand investment opportunities and investment. We propose several explanations for this rather unintuitive relationship. Broadly, these explanations are predicated on two distinct premises with respect to market efficiency: one that ETFs may increase the riskiness *and* size of future cash flows of firms and the other that ETFs lead to at least two departures from efficient pricing, comovement with the market and an increase in valuations driven by the downward sloping demand curve for stocks.

While these results help us partially alleviate immediate concerns about the deleterious effects of ETFs on the real economy, they in no way counsel complacency. Firstly, investment is not the only real variable that ETFs may affect. Agency costs, financing decisions, and capital structure are examples of such variables. Ultimately, changes in these parameters may have a protracted impact on the operating activities of companies, affecting sectors, markets, and economies. Secondly, our results leave us with an issue akin to the joint hypothesis problem: is the increase in investment opportunities caused by ETFs driven by an increase in future expected cash flows or is it merely driven by an exogenous increase in the demand for stocks? Our methodology allows us to establish the direction, magnitude, and channels through which ETFs affect investment, but it only allows us to go thus far. A search for finer instruments and methods that allow for discerning between fundamental and non-fundamental channels of influence could yield valuable implications for investors, policy-makers, and corporate managers. For now, we conclude by advising investors to continue using index-tracking ETFs as a detour around the high fees of active managers and corporate executives to seize on the elevated valuations and invest in profitable investment projects to drive the organic growth of their companies reflected in their market prices.

7. References

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8. Appendices

8.1 Appendix A. Implied cost of capital estimation

We derive the implied cost of capital (ICC) using a methodology proposed by Gebhardt, Lee & Swaminathan (2001) and adopted by Hou, van Dijk & Zhang (2012). The adaptation relies on a model for forecasting net earnings proposed by Fama and French (2000). We do not report interim results and estimations for the sake of brevity.

The technique of estimating the ICC proposed by Gebhardt et al (2001) uses the residual income model of company valuation and a company's actual market value to back out the cost of its equity capital. In the general form, the residual income model assumes the following:

$$M_{i,t} = B_{i,t} + \sum_{k=1}^{\infty} \frac{E_t\left[\left(ROE_{i,t+k} - R_i\right) \cdot B_{i,t+k-1}\right]}{(1 + R_i)^k}$$

where *M* denotes the market value of equity, *B* – its book value, and *R* – the required return on equity (the cost of equity).

Following Gebhardt et al (2001), we divide the earnings forecasting timeline in 3 parts. First, we explicitly forecast net earnings for the next 3 years. Next, we assume that from year 4 to year 11 earnings steadily mean-revert to the industry mean. From year 12 onwards, we assume that net earnings become a perpetuity. To forecast future earnings for the first three years (T=1, 2, and 3), we estimate the following pooled cross-sectional regressions for each year t in the sample for the previous 5 years:

$$NI_{i,t+T} = \beta_0 + \beta_1 \cdot M_{i,t} + \beta_2 \cdot TA_{i,t} + \beta_3 \cdot D_{i,t} + \beta_4 \cdot DD_{i,t} + \beta_5 \cdot NI_{i,t} + \beta_6 \cdot NegNI_{i,t} + \beta_7 \cdot ChangeWC_{i,t} + \varepsilon_{it}$$

where *NI* is net income, *M* – market value of equity, *TA* – total assets, *D* – dividends paid, *DD* – a dummy taking the value of 1 if the firm made a positive payout in year t, *NegNI* – a dummy taking the value of 1 if the firm's earnings were negative in year t, *ChangeWC* – the change in working capital to reflect changes in operating accruals.

Having estimated the required inputs, we solve the above equation for the cost of equity for each company in each year in the sample (a total of 7500 equations). Finally, we use market leverage and the after-tax cost of debt to compute the ICC.

8.2 Appendix B. Bootstrap simulation

Table 12. Bootstrap simulation
(100 reps)

The results of bootstrap estimations for quantifying the magnitude of mediation effects. The proportion (%) of the total effect mediated is reported along with the 95% confidence interval for the 3 mediation analyses in the study.

Mediation analysis 1: ETF--TQ--INV
Independent (treatment) variable: **ETF**
Dependent variable: **INV**

Mediator	Effect	Mean	95% Confidence Interval	
IOS				
	ACME*	0.4633	0.3718	0.5534
	Direct Effect	0.2374	0.0374	0.4322
	Total Effect	0.7006	0.4963	0.9059
	% of Tot Eff mediated	66.26%	51.14%	93.35%

Mediation analysis 2: ETF—WACC| CFOTA--IOS
Independent (treatment) variable: **ETF**
Dependent variable: **IOS**

Mediator	Effect	Mean	95% Confidence Interval	
WACC				
	ACME	0.0361	0.0250	0.0471
	Direct Effect	0.1239	0.0894	0.1575
	Total Effect	0.1600	0.1236	0.1952
	% of Tot Eff mediated	22.55%	18.49%	29.20%
CFO/TA				
	ACME	0.0531	0.0354	0.0705
	Direct Effect	0.0869	0.0524	0.1205
	Total Effect	0.1400	0.1032	0.1780
	% of Tot Eff mediated	37.92%	29.83%	51.42%

Mediation analysis 3: ETF--Beta (E)| SI| BA--WACC
Independent (treatment) variable: **ETF**
Dependent variable: **WACC**

Mediator	Effect	Mean	95% Confidence Interval	
Beta (E)				
	ACME	0.0975	0.0610	0.1309
	Direct Effect	0.0808	0.0466	0.1141
	Total Effect	0.1783	0.1313	0.2239
	% of Tot Eff mediated	54.75%	43.53%	74.24%
SI				
	ACME	0.0537	0.0416	0.0661
	Direct Effect	0.1248	0.0667	0.1813
	Total Effect	0.1785	0.1237	0.2306
	% of Tot Eff mediated	30.04%	23.29%	43.42%
BA				
	ACME	0.0129	0.0079	0.0187
	Direct Effect	0.1686	0.1212	0.2148
	Total Effect	0.1815	0.1354	0.2275
	% of Tot Eff mediated	7.10%	5.67%	9.52%

* ACME - average causal mediation effect.

8.3 Appendix C. Interim steps of mediation analysis

Table 13. Interim steps of mediation analysis

$$INV_{it} = \beta_0 + \beta_1 \cdot IOS_{it} + \beta_{2(1;2)} \cdot ln(Mktcap)_{it}^{1;2} + GICS_{it} + \delta_t + \varepsilon_{it}$$

$$IOS_{it} = \beta_0 + \beta_1 \cdot WACC_{it} + \beta_2 \cdot CF_{it} + \beta_{3(1;2)} \cdot \ln(Mktcap)_{it}^{1;2} + \beta_4 \cdot GICS_{it} + \delta_t + \varepsilon_{it}$$

$$WACC_{it} = \beta_0 + \beta_1 \cdot Beta_{it} + \beta_2 \cdot SI_{it} + \beta_3 \cdot BA_{it} + \beta_3 \cdot DE_{it} + \beta_{4(1;2)} \cdot \ln(Mktcap)_{it}^{1;2} + \beta_5 \cdot GICS_{it} + \delta_t + \varepsilon_{it}$$

INV is a proxy for a firm's investment activity and is calculated by dividing the sum of NTM Capex and R&D by the total assets at the end Q3 of year t. Tobin's Q is defined as a firm's market value of assets divided by the book value of assets at the end of Q3 of year t. CFO/TA if defined as NTM operating cash flow scaled by total assets measures at the end of Q3 of year t. WACC is measured using 1-year forward beta at the end of Q3 of year t. Beta (E) is 1-year forward beta at the end of Q3 of year t. SI is the percentage of a stock's market capitalization sold short at the end of Q3 of year t. B/A is the average bid-ask spread measured over 1 month before the end of Q3 of year t. D/E is a firm's market debt-to-equity ratio at the end of Q3 of year t. Mkt Cap is a firm's market capitalization at the end of May in year t. GICS and Date denote industry- and time-fixed effects respectively.

	(1)		(2)		(3)	
	INV		Tobin's Q		WACC	
Tobin's	2.512***	*(20.04)*	-		-	
WACC	-		0.178***	*(12.35)*	-	
CFO/TA	-		7.537***	*(19.86)*	-	
Beta (E)	-		-		3.775***	*(82.76)*
SI	-		-		0.009***	*(4.11)*
B/A	-		-		1.863***	*(3.13)*
D/E	-		-		-1.525***	*(-28.92)*
log(Mkt Cap)	-3.676	*(-1.31)*	-1.531**	*(-2.07)*	-0.485	*(-1.16)*
log(Mkt Cap)^2	0.244	*(1.29)*	0.133***	*(2.65)*	0.0349	*(1.27)*
Constant	30.180***	*(2.88)*	2.930	*(1.08)*	6.570***	*(4.13)*
R-squared	0.362		0.401		0.861	
F-statistic	135.2		50.22		681.7	
Observations	5593		3426		5337	

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01