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Three Essays on Market Efficiency and Corporate Diversification

Fawzi Jaber Hyder
University of Central Florida

THREE ESSAYS ON MARKET EFFICIENCY AND CORPORATE DIVERSIFICATION

by

FAWZI J. HYDER
M.B.A. Lebanese American University, 2008
B.A. Lebanese University, 2004
B.A. Lebanese University, 2001

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ABSTRACT

In my first essay, I use additions to the S&P 500 index as a laboratory to investigate how the interaction between arbitrageurs and arbitrage risk affects security prices. I find that the price effect is strong when there is high arbitrage risk (as measured by the lack of close substitutes) and low presence of arbitrageurs (as measured by low ownership by active institutions). Furthermore, a strong presence of arbitrageurs moderates the effect of arbitrage risk on the post-addition price reaction of added stocks. I also find a significant decrease in arbitrageurs' ownership in the added stocks post addition. More importantly, this decrease is accompanied by a significant increase in arbitrageurs' ownership in the added stocks' close substitutes.

My second essay examines the sensitivity of investments to changes in investment opportunities for diversified and for single-segment firms. Because many concerns have been raised about existing proxies of investment opportunities, I introduce and examine the empirical performance of a new proxy based on financial analysts' earnings forecasts. The findings are consistent with the idea that firms respond efficiently to changes in investment opportunities. I find that firms increase (decrease) their capital expenditures when there is a favorable (unfavorable) change in opportunities. In addition, I find that diversified firms are more sensitive to changes in investment opportunities than are single-segment firms and that much of the difference in investment behavior between the two types of firms is explained by changes in investment opportunities. My findings are consistent with the idea that, when compared to single-segment firms, diversified firms use their larger internal capital markets and enjoy a less constrained response to changes in investment opportunities. The overall findings are in contrast to existing evidence that diversified firms allocate resources inefficiently.

In my third essay, I investigate how the diversification discount depends on internal and external governance control mechanisms. The study uses CEO power to measure internal control and institutional ownership to measure external control. I find that CEO power has a negative effect on firm value and that this effect is greater for diversified firms. I also find that while institutional ownership is positively related to the value of single-segment firms it is not significantly related to the value of multi-segment firms. The overall findings that the diversification discount is more pronounced for firms with weaker internal and external governance control mechanisms support the hypothesis that governance control mechanisms are less effective in diversified firms than in single-segment firms.

For Rawia, Leya Alondra and Leonardo.

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1. Introduction

In a perfect financial market, any price deviation from fundamental value can be arbitraged away. However, limits to arbitrage may hinder investors' ability to deploy effective arbitrage strategies (Mitchell, Pulvino and Stafford, 2002; Stambaugh, Yu, and Yuan 2015). One of the major limitations to arbitrage is the lack of perfect substitutes. When perfect substitutes are unavailable, arbitrageurs may be reluctant to explore arbitrage opportunities as they become more vulnerable to arbitrage risk (Wurgler and Zhuravskaya, 2002). In this paper, we investigate how arbitrage risk and the presence of arbitrageurs jointly affect asset prices, because the execution of any arbitrage strategy requires existence of arbitrageurs.

The role of arbitrage risk has been extensively examined in finance literature. Arbitrage risk is closely related to the existence of perfect substitutes for a given security. Scholes (1972) highlights the critical role of perfect substitutes in absorbing supply shocks to a given security; he states that "the shares a firm sells are not unique works of art but abstract rights to an uncertain income stream for which close counterparts exist either directly or indirectly via combinations of assets of various kinds" (1972, p. 179). Brunnermeier and Nagel (2004) argue that the technology bubble is caused by arbitrageurs' inability to find close substitutes to hedge short positions in the technology sector. On the other hand, the role of arbitrageurs has not been fully understood. Although some theoretical models predict a major role of arbitrageurs (Dow and Gorton 1994;

Abreu and Brunnermeier 2002, 2003), empirical studies focus mostly on arbitrage risk effects and neglect the role of arbitrageurs.[1] Part of the reason behind this lack of empirical testing may stem from the difficulty in measuring arbitrageurs' presence in a given market as well as the level of their interest in a given arbitrage setting. Nevertheless, their pre-ownership levels in the mispriced security still serves as a good proxy for their interest in the security. First of all, arbitrageurs may be more likely to take action as any significant price deviation is going to affect the value of their current holdings. Furthermore, high ownership levels by arbitrageurs signals high arbitrageurs' interest in that security.

Arbitrageurs are professional and highly specialized investors who are expected to take advantage of any opportunity that may arise in the market (Shleifer and Vishny 1997). Moreover, they are well positioned to deploy effective strategies and better equipped to handle arbitrage risk. The collective action of a "very large number of tiny arbitrageurs" will keep stock prices at their fundamental values (Shleifer and Vishny 1997). Therefore, the presence of arbitrageurs may limit stock prices' deviation for a given level of arbitrage risk. As the number of arbitrageurs increases, the competition among them may intensify and they may aggressively react to any mispricing, which may drive stock prices back to their fundamental values at a faster pace. Therefore, not only are they more likely to apply effective strategies, but also those strategies are more likely to succeed.

[1] Few empirical studies assess the role of arbitrageurs in the price formation process such as Brunnermeier and Nigel (2004) who investigate hedge funds role around the dotcom bubble. While other studies use the presence of potential arbitrageurs' to indirectly measure some aspects of arbitrage risk; D'Avolio (2002), Nagel (2005), and Hirshleifer, Teoh and Yu (2011) use institutional ownership as a proxy for ease of short selling.

In this essay, we use additions to the S&P 500 index as the laboratory to examine the direct effect of potential arbitrageurs on securities' prices and the extent to which they are restricted by the availability of close substitutes. We use active institutional investors as a proxy for arbitrageurs; for the remainder of the paper the two terms are used interchangeably. We examine arbitrageurs' trading behavior as well as the price reaction around S&P 500 index additions. One interesting thing about index inclusions is that the decisions about inclusion are not made by the added firms. As a result, a significant portion (if not all) of the demand for shares of the stocks newly added to the index is caused by passive index funds whose main goal is to minimize the tracking error. Additions to the S&P 500 are typically accompanied by a permanent positive price reaction (Shleifer 1986; Wurgler and Zhuravskaya, 2002; Chen, Noronha and Singal 2004). However, we expect this price reaction to vary significantly based on the interaction of arbitrage risk and arbitrageurs presence. With the availability of close substitutes (low arbitrage risk), arbitrageurs can trade away price movements unaccompanied by information and keep added stocks closer to their fundamental values. On the other hand, high arbitrage risk coupled with weak presence of arbitrageurs may trigger a significant price reaction.

We find that the strong presence of arbitrageurs pre-addition limits the post-addition price reaction. Furthermore, the enhanced ability of arbitrageurs to handle arbitrage risk weakens the effect of arbitrage risk on abnormal returns following index additions. We also find that arbitrageurs strategically shift away from the added stock towards its close substitutes. In the two quarters following the addition announcement, arbitrageurs sell on average 0.86% of the shares outstanding of the added firm while adding about 0.70% of the outstanding shares of each of the top three closest substitutes. Finally, we find that the post-addition price reaction is greater when the addition announcement is more likely to reflect positive information specific to the added firm.

Wurgler and Zhuravskaya (2002) are the first to explore the effect of arbitrage risk on stock returns in index additions. They show theoretically and empirically that cumulative abnormal returns following additions to the index increase in arbitrage risk. Although they predict a major role for arbitrageurs in limiting the post-addition price reaction, they do not empirically examine the effect of their presence on abnormal returns. On the other hand, few studies assess institutional investors' role in S&P 500 additions and mainly focus on the trading behavior of index funds and that of liquidity suppliers.[2] Ye (2012) highlights the role of active institutional investors in limiting the excess comovement of added stocks in the long-run. He finds a negative relationship between comovement and active institutional ownership; when the added stock has higher active institutional ownership post-addition, the anomalous comovement effect decreases significantly.

Our paper adds to the growing literature on arbitrage risk and limits to arbitrage (Shleifer, and Vishny, 1997; Mitchell, Pulvino, and Stafford, 2002; Wurgler and Zhuravskaya 2002; Hirshleifer, Teoh and Yu 2011; Stambaugh, Yu, and Yuan 2015). We also connect to the large literature on index inclusion and its effect on stock returns (Shleifer 1986; Harris and Gurel 1986; Kaul, Mehrotra, and Morck 2000; Denis, McConnell, Ovtchinnikov, and Yu 2003; Chen, Noronha and Singal 2004) as well as the literature on market efficiency especially studies dealing with the

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[2] Pruitt and Wei (1989) examine the changes in institutional ownership around S&P 500 additions and find that the increased demand by index funds is mainly supplied by non-index institutional investors. Using transaction level data, Green and Jame (2011) find that index funds trade strategically around S&P 500 additions. To reduce the price impact of their trades, index funds adds around 50% of the shares before or after the effective date. The authors also find that small and mid-cap funds are the major liquidity providers around additions.

slope of demand curves for individual stocks (Scholes 1972; Kraus and Stoll 1972; Mikkelson and Partch 1985; Holthausen, Leftwich and Mayers 1990). Our study is also related to the category of papers assessing the availability of perfect substitutes as well as the implications of additions on perfect substitutes returns (Wurgler and Zhuravskaya 2002; Cai 2007; Ahern 2012). Finally, our paper adds to the literature on the role of active institutional investors in the price formation process (Lakonishok, Shleifer and Vishny 1992; Sias, Starks and Titman 2006; Ye 2012).

The rest of the paper is organized as follows. Section 2 discusses the interaction of arbitrage risk and arbitrageurs' presence pre-addition announcements based on the information content in additions announcements and its effect on abnormal returns post-addition. Section 3 summarizes related literature on arbitrage risk and on additions to S&P 500 index. Section 4 contains our samples and the methodology we use to get our main variables. In Sections 5 and 6, we present our empirical analysis results and our robustness tests respectively. Finally, we conclude in Section 7.

2. The Interaction of Arbitrageurs and Arbitrage Risk

Arbitrageurs can mainly take advantage of any significant price deviation following index additions by shorting the added stock and buying its close substitutes. However, even when arbitrageurs do not get involved in such arbitrage strategy, they are still expected to play a major role in the price formation process post-addition. Arbitrageurs may drop part of their holdings in the added stock after addition or at least shift their new investments from the added stock towards its perfect substitutes. Their trading behavior may be mainly affected by the availability of close substitutes for the added stock (arbitrage risk) and by any information content in the addition announcement. In the following sections, we will try to explore arbitrageurs' reaction to index additions based on those two factors. We start by separately considering two scenarios based on the information content in index additions.

2.1. The addition announcement without any information about the added stock

As index funds must buy the added stock by the effective date to reduce tracking errors, the demand for the stock will increase significantly upon addition. This excess demand will put up pressure on the price of the added stock, which may relatively increase. Such price increase represents a premium that index funds must pay to compensate liquidity suppliers for the transaction costs and portfolio risks that they are bearing (Harris and Gurel 1986). Active institutional investors may exploit the information content, if any, in addition announcements to determine whether the relative run-up in stock price is justified by the information content of the addition announcement. Based on the information content and the level of added stock' price reaction, active institutional investors may determine whether the price appreciation is completely explained by new information and will react accordingly. When the price increase is not supported by positive information, active institutional investors may shift away from the added stock to its close substitutes.

In general, active institutional investors are less likely to hold shares of stocks included in the S&P 500 index (Cao, Chen, Goetzmann, and Liang, 2016).[3] The absence of information in the addition announcement may even reinforce such pattern. When active institutional investors are making new investments among a set of similar firms they may be reluctant to invest in a newly added stock. Consequently, new investments by active institutional investors are expected to be limited in an added stock while the flow of such investments is expected to rise to its close substitutes in the long-run. Those predicted trading patterns may lead to a significant decrease in the level of active institutional investors' holdings after addition.

If active institutional investors are unable to find close substitutes for the added stock (high arbitrage risk), their reaction to the addition announcement may be less significant even in the long-run. As they are left with fewer options, active institutional investors may still shift away from the added stock but at a weaker pace. On one hand, active institutional investors have an incentive to direct their new investments away from the added stock towards the market as a whole. On the other hand, they may still hold the added stock as they do not want to completely give up its upside potential.

The pre-addition presence of active institutional investors may also have a great impact on their post-addition reaction and on its implications. In general, the change in active institutional

[3] The authors document that hedge funds prefer to hold stocks that do not belong to the S&P 500 index; while 13% of the stocks reported in 13F filings are included in the S&P 500 index, only 8% of stocks with high hedge fund ownership (highest decile) are included in the S&P 500 index

investors' ownership levels post-addition is expected to be positively related to their pre-addition ownership levels. Moreover, higher ownership levels signal higher interest in the added stock from the part of potential arbitrageurs.[4] Thus, any price change in the absence of new information may trigger a significant reaction from the part of active institutional investors causing the added stock to deviate less from its fundamental value.

The greatest impact of active institutional investors trading activity is expected to occur when their pre-addition ownership levels are high and arbitrage risk is relatively low. On the other hand, the weakest reaction is expected to occur when arbitrage risk is high and when their pre-addition ownership levels are only marginal. The following table summarizes the price reaction post-addition date based on arbitrage risk level (availability of close substitutes) and the presence of active institutional investors pre-addition.

Table 1: Price Reaction Based on Arbitrage Risk and The Presence of Arbitrageurs

Arbitrage Risk	Presence of Arbitrageurs pre-addition	
	High	Low
High (No Close Substitutes)	Mixed results	Large price reaction post-addition Downward sloping demand curves
Low (Available Close Substitutes)	Weak price reaction post-addition Horizontal demand curves	Mixed results

2.2. <u>The addition announcement with positive information about the added stock</u>

Some studies suggest that addition announcements may contain positive information about the future prospects of the added firm.[5] While it is often difficult to quantify the information

[4] Arbitrageurs' interest in the added stock may not be limited only to arbitrageurs with existing long positions in the added stock, but it may also includes those with no outstanding positions pre-addition but who may take short positions post-addition.

[5] See, for example, Jain, 1987; Dhillon and Johnson, 1991; Denis, McConnell, Ovtchinnikov, and Yu 2003; Cai, 2007.

contained in the announcement, it is likely that the information content may vary from an addition to another; some announcements clearly contain less information such as the bureaucratic index changes in July 2002 where seven new firms were added simultaneously to the S&P 500 (Petajisto 2009).[6]

In order to identify positive information in additions, we investigate the relative change in ownership levels of potential arbitrageurs in the added stock and in the set of its close substitutes. Wurgler and Zhuravskaya (2002) argue that prices of close substitutes may increase around additions due to arbitrage activities. Greenwood (2005) also discusses how uninformed demand shocks affect prices of added stocks and those of their close substitutes due to arbitrage activities by informed investors.[7] However, such price reaction may not be solely triggered by arbitrage trading as the addition itself may signal some positive prospects for the industry as a whole (Cai, 2007). In that context, it is difficult to determine whether the price reaction in fundamentally similar firms is due to information spillover or due to arbitrage activities by examining solely price changes in the added stock and the set of its close substitutes. However, through examining the trading activity of arbitrageurs in those stocks, we can determine whether there is a significant information content in the addition announcement.

When addition conveys positive information, active institutional investors may increase or at least to hold their ownership levels in the added stock. As the demand shock following stock additions may lead to a run up in the stock price, the information content in the addition

[6] On July 19, 2002, S&P replaced all seven non-US firms in its S&P 500 index by U.S. firms. The announcement of the change took place 10 days earlier on July 9, 2002.
[7] Greenwood (2005) uses the redefinition of the Nikkei 225 index in April 14, 2000, as a framework to study demand curves of individual stocks.

announcement may not fully justify the post-addition price levels. Therefore, active institutional investors may still shift away from the added stock but at a much slower pace. In fact, active institutional investors may be actively trading the added stock in the window between announcement day and effective day. A possible scenario is that they may add some shares post-announcement date and sell them back on effective date to take advantage of the demand shock. However, as we are using quarterly data, we are unable to track the dynamics of their trading activity around addition announcement. Nevertheless, we can still conclude that a quarterly increase or a relatively small drop in the level of their holdings post-addition must be supported by the information content in the addition announcement. Moreover, if the addition announcement conveys positive information about the industry as a whole, active institutional investors may increase their ownership levels not only in the added stock but also in the set of its close substitutes.

3. Literature Review

3.1. Arbitrageurs and Arbitrage Risk

The no arbitrage assumption is essential in finance theory; many models such as the CAPM and the APT to name a few rely on risk neutral arbitrageurs' ability to instantly eliminate any arbitrage opportunity that may arise in the market (Sharpe 1964; Ross 1976). In theory, any price change not associated with new information affecting the fundamental value of the stock or the level of risk for a given security may create an arbitrage opportunity; investors can take a long (short) position in the underpriced (overpriced) security and a short (long) position in its close substitutes. Such strategies are zero-investment and risk-free strategies as investors can use the proceeds from short selling to finance their long positions (Shleifer and Vishny 1997). However, in practice, imperfect information, margin requirements, short selling impediments and other market frictions make arbitrage both risky and capital intensive (Mitchell, Pulvino and Stafford, 2002), which may limit arbitrage effectiveness and make it less appealing to arbitrageurs.

Shleifer and Vishny (1997) argue that arbitrage opportunities are more challenging in the stock markets than in bond and foreign exchange markets where fundamental risk is almost insignificant. Fundamental risk refers to the possibility that asset prices may not converge back to their fundamental values in the long-run. Shleifer and Vishny (1997) also claim that even when no fundamental risk exists in the long-run, capital and performance constraints may force arbitrageurs to prematurely liquidate their positions if mispricing worsen in the short-run. Stambaugh and Yuan (2015), and Stambaugh, Yu and Yuan (2015) show that arbitrageurs are more likely to react to underpricing than to overpricing opportunities as they may be less willing to short stocks than to buy them. Consequently, arbitrage risk and arbitrage asymmetry may leave more uncorrected overpricing than uncorrected overpricing.[8]

Many theoretical models discuss the role of arbitrageurs under different arbitrage risk situations. When their presence is limited, arbitrageurs may be reluctant to take action against stocks' deviation from fundamental values as their reaction may not lead to a quick correction. Even if the stock is expected to converge back to its fundamental value in the long-run, it may shift further away from its fundamentals over the short-run. In order to avoid this short-term underperformance, arbitrageurs may forgo profitable long-term arbitrage opportunities (Shleifer and Vishny 1997). Furthermore, Dow and Gorton (1994) argue that an arbitrageur's reaction to mispricing depends on his belief that other arbitrageurs will follow his lead in the short-term. Abreu and Brunnermeier (2002) claim that because of synchronization risk, or the uncertainty about the reaction of other arbitrageurs in the market, arbitrageurs may be reluctant to taking advantage of mispricing. As the presence of arbitrageurs weaken, each arbitrageur may become more skeptical about other arbitrageurs reaction. This skepticism may even push some arbitrageurs to ride the mispricing wave if they believe that their arbitrage efforts may not be rewarded in the short-run. Abreu and Brunnermeier (2003) argue that arbitrageurs may temporarily invest in an overpriced security if they believe other arbitrageurs are less likely to trade against it.

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[8] Such arbitrage asymmetry may partly explain the asymmetric price response to S&P 500 additions and deletions documented by Chen, Noronha and Singal (2004).

3.2. Demand curves of individual stocks

One of the implications of the no arbitrage assumption is the horizontal demand curves for individual stocks (Scholes 1972). When stocks have perfect substitutes, arbitrage risk diminishes due to arbitrageurs' ability to hedge their position in the mispriced stock with an offsetting position in the set of its perfect substitutes (Wurgler and Zhuravskaya 2002). Consequently, demand curves for individual stocks are kept flat in the long-run. On the other hand, when arbitrage risk exists and risk averse arbitrageurs are reluctant to undertake risky arbitrage strategies, mispricing resulting from supply or demand shocks may persist in the long-run.

Early studies on the horizontal demand curves for individual stocks have mainly focused on large block trades. Scholes (1972), Hess and Frost (1982), Mikkelson and Partch (1985), and Loderer, Cooney, and Van Drunen (1991) investigate the price reaction following seasoned equity offerings. Kraus and Stoll (1972), and Holthausen, Leftwich and Mayers (1987; 1990) study the effect of block trades by institutional investors. Finally, Ofek (2000) considers the IPO lock-up period setting. Most of these studies find immediate negative price reaction following large block sales. However, such findings are not only consistent with downward sloping demand curves but also with the information hypothesis as any large buy (sale) order may signal good (bad) news about the firm.

3.3. Index Additions

Attempts to find information free events causing demand or supply shocks, lead Shleifer (1986) to start an interesting line of investigation through examining the effect of demand shocks initiated by inclusion in the S&P 500 index on stock prices. The author finds that added stocks enjoy a permanent price increase that is not explained by any risk factor and concludes that demand curves for individual stocks are downward sloping. Consequently, he concludes that the permanent price reaction following index additions is consistent with a downward sloping demand curve.[9] Since Shleifer (1986) early work, the positive price reaction to stocks added to an index, mainly the S&P 500, has been well documented in finance literature.

Wurgler and Zhuravskaya (2002) develop a theoretical model to determine the conditions under which demand curves for individual stocks are kept flat. They argue that demand shocks are completely absorbed without any price reaction when there is no arbitrage risk (the added stock has perfect substitutes) and many risk neutral arbitrageurs are present in the market. The authors find that arbitrage fails to flatten the demand curves for stocks because perfect substitutes do not exist. They also show that abnormal returns are positively related to the difficulty in finding perfect substitutes for the added stock.

Harris and Gurel (1986) provide evidence on the price pressure hypothesis as they document a complete reversal two weeks following additions announcement. Their results imply that the demand curve for individual stocks is downward sloping in the short-run and horizontal in the long-run. Lynch and Mendenhall (1997) document a partial reversal in abnormal returns following additions which indicates that a part of the abnormal return is explained by the temporary price-pressure hypothesis. However, as there is no complete reversal, results still provide strong support to the long-run downward-sloping demand curve.

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[9] Many later studies provide evidence on the long-term demand curves of individual stocks such as Kaul, Mehrotra, and Morck (2000), Liu (2000), and, Wurgler and Zhuravskaya (2002).

On the other hand, Chen, Noronha and Singal (2004) document an asymmetric price response to additions and deletions to the S&P 500; while added stocks experience a permanent price increase, deleted stocks price decrease is only temporary and disappears 60 days after the effective date. This asymmetric reaction rules out the imperfect substitution hypothesis and provides strong evidence on the investor awareness hypothesis; an application of Merton (1987) theory of capital market equilibrium with incomplete information.[10] Elliot, Van Ness, Walker and Warr (2006) find that increased investor awareness is the primary force behind the cross-section of abnormal announcement returns. However, they also report some evidence on the price pressure hypothesis due to partial price reversal after the inclusion date.

The Liquidity improvement hypothesis (lower bid-ask spread, higher trading volume) provides another explanation for the post-addition price reaction. The hypothesis stems from Amihud and Mendelson (1986) work, where lower bid-ask spread leads to lower expected returns and therefore to higher stock prices. Beneish and Whaley (1996) find that while added stocks enjoy a permanent increase in trading volume post-addition, the change in bid-ask spread is only temporary. Hedge and McDermott (2003) document a long-term improvement in liquidity for stocks added to the S&P 500. They find a significant decrease in quoted spread and an increase in the quoted depth, trading volume and trading frequency.

Finally, there is some strong empirical evidence supporting the information hypothesis of stocks additions to S&P 500. Jain (1987) is the first to provide evidence on that hypothesis as he

[10] Miller (1977) also hints to the relevance of investor awareness as he states: "Realistically, there are more securities available than the typical investor can evaluate. The probability that a particular stock will be purchased by an investor is the probability that he will investigate a stock and the conditional probability that after investigation he will decide to include it in his portfolio."

documents a positive price reaction to a sample of stocks added to S&P supplementary indices which were not tracked by index funds. Dhillon and Johnson (1991) report a significant positive reaction to call options and nonconvertible bonds for firms added to the S&P 500. While Denis, McConnell, Ovtchinnikov, and Yu (2003) show that companies added to the S&P 500 index experience a significant increase in forecasted and in realized earnings. Finally, Cai (2007) investigates whether S&P additions convey any favorable information about the industry of the added stock as well. The author documents a significant positive price reaction for the industry and size matched firms which are negatively related to the added firm's weight in its industry. He concludes that additions not only convey favorable information about the added stock but also about the industry it represents. His findings provide a good explanation for Standard and Poor's statement about included firms' industries: "companies in the S&P 500 are considered leading companies in leading industries".

4. Data and Variables

4.1. S&P 500 Index Addition Sample

Our sample includes S&P 500 Index additions from April 1981 through December 2013. Starting September 1976, Standard and Poor's began to announce index changes after the market close usually on Wednesdays with the changes becoming effective the following trading day. Since October 1989, Standard and Poor's started pre-announcing the changes at least one trading day before the effective day in order to reduce the demand shock effect on added stocks' prices.[11] As active institutional investors' classification is only available from the second quarter of 1981, we limit our sample to additions announced after the first quarter of 1981. We search Lexis Nexis database to identify the announcement date for each addition.

The primary sample includes 830 stock additions over the period April 1st 1981 - December 31st 2013. We remove additions triggered or affected by major fundamental news to reduce the latter's influence on cumulative abnormal returns. For additions prior to December 2000, we rely on Chen, Noronha and Singal (2004) in determining such "contaminated" additions. For post-2000 additions, we check Lexis Nexis database for any major news reported from two days before the announcement date to two days after the effective date. Consequently, we exclude 223 additions triggered by significant contemporaneous events (mergers, spin-offs, change of share class or any other form of restructuring) or affected by major news (seasoned equity offerings earnings announcement, earnings guidance, revised earnings, major industry or legal news).

[11] Over our sample period, the number of trading days between announcement day and effective day ranges from a day to a maximum of 68. The median number of trading days between the two dates is 1 day for the full sample and 3 days for additions announced after October 1989.

Furthermore, we exclude nine observations with less than 250 trading days of pre-addition data on CRSP.[12] We also exclude three observations with missing institutional ownership data in the quarter preceding the addition announcement or in the addition quarter. Finally, we eliminate 20 additions with missing information on COMPUSTAT or with less than three close substitutes matches based on Fama and French (1991) classification. Those requirements limit our final sample to 575 additions.

Table 3 presents summary statistics for those 575 stock additions to the S&P 500. Cumulative abnormal returns are calculated by summing returns over the CRSP value-weighted market index. For robustness tests, cumulative abnormal returns are also calculated using the market adjusted model where beta is estimated using a [-252; -15] trading days window preceding the addition announcement. The mean cumulative abnormal return from the announcement day to the effective day is 5.06%. The mean cumulative abnormal return from the announcement day to 10 days and to 20 days after the effective day are 3.60% and 3.40%, respectively.

4.2. Variables

4.2.1. Measures of Demand Shock

Following Wurgler and Zhuravskaya (2002), we use two measures of demand shock size, DSP and DSB. DSP is the is the size of demand shock as a percentage of market capitalization, or the ratio of S&P 500–tracking index fund capitalization to S&P 500 total capitalization during a

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[12] Wurgler and Zhuravskaya (2002) arbitrage risk measures require historical returns availability on CRSP for at least 250 trading days pre-event. Most of the added firms with less than 250 trading days pre-addition were either spun-off or publicly listed less than 12 months before being added to the S&P 500 index.

given year. DSB is the dollar value of S&P 500 index fund demand in billions of dollars. As firms added to the S&P 500 index during a given year witness the same percentage demand shock, variable DSP varies only across years. On the other hand, the shock size in billions of dollars (DSB) varies across added stocks within any given year.

As the demand shock size may vary significantly during any given year, we adjust Wurgler and Zhuravskaya (2002) measures to reflect such variations over time. We assume that the rate of change in demand shock size is constant over any given year and we estimate the demand shock size as a percentage of market capitalization for each addition using the beginning of year and the ending of year values. Consequently, we adjust the demand shock size in billions of dollars variable using the adjusted demand shock size as a percentage of market capitalization. The adjusted demand shock size as a percentage of market capitalization is extrapolated as follow:

$$ADSP_{it} = DSP_{t-1} + (DSP_t - DSP_{t-1}) \left(\frac{ND_i}{ND_t}\right)$$

Where:

DSP_{t-1} is the demand shock as percentage of market capitalization at the end of year t-1.

DSP_t is the demand shock as percentage of market capitalization at the end of year t.

ND_i is the number of days between the beginning of year t and the effective addition date for stock i.

ND_t is the number of days in year t.

Table 4 contains summary statistics of the demand shock size variables, the S&P 500 total capitalization and the S&P 500–tracking index fund capitalization during some selected years over the period 1981-2013. S&P 500 total capitalization is the aggregate market value of all 500 firms included in the index at the end of each given year. S&P 500–tracking index fund capitalization is the aggregate capitalization of all funds indexed to the S&P 500 as reported in the annual survey of indexed assets issued by the S&P Dow Jones Indices. As Standard and Poor's estimates are only available for years 1983 through 2013, we supplement the values for years 1981 and 1982 from Wurgler and Zhuravskaya (2002). Over the sample period, S&P 500 total capitalization grew by 19 times, from $851 billion to $17,002 billion while S&P 500–tracking index fund capitalization grew by 54 times, increasing from $34.5 billion to $1,878.3 billion. The higher growth rate in S&P 500–tracking index fund capitalization translates to a significant increase in the demand shock size as a percentage of market capitalization (DSP) from 4.1% in 1981 to 11.0% in 2013. However, most of the growth in the demand shock size occurs during the period 1981-1996 as DSP increases from 4.1% to 10.4%. Over the period 1997-2013, DSP varies within a smaller range between 9.7% and 12.7%. Finally, the median demand shock size in current dollars ranges from $32.9 million in 1981 to a high of $1,374.9 million in 2013.

4.2.2. Measures of Arbitrage Risk

Wurgler and Zhuravskaya (2002) introduce two arbitrage risk measures based on two types of substitutes, the market portfolio and the top three substitutes that match the added stock industry, size and book-to-market ratio. In our analysis, we mainly rely on the latter measure as by construction it is more directly related to the availability of close substitutes for the added stock while the other measure relies on the market as a substitute security.[13] Moreover, it is also more

[13] In the robustness part, we replicate our analysis using arbitrage risk measures based on the market portfolio.

relevant as we track the change in active institutional investors' holdings in the top three close substitutes used to compute it. We call this arbitrage risk measure "A".[14]

Arbitrage risk A_i is the variance of the residuals of the model $R_{it} - R_{ft} = \beta_{1i}(R_{PS1it} - R_{ft}) + \beta_{2i}(R_{PS2it} - R_{ft}) + \beta_{3i}(R_{PS3it} - R_{ft})$, where R_{PS1it}, R_{PS2it}, and R_{PS2it} represents the return on the top three close substitutes based on industry-, size-, and book-to-market matching and R_{ft} is the T-Bill return. Daily values for R_{ft} are from French's website. To determine the set of top three close substitutes, we also follow Wurgler and Zhuravskaya (2002) methodology.[15] First, we identify all the stocks in the same Fama and French (1997) industry. We compute the absolute difference between their market capitalizations and that of the added stock as well as the absolute difference based on their book-to-market ratios. Then, we place those potential substitutes into quintiles by the absolute difference between their market capitalizations and that of their book-to-market ratios. We sort those stocks by market cap difference quintile and then by book-to-market difference quintile. Finally, we select the top three ranked stocks; to break ties between stocks with the same market cap and book-to-market quintiles, we choose the stock with the smallest absolute difference in market cap. As we require the availability of historical returns and institutional ownership data for each substitute, we replace substitutes with missing data with the next ranked substitute.

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[14] Wurgler and Zhuravskaya (2002) call this measure A_2, while A_1 represents their arbitrage risk measure based on the market portfolio.

[15] We use some variations of Wurgler and Zhuravskaya (2002) approach in the robustness part.

Following Wurgler and Zhuravskaya (2002), we treat arbitrage risk measures as a proxy for the availability of close substitutes; a higher arbitrage risk for a given stock implies that it is more difficult for investors to find close substitutes for that stock.

4.2.3. Active Institutional Investors Ownership

We obtain quarterly institutional ownership data for all common stocks traded on NYSE, AMEX, and NASDAQ through 13F filings from Thomson Financial. Institutional investors are required by the SEC to report all equity positions greater than 10,000 shares or $200,000 at the end of each quarter. We use Bushee (2004) classification of institutional investors to identify active institutional investors. Each year, the author uses a grouping technique based on ownership stability and stake size to classify each institutional investor into one of three categories: "transient," "dedicated," and "quasi-indexer." Bushee (2004) define transient institutional investors as active investors with high portfolio turnover and small stake sizes. Consequently, we consider transient institutions in any given year to be active institutional investors in that same year. For each added stock, we compute aggregate active institutional holdings in the quarter preceding the addition announcement at the end of that quarter. Similarly, we find the average level of active institutional holdings in the three closest substitutes.

5. Empirical Results

5.1. The effect of arbitrageurs and arbitrage risk on S&P 500 index additions

To assess the effect of arbitrage risk on post-addition cumulative abnormal returns, we split the sample into above-median and below-median adjusted arbitrage risk sub-samples. Figure 1 plots mean cumulative abnormal returns for added stocks based on arbitrage risk A (availability of close substitutes). This figure clearly shows that added stocks with high arbitrage risk (no close substitutes) consistently have a higher CAR than those with lower arbitrage risk (close substitutes are available) up to 20 days after the effective date.

In table 5, we report the mean difference in Cumulative Abnormal Return based on the availability of close substitutes (arbitrage risk A). The mean difference between the two groups by effective day is 2.18% and statistically significant at the 1% significance level. The mean difference between the two groups diminishes over time and reaches 1.74% twenty trading days following the effective day. However, the mean difference widens again to reach 2.69% sixty trading days following the effective day and it remains significant at the 10% significance level. Consequently, added stocks with no close substitutes (higher arbitrage risk) enjoy a larger price response after being added to to the S&P 500. Such result confirms findings in Wurgler and Zhuravskaya (2002) and shows that their results extend beyond the second addition period.[16] Moreover, it demonstrates that the effect of arbitrage risk on post-addition price reaction remains significant up to 20 trading days following the addition announcement.

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[16] Wurgler and Zhuravskaya (2002) limit their empirical study to the second addition period, which covers the period September 1976 – September 1989.

When more close substitutes are available, active institutional investors have an option to invest in a wider range of similar stocks. Therefore, their ownership levels in a given stock are expected to be negatively related to the number of its close substitutes. Our sample confirms this pattern as active institutional investors hold on average 21.39% of the shares outstanding of stocks in the high arbitrage risk group while holding only an average of 15.24% in the low arbitrage risk group. If we consider the high arbitrage risk sub-sample, high arbitrage risk is expected to have a positive effect on added stocks' abnormal returns while high active institutional ownership is expected to have a negative effect on abnormal returns. Therefore, we can better infer the effect of arbitrage risk or of arbitrageurs' presence on cumulative abnormal returns when controlling for the other factor.

To control for the level of active institutional ownership, we follow Wurgler, and Zhuravskaya (2002) approach and exclude added stocks in the extreme two quartiles of the active institutional ownership distribution (AIO).[17] Then, we split the remaining stocks into above-median and below-median adjusted arbitrage risk groups (Figure 2). This figure clearly shows that added stocks with high arbitrage risk consistently have a higher CAR compared to those with lower arbitrage risk up to 20 days after the effective date. The difference in CAR between the two groups reaches a high of 3.60% by effective day and decreases to only 2.61% twenty trading days following the effective date. Consequently, added stocks with higher arbitrage risk enjoy a larger cumulative price response.

[17] As Wurgler and Zhuravskaya (2002) do not empirically test the effect of arbitrageurs' presence, they use this approach to exclude added stocks in the extreme two quartiles of the demand shock distribution.

Figures 3 and 4 plot mean cumulative abnormal returns for added stocks based on the pre-addition level of active institutional ownership.[18] To control for the effect of arbitrage risk, we exclude stocks in the highest and lowest quartiles of arbitrage risk A (Figure 4). Those figures show that stocks with weaker active institutional ownership presence in the quarter preceding announcement enjoy a higher CAR from announcement date and up to 20 days after effective date. Consequently, the level of active institutional ownership is negatively related to the CAR post-additions.

As active institutional ownership varies with changes in total institutional ownership and changes in institutional investors trading behavior, using the full sample median to divide the sample may create some bias. For example, additions in the early years of the sample are going to be overrepresented in the Low AIO sub-sample, while those in later years are going to be overrepresented in the High AIO sub-sample. To address such bias, we divide the sample based on the cross-sectional median of pre-addition active institutional ownership. In table 6, we report the mean difference in Cumulative Abnormal Return between announcement date and effective date based on the pre-addition level of active institutional investors' ownership. The mean difference between the two groups by effective date is only 0.68% and statistically insignificant. Ten trading days following the effective date, the mean difference increases to 1.32% and becomes statistically significant at the 10% significance level. The mean difference diminishes over time and becomes economically and statistically insignificant.

[18] We divide the sample based on the median pre-addition active institutional ownership of the full sample.

When we consider the two factors simultaneously, we find further evidence supporting our earlier predictions. Figure 5 plots mean cumulative abnormal returns for added stocks based on the availability of close substitutes (A) and the pre-addition level of active institutional investors' ownership (AIO). We independently classify each addition into one of four categories (High AIO – Low A, High AIO – Low A, Low AIO – Low A, Low AIO – High A) based on the median values of the full sample. Figure 5 shows that the largest price reaction occurs when the added stock has high arbitrage risk (no close substitutes) and low arbitrageurs' presence (Low AIO – High A). The CAR of the latter group is consistently the highest among the four groups up to 20 days following the effective date. On the other hand, the weakest price reaction occurs when the added stock has low arbitrage risk (close substitutes are available) and a strong arbitrageurs' presence (High AIO – Low A). Finally, the two remaining groups exhibit a similar price reaction except on effective date where the CAR of the "High AIO – High A" group is higher than that of the "Low AIO – Low A" group. Those results show that the lack of close substitutes coupled with the absence of arbitrageurs have a magnifying effect on CAR for stocks added to the S&P 500. Those two effects reinforce findings of the downward slopping demand curve documented in prior studies.

In table 7, we report the average CAR between announcement day and effective day (Panel A), 10 trading days following effective day (Panel B) and 20 trading days following effective day (Panel C) based on the classification used in figure 5 as well as the difference in means between the four different groups. In this classification we use the cross-sectional median values of active institutional ownership to divide the sample based on the pre-addition levels of active institutional ownership.[19] Although added stocks with high arbitrage risk (no close substitutes) consistently have a higher CAR than those with low arbitrage risk (close substitutes are available), the difference in means is statistically significant when arbitrageurs' presence is limited. When arbitrageurs' presence is high, the effect of arbitrage risk is only significant between announcement day and effective day (Panel A).

On the other hand, the role of arbitrageurs seems to be more relevant when close substitutes are not available. When arbitrage risk is high, added stocks with strong arbitrageurs' presence enjoy a CAR that is significantly lower than that for stocks with a weak active institutional ownership presence. The difference in means remains economically and statistically significant up to at least 10 trading days following the effective date. Those results signal an interaction between arbitrage risk and the pre-addition arbitrageurs' presence. We explore the dynamics of such interaction and its effect on added stocks' price reaction in the following section.

5.2. Multivariate Analysis

We start our multivariate analysis by replicating some of Wurgler, and Zhuravskaya (2002) regressions. We divide the sample based on the pre-addition arbitrageurs' presence into high AIO and low AIO sub-samples (table 8). We find that CAR [AD-ED] increases in arbitrage risk and in the demand shock size, consistent with Wurgler, and Zhuravskaya (2002).[20] However, we notice major differences between the regression results of the two sub-samples. For the low AIO sub-

[19] All reported results hereafter use the cross-sectional median values to determine high and low pre-addition levels of active institutional ownership.

[20] Throughout the paper, we report the results using the demand shock size as a percentage of market capitalization (ADSP); all the results are quantitatively and qualitatively similar when the demand shock size in billions of dollars (ADSB) is used instead.

sample, the coefficient of arbitrage risk is significantly positive across all model specifications. As for the high AIO sub-sample, the arbitrage risk coefficient is only significant in CAR [AD, ED] regression. Moreover, the coefficient of arbitrage risk in CAR [AD, ED] regression decreases by more than 50% as we move from the low AIO sub-sample to the high AIO sub-sample. Ten trading days following the effective date, the effect of arbitrage risk becomes insignificant in the high AIO sub-sample. The predictive power of the model is also more significant when arbitrageurs' presence is limited; R-Square in model (1) – Panel A for the low AIO sub-sample is 0.183 versus 0.081 for the high AIO sub-sample. Such results imply that the effect of arbitrage risk is much more pronounced when arbitrageurs' presence is limited. Therefore, a strong presence of arbitrageurs moderates the effect of arbitrage risk on the post-addition price reaction.

We also find that the positive effect of demand shock size across the two sub-samples is only significant between the announcement day and the effective day. Ten trading days following the effective day, the coefficient of demand shock size becomes insignificant implying that the effect of the demand shock on the post-addition price reaction is only temporary.

To assess further the interaction effect of arbitrage risk and presence of arbitrageurs, we add a dummy variable HAIO to the model; HAIO is equal to one if the pre-addition level of active institutional ownership is higher than the cross-sectional median level and zero otherwise. The coefficient of the interaction term between HAIO and arbitrage risk A is consistently and significantly negative across all the specifications in table 9. Ten trading days following the effective date, high arbitrageurs' presence eliminates the positive effect of arbitrage risk on CAR. These results highlight the critical role of arbitrageurs in the price formation process; a strong presence of active institutional investors limits to large extent stock prices' deviation from their fundamental values following significant demand shocks.

5.3. Information content in the addition announcement

So far, we have not considered the information content if any in addition announcements. When an addition announcement contains some positive information about the added firm, active institutional investors may increase their ownership levels in the added firm or at least sell fewer shares post-addition. Meanwhile, active institutional investors may increase their ownership levels in close substitutes due to information spillover (information) or as a relatively underpriced substitute for the added stock (no information).

To account for the information content, we consider an additional factor based on the reaction of active institutional investors to the announcement. We compute the adjusted change in active institutional investors' ownership; it is equal to the change in active institutional ownership minus the average ownership change in the corresponding top three close substitutes. When the addition announcement is information free, active institutional investors are likely to decrease their ownership levels in the added stock and increase their ownership levels in the closest substitutes. Because the level active institutional ownership as well as the level of total institutional ownership are increasing over most of the sample period, the adjusted change allows us to control for the general trend in quarterly changes in institutional investors' ownership.

Figure 6 plots changes in active institutional ownership levels around additions in the added stock and the set of its top three close substitutes. In the quarter preceding addition announcement, active institutional investors hold 18.12% of the shares outstanding of the added stock and an average of 14.33% in its closest three substitutes. One year following the addition announcement, active institutions' holdings in the added stock decrease by 1.31% to reach 16.81% while their average holdings in each of the closest three substitutes increases by 0.62% to reach 14.95%. During the quarter in which the addition announcement takes place, active institutional investors sell on average 0.78% of the outstanding shares of the added firm while adding 0.72% of the outstanding shares of the top three closest substitutes.[21]

After adjusting for the changes in the top three substitutes, active institutional investors drop on average more than 1.02% of the shares outstanding of the added stock. This trend continues in the following quarter but at a slower pace for active institutional ownership in the added stock and at a faster pace for their holdings in the top three substitutes. While the largest drop in active institutional holdings in the added stock occurs during the quarter in which the addition is announced, the largest growth in their holdings in the top three substitutes occurs one quarter following additions. Active institutional investors sell a total of 0.86% of the shares outstanding in the two quarters following the addition announcement while adding a total of 0.70% of the shares outstanding of each of the closest three substitutes. As a result, the adjusted change in active institutional ownership becomes -1.56%.

As we cannot assess the dynamics of active institutional investors' holdings in the period separating two consecutive quarters, we are unable to clearly determine the timing of their transactions during the announcement quarter. A less likely scenario is that they sell the added stock before the addition announcement. Another possibility is that they only adjust their holdings

[21] 0.24% of the outstanding shares of each the top three substitutes.

after the effective date. However, the significant negative relationship between their pre-addition ownership levels and post-announcement cumulative abnormal return implies that a major part of the change occurs between announcement and effective dates. As for the close substitutes, active institutions may react over the two quarters following the announcement. Such trading behavior reinforces our prediction that arbitrageurs shift their new investments away from the added stock and towards its closest substitutes.

If the addition announcement conveys positive information about the industry as a whole, arbitrageurs may increase their holdings in the added stock as well as the set of its close substitutes (information spillover). Therefore, the adjusted change may not reflect positive information at the industry level. On the other hand, when the level of competition increases in a given industry, index addition of a firm in that industry may convey positive information specific to the firm and may to some extent reflect negative information about its competitors (Cai 2007). Consequently, the adjusted change measure is expected to be the highest. Finally, when the addition announcement is information free, the adjusted change is expected to be the lowest as arbitrageurs may be selling shares of the added stock and adding shares of its close substitutes. Based on those expected trading patterns, we assume that the value of information specific to the added firm is positively correlated with the adjusted change in active institutional ownership. The following table summarizes those three different scenarios:

Table 2: The Effect of Information on Arbitrageurs Trading Behavior

	Added stock	***Close substitutes***	***Adjusted Change***
The addition announcement conveys positive information about the stock and its industry	Positive Information (Arbitrageurs may add shares or at least hold more shares)	Positive Information (Arbitrageurs may add new shares – information spillover)	Undetermined
The addition announcement conveys positive information specific to the firm	Positive Information (Arbitrageurs may add shares or at least hold more shares)	Negative to No Information (Arbitrageurs may drop part of their shares)	Highest (positive)
The addition announcement conveys no information	No Information (Arbitrageurs may sell part of their shares)	No Information (Arbitrageurs may add new shares – arbitrage activities)	Lowest (negative)

In table 10, we add the adjusted change in active institutional ownership to the model. We find that the coefficient of adjusted change is consistently positive in all the specifications of the model. Such result implies that the post-addition price reaction is higher when the addition announcement is more likely to reflect positive information specific to the added firm. To assess the effect of trading activity of arbitrageurs in the close substitutes, we add the average quarterly change in arbitrageurs' ownership of the top three substitutes to the model (table 11). Regression results show that the change in arbitrageurs' holdings in the set of close substitutes is negatively related to the CAR of the added stock. The more arbitrageurs shift away to the set of close substitutes the lower the CAR for the added stock. The importance of this result stems from the fact that such negative relationship indicates that the information spillover does not fully explain the change in arbitrageurs holdings in the set of close substitutes. If arbitrageurs are shifting away to the close substitutes solely due to information spillover, then their trading behavior should not have a negative effect on the price of the added stock.

5.4. Price reaction for the close substitutes

Cai (2007) documents that industry and size matching firms for added stocks enjoy significant abnormal returns around index additions. We confirm his results and document an average cumulative abnormal return of 0.62% between announcement and effective date for the top three close substitutes. We also find that the price reaction of the close substitutes varies based on the level of substitution between the added stock and each potential substitute. The average CAR for the closest substitute is 0.74%, while it is 0.63% and 0.48% for the next two closest substitutes. However, the difference in means between the three groups is not statistically significant.

In table 12, we divide the sample into two sub-samples based on the price reaction of close substitutes. A higher price reaction for the close substitutes may signal more significant trading activity on the part of arbitrageurs due either to arbitrage activity or to information spillover. We find that when there is a higher price reaction for the close substitutes, arbitrageurs' presence effect appears to be much more pronounced. The predictive power of the model and the significance of the interaction between arbitrageurs' presence and the other variables decreases significantly as we move from the high price reaction sub-sample to the low price reaction sub-sample.

6. Robustness Tests

6.1. The momentum effect

Recent studies point to the momentum effect in the S&P 500 index additions setting (Kasch, and Sarkar 2014; Chen, Singal, and Whitelaw 2016). Kasch, and Sarkar (2014) find that stocks added to the S&P 500 enjoy a pre-inclusion price momentum.[22] To control for the momentum effect, we add the variable MO to the model (table 13); MO is the compounded daily return between 1 and 13 months prior to the addition announcement. Our results remain strongly significant after controlling for the momentum effect. Moreover, we confirm the findings in prior studies that stocks that outperformed pre-addition trigger a stronger price reaction following the addition announcement.

6.2. Sample Construction

As we mainly follow Wurgler and Zhuravskaya (2002) in constructing our set of close substitutes, we try different approaches to build our sample to check whether our results are robust to the selection criteria.

First, we slightly modify the selection criteria applied by Wurgler and Zhuravskaya (2002). Instead of placing the set of stocks within the same Fama and French (1997) industry classification in quintiles by the absolute difference in size and book-to-market ratio, we alternatively place them into quartiles and deciles, which leads to some changes in the set of three closest substitutes. Secondly, we change the industry classification used to match close substitutes to each added

[22] On average market capitalization of added stocks increase by around 56% in the two years leading to announcement.

stock. Instead of using Fama and French (1997) industry classification we follow Cai (2007) and use the SIC codes industry classification; we alternatively use the two-, three- and four-digit SIC codes. The regression results clearly show that our results are not affected by the criteria used to construct the sample of close substitutes.[23]

6.3. Arbitrage Risk Measures

As it may be harder and even riskier to hedge their positions with close substitutes, arbitrageurs may use a major market index replicating the market to hedge such positions. According to CAPM, when a stock plots below the security market line, arbitrageurs can short the overvalued stock and buy the market as a whole. Therefore, we assess whether our results are robust to the arbitrage risk measure used in the analysis by replicating all of our reported results by alternatively using arbitrage risk measures based on the market portfolio.

We replicate Wurgler, and Zhuravskaya (2002) arbitrage risk measure A_1, where A_{1i} is the variance of the residuals of the model $R_{it} - R_{ft} = \beta_{1i}(R_{mt} - R_{ft})$, where R_{mt} is the return on CRSP's value-weighted AMEX/NASDAQ/NYSE index and R_{ft} is the T-Bill return. Daily values for R_{ft} are from French's website. As arbitrageurs can also use the S&P 500 index to hedge their positions, we add a third measure and we call it A_2. Arbitrage risk A_{2i} is the variance of the residuals of the model $R_{it} - R_{ft} = \beta_{1i}(R_{SPt} - R_{ft})$, where R_{SPt} is the return on the S&P 500 Index.

[23] All of these results are available upon request.

Although our results are robust to the arbitrage risk measure used, the significance level and explanatory power of the models are the highest when arbitrage risk measure A is used. Therefore, arbitrage risk measure A may capture better arbitrage limitations faced by arbitrageurs. These findings along with the trading activity of arbitrageurs in close substitutes signal that the availability of close substitutes helps arbitrageurs in keeping stock prices close to their fundamental values.

7. Conclusion

In this paper, we explore the interaction of arbitrage risk and arbitrageurs' presence and its effect on security prices. We use additions to the S&P 500 index as a framework for our analysis by extending Wurgler, and Zhuravskaya (2002) earlier work through considering the critical role of arbitrageurs in the price formation process following stock additions. We use active institutional investors' ownership levels as a proxy for presence of arbitrageurs.

We confirm earlier findings of Wurgler, and Zhuravskaya (2002); cumulative abnormal returns following index additions are positively correlated with the lack of close substitutes (high arbitrage risk) and the demand shock size. We also find that strong presence of arbitrageurs significantly reduces the price reaction to the addition announcement. As arbitrageurs' ownership levels increase, cumulative abnormal return following additions decreases significantly. Furthermore, arbitrageurs' enhanced ability to handle arbitrage risk weakens the effect of arbitrage risk on abnormal returns following stock additions. These results highlight the critical role of arbitrageurs in the price formation process around additions.

Arbitrageurs strategically shift away from the added stock towards its close substitutes in the long-run. We find that arbitrageurs' ownership levels in the added stock drop after addition, while increasing in the set of its close substitutes. By the end of the second quarter following the addition announcement, arbitrageurs sell on average 0.86% of the outstanding shares of the added firm while adding about 0.70% of the outstanding shares of each of the top three closest substitutes. We also find that the post-addition price reaction is higher when the addition announcement is more likely to reflect positive information specific to the added firm. Finally, we find that the change in arbitrageurs' holdings in the close substitutes is negatively related to the post-addition price reaction.

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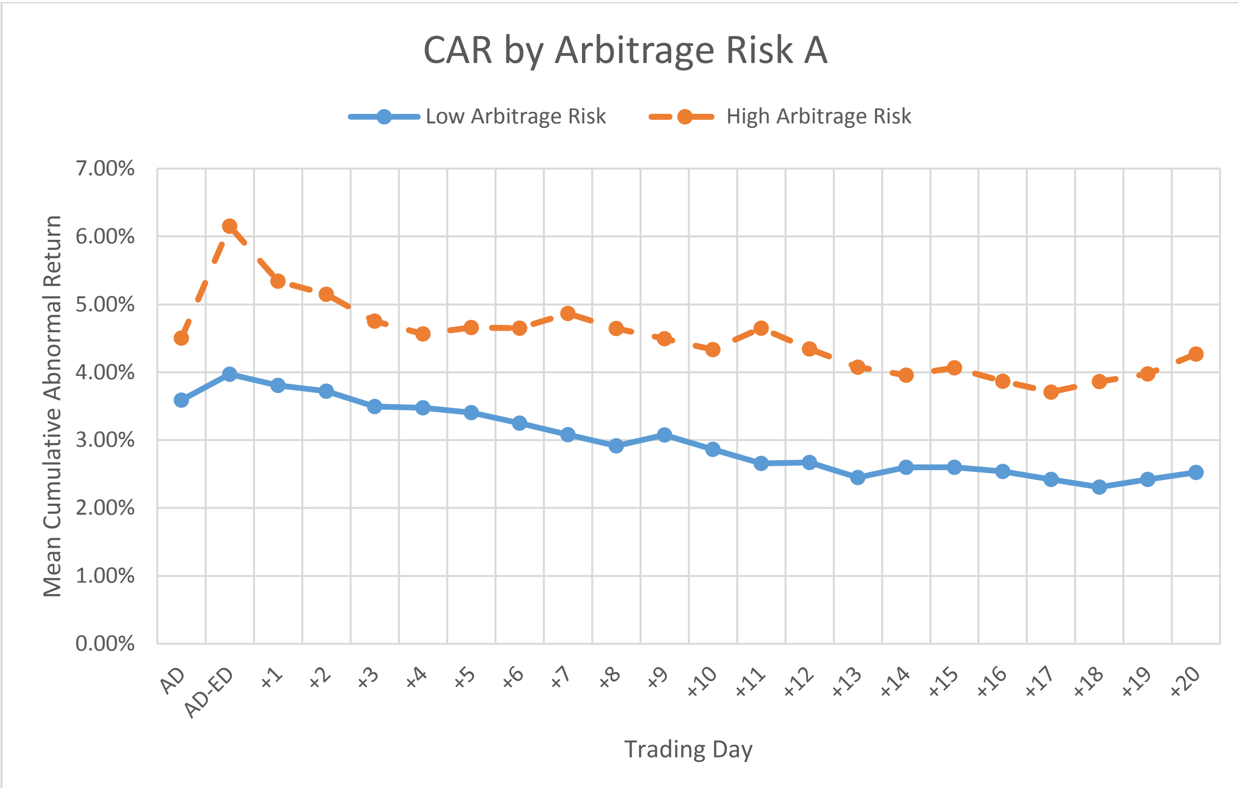

Figure 1: CAR by Arbitrage Risk A

Mean cumulative abnormal returns for stocks added to the S&P 500, by the level of adjusted arbitrage risk A. The sample includes 575 stocks that were added to the S&P 500 between January 1981 and December 2013. We split the sample into above-median and below-median adjusted arbitrage risk A. Cumulative abnormal returns are calculated by summing returns over the CRSP value-weighted market index. Arbitrage risk A is the variance of the residuals of the model $R_{it} - R_{ft} = \beta_{1i}(R_{PS1it} - R_{ft}) + \beta_{2i}(R_{PS2it} - R_{ft}) + \beta_{3i}(R_{PS3it} - R_{ft})$, where R_{PS1it}, R_{PS2it}, and R_{PS3it} represents the return on the top three close substitutes based on industry-, size-, and book-to-market matching. Daily values for R_{ft} are from French's website.

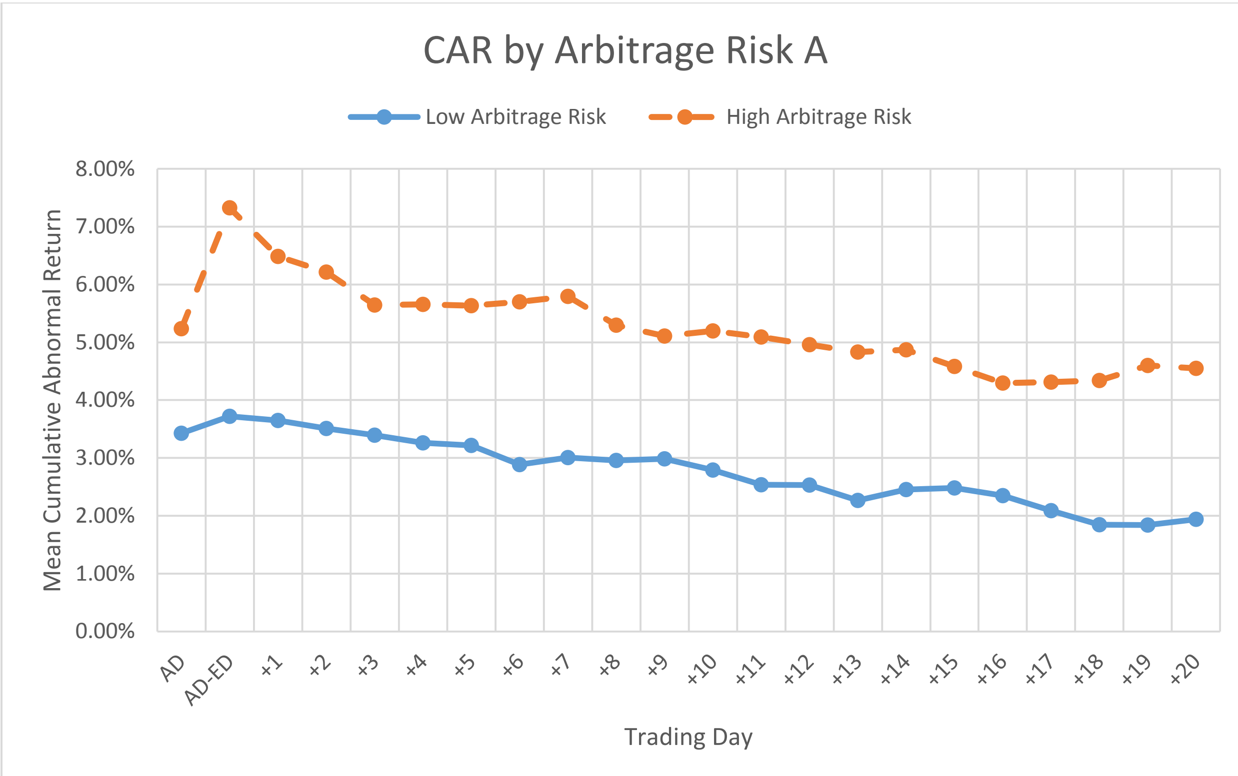

Figure 2: CAR by Arbitrage Risk A (Excluding extreme Active Institutional Ownership Quartiles)

Mean cumulative abnormal returns for stocks added to the S&P 500, by the level of adjusted arbitrage risk A. The sample includes 575 stocks that were added to the S&P 500 between January 1981 and December 2013. To control for the level of active institutional ownership, we exclude stock additions in the extreme two quartiles of the pre-addition active institutional ownership. Then, we split the remaining additions into above-median and below-median arbitrage risk A. Cumulative abnormal returns are calculated by summing returns over the CRSP value-weighted market index. Arbitrage risk A is the variance of the residuals of the model $R_{it} - R_{ft} = \beta_{1i}(R_{PS1it} - R_{ft}) + \beta_{2i}(R_{PS2it} - R_{ft}) + \beta_{3i}(R_{PS3it} - R_{ft})$, where R_{PS1it}, R_{PS2it}, and R_{PS3it} represents the return on the top three close substitutes based on industry-, size-, and book-to-market matching. Daily values for R_{ft} are from French's website.

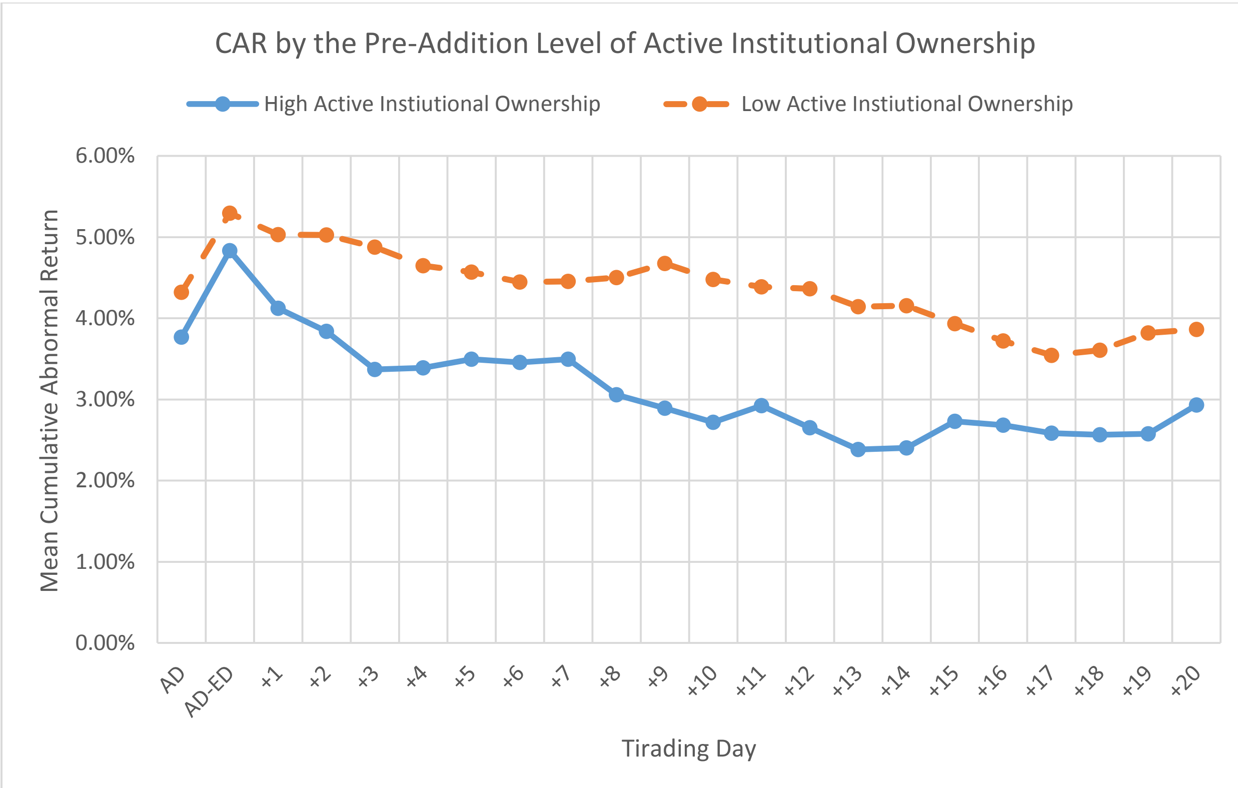

Figure 3: CAR by the Pre-Addition Level of Active Institutional Ownership

Mean cumulative abnormal returns for stocks added to the S&P 500, by the level of Active Institutional Investors' ownership in the quarter preceding the addition announcement. The sample includes 575 stocks that were added to the S&P 500 between January 1981 and December 2013. We split the sample into above-median and below-median pre-addition active institutional investors' ownership. Cumulative abnormal returns are calculated by summing returns over the CRSP value-weighted market index.

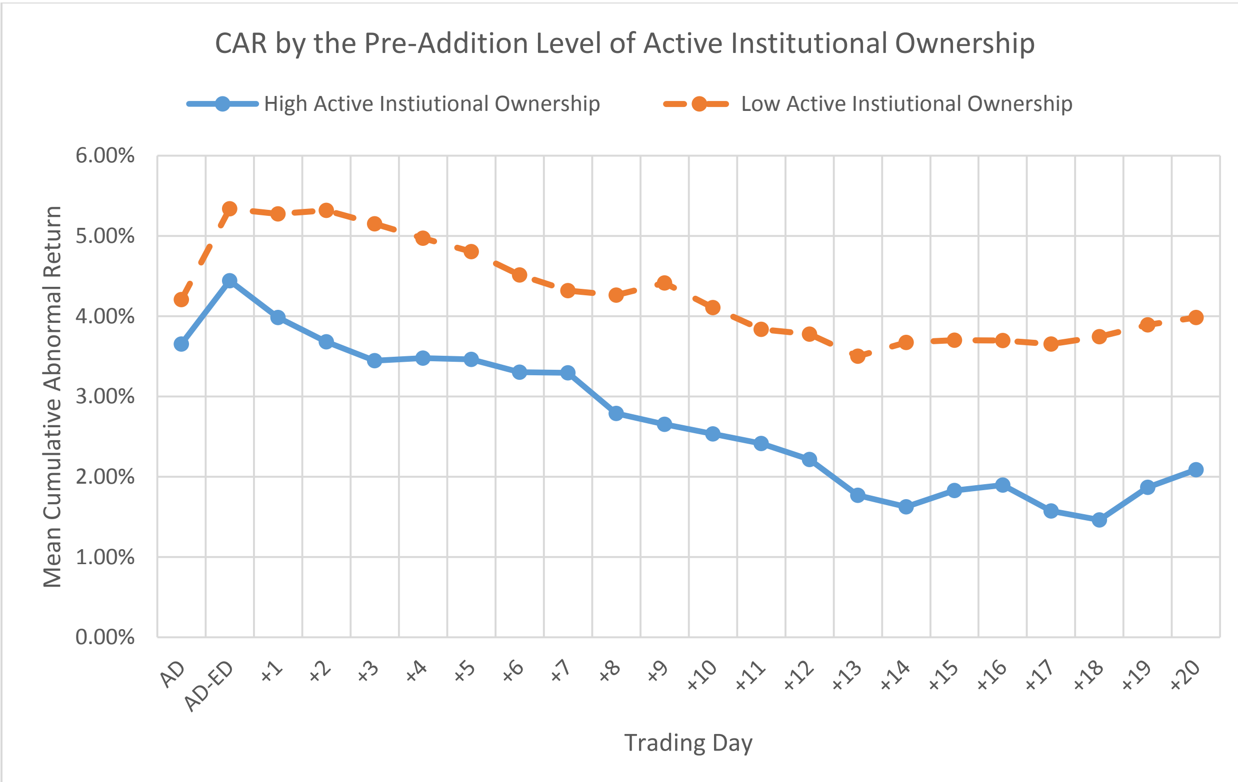

Figure 4: CAR by the Pre-Addition Level of Active Institutional Ownership (Excluding Extreme Arbitrage Risk A Quartiles)

Mean cumulative abnormal returns for stocks added to the S&P 500, by the level of Active Institutional Investors' ownership in the quarter preceding the addition announcement. The sample includes 575 stocks that were added to the S&P 500 between January 1981 and December 2013. To control for the level of arbitrage risk, we follow Wurgler and Zhuravskaya (2002) by excluding stock additions in the extreme two quartiles of the arbitrage-risk distribution (A). We split the remaining additions into above-median and below-median active institutional investors' ownership pre-addition groups. Cumulative abnormal returns are calculated by summing returns over the CRSP value-weighted market index. Arbitrage risk A is the variance of the residuals of the model $R_{it} - R_{ft} = \beta_{1i}\left(R_{PS1it} - R_{ft}\right) + \beta_{2i}\left(R_{PS2it} - R_{ft}\right) + \beta_{3i}\left(R_{PS3it} - R_{ft}\right)$, where R_{PS1it}, R_{PS2it}, and R_{PS3it} represents the return on the top three close substitutes based on industry-, size-, and book-to-market matching. Daily values for R_{ft} are from French's website.

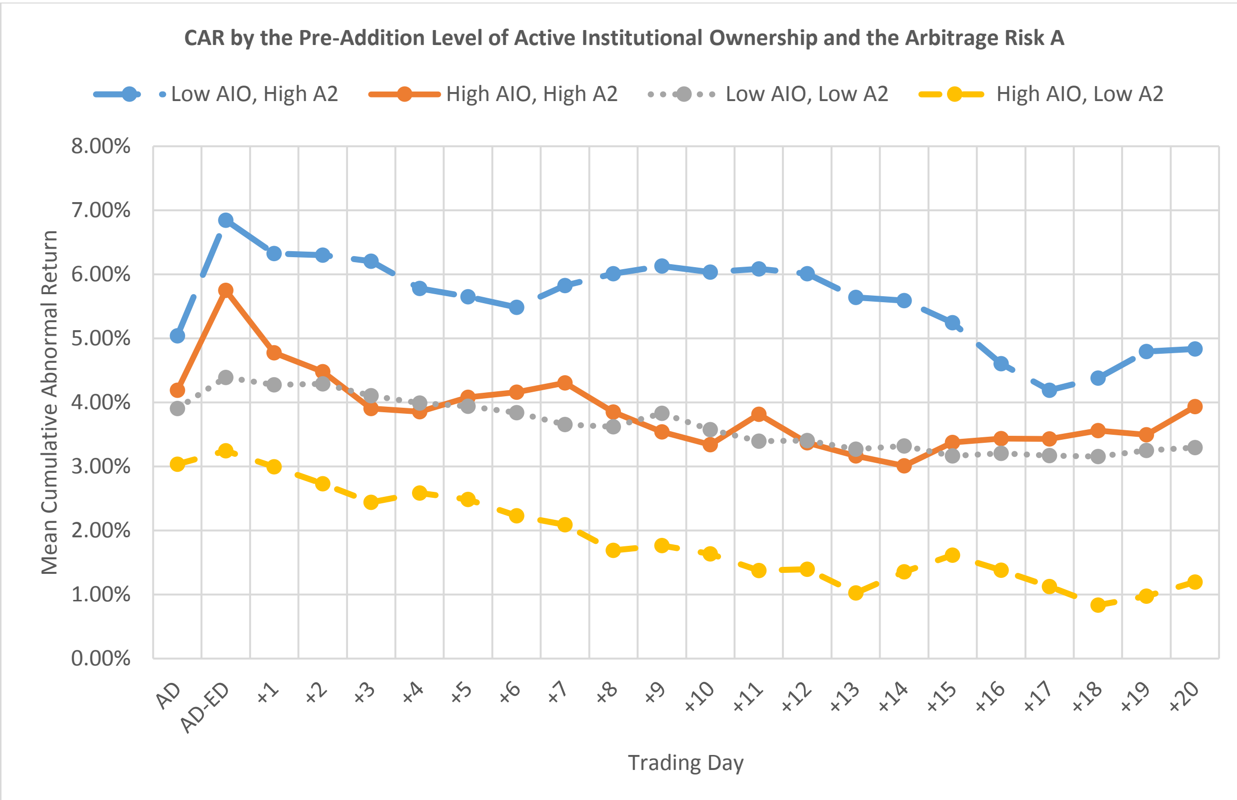

Figure 5: CAR by the Pre-Addition Level of Active Institutional Ownership and the Arbitrage Risk A

Mean cumulative abnormal returns for stocks added to the S&P 500, by the level of Active Institutional Investors' ownership in the quarter preceding the addition announcement and by the level of arbitrage risk A. The sample includes 575 stocks that were added to the S&P 500 between January 1981 and December 2013. We split the sample into four sub-samples based on the level of arbitrage risk (A) and the level of active institutional ownership (AIO). We compute the median values of A and AIO for the full sample. Then, we classify each addition into one of four categories (High AIO – Low A, High AIO – Low A, Low AIO – Low A, Low AIO – High A). Cumulative abnormal returns are calculated by summing returns over the CRSP value-weighted market index. Arbitrage risk A is the variance of the residuals of the model $R_{it} - R_{ft} = \beta_{1i}(R_{PS1it} - R_{ft}) + \beta_{2i}(R_{PS2it} - R_{ft}) + \beta_{3i}(R_{PS3it} - R_{ft})$, where R_{PS1it}, R_{PS2it}, and R_{PS3it} represents the return on the top three close substitutes based on industry-, size-, and book-to-market matching. Daily values for R_{ft} are from French's website. AIO is the active institutional ownership in the added stock in the quarter preceding the addition announcement. We use Bushee (2004) Institutional Investor Classification to identify active institutional investors.

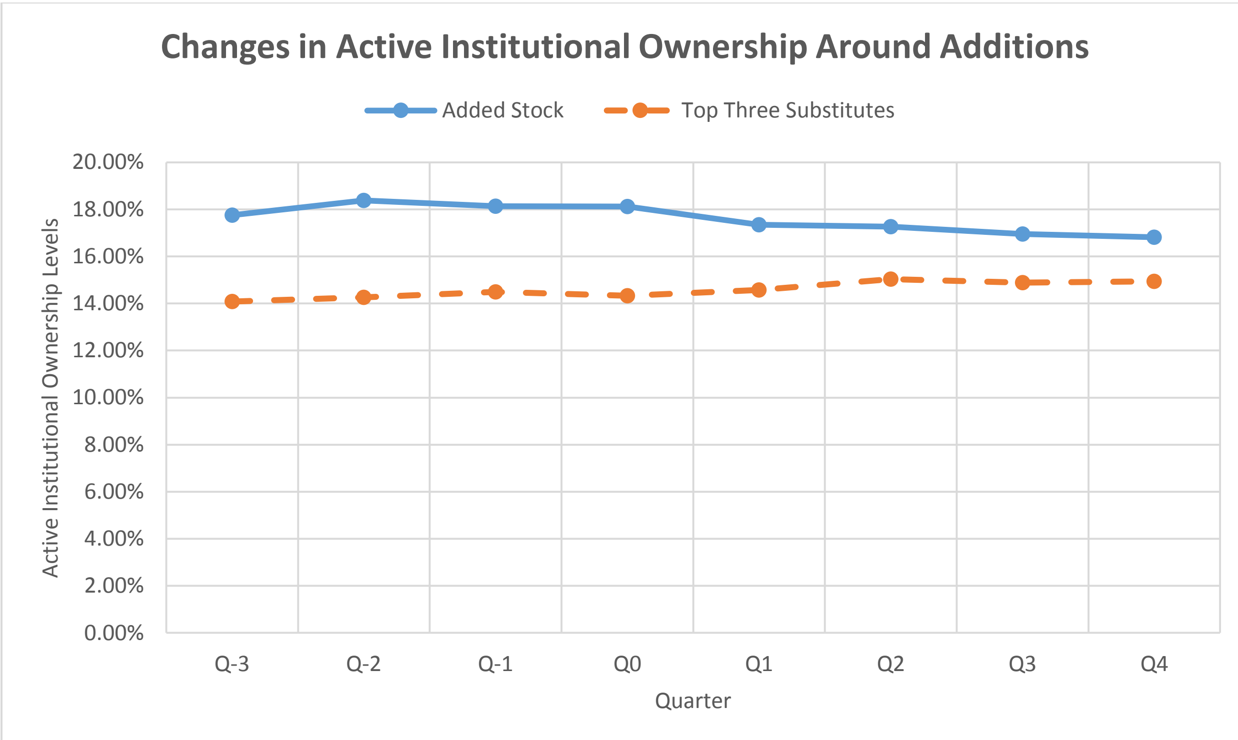

Figure 6: Changes in Active Institutional Ownership around Additions

Changes in Active Institutional Ownership Levels around Additions in the added stock and the set of its top three close substitutes. The sample includes 575 stocks that were added to the S&P 500 between January 1981 and December 2013. The Active Institutional Ownership Level in the top three close substitutes is the average ownership level in the closest three substitutes. Q_{-3}, Q_{-2}, Q_{-1} and Q_0 represent the four quarters preceding the addition announcement. The addition announcement takes place in Q_1 while Q_2, Q_3 and Q_4 represent respectively the following three quarters. Active Institutional Ownership is reported at the end of each quarter.

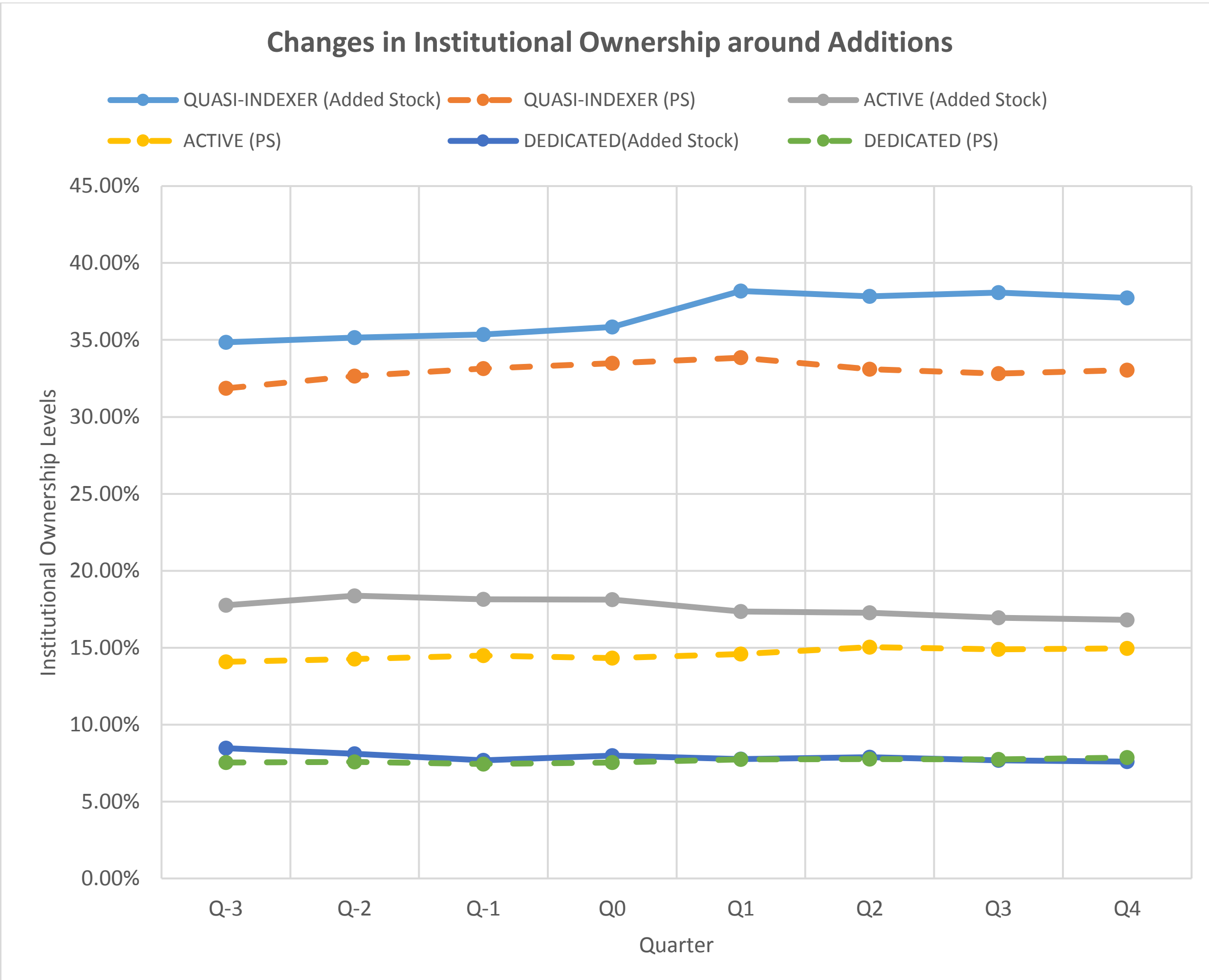

Figure 7: Changes in Institutional Ownership around Additions

Changes in Institutional Ownership Levels around Additions in the added stock and the set of its top three close substitutes by type of institutional investors. The sample includes 575 stocks that were added to the S&P 500 between January 1981 and December 2013. We use Bushee (2004) Institutional Investor Classification to identify each institutional investors' category. Active or "Transient Institutions" are characterized with high portfolio turnover and small stake sizes. "Dedicated Institutions" are characterized by stable ownership and large stake sizes. "Quasi-Indexer Institutions are characterized by high ownership stability and small stake sizes. Ownership Level in the top three close substitutes is the average ownership level in the closest three substitutes. Q_{-3}, Q_{-2}, Q_{-1} and Q_0 represent the four quarters preceding the addition announcement. The addition announcement takes place in Q_1 while Q_2, Q_3 and Q_4 represent respectively the following three quarters. Active Institutional Ownership is reported at the end of each quarter.

Table 3: Descriptive Statistics

Variable	Mean	Std. Dev.	5%	25%	Median	75%	95%
CAR [AD-ED]	5.064%	5.862%	-1.929%	1.794%	3.979%	7.375%	15.552%
CAR [AD, ED+5]	4.033%	7.025%	-6.647%	0.383%	3.741%	7.630%	14.606%
CAR [AD, ED+10]	3.600%	8.909%	-9.497%	-1.200%	3.330%	8.352%	16.696%
CAR [AD, ED+20]	3.398%	10.295%	-12.744%	-2.676%	3.422%	8.699%	19.858%
CARPS [AD, ED]	0.615%	5.255%	-5.328%	-1.450%	0.189%	1.979%	7.420%
A_i (×1,000)	0.559	0.628	0.091	0.218	0.355	0.613	1.814
AIO	18.122%	12.151%	2.731%	8.504%	16.025%	25.437%	40.024%
Δ AIO	-0.781%	5.569%	-7.972%	-2.293%	-0.648%	0.925%	6.552%
AIOPS	14.328%	12.174%	0.547%	5.630%	12.059%	20.205%	37.544%
Δ AIOPS	0.242%	7.572%	-6.672%	-1.396%	0.000%	1.293%	6.988%
Adj. Δ	-1.022%	8.703%	-10.081%	-3.127%	-0.607%	1.558%	7.686%
Demand Shock Size (%)	9.035%	2.411%	4.138%	7.579%	10.003%	10.464%	11.395%
Demand Shock Size ($ Millions)	675.191	969.104	22.210	94.980	517.170	807.082	1923.803

Summary statistics for the characteristics of 575 additions to the S&P 500 Index between January 1981 and December 2013. CAR [AD, ED] is the cumulative abnormal return over the market $(\boldsymbol{R_{it} - R_{mt}})$ between the announcement day and the effective day of each added stock. CAR [AD, ED+5], CAR [AD, ED+10] and CAR [AD, ED+20] represent the cumulative abnormal return over the market $(\boldsymbol{R_{it} - R_{mt}})$ between the announcement day and 5, 10 and 20 trading days following the effective day respectively. CARPS [AD, ED] is the cumulative abnormal return over the market $(\boldsymbol{R_{it} - R_{mt}})$ between the announcement day and the effective day for the three closest substitutes for each added stock. Arbitrage risk A_i is the variance of the residuals of the model $\boldsymbol{R_{it} - R_{ft} = \beta_{1i}(R_{PS1it} - R_{ft}) + \beta_{2i}(R_{PS2it} - R_{ft}) + \beta_{3i}(R_{PS3it} - R_{ft})}$, where $\boldsymbol{R_{PS1it}}$, $\boldsymbol{R_{PS2it}}$, and $\boldsymbol{R_{PS3it}}$ represents the return on the top three close substitutes based on industry-, size-, and book-to-market matching. Daily values for $\boldsymbol{R_{ft}}$ are from French's website. AIO is the active institutional ownership in the added stock in the quarter preceding the addition announcement. AIOPS is the average active institutional ownership in the top three close substitutes of added stock in the quarter preceding the addition announcement. Change in AIO is the change in active institutional ownership in the added stock in the quarter following addition announcement. Change in AIOPS is the average change in active institutional ownership in the top three close substitutes of the added stock in the quarter following addition announcement. Demand Shock Size (%) is the size of demand shock as a percentage of market capitalization; it is equal to the ratio of S&P 500–tracking index fund capitalization to S&P 500 total capitalization. Demand Shock Size ($ Millions) is the dollar value in millions of the demand shock over all firms added to the S&P 500 index.

Table 4: Demand Shock Statistics to Stocks Added to the S&P 500 Index (Selected Years)

	1981	1984	1988	1992	1996	2000	2004	2008	2012
S&P 500–tracking index fund capitalization ($ billion)	34.5	55	155	295	577	1,120.6	1,106.6	914.5	1,562.8
S&P 500 total capitalization ($ billion)	851	1,200	1,870	2,990	5,550	11,600	11,200	8,109	13,113
Size of demand shock (% of market capitalization)	4.1	4.6	8.3	9.9	10.4	9.7	9.9	11.3	11.9
Size of demand shock (median; $ million)	32.9	34.8	99.1	178.0	461.7	675.4	763.7	717.4	1,222.3

S&P 500–tracking index fund capitalization is the aggregate capitalization of all funds indexed to the S&P 500 as reported in the annual survey of indexed assets issued by the S&P Dow Jones Indices. S&P 500 total capitalization is the aggregate market value of all 500 firms included in the index at the end of each given year. Standard and Poor's estimates are available for years 1983 through 2013. We estimate the values for years 1981 and 1982 based on values reported by Wurgler and Zhuravskaya (2002). S&P 500–tracking index fund capitalization and S&P 500 total capitalization are end-of-year values and in billions of current dollars. The size of demand shock as percentage of market capitalization is the ratio of S&P 500–tracking index fund capitalization to S&P 500 total capitalization. The dollar value of the demand shock is the median shock over all firms added to the S&P 500 index in a given year.

Table 5: Mean Difference in CAR based on Arbitrage Risk A

Arbitrage Risk	CAR [AD, ED] (1)	CAR [AD, ED+5] (2)	CAR [AD, ED+10] (3)	CAR [AD, ED+20] (4)
High (A Above Median)	6.15%	4.66%	4.33%	4.27%
Low (A Below Median)	3.97%	3.41%	2.87%	2.53%
Mean Difference	2.18%***	1.25%**	1.47%**	1.74%**
(t-stat)	(4.53)	(2.14)	(1.98)	(2.03)

Mean Difference in Cumulative Abnormal Return based on Adjusted Arbitrage Risk A. Cumulative abnormal returns are calculated by summing abnormal returns between the announcement day and the effective day (1), 5 trading days following the effective day (2) 10 trading days following the effective day (3) and 20 trading days following the effective day (4). Each addition is classified based on the level of Arbitrage Risk A. If A is above the median value, we consider that the added stock has high arbitrage risk Cumulative abnormal returns are calculated by summing returns over the CRSP value-weighted market index. Arbitrage risk A_i is the variance of the residuals of the model $R_{it} - R_{ft} = \beta_{1i}(R_{PS1it} - R_{ft}) + \beta_{2i}(R_{PS2it} - R_{ft}) + \beta_{3i}(R_{PS3it} - R_{ft})$, where R_{PS1it}, R_{PS2it}, and R_{PS3it} represents the return on the top three close substitutes based on industry-, size-, and book-to-market matching. Daily values for R_{ft} are from French's website. AIO is the active institutional ownership in the added stock in the quarter preceding the addition announcement. T-statistics are provided below the mean difference in the table. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 6: Mean Difference in CAR based on Pre-addition Active Institutional Ownership

Pre-addition Active Institutional Ownership	CAR [AD, ED] (1)	CAR [AD, ED+5] (2)	CAR [AD, ED+10] (3)	CAR [AD, ED+20] (4)
High (AIO Above Median)	4.72%	3.62%	2.92%	3.24%
Low (AIO Below Median)	5.39%	4.43%	4.24%	3.55%
Mean Difference	-0.68%	-0.81%	-1.32%*	-0.30%
(t-stat)	(-1.38)	(-1.39)	(-1.79)	(-0.35)

Mean Difference in Cumulative Abnormal Return between announcement date and effective date based on difference in pre-addition active institutional ownership. Each observation is classified into High or Low active institutional ownership based on whether the pre-addition level of active institutional ownership in the added stock is above or below the annual cross-sectional median ownership level. Cumulative abnormal returns are calculated by summing abnormal returns between the announcement day and the effective day (1), 5 trading days following the effective day (2) 10 trading days following the effective day (3) and 20 trading days following the effective day (4). AIO is the active institutional ownership in the added stock in the quarter preceding the addition announcement. We use Bushee (2004) Institutional Investor Classification to identify active institutional investors. T-statistics are provided below the mean difference in the table. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 7: Mean Difference in CAR based on Arbitrage Risk and Pre-addition Active Institutional Ownership

Arbitrage Risk	Pre-Addition Active Institutional Ownership High (Above Median)	Pre-Addition Active Institutional Ownership Low (Below Median)	Mean Difference (t-stat)
Panel A: CAR [AD, ED]			
High (A Above Median)	5.58%	7.06%	-1.48%* (-1.76)
Low (A Below Median)	3.26%	4.38%	-1.12%** (-2.18)
Mean Difference (t-stat)	2.32%*** (4.02)	2.69%*** (3.40)	
Panel B: CAR [AD, ED+10]			
High (A Above Median)	3.31%	5.86%	-2.55%* (-1.92)
Low (A Below Median)	2.27%	3.26%	-0.99% (-1.34)
Mean Difference (t-stat)	1.04% (0.98)	2.60%** (2.37)	
Panel C: CAR [AD, ED+20]			
High (A Above Median)	3.85%	4.82%	-0.97% (-0.64)
Low (A Below Median)	2.22%	2.77%	-0.55% (-0.61)
Mean Difference (t-stat)	1.64% (1.35)	2.05% (1.59)	

Mean Difference in Cumulative Abnormal Return between announcement date and effective date (Panel A), 10 trading days following the effective day (Panel B) and 20 trading days following the effective day (Panel C) based on adjusted arbitrage risk as well as pre-addition active institutional ownership. Each addition is classified into High or Low arbitrage risk based on whether the arbitrage risk (A) is above or below the median of the full sample. Furthermore, each observation is classified into High or Low active institutional ownership based on whether the pre-addition level of active institutional ownership in the added stock is above or below the annual cross-sectional median ownership level. CARs are calculated by summing abnormal returns between the announcement day and the effective day. Arbitrage risk A_i is the variance of the residuals of the model $R_{it} - R_{ft} = \beta_{1i}(R_{PS1it} - R_{ft}) + \beta_{2i}(R_{PS2it} - R_{ft}) + \beta_{3i}(R_{PS3it} - R_{ft})$, where R_{PS1it}, R_{PS2it}, and R_{PS3it} represents the return on the top three close substitutes based on industry-, size-, and book-to-market matching. Daily values for R_{ft} are from French's website. AIO is the active institutional ownership in the added stock in the quarter preceding the addition announcement. We use Bushee (2004) Institutional Investor Classification to identify active institutional investors. T-statistics are provided below the mean difference in the table. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 8: Effect of Arbitrage Risk and Demand Shock Size on S&P 500 Additions Cumulative Abnormal Returns by the Pre-Addition Level of Active Institutional Investors Ownership

Variable	Dependent Variable							
	Low Active Institutional Ownership				High Active Institutional Ownership			
	CAR [AD, ED]		CAR [AD, ED+10]		CAR [AD, ED]		CAR [AD, ED+10]	
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Intercept	0.083	3.304^{***}	1.557	1.753^{***}	1.629	3.481^{***}	3.149	2.907^{***}
	(0.06)	(7.45)	(0.80)	(2.81)	(1.50)	(9.38)	(1.56)	(4.21)
A_i (×1,000)	4.669^{***}		5.997^{***}		1.860^{***}		-0.040	
	(7.52)		(6.85)		(4.492)		(-0.05)	
$ADSP_i$	0.347^{**}		-0.012		0.206^{*}		-0.023	
	(2.35)		(-0.06)		(1.80)		(-0.11)	
A_i (×1,000) x $ADSP_i$		0.483^{***}		0.575^{***}		0.204^{***}		0.002
		(7.88)		(6.66)		(4.95)		(0.02)
N	296	296	296	296	279	279	279	279
R^2	0.183	0.174	0.139	0.131	0.082	0.081	0.000	0.000

This table contains 8 OLS regressions of S&P 500 Index addition cumulative abnormal returns over the period January 1981 – December 2013. We divide the sample into two sub-samples High and Low active institutional ownership based on whether the pre-addition level of active institutional ownership in each added stock is above or below the median ownership level for the full sample. The dependent variable is the cumulative abnormal return between the announcement day and the effective day and10 trading days following the effective day. Cumulative abnormal returns are calculated by summing returns over the CRSP value-weighted market index. The announcement date and the effective date are the same for stocks added to the S&P 500 Index over the period January 1981 – September 1989. For stocks added after October 1989, the period between announcement date and effective date is at least one day and can go up to about a month. Independent variables include arbitrage risk A, demand shock size (ADSP) and an interaction term between arbitrage risk A and demand shock size (ADSP). Arbitrage risk A is the variance of the residuals of the model $R_{it} - R_{ft} = \beta_{1i}(R_{PS1it} - R_{ft}) + \beta_{2i}(R_{PS2it} - R_{ft}) + \beta_{3i}(R_{PS3it} - R_{ft})$, where R_{PS1it}, R_{PS2it}, and R_{PS3it} represents the return on the top three close substitutes based on industry-, size-, and book-to-market matching. Daily values for R_{ft} are from French's website. ADSP is the size of demand shock as a percentage of market capitalization; it is equal to the ratio of S&P 500–tracking index fund capitalization to S&P 500 total capitalization during a given year. We use Bushee (2004) Institutional Investor Classification to identify active institutional investors. T-statistics are provided below the coefficients in the table. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 9: Interaction between Arbitrage Risk, Demand Shock Size and Active Institutional Investors Ownership and its Effect on S&P 500 Additions Cumulative Abnormal Returns

Variable	Dependent Variable							
	CAR [AD, ED]				CAR [AD, ED+10]			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Intercept	0.842	3.442***	0.083	3.304***	2.307	2.376***	1.557	1.753***
	(0.93)	(11.56)	(0.07)	(8.39)	(1.60)	(5.01)	(0.80)	(2.82)
A_i (×1,000)	2.935***		4.669***		2.381***		5.997***	
	(7.98)		(8.45)		(4.06)		(6.86)	
$ADSP_i$	0.286***		0.347***		-0.004		-0.012	
	(2.99)		(2.64)		(-0.03)		(-0.06)	
A_i (×1,000) x $ADSP_i$		0.314***		0.483***		0.237***		0.575***
		(8.59)		(8.87)		(4.07)		(6.68)
HAIO			1.547	0.178			1.591	1.154
			(0.87)	(0.30)			(0.57)	(1.24)
HAIO x A_i			-2.808***				-6.037***	
			(-3.812)				(-5.18)	
HAIO x $ADSP_i$			-0.141				-0.010	
			(-0.75)				(-0.03)	
HAIO x A_i (×1,000) x $ADSP_i$				-0.279***				-0.573***
				(-3.82)				(-4.97)
N	575	575	575	575	575	575	575	575
R^2	0.118	0.114	0.153	0.147	0.028	0.028	0.082	0.078

This table contains 8 OLS regressions of S&P 500 Index addition cumulative abnormal returns over the period January 1981 – December 2013. The dependent variable is the cumulative abnormal return between the announcement day and the effective day and10 trading days following the effective day. Cumulative abnormal returns are calculated by summing returns over the CRSP value-weighted market index. The announcement date and the effective date are the same for stocks added to the S&P 500 Index over the period January 1981 – September 1989. For stocks added after October 1989, the period between announcement date and effective date is at least one day and can go up to about a month. Independent variables include arbitrage risk A, demand shock size (ADSP), a dummy variable HAIO and interaction terms between HAIO and the other variables. Arbitrage risk A is the variance of the residuals of the model $R_{it} - R_{ft} = \beta_{1i}(R_{PS1it} - R_{ft}) + \beta_{2i}(R_{PS2it} - R_{ft}) + \beta_{3i}(R_{PS3it} - R_{ft})$, where R_{PS1it}, R_{PS2it}, and R_{PS3it} represents the return on the top three close substitutes based on industry-, size-, and book-to-market matching. Daily values for R_{ft} are from French's website. ADSP is the size of demand shock as a percentage of market capitalization; it is equal to the ratio of S&P 500–tracking index fund capitalization to S&P 500 total capitalization during a given year. HAIO is a dummy variable equal to one if the pre-addition level of active institutional ownership is higher than the median level and zero otherwise. We use Bushee (2004) Institutional Investor Classification to identify active institutional investors. T-statistics are provided below the coefficients in the table. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 10: Effect of Arbitrage Risk, Demand Shock Size, Active Institutional Investors Ownership and Change in Active Institutional Ownership on S&P 500 Additions Cumulative Abnormal Returns

Variable	Dependent Variable							
	CAR [AD, ED]				CAR [AD, ED+10]			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Intercept	0.844	3.491***	0.234	3.379***	2.371*	2.531***	1.877	1.892***
	(0.94)	(11.69)	(0.19)	(8.64)	(1.66)	(5.37)	(0.97)	(3.05)
A_i (×1,000)	2.894***		4.333***		2.260***		5.475***	
	(7.87)		(7.81)		(3.88)		(6.22)	
$ADSP_i$	0.292***		0.064**		0.008		-0.031	
	(3.05)		(2.03)		(0.05)		(-0.15)	
A_i (×1,000) x $ADSP_i$		0.311***		0.449***		0.227***		0.522***
		(8.51)		(8.20)		(3.94)		(6.01)
Adj Δ AIO_i	0.064**	0.064**	0.150***	0.181***	0.181**	0.182**	0.232***	0.233***
	(2.05)	(2.03)	(3.48)	(3.63)	(3.63)	(3.68)	(3.39)	(3.41)
HAIO			1.449	-0.003			1.244	1.071
			(0.82)	(-0.01)			(0.45)	(1.15)
HAIO x A_i			-2.481***				-5.512***	
			(-3.37)				(-4.72)	
HAIO x $ADSP_i$			-0.153				0.018	
			(-0.82)				(0.06)	
HAIO x A_i (×1,000) x $ADSP_i$				-0.249***				-0.518***
				(-3.41)				(-4.48)
HAIO x Adj Δ AIO_i			-0.231***	-0.231***			-0.190**	-0.191**
			(-3.71)	(-3.70)			(-1.92)	(-1.93)
N	575	575	575	575	575	575	575	575
R^2	0.125	0.121	0.176	0.169	0.050	0.051	0.101	0.097

This table contains 8 OLS regressions of S&P 500 Index addition cumulative abnormal returns over the period January 1981 – December 2013. The dependent variable is the cumulative abnormal return between the announcement day and the effective day and10 trading days following the effective day. The announcement date and the effective date are the same for stocks added to the S&P 500 Index over the period January 1981 – September 1989. For stocks added after October 1989, the period between announcement date and effective date is at least one day and can go up to about a month. Independent variables include arbitrage risk A, demand shock size (ADSP), the adjusted change in active institutional ownership (Adj Δ AIO_i), a dummy variable HAIO and interaction terms between HAIO and the other variables. Arbitrage risk A is the variance of the residuals of the model $R_{it} - R_{ft} = \beta_{1i}(R_{PS1it} - R_{ft}) + \beta_{2i}(R_{PS2it} - R_{ft}) + \beta_{3i}(R_{PS3it} - R_{ft})$, where R_{PS1it}, R_{PS2it}, and R_{PS3it} represents the return on the top three close substitutes based on industry-, size-, and book-to-market matching. Daily values for R_{ft} are from French's website. ADSP is the size of demand shock as a percentage of market capitalization; it is equal to the ratio of S&P 500–tracking index fund capitalization to S&P 500 total capitalization during a given year. Adj Δ AIO_i is the adjusted quarterly change in active institutional ownership in the added stock; it is equal to the change in active institutional ownership in the added stock minus the average change in active institutional ownership in the top three close substitutes of the added stock in the quarter following addition announcement. AIO is the active institutional ownership in the added stock in the quarter preceding the addition announcement. HAIO is a dummy variable equal to one if the pre-addition level of active institutional ownership is higher than the median level and zero otherwise. We use Bushee (2004) Institutional Investor Classification to identify active institutional investors. T-statistics are provided below the coefficients in the table. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 11: Effect of Arbitrage Risk, Demand Shock Size, Active Institutional Investors Ownership and Change in Active Institutional Ownership in the close substitutes on S&P 500 Additions Cumulative Abnormal Returns

Variable	Dependent Variable							
	CAR [AD, ED]				CAR [AD, ED+10]			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Intercept	0.922	3.443***	0.253	3.502***	2.410*	2.378***	1.723	1.949***
	(1.04)	(11.79)	(0.21)	(9.14)	(1.69)	(5.08)	(0.89)	(3.16)
A_i (×1,000)	2.857***		4.298***		2.281***		5.635***	
	(7.91)		(7.98)		(3.93)		(6.48)	
$ADSP_i$	0.277***		0.352***		-0.016		-0.007	
	(2.95)		(2.77)		(-0.10)		(-0.04)	
A_i (×1,000) x $ADSP_i$		0.305***		0.446***		0.225***		0.539***
		(8.50)		(8.40)		(3.92)		(6.30)
Δ $AIOPS_i$	-0.183***	-0.183***	-0.272***	-0.270***	-0.235***	-0.234***	-0.266***	-0.267***
	(-4.83)	(-4.82)	(-6.20)	(-6.14)	(-3.87)	(-3.85)	(-3.75)	(-3.76)
HAIO			1.372	0.018			1.437	0.867
			(0.80)	(0.03)			(0.52)	(0.93)
HAIO x A_i			-2.460***				-5.626***	
			(-3.43)				(-4.86)	
HAIO x $ADSP_i$			-0.140				-0.028	
			(-0.76)				(-0.09)	
HAIO x A_i (×1,000) x $ADSP_i$				-0.244***				-0.534***
				(-3.43)				(-4.66)
HAIO x Δ $AIOPS_i$			0.320***	0.314***			0.161	0.163
			(3.94)	(3.86)			(1.23)	(1.24)
N	575	575	575	575	575	575	575	575
R^2	0.153	0.149	0.207	0.201	0.053	0.053	0.105	0.101

This table contains 8 OLS regressions of S&P 500 Index addition cumulative abnormal returns over the period January 1981 – December 2013. The dependent variable is the cumulative abnormal return between the announcement day and the effective day and10 trading days following the effective day. The announcement date and the effective date are the same for stocks added to the S&P 500 Index over the period January 1981 – September 1989. For stocks added after October 1989, the period between announcement date and effective date is at least one day and can go up to about a month. Independent variables include arbitrage risk A, demand shock size (ADSP), the average change in active institutional ownership in the perfect three substitutes (Δ $AIOPS_i$), a dummy variable HAIO and interaction terms between HAIO and the other variables. Arbitrage risk A is the variance of the residuals of the model $R_{it} - R_{ft} = \beta_{1i}(R_{PS1it} - R_{ft}) +$

$\beta_{2i}(R_{PS2it} - R_{ft}) + \beta_{3i}(R_{PS3it} - R_{ft})$, where R_{PS1it}, R_{PS2it}, and R_{PS3it} represents the return on the top three close substitutes based on industry-, size-, and book-to-market matching. Daily values for R_{ft} are from French's website. ADSP is the size of demand shock as a percentage of market capitalization; it is equal to the ratio of S&P 500–tracking index fund capitalization to S&P 500 total capitalization during a given year. DSB is the dollar value of S&P 500 index fund demand in billions of dollars. Δ $AIOPS_i$ is the average quarterly change in active institutional ownership in the top three substitutes of the added stock. HAIO is a dummy variable equal to one if the pre-addition level of active institutional ownership in the quarter preceding the addition announcement is higher than the cross-sectional median level and zero otherwise. We use Bushee (2004) Institutional Investor Classification to identify active institutional investors. T-statistics are provided below the coefficients in the table. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 12: Effect of Arbitrage Risk, Demand Shock Size and Active Institutional Investors Ownership on S&P 500 Additions Cumulative Abnormal Returns by Price Reaction of Close substitutes

Variable	Dependent Variable							
	Large Price Reaction for Substitutes (CARPS Above Median)				Small Price Reaction for Substitutes (CARPS Below Median)			
	CAR [AD, ED]		CAR [AD, ED+10]		CAR [AD, ED]		CAR [AD, ED+10]	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Intercept	0.739	3.157^{***}	0.526	1.630^{*}	-0.251	3.950^{***}	2.734	2.455^{***}
	(0.42)	(5.84)	(0.18)	(1.82)	(-0.16)	(7.31)	(1.07)	(2.92)
A_i (×1,000)	5.512^{***}		7.700^{***}		2.612^{***}		3.022^{**}	
	(7.50)		(6.32)		(3.26)		(2.39)	
$ADSP_i$	0.252		0.095		0.480^{***}		-0.060	
	(1.38)		(0.31)		(2.72)		(-0.22)	
A_i (×1,000) x $ADSP_i$		0.570^{***}		0.778^{***}		0.298^{***}		0.265^{**}
		(7.70)		(6.34)		(3.87)		(2.21)
Δ $AIOPS_i$	-0.294^{***}	-0.289^{***}	-0.282^{***}	-0.277^{***}	-0.176^{**}	-0.177^{**}	-0.139	-0.138
	(-5.41)	(-5.34)	(-3.13)	(-3.08)	(-2.31)	(-2.30)	(-1.16)	(-1.15)
HAIO	0.945	0.466	2.318	1.230	2.019	-0.292	1.055	0.668
	(0.39)	(0.59)	(0.58)	(0.94)	(0.82)	(-0.34)	(0.27)	(0.50)
HAIO x A_i	-3.284^{***}		-7.215^{***}		-1.847		-4.322^{**}	
	(-3.56)		(-4.72)		(-1.53)		(-2.28)	
HAIO x $ADSP_i$	-0.038		-0.088		-0.256		-0.007	
	(-0.15)		(-0.21)		(-0.98)		(-0.02)	
HAIO x A_i (×1,000) x $ADSP_i$		-0.331^{***}		-0.719^{***}		-0.189		-0.396^{**}
		(-3.58)		(-4.68)		(-1.61)		(-2.16)
HAIO x Δ $AIOPS_i$	0.303^{***}	0.295^{***}	0.131	0.125	0.298^{**}	0.295^{***}	0.121	0.120
	(3.13)	(3.06)	(0.81)	(0.78)	(1.97)	(1.93)	(0.51)	(0.50)
N	575	575	575	575	575	575	575	575
R^2	0.320	0.320	0.191	0.191	0.099	0.078	0.031	0.028

This table contains 8 OLS regressions of S&P 500 Index addition cumulative abnormal returns over the period January 1981 – December 2013. The sample is divided based on the average cumulative abnormal return of the added stock's closest substitute between the announcement day and the effective day (CARPS). The dependent variable is the cumulative abnormal return between the announcement day and the effective day and10 trading days following the effective day. Cumulative abnormal returns for the added stock are calculated by summing returns over the CRSP value-weighted market index between the announcement day and the effective day, and 10 trading days following the effective day. Cumulative abnormal returns for each perfect substitute is calculated by summing returns over the CRSP value-weighted market index between the announcement day and the effective day. The announcement date and the effective date are the same for stocks added to the S&P 500 Index over the period January 1981 – September 1989. For stocks added after October 1989, the period between announcement date and effective date is at least one day and can go up to about a month. Independent variables include arbitrage risk A, demand shock size (ADSP), the average change in active institutional ownership in the perfect three substitutes (Δ AIOPS$_i$), a dummy variable HAIO and interaction terms between HAIO and the other variables. Arbitrage risk A is the variance of the residuals of the model $R_{it} - R_{ft} = \beta_{1i}(R_{PS1it} - R_{ft}) + \beta_{2i}(R_{PS2it} - R_{ft}) + \beta_{3i}(R_{PS3it} - R_{ft})$, where R_{PS1it}, R_{PS2it}, and R_{PS3it} represents the return on the top three close substitutes based on industry-, size-, and book-to-market matching. Daily values for R_{ft} are from French's website. ADSP is the size of demand shock as a percentage of market capitalization; it is equal to the ratio of S&P 500–tracking index fund capitalization to S&P 500 total capitalization during a given year. Δ AIOPS$_i$ is the average quarterly change in active institutional ownership in the top three substitutes of the added stock. HAIO is a dummy variable equal to one if the pre-addition level of active institutional ownership in the quarter preceding the addition announcement is higher than the cross-sectional median level and zero otherwise. We use Bushee (2004) Institutional Investor Classification to identify active institutional investors. T-statistics are provided below the coefficients in the table. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 13: Effect of Arbitrage Risk, Demand Shock Size, Momentum and Active Institutional Investors Ownership on S&P 500 Additions Cumulative Abnormal Returns

Variable	Dependent Variable							
	CAR [AD, ED]				CAR [AD, ED+10]			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Intercept	0.942	0.159	3.341***	3.366***	2.441*	1.486	2.227**	1.606***
	(1.07)	(0.13)	(11.30)	(8.76)	(1.72)	(0.78)	(4.70)	(2.62)
A_i (×1,000)	2.593***	3.771***			1.879***	4.311***		
	(6.76)	(6.60)			(3.05)	(4.71)		
$ADSP_i$	0.264***	0.351***			-0.034	-0.008		
	(2.82)	(2.78)			(-0.23)	(-0.04)		
A_i (×1,000) x $ADSP_i$			0.278***	0.396***			0.185***	0.412***
			(7.26)	(7.08)			(3.01)	(4.62)
MO_i	0.006**	0.013**	0.006**	0.013***	0.009*	0.032***	0.009*	0.033***
	(1.99)	(2.65)	(2.04)	(2.76)	(1.88)	(4.16)	(1.87)	(4.35)
Δ $AIOPS_i$	-0.183***	-0.267***	-0.182***	-0.265***	-0.235***	-0.253***	-0.234***	-0.253***
	(-4.83)	(-6.10)	(-4.82)	(-6.03)	(-3.87)	(-3.60)	(-3.85)	(-3.61)
HAIO		1.513		0.053		1.660		1.247
		(0.88)		(0.09)		(0.60)		(1.34)
HAIO x A_i		-2.087***				-4.259***		
		(-2.76)				(-3.52)		
HAIO x $ADSP_i$		-0.156*				-0.022		
		(-0.85)				(-0.08)		
HAIO x A_i (×1,000) x $ADSP_i$				-0.211***				-0.401***
				(-2.81)				(-3.35)
HAIO x Δ $AIOPS_i$		0.311***		0.304***		0.149		0.150
		(3.83)		(3.75)		(1.15)		(1.16)
HAIO x MO_i		-0.009		-0.010		-0.033***		-0.035**
		(-1.52)		(-1.59)		(-3.44)		(-3.61)
N	575	575	575	575	575	575	575	575
R^2	0.159	0.219	0.155	0.212	0.059	0.132	0.058	0.131

This table contains 8 OLS regressions of S&P 500 Index addition cumulative abnormal returns over the period January 1981 – December 2013. The dependent variable is the cumulative abnormal return between the announcement day and the effective day and10 trading days following the effective day. Cumulative abnormal returns are calculated by summing returns over the CRSP value-weighted market index. The announcement date and the effective date are the same for stocks added to the S&P 500 Index over the period January 1981 – September

1989. For stocks added after October 1989, the period between announcement date and effective date is at least one day and can go up to about a month. Independent variables include arbitrage risk A, demand shock size (ADSP), the momentum factor (MO_i), the average change in active institutional ownership in the perfect three substitutes (Δ $AIOPS_i$), a dummy variable HAIO and interaction terms between HAIO and the other variables. Arbitrage risk A is the variance of the residuals of the model $R_{it} - R_{ft} = \beta_{1i}\left(R_{PS1it} - R_{ft}\right) + \beta_{2i}\left(R_{PS2it} - R_{ft}\right) + \beta_{3i}\left(R_{PS3it} - R_{ft}\right)$, where R_{PS1it}, R_{PS2it}, and R_{PS3it} represents the return on the top three close substitutes based on industry-, size-, and book-to-market matching. Daily values for R_{ft} are from French's website. ADSP is the size of demand shock as a percentage of market capitalization; it is equal to the ratio of S&P 500–tracking index fund capitalization to S&P 500 total capitalization during a given year. MO_i is the compounded daily return between 1 and 13 months prior to the addition announcement. Δ $AIOPS_i$ is the average quarterly change in active institutional ownership in the top three substitutes of the added stock. HAIO is a dummy variable equal to one if the pre-addition level of active institutional ownership in the quarter preceding the addition announcement is higher than the cross-sectional median level and zero otherwise. We use Bushee (2004) Institutional Investor Classification to identify active institutional investors. T-statistics are provided below the coefficients in the table. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

ESSAY 2:
THE EFFECT OF CHANGES IN FINANCIAL ANALYSTS' FORECASTS ON INVESTMENT BEHAVIOR IN FOCUSED AND MULTI-SEGMENT FIRMS

1. Introduction

One of the puzzles facing financial economists interested in the organizational structure of firms is the pervasiveness and persistence of corporate diversification, despite mounting evidence that corporate diversification reduces firm value. In 1992, 87.6 percent of the 500 largest U.S. public companies operated in more than one industry, as classified based on 4-digit SIC codes, and 69.6 percent operated in at least five different industries (Montgomery 1994). More recently, Maksimovic and Phillips (2007) report that production by conglomerates accounts for more than 50% of total production in the United States.

Yet, over the past two decades, corporate diversification has been frequently associated with unfavorable terms such as "diversification discount" and "inefficient internal capital markets." Many researchers conclude that corporate diversification leads to value destruction and that diversified firms are wasting resources through an inefficient allocation of internally generated funds (Berger and Ofek 1995; Lamont 1997; Scharfstein and Stein 2000; Rajan, Servaes, and Zingales 2000; Wulf 2009). Studies of corporate spinoffs strengthen these conclusions by finding short-term and long-term value creation after focus-increasing spinoffs (Daley, Mehrotra, and Sivakumar 1997; Desai and Jain 1999).

Inefficient capital allocation has been identified as a significant mechanism by which corporate diversification destroys value. For instance, Ozbas and Scharfstein (2010) find that unrelated segments exhibit lower sensitivity of investment to growth options than stand-alone firms. Gertner, Powers, and Scharfstein (2002) examine the investment behavior of firms before and after spinoff from their parent companies and find that firm investment after the spinoff is significantly more sensitive to measures of growth opportunities.

Of central concern for empirical studies on internal capital markets is how to measure growth opportunities. Because growth opportunities are not directly observed, researchers have used different measures of growth opportunities. However, how are these measures selected? And is it possible to measure their performance? Kallapur and Trombley (1999) state that many studies rely on “intuitive arguments” to choose proxies for investment opportunities and point out that the findings of many studies are not robust to the choice of growth opportunity measures.[24] Adam and Goyal (2008) declare that little is known about the performance of these measures due to the difficulty of measuring growth opportunities. Baker (1993) argues that this lack of understanding is one of the major problems in empirical research. Finally, Stein (2003) acknowledges that internal capital budgeting - one of the most important financial decisions of firms - also remains one of the least understood.

The most common measure for growth opportunities, Tobin’s Q, is considered to suffer from measurement error problems.[25] Whited (2001) considers Tobin’s Q to be a poor measure of investment opportunities and concludes that findings of internal capital markets inefficiency are an artifact of measurement errors. Indeed, Custodio (2014) shows that Q-based measures suffer from a significant upward bias due to mergers and acquisitions activity and its accounting implications. Villalonga (2004) further argues that much of the evidence on internal capital

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[24] Findings reported by Smith and Watts (1992), Gaver and Gaver (1993), and Skinner (1993) where they examine the association between different proxies for investment opportunities and financing, dividend, compensation, and accounting policies.

[25] See for example, Shin and Stulz (1998), Scharfstein (1998), Rajan, Servaes and Zingales (2000), Gertner, Powers, and Scharfstein (2002), Billet and Mauer (2003), Ozbas and Scharfstein (2010), and, Duchin and Sosyura (2013).

markets inefficiency is misleading because of biased estimates of the investment opportunities of diversified firms' segments.

Some studies have used other accounting variables to measure growth opportunities, variables such as return on assets (Billet and Mauer 2003), growth in industry sales (Billet, King and Mauer 2007), or industry investment (Gertner, Powers, and Scharfstein 2002). These measures have been used in backward-looking and in forward-looking approaches, but both approaches have been criticized for their underlying assumptions. On the one hand, forward-looking approaches assume that expected outcomes are equal to future realized outcomes and further assume that the investment decision itself does not affect future outcomes. On the other hand, backward-looking approaches typically assume stability in investment opportunities across industries, so that industries with relatively higher past investment opportunities are assumed to also have relatively higher future investment opportunities.

This study contributes to the literature by proposing and testing the empirical performance of a measure of growth opportunities that uses financial analysts' earnings forecasts. A measure based on analyst forecasts has the desirable properties that (i) it is based on data observed prior to firms making their investments and that (ii) it is forward looking. Earnings forecast by financial analysts provide a clear ex ante prediction of how much growth a firm is expected to experience within a preset future window and so such predictions are directly comparable across firms and across different industries.

Using changes in analyst earnings forecasts to measure future growth opportunities and using capital expenditure to measure firm investments, we present findings consistent with the idea that diversified firms respond efficiently to changes in investment opportunities. In particular, we find that when analysts' earnings forecasts increase, diversified firms increase capital expenditures and when earnings forecasts decrease, diversified firms decrease capital expenditures. Also consistent with the idea that diversified firms respond efficiently to growth opportunities, we find that changes in analysts' earnings forecasts explain a statistically and economically significant proportion of the investment behavior of firms.

We also examine how the response of investments to growth opportunities differs between diversified and focused firms. The findings of prior literature that the investments of diversified firms respond less to growth opportunities than the investments of focused firms can be interpreted as presented evidence of under-reaction to growth opportunities by diversified firms, which is the usual interpretation in the literature. However, an alternative interpretation is that the investments of focused firms overreact to growth opportunities.

Theory proposes that, rather than undertaking optimal levels of new investments, firms in general may either overinvest or underinvest. Overinvestment may result from CEO's desire for empire building (Jensen 1986 and 1993) and greater private benefits derived from managing more resources (Stein 1997). Overinvestment may also be a result of manager overconfidence, so that overconfident CEOs believe that their decisions will maximize shareholder wealth and overinvest (Heaton 2002). Underinvestment may be a result of limited internal resources and asymmetric information costs of external financing (Stulz 1990). Moreover, if shareholders believe that CEOs tend to overinvest due to overconfidence, this may lead to less capital supplied by shareholders and to underinvestment. Stein (2003) points out that many theoretical models predict that firms will overinvest when the level of internal cash flow is higher than firms' investment opportunities and will underinvest when internal cash flow is lower than firms' investment opportunities.

Both overinvestment and underinvestment will tend be less pronounced in diversified firms. This is because internally generated cash flow and external financing are more sensitive to changes in growth opportunities for focused firms than they are for diversified firms. This means that when investment opportunities improve, for example, the access to external and to internal financing for focused firms will increase by more than for diversified firms. The increased access to funds will lead focused firms to both overinvest and to invest more than diversified firms. Although diversified firms may also tend to overinvest in response to greater opportunities, they will overinvest less compared to focused firms. This is because diversified firms face a wider menu of investment choices and hence have the ability to direct funds towards the more promising divisions (Stein 1997).

When investment opportunities are sparse, focused firms typically have less access to external funding and lower internally generated cash flow than diversified firms. The argument is based on the idea that diversified firms are less sensitive to the performance of any particular segment because they rely on the diversification benefits of an internal capital market (Weston 1970) and the resulting higher debt capacity (Lewellen 1971). Consequently, the underinvestment problem should be less pronounced for diversified than for focused firms (Stulz 1990).

Comparing the investment behavior of diversified firms to the behavior of focused firms, we find that capital expenditures are more sensitive to changes in investment opportunities for diversified firms than for focused firms. Moreover, changes in financial analysts' forecasts explain more of the variation in the investment behavior of diversified firms than the investment behavior of focused firms. We conclude that the investment behavior of diversified firms is consistent with an efficient allocation of resources. Overall, the evidence questions the conclusions based on prior findings of suboptimal investment behavior by diversified firms and suggests that these conclusions are sensitive to the choice of growth opportunity measures.

Our paper adds to the literature on internal capital market allocation efficiency in diversified firms (Scharfstein and Stein 2000; Rajan, Servaes and Zingales 2000; Maksimovic and Phillips 2007; Ozbas and Scharfstein 2010; Hovakimian 2011; Duchin and Sosyura 2013; Matvos and Seru; 2014). The paper also extends prior studies proposing new methodologies that tackle capital allocations in multi-segment firms (Whited 2001; Villalonga 2004; Maksimovic and Phillips 2007).

The rest of the paper is organized as follows. Section 2 reviews the literature. Section 3 develops the main hypotheses. Section 4 describes the sample, variables, and methodology with a focus on the key variables measuring investment opportunities and investment behavior. The empirical analysis is presented in Section 5 and Section 6 concludes the paper.

2. Literature Review

Numerous studies in the finance literature tackle the topic of corporate diversification and the efficiency of internal capital markets in diversified firms. The debate continues as to whether diversification creates or destroys value.

Corporate diversification is often a natural consequence of a firm's growth, where the availability of resources allows the firm to benefit from new investment opportunities in other industries (Gomes and Livdan 2002) and to benefit from reallocating internally generated funds from less profitable to more profitable projects. An internal capital market is then said to be efficient if it allocates funds within the firm in a way that maximizes shareholder wealth (Shin and Stulz 1998).

Williamson (1975) suggests that, due to internal capital markets, diversified firms have the ability to allocate capital more efficiently than external capital markets because diversified firms' managers are better informed about investment opportunities than external investors. The importance of internal capital markets in diversified firms is even greater when external capital markets are costly or less developed (Fauver, Houston and Naranjo 2003). Gertner, Scharfstein, and Stein (1994) present models that identify circumstances under which internal capital markets lead to more efficient investment decisions. Finally, Stein (1997) points that predictions from agency theory are in line with efficient allocation of resources in diversified firms. He argues that even if CEOs of diversified firms enjoy private benefits and even if such CEOs tend to overinvest, they still have an incentive to direct funds to the most promising projects. Consequently, their winner-picking behavior will add value to diversified firms.

Lang and Stulz (1994) find that diversified firms sell at a market discount when compared to stand-alone firms. Berger and Ofek (1995) reveal that this discount is correlated with the inefficient allocation of resources – investments in low Q segments. Shin and Stulz (1998) point out that capital is not allocated to the segment with the better investment opportunities in diversified firms. They report that investments by a division within diversified firms depend more on the division's own cash flow than on the firm's cash flow. Rajan, Servaes and Zingales (2000) also claim that diversified firms invest more than single-segment firms in industries with relatively poor investment opportunities. They present a one-layer agency model, where the only conflict is between the CEO and the divisional managers. Because divisional managers expect firm resources to be allocated based on opportunities in each division, they have an incentive to distort investments before any future allocations are made.

Scharfstein and Stein (2000) argue that rent-seeking behavior by divisional managers leads top management to overinvest in relatively weaker divisions and underinvest in relatively stronger divisions. They present a two-tiered agency model where managers of weaker divisions spend time and effort to strengthen their outside options, which forces the CEO to compensate them for staying in the firm. As an agent, the CEO finds it less costly to channel more funds to these weaker divisions. Ozbas and Scharfstein (2010) empirically test these predictions and find that investments of focused firms are more sensitive to industry Q than investments of diversified firms. When compared to focused firms, unrelated segments of conglomerates invest less in high-Q industries and more in low-Q industries. The authors also find this inefficient investment behavior to be more pronounced in diversified firms with low rather than high managerial ownership. Finally, Duchin and Sosyura (2013) show that divisional managers with strong social connections to the CEO receive substantially more capital allocation.

Many recent studies note that internal capital markets in diversified firms are efficient especially under severe economic conditions. In a study at the plant level, Maksimovic and Phillips (2002) find that conglomerates allocate resources efficiently and that their growth is consistent with optimal behavior. Dimitrov and Tice (2006) find that during recessions segments of bank-dependent diversified firms experience a lower decline in sales and inventory growth than rival bank-dependent focused firms. Their findings are consistent with less binding credit constraints for diversified firms. Gopalan and Xie (2011) show that the diversification discount decreases during industry distress as segments of diversified firms are able to avoid any financial constraints that may arise. Hovakimian (2011) finds that internal capital market efficiency in diversified firms is related to the business cycle and states that internal capital markets improve their efficiency during recessions, when external capital markets are more restrictive.

Matvos and Seru (2014) find that diversified firms efficiently reallocate resources to mediate the effect of financial shocks. They estimate that internal capital markets in diversified firms offset financial market distress during the 2008 financial crisis by 16%-30%. Consequently, they suggest that capital allocations decisions in diversified firms play a greater role in determining macroeconomic outcomes than previously anticipated. These results are supported by Kuppuswamy and Villalonga (2015), who reveal that diversified firms increased in value relative to stand alone firms during the financial crisis due to the debt coinsurance and to a more efficient internal capital market. Almeida, Kim and Kim (2015) also report a similar finding in Korea in the aftermath of the 1997 Asian financial crisis.

3. Hypothesis

In this section we develop three related hypotheses. In the first hypothesis, we link the change in investment behavior in diversified and focused firms to industry-level variation in investment opportunities. The second hypothesis proposes that the investments of diversified firms should be more sensitive to changes in investment opportunities than the investments of focused firms. The third hypothesis states that, compared to focused firms, the variation in investment behavior of diversified firms is better explained by the variation in investment opportunities.

In a perfect world with frictionless capital markets, investment efficiency implies that funds are allocated to projects so that the marginal product of capital is equated across every project in the economy (Stein 2001). In a diversified firm, such efficiency would imply that the marginal return of investment is equated across all of its segments. Prior studies set the investment behavior of focused firms as a benchmark for diversified firms' investment behavior assuming focused firms are investing at optimal levels. As discussed before, this may lead to misleading conclusions about the efficiency of internal capital markets in diversified firms. It is hard to determine whether a given firm is investing at the optimal level or not. Is the $1 billion invested by a given firm during a given year the optimal amount? Or should the firm invest less or more than that given the firm's opportunities? The complications arise from the fact that we observe the outcome of the investment decision but not the expected outcome at the time the investment decision is made. However, even if we cannot determine whether a firm is investing at an optimal level or not, we can at least examine some of the aspects of its investment behavior and check whether the behavior is consistent with optimal investment behavior or not. As first test, we examine the sensitivity of firm investment behavior to investment opportunities.

If a firm is investing at optimal levels, further changes in investments should be directly linked to changes in investment opportunities. If there are no changes in investment opportunities in a given year, the firm should invest the same amount of money it invested last year. If the firm increases its investment because it has access to more funds, this implies that the firm was either underinvesting last year, so that this year it is moving towards its optimal investment levels, or that it is going to overinvest this year. Because there may be factors preventing firms from investing at optimal levels, firms may not have invested optimally in previous years. However, even if firms are not investing at optimal levels, firms should at least react in a way that reflects efficient behavior i.e., firms should respond to any favorable change in investment opportunities by increasing their investment levels and to any unfavorable change by decreasing their investments.

If there is a favorable change in investment opportunities for a focused firm, the optimal behavior of the focused firm will be to increase its investment to reach a new equilibrium level. However, due to capital constraints the firm may have less access to external funding and therefore, its response may fall short below optimal levels. On the other hand, if there is a favorable change in investment opportunities of a diversified firm' segment, the firm can channel more funds to its segment through its access to a larger internal capital market and to lower cost external funding. On the other hand, if there is an unfavorable change in investment opportunities, the optimal behavior will be to decrease investment to reach a new equilibrium level. As focused firms have no other investment options beyond their own industry, those firms may tend not to decrease their investment to optimal levels and therefore maintain a higher level of investment. Such problem is less likely to be faced by a diversified firm; diversified firms may also want to keep as much capital as possible invested within the firm. However, diversified firms have an option to channel funds from the least promising segments to the most profitable segments. In this way, even if capital is kept in the firm, at least it is channeled in the right direction.

Although we expect focused firms and diversified firms to react in a way that reflects efficient behavior (*H1*), we expect diversified firms to react more significantly to any change in investment opportunities (*H2*). Any change in investment behavior should be mainly explained by the change in investment opportunities. However, other factors may also affect the investment behavior of firms such as limited access to internal and to external funding, and managers' tendency towards overinvesting. Therefore, the more the firm is sensitive to those factors, the lower the explanatory power of changes in investment opportunities in explaining changes in investment behavior. Since focused firms are more likely to be affected by these factors, we expect the variation in their investment behavior to be less correlated with the changes in investment opportunities (*H3*).

Hypothesis 1: *The change in investment behavior of diversified and focused firms is positively correlated with variations in investment opportunities.*

Hypothesis 2: *Diversified firms' investments are more sensitive to changes in investment opportunities than focused firms' investments.*

Hypothesis 3: *The variation in investment opportunities explains more of the variation in investments of diversified firms relative to focused firms.*

4. Data and Variables

This section describes the samples and the methodology used to compute the change in investment opportunities and the change in investment behavior.

4.1. Data and Methodology

4.1.1. Multi-Segment Firms Sample

The primary sample of multi-segment firms covers all the firms over the period 1991-2015 on the active and research files of the COMPUSTAT segment database. We build our investment opportunities measure at the Fama-French (1991) industry level. We define a multi-segment firm as a firm reporting at least two industries based on Fama-French (1991) industry classification.[26]

Following Berger and Ofek (1995), we exclude firms with at least one segment in the financial services industry (SIC 6000-6999) or in utilities (SIC 4900-4999) or with missing or undetermined SIC codes.[27] We also exclude American Depository Receipts (ADRs) and firms with total annual sales less than $20 million. We also require the availability of all segments' capital expenditures data for a firm to be included in the final sample. These procedures limit our sample to 22,730 segment-year observations.

Table 15 provides descriptive statistics for the segment-level data. The median segment has $265 million of assets, $327 million in sales and $10 million in capital expenditures. Table 16 represents summary statistics of the sample of diversified firms. The average firm has $4.2 billion of assets, $4.4 billion of annual sales, and annual capital expenditures of $255 million. The average

[26] Fama-French (1991) classify all industries into 48 different industries based on their 4-digit SIC code classification. Table 18 contains a complete list of those 48 industries.
[27] Based on Fama-French (1991) industry classification, financial services industry includes banking (industry code: 44), Insurance (industry code: 45), Real Estate (industry code: 46) and Trading (industry code: 47). The Fama-French (1991) industry code for utilities is 31.

age of the diversified firm in the sample is 26 years. Finally, the average number of segments that a firm operates is 2.4.

4.1.2. Single-Segment Firms Sample

This sample includes all single-segment firms over the period 1991-2015 on COMPUSTAT data files. A single-segment (or focused) firm is defined as a firm reporting financial data on exactly one segment at the Fama-French (1991) industry level. Financial firms (SIC 6000-6999), utility firms (SIC 4900-4999), and firms with incomplete data are excluded from the sample. We also exclude small firms with less than $20 million of annual sales. Table 17 represents summary statistics of the single-segment firms' sample. The average firm has $1.6 billion of assets and $1.5 billion of annual sales. The average age of a single-segment firm is 13 years. The leverage of single-segment firms is lower than that of diversified firms (45% versus 49%), possibly due to the higher debt capacity of diversified firms.

4.1.3. All Firms Sample

This sample includes all segment-level observations and covers 73,248 segment-years over the period 1991-2015. A dummy variable is added to differentiate between the segments of multi-segment firms and those of single-segment firms.

4.2. Variables Description

4.2.1. Measuring Changes in Investments

The measure used to capture changes in investment behavior is based on capital expenditures at the segment level in single-segment and multi-segment firms. In order to make investment comparable across segments of diversified firms we normalize each segment's capital expenditures by the same segment's assets.[28] Because capital expenditures reported in year t represents a flow of expenditures over the period t-1 to t, we use the average value of total assets during that period (using the beginning or ending values may overstate or understate the value of total assets). The main measure of investments we use is capital expenditures normalized by average assets ($CAPX_t$). We also use the change in capital expenditures (CI_t) as an alternative measure that captures the change in investments. The formula we use to compute the change in capital expenditures for a given firm is shown below:

$$CI_t = \frac{CAPX_t}{\frac{(AT_t + AT_{t-1})}{2}} - \frac{CAPX_{t-1}}{\frac{(AT_{t-1} + AT_{t-2})}{2}},$$

where

- $CAPX_t$: Capital expenditures in millions of dollars reported in year t
- $CAPX_{t-1}$: Capital expenditures in millions of dollars reported in year $t-1$
- AT_t: Total assets in millions of dollars in year t
- AT_{t-1}: Total assets in millions of dollars in year $t-1$.

4.2.2. Measuring Changes in Investment Opportunities

We use financial analysts' estimates to create a measure for investment opportunities. The Institutional Brokers' Estimate System (I/B/E/S) provides earnings estimates for U.S. firms since 1976. Reported estimates cover different measures where the most common include, but are not limited to, BPS (Book Value per share), EBI (EBIT per share), EBS (EBITDA), EPS (Earnings per share), NET (Net Income), OPR (Operating Profit), ROE (Return on Equity), ROA (Return on

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[28] Rajan, Servaes, and Zingales 2000 argue that diversified firms are more likely to report segments' sales strategically as SFAS leaves some discretion in the breakdown of a firm's activity. Therefore, segments' assets is a better measure than segments' sales to normalize capital expenditure.

Assets) and SAL (Revenue). Table 18 shows the distribution of fiscal year end estimates made for the period 1991-2015 by type of estimate.

Given that EPS estimates are the most common estimates, and have the widest firm coverage, we choose EPS estimates to construct our proxy for investment opportunities.[29] Analysts' estimates are made for annual fiscal periods, quarterly fiscal periods, and semi-annual periods. In addition, analysts provide long-term growth estimates. To construct a measure that can be applied consistently in the cross-section and over time, we consider only the fiscal year-end estimates. Of these estimates, we include only those made at least 18 months before the fiscal year end date.[30] For example, if the fiscal year ends in Dec 31, 2017, we consider only estimates made before Jul 1, 2016.

Any given financial analyst may issue several estimates for the same firm and for the same fiscal period. We assign equal weights to all analysts by dividing the sample into four estimation periods (as shown in table 19) and restricting to one the number of estimates made by the same analyst, for the same firm, for the same period. We restrict our sample to EPS estimates made in the second estimation period (18 to 30 months prior), and we consider only the last EPS estimate made by a given analyst for the same firm, for the same fiscal period. In following this procedure, we ensure that a financial analyst has at most one EPS estimate 18 to 30 months before the fiscal year end period. We exclude all firms followed by less than two financial analysts during the second estimation period, which should reduce estimation noise.

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[29] EPS estimates represent 19.12% of total issued estimates. Moreover, these estimates cover an average of 5,472 firms per year.

[30] As financial analysts may observe capital expenditures or directions of future capital expenditures, we require the 18 months interval to reduce the effects of any endogeneity issue that may arise.

The next step involves merging the EPS estimates sample with the single-segment firms' sample to create the expected ROA variable. By multiplying the average EPS estimate for each firm by its corresponding number of shares outstanding, we get the total estimated earnings per firm per year.

To build our measure of growth opportunities at the industry level, we use Fama-French (1991) industry classification. Each year, we group all the firms with complete data within the same industry and we compute their corresponding total expected earnings and total assets. For each industry that includes at least three single-segment firms with sufficient data, we divide the total expected earnings by the corresponding total assets to get our measure of growth opportunities (IO_t: the expected return on assets). Then, we compute the change in investment opportunities at the industry level ($CIO = IO_t – IO_{t-1}$) by computing the yearly change in expected return on assets for each industry.

The following figure illustrates the timeline for different estimation periods and how the change in investment opportunities is computed.

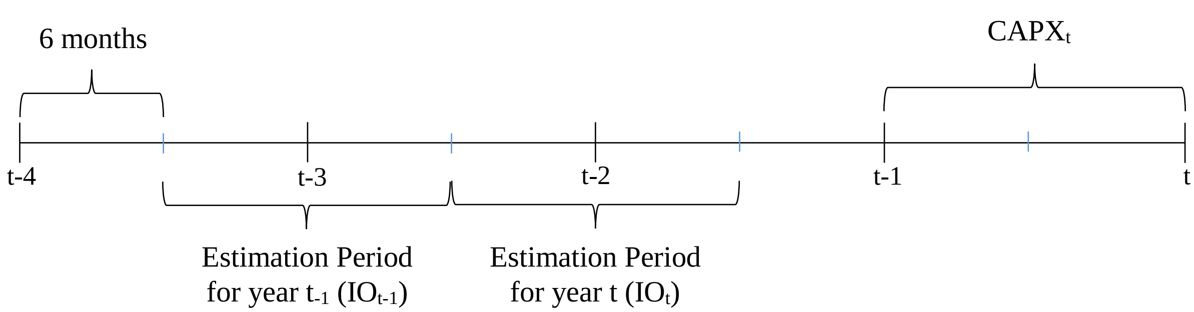

Figure 8: Timeline for Different Estimation Periods

Table 21 represents summary statistics of the average change in investment opportunities across industries and across time. Over the period 1991-2015, the "Candy and Soda" industry had the highest average change in investment opportunities (0.32%) followed by the "Rubber and Plastic Products" industry (0.28%). On the other hand, the "Electrical Equipment" industry had the lowest average change in investment opportunities over the same period (-0.28%). The "Recreation" industry had the highest volatility in expected return on assets, while the "Transportation" industry had the lowest volatility.

Finally, we merge the change in investment opportunities variable separately with the corresponding segments of single-segment firms and those of multi-segment firms. If the expected change in ROA is missing for a given industry in a given year, we drop all the segment-year observations corresponding to this industry from both the single-segment and multi-segment firms' samples.

5. Empirical Results

First, we test the sensitivity of investment behavior to changes in investment opportunities by regressing the change in investments at the segment level on the change in investment opportunities, the lagged change in investment, and a vector of control variables. We therefore estimate the following model:

$$\Delta I_{it} = \alpha + \beta CIO_{i,t} + \gamma \Delta I_{i,t-1} + \delta D_{i,t} + \theta X_{i,t} + \varepsilon_{i,t}$$

where ΔI_{it} is the change in investment levels, we use two measures to account for changes in investments at the segment level. The first measure is $CAPX_{it}$, the capital expenditures normalized by average assets for segment i in year t, while the second measure is CI_{it}, the change in capital expenditures normalized by average assets for segment i in year t. CIO_{it} is the change in investment opportunities faced by segment i in year t; the change in investment opportunities is the change in expected return on assets at the Fama-French (1991) industry level based on financial analysts' forecasts. D_{it} is a diversification dummy equal to one if the segment is part of a multi-segment firm and zero otherwise.

To control for other variables that may affect each segment's investment behavior, we add seven control variables to the model: Lag LogA, Lag Prof., Lag Lev., Lag M2B, Firm Age, Cash Flow and Lag Ind. M2B. "Lag LogA" is the natural logarithm of lagged total assets expressed in millions of dollars. "Lag Prof." represents the profitability of the firm and is expressed as the ratio of EBIT to total sales in the previous year. "Lag Lev." represents the ratio of total debt to total assets in the previous year. "Lag M2B" is the lagged market to book ratio. "Firm Age" represents the number of years since the firm was added to the COMPUSTAT industrial files. "Cash Flow" is the sum of net cash flow from operating activities, other financing activities and the exchange rate effect scaled by average assets and by the number of firm's segments. "Lag Ind. M2B" is the lagged Fama-French (1991) industry Market to Book ratio.

We expect the coefficient of CIO to be significantly positive for segments of both single-segment and multi-segment firms. In other words, we expect segments to significantly change their investments in the same direction as the change in investment opportunities. Any favorable change in investment opportunities at the segment level will lead firms to increase their investment in that segment, while an unfavorable change will reduce investments. However, we expect diversified firms' investment behavior to be significantly more sensitive to changes in investment opportunities than that of single-segment firms.

The coefficient of Lag CI indicates whether firms overreact or underreact in their previous responses to changes in investment opportunities. If firms are investing efficiently and are changing their investments in response to changes in investment opportunities, the coefficient of Lag CI should not be significantly different from zero. However, if the coefficient is significantly positive, this will imply that there is a lagged increase (decrease) in investments due to lagged favorable (unfavorable) changes in investment opportunities. If firms had underreacted in previous periods, a part of the change in investment behavior this period will be partly due to a correction to such under-reaction. On the other hand, a significantly negative sign will imply that, in previous periods, firms had overreacted to changes in investment opportunities.

5.1. Change in Investment Opportunities and Investments at the Segment Level

Table 22 shows the results of OLS regressions for segments of single-segment and multi-segment firms.[31] In panel A, the dependent variable is the segment's capital expenditure in year t,

[31] All regressions throughout the paper are based on segment-level observations.

while the dependent variable in panel B is the change in capital expenditures at the segment level in year t.

The coefficient of CIO is consistently positive across all regressions, which implies that segments of single-segment and multi-segment firms are more likely to change their investment levels in the same direction of changes in investment opportunities. Any favorable change in investment opportunities for a segment is expected to lead firms to increase their investment levels in that segment while an unfavorable change may result in lower levels of investments. That behavior is consistent with efficient investment behavior. However, we notice the quantitative and qualitative difference in sensitivity between the two samples.

While the coefficient of CIO is significantly positive in all models where the multi-segment firms sample is used, the coefficient is not statistically significant in three out of four models in the single-segment firms sample in panel A. In panel B, the coefficient is positive across all regressions for both samples. However, the coefficient in the multi-segment firms sample is almost three times larger than the estimate in the single-segment firms' sample. This result implies that segments of diversified firms are more sensitive to changes in investment opportunities than segments of single-segment firms. Moreover, the regression R-squared within the multi-segment firms is consistently larger than that the regression R-squared within the single-segment firms (table 22, Panel B). This implies that the change in investment opportunities explains more of the variation in multi-segment firms' investment behavior (CI) compared to that of single-segment firms. However, this result does not hold for the level of investment (CAPX), since the R-squared is higher for the sample of single-segment firms.

To assess whether the difference between the coefficients is statistically significant we consider the full sample (including all segments) and we interact the diversification dummy "D" with all independent variables. Table 23 shows that the coefficient of the interaction term between the dummy variable "D" and the change in investment opportunities "CIO" is significantly positive across all specifications. The larger internal capital market of diversified firms allows them to channel more funds to segments with favorable changes in investment opportunities at the same time diversified firms have an option to divert investments away from segments with unfavorable changes in investment opportunities to segments with better opportunities. When segments of a diversified firm face opposite changes in investment opportunities the reaction of the multi-segment firm is expected to be even stronger to these changes. On the one hand, the firm is more likely to increase investments in segments with favorable changes in investment opportunities. On the other hand, it is less likely to invest in other segments with deteriorating investment opportunities. These two investment patterns are not necessarily independent from each other, as capital expenditures diverted from segments with unfavorable changes in investment opportunities will strengthen capital expenditures in segments with favorable changes in investment opportunities.

Table 23 (Panel B) also shows that the coefficient of Lag CAPX is significantly positive, implying that year t investments are positively correlated with investment in year t-1. When compared to single-segment firms, year t investments of segments of multi-segment firms are significantly less related to year t-1 investments. Table 23 (Panel A) also shows that the coefficient of Lag CI is significantly negative, implying that in year t-1 single- and multi-segment firms overreacted to changes in investment opportunities. Therefore, a significant part of the change in investment behavior in year t is partly due to a correction of the over-reaction in year t-1. The significant negative sign of the interaction term between the diversification dummy "D" and the lagged change in investment "LCI" implies that multi-segment firms are more likely to overreact to changes in investment opportunities relative to single-segment firms.

5.2. Favorable vs Unfavorable Changes in Investment Opportunities

To further examine how investments react to changes in investment opportunities at the industry level, we divide the sample based on the direction of change. A positive change in the expected return on assets (CIO) implies a favorable change in investment opportunities while a negative change implies an unfavorable change in investment opportunities. Dividing the sample based on the direction of change in investment opportunities will also allow us to explore whether firms' tendency to overinvest affects their responses to these changes. A tendency to overinvest may lead firms to react more significantly to favorable changes in investment opportunities than they would respond to unfavorable changes. Such a tendency will reinforce the segments' expected reaction to favorable changes while constraining the reaction to unfavorable changes.

In table 24, we report regression results conditional on favorable changes in investment opportunities. In all the reported models, the coefficient of CIO is not significantly different from zero implying that single-segment firms do not react significantly to favorable changes in investment opportunities. Because a favorable change in investment opportunities indicates that the expected return on assets for year t is higher than that for year t-1, single-segment firms may not have generated enough cash flows in year t-1 to invest at optimal levels in year t. Moreover, these firms may have less access to costly external capital funding based on the relatively poor performance in year t-1. Those two factors will limit the response of single-segment firms to favorable changes in investment opportunities, especially given that the lower the return on assets in year t-1 relative to year t, the more favorable the change in investment opportunities. The insignificant response of focused firms to favorable changes in opportunities suggests that focused firms may underinvest.

In contrast, segments of multi-segment firms respond significantly to favorable changes in investment opportunities at the industry level. The coefficient of the interaction term between the dummy variable "D" and the change in investment opportunities variable "CIO" is significantly positive in all model specifications. Although, we cannot tell whether investment levels of those segments are optimal or not, we can still conclude that the investment behavior of multi-segment firms complies more closely with an efficient allocation of resources.

The difference in responses between segments of focused and diversified firms may be explained by the financing limitations imposed on each type of firm. Even if segments of multi-segment firms did not generate enough cash flow in year t-1, these segments can still benefit from cash flow generated by other segments with better investment opportunities in year t-1. Consequently, internal capital markets in multi-segment firms coupled with lower cost external funding allow segments of multi-segment firms to react more efficiently to changes in investment opportunities at the industry level.

In table 25, we report results based on unfavorable changes in investment opportunities. Once again, the coefficient of CIO is not significantly different from zero in any of the specifications, implying that single-segment firms do not react significantly to unfavorable changes in investment opportunities. When a single-segment firm faces an unfavorable change in its investment opportunities, its expected return on assets for year t is lower than that for year t_{-1}. In this case, optimal investment behavior requires the single-segment firm to decrease its investment to reach a new equilibrium level in year t. As the firm may have generated relatively high levels of cash flow in year t_{-1} and with no other investment options available, the single-segment firm may tend to overinvest in year t. Therefore, between the urge of decreasing investment levels due to the unfavorable changes and of maintaining high levels of investment due to private benefits derived by managers, single-segment firms do not respond efficiently to unfavorable changes in investment opportunities,

The response of multi-segment firms to unfavorable changes at the segment level are not significantly better than that of single-segment firms. The coefficient of interaction term between the dummy variable "D" and "CIO" is consistently insignificant in all regression models. Consequently, multi-segment firms do not lower their investment to optimal levels of investment in response to unfavorable changes in investment opportunities. Although segments of multi-segment firms have an option to divert part of the funds generated at the segment level in year t_{-1} to other segments with better investment opportunities in year t, the rent seeking behavior of segments' managers and the agency problems at the divisional levels prevents multi-segment firms from efficiently responding to unfavorable changes in investment opportunities. While managers of single-segment and multi-segment firms want to keep internally generated funds in year t_{-1} in the firm in year t, segments' managers in multi-segment firms have an incentive to keep these funds in their own divisions (Scharfstein and Stein 2000).

5.3. Changes in Investment Opportunities of Complementary Segments in Multi-Segment Firms

Investment behavior in multi-segment firms may not be affected solely by the change in investment opportunities at the segment level but also by the change in investment opportunities across the other complementary segments. For example, if a diversified firm has two segments witnessing an increase in their investment opportunities, the multi-segment firm may not direct funds to one segment without considering the other segments unless the firm has access to completely unrestricted funding. If the favorable change in investment opportunities for segment 1 was more than that for segment 2, the diversified firm may channel less funds to segment 2 than it would channel if the changes in investment opportunities were equal across the two segments. To account for the change in investment opportunities for the other segments, we compute the weighted average change in investment opportunities for these complementary segments. The formula we use to compute the change in investment opportunities for complementary segments is as follows:

$$Comp.CIO_{i,j} = \sum_{k=1}^{N} \left(w_k \times CIO_{k,j}\right) - \left(w_i \times CIO_{i,j}\right),$$

where

- $Comp.CIO_{i,j}$: Change in investment opportunities for complementary segments of segment i in multi-segment firm j
- $CIO_{i,j}$: Change in investment opportunities for segment i in multi-segment firm j
- w_k: The weight of segment's k assets to total assets of multi-segment firm j that includes N different segments at the Fama-French (1991) industry levels.

In table 26, we add the change in investment opportunities in complementary segments "Comp. CIO" to the model. Even after accounting for the change in investment opportunities for the other segments, the sensitivity of investment to changes in investment opportunities at the segment level remains quantitatively and qualitatively similar to previous results. In all specifications, the coefficient of "Comp. CIO" is not significantly different from zero, which implies that investment in segment i is not affected by changes in investment opportunities within other segments. The year t investment in segment i is only affected by the change in investment opportunities at the own segment level.

6. Conclusion

In this paper, we revisit the issue of internal capital markets efficiency in focused and diversified firms. We advance and use a new measure of investment opportunities, which is based on financial analysts' estimates. Prior studies set the investment behavior of focused firms as a benchmark for diversified firms' investment behavior assuming focused firms are investing at optimal level. Such proposition leads to misleading conclusion about internal capital market inefficiency in diversified firms. Because we observe the outcome of the investment decision but not the expected outcome when the investment decision is made, it is difficult to determine whether a firm is investing at the optimal level of investment or not. However, we can at least cover some of the aspects of its investment behavior and check whether such aspects conform to an optimal investment behavior or not. Therefore, we check the sensitivity of such behavior to changes in investment opportunities.

When compared to single-segment firms, multi-segment firms' investments are more sensitive to changes in investment opportunities as measured by the change in expected return on assets at the Fama-French (1991) industry level. When compared to multi-segment firms, single-segment firms have additional constraints that may limit their response to changes in investment opportunities. Moreover, the change in investment opportunities explains much of the variation in investment behavior of multi-segment firms compared to the investment behavior of single-segment firms. Therefore, we conclude that the investment behavior of multi-segment firms conform better with efficient allocation of resources when compared to the investment behavior of single-segment firms.

However, we find that the response of multi-segment firms to changes in investment opportunities is affected by the direction of change. Multi-segment firms' larger internal capital markets and their higher debt capacity allow their segments to respond efficiently to favorable changes in investment opportunities. On the other hand, when there is an unfavorable change in investment opportunities, agency problems at the divisional level prevents multi-segment firms from efficiently responding to such changes. Consequently, single-segment and multi-segment firms are more likely to overinvest when there is an unfavorable change in investment opportunities.

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Table 14: Variables Description

Variable	Description
CAPX	Segment's annual capital expenditures normalized by average assets.
CI	Change in segment's capital expenditures normalized by average total assets.
Lag CAPX	Segment's lagged annual capital expenditures normalized by average assets
Lag CI	Lagged change in segment's capital expenditures normalized by average total assets.
IO	Proxy for investment opportunities at the industry level (Fama and French (1991) industry classification). This variable represents the estimated return on assets based on financial analysts' forecasts.
CIO	Change in investment opportunities (change in expected ROA).
Comp. CIO	Average complementary change in investment opportunities for the other segments in a multi-segment firm.
Assets	Total assets expressed in millions of dollars.
Lag LogA	Natural logarithm of lagged assets of the segment expressed in millions of dollars.
Lag Prof.	The lagged profitability of the firm and is expressed as the ratio of EBIT to total sales.
Lag Lev.	The lagged leverage of the firm and is expressed as the ratio of total debt to total assets.
Lag M2B	The lagged Market to Book ratio.
Firm Age	The number of years since the firm was added to the COMPUSTAT industrial files.
Lag Ind. M2B	The lagged Fama-French (1991) industry Market to Book ratio.
Cash Flow	The sum of net cash flow from operating activities, other financing activities and the exchange rate effect normalized by average assets and divided by the number of firm's segments.
No. of Segments	Number of Fama-French (1991) segments operated by the firm.
D	Dummy variable equals one if the firm is multi-segment and zero otherwise.

Table 15: Descriptive Statistics of Segments

Variable	N	Mean	Std. Dev.	25%	Median	75%
Assets (millions)	22,730	1,974.32	6,941.30	71.38	265.00	1,162.00
Sales (millions)	22,730	2,137.19	7,114.70	94.77	327.47	1,308.00
CAPX (millions)	22,730	119.36	601.74	1.72	9.71	50.08

Summary statistics for the characteristics of the 22,730 segment-years observations of the multi-segment firms sample; Assets is the book value of segment's total assets in millions of dollars. Sales is the value of segment's annual sales expressed in millions of dollars. CAPX is the segment's annual capital expenditures in millions of dollars.

Table 16: Descriptive Statistics of Multi-Segment Firms

Variable	N	Mean	Std. Dev.	25%	Median	75%
Assets (millions)	11,791	4,151.07	13,099.58	149.48	627.34	2,626.84
Sales (millions)	11,791	4,424.99	11,887.72	206.72	749.20	2,854.87
CAPX (millions)	11,791	255.35	993.56	4.29	24.98	127.80
Profitability (%)	11,791	7.17	14.94	3.35	7.44	11.97
Leverage	11,791	0.49	0.62	0.33	0.46	0.58
Firm Age	11,791	26.44	15.99	12.00	24.00	40.00
M2B	11,791	1.56	0.97	1.10	1.37	1.77
Cash Flow (millions)	11,791	426.55	1505.42	6.84	47.35	234.48
No. of Segments	11,791	2.42	0.73	2.00	2.00	3.00

Summary statistics for the characteristics of the 11,791 firm-years observations' in our diversified firms sample; Assets is the book value of total assets in millions of dollars. Sales is the value of annual sales expressed in millions of dollars. CAPX is the annual capital expenditures in millions of dollars. Profitability is the profitability of the firm and is expressed as the ratio of EBIT to total sales. Leverage is the ratio of total debt to total assets. Firm Age is the number of years since the firm was added to the COMPUSTAT industrial files. M2B is the market to book ratio. Cash Flow in millions of dollars is the sum of net cash flow from operating activities, other financing activities and the exchange rate effect. No. of segments is the number of Fama-French (1991) segments operated by the multi-segment firm.

Table 17: Descriptive Statistics of Single-Segment Firms

Variable	N	Mean	Std. Dev.	25%	Median	75%
Assets (millions)	50,554	1,643.73	6,254.67	70.45	235.06	858.43
Sales (millions)	50,554	1,490.06	5,547.13	71.55	225.50	799.45
CAPX (millions)	50,554	107.68	544.65	1.66	8.36	40.24
PROF (%)	50,554	2.25	52.54	0.76	6.08	12.54
Leverage	50,554	0.45	0.31	0.26	0.41	0.58
FIRMAGE	50,554	16.44	11.91	8.00	12.00	21.00
M/B	50,554	1.95	1.97	1.08	1.46	2.20
Cash Flow (millions)	50,554	171.03	852.19	1.38	13.95	74.62
No. of Segments	50,554	1.00	1.00	1.00	1.00	1.00

Summary statistics for the characteristics of the 50,554 firm-years observations' in our single-segment firms sample; Assets is the book value of total assets in millions of dollars. Sales is the value of annual sales expressed in millions of dollars. CAPX is the annual capital expenditures in millions of dollars. Profitability is the profitability of the firm and is expressed as the ratio of EBIT to total sales. Leverage is the ratio of total debt to total assets. Firm Age is the number of years since the firm was added to the COMPUSTAT industrial files. M2B is the market to book ratio. Cash Flow in millions of dollars is the sum of net cash flow from operating activities, other financing activities and the exchange rate effect. No. of segments is the number of Fama-French (1991) segments operated by the multi-segment firm.

Table 18: Distribution of financial analysts' estimates by measure

MEASURE	Total Number of estimates	Percentage of total estimates	Number of firm-year estimates	Average Number of Firms covered per year
BPS	2,662,741	2.69%	46,348	1,854
EBI	5,339,331	5.39%	47,634	1,905
EBT	6,643,828	6.71%	56,650	2,266
ENT	5,804,908	5.86%	24,639	986
EPS	**18,934,112**	**19.12%**	136,797	5,472
GPS	5,784,442	5.84%	54,502	2,180
NET	10,090,268	10.19%	68,221	2,729
OPR	4,106,108	4.15%	50,043	2,002
PRE	8,904,597	8.99%	65,317	2,613
ROA	1,312,009	1.32%	35,011	1,400
ROE	2,791,413	2.82%	49,526	1,981
SAL	11,548,162	11.66%	90,370	3,615
Other Measures	15,121,255	15.27%	74,352	2,974
All Measures	99,043,174	100.00%	139,234	5,569

Distribution of financial analysts' fiscal year end estimates made for the period 1991-2015 by type of estimate. BPS is Book Value per share. EBI is EBIT per share. EBT is EBITDA. ENT is Enterprise Value. EPS is Earnings per share. GPS is the GAAP Earnings per share. NET is Net Income. OPR is the operating profit. PRE is Pre-Tax Profit. ROA is Return on Assets. ROE is Return on Equity. SAL is Revenue. Other Measures include CPS (Cash Flow per share), CPX (Capital Expenditures), DPS (Dividend per share), GRM (Gross Margin), PRE (Pre-Tax Profit), NAV (Net Asset Value) and NDT (Net Debt) among others.

Table 19: Distribution of EPS estimates by estimation period

Estimation period	Number of estimates	Percentage
Less than 18 months	15,981,395	84.41%
18 – 30 months	2,212,342	11.68%
31 – 42 months	480,013	2.54%
More than 42 months	260,362	1.38%
Total	18,934,112	100.00%

Distribution of financial analysts' EPS estimates by estimation period. The first time period covers all estimates made 18 months before the estimation date. The second time period covers all estimates made 18 to 30 months before the estimation date. The third time period covers all estimates made 31 to 42 months before the estimation date. Finally, the fourth time period covers all estimates made at least 42 months before the estimation date.

Table 20: Fama and French (1991) Industry Classification

Industry Code	Industry Definition
1	Agriculture
2	Food Products
3	Candy & Soda
4	Beer & Liquor
5	Tobacco Products
6	Recreation
7	Entertainment
8	Printing and Publishing
9	Consumer Goods
10	Apparel
11	Healthcare
12	Medical Equipment
13	Pharmaceutical Products
14	Chemicals
15	Rubber and Plastic Products
16	Textiles
17	Construction Materials
18	Construction
19	Steel Works Etc
20	Fabricated Products
21	Machinery
22	Electrical Equipment
23	Automobiles and Trucks
24	Aircraft
25	Shipbuilding, Railroad Equipment
26	Defense
27	Precious Metals
28	Non-Metallic and Industrial Metal Mining
29	Coal
30	Petroleum and Natural Gas
31	Utilities
32	Communication
33	Personal Services
34	Business Services
35	Computers
36	Electronic Equipment
37	Measuring and Control Equipment
38	Business Supplies
39	Shipping Containers
40	Transportation
41	Wholesale
42	Retail
43	Restaurants, Hotels, Motels
44	Banking

Industry Code	Industry Definition
45	Insurance
46	Real Estate
47	Trading
48	Other

Table 21: Average Change in Investment Opportunities across industries and across time

Industry Code	Years					Average CIO	Std. Dev. CIO	Average Number of Firms
	1991-1995	1996-2000	2001-2005	2006-2010	2011-2015			
1	1.00%	2.67%				1.20%	1.97%	3.46
2	0.31%	-0.34%	0.48%	0.67%	-0.49%	0.10%	1.56%	20.07
3	0.40%	0.65%	0.03%	0.38%	0.19%	0.32%	1.82%	8.15
4		-0.06%	0.43%	0.29%	-0.24%	0.09%	0.86%	4.11
6	0.57%	0.23%	-0.16%	0.73%	-0.59%	0.13%	3.48%	9.74
7	-0.10%	-0.37%	0.33%	-0.68%	0.37%	-0.07%	1.18%	19.00
8	-1.41%	-0.33%	-0.43%	0.34%	1.58%	0.07%	3.15%	8.15
9	-0.33%	1.14%	0.71%	-1.14%	0.42%	0.18%	1.84%	23.96
10	-0.30%	-0.21%	0.32%	0.56%	-0.01%	0.06%	1.81%	15.67
11	-0.17%	0.06%	0.49%	-0.22%	-0.06%	0.02%	1.12%	26.30
12	0.04%	0.73%	0.72%	-0.91%	-0.20%	0.05%	1.34%	62.37
13	0.05%	2.07%	-1.58%	-0.05%	0.36%	0.18%	2.14%	118.74
14	0.21%	-0.40%	0.05%	-0.07%	0.75%	0.15%	1.38%	28.11
15	0.01%	-0.07%	-0.39%	0.94%	0.34%	0.25%	1.76%	6.56
16	0.10%	0.18%	-0.70%		0.69%	0.21%	1.17%	7.91
17	0.14%	0.03%	-0.99%	-0.16%	0.91%	0.02%	1.77%	15.37
18	-0.21%	0.24%	0.29%	-0.03%	-0.99%	-0.17%	1.69%	12.77
19	0.46%	-0.64%	0.11%	1.20%	-1.27%	-0.08%	2.73%	21.70
20		-0.59%		-0.25%		-0.60%	1.25%	3.94
21	0.35%	0.84%	-0.25%	0.02%	-0.12%	0.16%	2.31%	47.52
22	0.62%	-0.16%	-0.67%	0.04%	-1.09%	-0.28%	2.04%	13.00
23	-0.18%	0.35%	-0.18%	0.03%	0.59%	0.14%	2.04%	21.11
24		1.86%	-0.71%	0.10%	-0.75%	0.24%	2.82%	5.61
25			-0.14%		-1.37%	0.18%	3.85%	3.09
27	-0.43%	0.62%	-0.74%	1.76%	-1.49%	-0.11%	2.64%	10.11
30	0.27%	0.39%	0.81%	-0.36%	-1.00%	-0.02%	1.75%	63.89
32	0.18%	-0.70%	1.39%	-0.10%	-0.38%	0.06%	1.20%	46.78

Industry Code	Years					Average CIO	Std. Dev. CIO	Average Number of Firms
	1991-1995	1996-2000	2001-2005	2006-2010	2011-2015			
33	0.36%	-0.43%	0.74%	0.74%	-0.67%	0.14%	2.54%	16.77
34	-0.06%	-0.06%	0.46%	0.03%	0.52%	0.20%	1.07%	209.19
35	0.16%	2.11%	-0.01%	-0.90%	-0.42%	0.15%	2.15%	72.00
36	0.99%	0.76%	-0.68%	0.32%	-0.92%	0.02%	2.43%	119.33
37	0.53%	0.53%	-0.33%	0.05%	0.36%	0.24%	1.48%	30.56
38	0.07%	0.13%	-0.37%	-0.37%	0.89%	0.13%	1.75%	14.96
40	0.37%	0.35%	-0.12%	-0.09%	0.43%	0.20%	0.74%	52.33
41	0.11%	-0.14%	0.24%	0.18%	0.11%	0.10%	1.28%	43.41
42	0.22%	0.69%	-0.17%	-0.13%	0.38%	0.21%	0.79%	105.67
43	0.53%	0.67%	-0.15%	1.08%	-1.31%	0.05%	1.47%	28.81
48	-0.69%	-0.52%	-0.06%	0.52%	-0.19%	-0.19%	1.30%	9.30
Average	0.07%	0.21%	-0.02%	0.13%	-0.11%	**0.05%**		35.77
Std. Dev.	1.79%	2.05%	1.73%	2.23%	2.10%	**2.00%**		46.48

This table contains average values for the change in investment opportunities (CIO) across Fama-French (1991) industries and across time. The change in investment opportunities represents the change in expected return on assets based on financial analysts' forecasts Industries with less than three observations in 4 out of the 5-year interval periods are excluded from the table. The average CIO, in any year-interval, for industries with less than three years of complete data in that same year-interval is left blank. Average CIO for each industry is the average of all firms in that industry. Average CIO for each year interval is the average of all firms in that year interval. The same methodology applies to standard deviation values. Average Number of Firms in each industry is the average annual number of all firms in that industry. The average and the standard deviation of the full sample is marked in bold.

Table 22: Effect of change in investment opportunities on investment behavior at the segment level (Multi-Segment Firms vs Single-Segment Firms)

Panel A: Dependent Variable is Capital expenditures normalized by average assets (CAPX)

Variable	Segments of Multi-Segment Firms				Segments of Single-Segment Firms			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
CIO	0.126***	0.107***	0.110***	0.107***	0.036***	0.004	0.004	0.002
	(4.63)	(3.94)	(4.08)	(3.95)	(2.89)	(0.31)	(0.36)	(0.19)
Lag CAPX	0.134***	0.124***	0.135***	0.135***	0.352***	0.320***	0.320***	0.320***
	(19.35)	(17.93)	(19.57)	(19.50)	(94.22)	(85.47)	(85.55)	(85.53)
Lag LogA		-0.003***	0.000	0.000		-0.010***	-0.010***	-0.010***
		(-5.05)	(0.27)	(0.32)		(-25.10)	(-24.84)	(-24.99)
Lag Prof.		0.042***	0.037***	0.037***		0.000*	0.000**	0.000**
		(5.74)	(5.10)	(5.15)		(1.94)	(2.38)	(2.29)
Lag Lev.		-0.018***	-0.019***	-0.019***		-0.019***	-0.019***	-0.019***
		(-4.28)	(-4.32)	(-4.32)		(-17.39)	(-17.15)	(-17.09)
Lag M2B		0.009***	0.009***	0.009***		0.003***	0.003***	0.003***
		(9.68)	(9.77)	(9.33)		(23.48)	(22.57)	(21.36)
Firm Age		-0.001***	-0.001***	-0.001***		-0.000***	-0.000***	-0.000***
		(-8.99)	(-10.98)	(-11.03)		(-6.79)	(-6.93)	(-6.78)
Cash Flow			0.009***	0.009***			0.017***	0.018***
			(18.61)	(18.60)			(9.80)	(9.91)
Lag Ind. M2B				0.002**				0.001***
				(2.09)				(3.45)
N	22,730	22,730	22,730	22,730	50,544	50,544	50,544	50,544
R^2	0.017	0.030	0.045	0.045	0.149	0.188	0.190	0.190
Firm F. E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Panel B: Dependent Variable is Change in Capital expenditures normalized by average assets (CI)

Variable	Segments of Multi-Segment Firms				Segments of Single-Segment Firms			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Intercept	-0.003***	0.002	-0.003	0.000	-0.004***	-0.002*	-0.002**	-0.001
	(-5.02)	(0.71)	(-1.11)	(-0.14)	(-13.98)	(-1.91)	(-2.00)	(-0.98)
CIO	0.204***	0.197***	0.197***	0.200***	0.072***	0.066***	0.066***	0.067***
	(5.68)	(5.50)	(5.55)	(5.65)	(4.63)	(4.23)	(4.22)	(4.29)
Lag CI	-0.679***	-0.681***	-0.665***	-0.665***	-0.194***	-0.198***	-0.198***	-0.197***
	(-82.73)	(-82.96)	(-81.68)	(-81.68)	(-48.96)	(-49.83)	(-49.85)	(-49.84)
Lag LogA		-0.002***	-0.001***	-0.001***		-0.001***	-0.001***	-0.001***
		(-5.19)	(-2.93)	(-2.96)		(-7.95)	(-8.79)	(-8.87)
Lag Prof.		0.008***	0.004*	0.004		0.000	0.000	0.000
		(2.80)	(1.66)	(1.62)		(0.32)	(0.55)	(0.60)
Lag Lev.		-0.004	-0.002	-0.002		-0.004***	-0.003***	-0.003***
		(-1.61)	(-0.80)	(-0.88)		(-4.01)	(-3.27)	(-3.38)
Lag M2B		0.002**	0.001	0.001		0.001***	0.001***	0.001***
		(2.28)	(0.71)	(1.05)		(8.65)	(7.92)	(7.97)
Firm Age		0.000***	0.000**	0.000**		0.000***	0.000***	0.000***
		(2.82)	(2.12)	(2.08)		(9.80)	(9.56)	(9.50)
Cash Flow			0.012***	0.012***			0.011***	0.011***
			(21.76)	(21.75)			(6.20)	(6.08)
Lag Ind. M2B				-0.002*				-0.000
				-(1.73)				-(1.34)
N	19,428	19,428	19,428	19,428	43,337	43,337	43,337	43,337
R^2	0.262	0.264	0.281	0.282	0.053	0.058	0.058	0.058

These tables use segments data from the multi-segment firms and single-segment firms samples. Each of the two samples covers the period 1991-2015. Dependent variables include the segment capital expenditures normalized by average assets (Panel A) and the change in investment capital expenditures normalized by average assets (Panel B). Independent variables include variables CIO, Lag CAPX (Panel A), Lag CI (Panel B) and control variables (Lag LogA, Lag Prof., Lag Lev., Lag M2B, Firm Age, Cash Flow and Lag Ind. M2B). CIO is the change in investment opportunities for the segment; change in expected return on assets at the Fama-French (1991) industry level. Lag CAPX is the lagged capital expenditures of the segment normalized by its average total assets. Lag CI is the lagged change in the capital expenditures normalized by average assets. Lag LogA is the natural logarithm of lagged assets of the segment expressed in millions of dollars. Lag Prof. is the lagged profitability of the firm and is expressed as the ratio of EBIT to total sales. Lag Lev. is the lagged leverage of the firm and is expressed as the ratio of total debt to total assets. Lag M2B is the lagged Market to Book ratio. Firm Age is the number of years since the firm was added to the COMPUSTAT industrial files. Cash Flow is the sum of net cash flow from operating activities, other financing activities and the exchange rate effect scaled by average assets and by the number of firm's segments. Lag Ind. M2B is the lagged Fama-French (1991) industry Market to Book ratio. T-statistics are provided below the coefficients in the table. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 23: Effect of change in investment opportunities on investment behavior at the segment level (Full Sample)

Panel A: Dependent Variable is Capital expenditures normalized by average assets (CAPX)

Variable	(1)	(2)	(3)	(4)
CIO	0.036**	0.007	0.008	0.006
	(2.35)	(0.43)	(0.52)	(0.40)
Lag CAPX	0.365***	0.331***	0.332***	0.331***
	(78.99)	(71.21)	(71.54)	(71.51)
Lag LogA		-0.007***	-0.006***	-0.006***
		(-16.97)	(-14.73)	(-14.80)
Lag Prof.		0.000	0.000**	0.000**
		(1.64)	(2.06)	(2.00)
Lag Lev.		-0.018***	-0.018***	-0.018***
		(-13.60)	(-13.16)	(-13.13)
Lag M2B		0.004***	0.003***	0.003***
		(19.85)	(19.29)	(18.40)
Firm Age		-0.001***	-0.001***	-0.001***
		(-12.02)	(-13.66)	(-13.63)
Cash Flow			0.020***	0.020***
			(8.91)	(8.98)
Lag Ind. M2B				0.001**
				(2.25)
D	0.007***	-0.018***	-0.022***	-0.023***
	(5.49)	(-5.15)	(-6.36)	(-6.40)
D x CIO	0.102***	0.109***	0.109***	0.108***
	(3.97)	(4.31)	(4.33)	(4.28)
D x Lag CAPX	-0.203***	-0.182***	-0.173***	-0.173***
	(-29.78)	(-26.76)	(-25.48)	(-25.51)
D x Lag LogA		0.003***	0.004***	0.004***
		(6.25)	(8.85)	(8.95)
D x Lag Prof.		0.028***	0.023***	0.023***
		(6.10)	(5.03)	(5.10)
D x Lag Lev.		-0.002	-0.003	-0.003
		(-0.63)	(-1.00)	(-1.00)
D x Lag M2B		0.005***	0.005***	0.005***
		(7.58)	(7.50)	(7.12)
D x Firm Age		0.000**	0.000***	0.000***
		(-2.06)	(-2.85)	(-2.85)
D x Cash Flow			-0.011***	-0.012***
			(-5.10)	(-5.17)
D x Lag Ind. M2B				0.001
				(1.00)
N	73,284	73,284	73,284	73,284
R^2	0.090	0.115	0.122	0.123
Firm F. E.	Yes	Yes	Yes	Yes

Panel B: Dependent Variable is Change in Capital expenditures normalized by average assets (CI)

Variable	(1)	(2)	(3)	(4)
Intercept	-0.004***	-0.002*	-0.002**	-0.002
	(-12.76)	(-1.94)	(-2.00)	(-1.11)
CIO	0.070***	0.064***	0.064***	0.065***
	(3.78)	(3.42)	(3.45)	(3.50)
Lag CI	-0.264***	-0.266***	-0.262***	-0.262***
	(-68.31)	(-68.88)	(-68.22)	(-68.21)
Lag LogA		-0.001***	-0.001***	-0.001***
		(-6.94)	(-7.67)	(-7.74)
Lag Prof.		0.000	0.000	0.000
		(0.30)	(0.49)	(0.53)
Lag Lev.		-0.004***	-0.003***	-0.003***
		(-3.65)	(-3.04)	(-3.13)
Lag M2B		0.001***	0.001***	0.001***
		(7.84)	(7.24)	(7.25)
Firm Age		0.000***	0.000***	0.000***
		(8.82)	(8.65)	(8.60)
Cash Flow			0.011***	0.011***
			(5.22)	(5.12)
Lag Ind. M2B				0.000
				(-1.09)
D	0.037***	0.037***	0.032***	0.034***
	(56.54)	(16.00)	(13.77)	(12.87)
D x CIO	0.093***	0.091***	0.090***	0.094***
	(2.95)	(2.88)	(2.89)	(2.99)
D x Lag CI	-0.585***	-0.589***	-0.580***	-0.580***
	(-101.27)	(-101.61)	(-100.64)	(-100.65)
D x Lag LogA		0.001**	0.002***	0.002***
		(2.23)	(5.11)	(5.11)
D x Lag Prof.		0.006***	0.003*	0.003
		(3.22)	(1.66)	(1.60)
D x Lag Lev.		-0.006***	-0.005**	-0.005**
		(-2.91)	(-2.20)	(-2.27)
D x Lag M2B		0.004***	0.003***	0.003***
		(6.09)	(4.16)	(4.54)
D x Firm Age		-0.000***	-0.000***	-0.000***
		(-7.92)	(-8.47)	(-8.49)
D x Cash Flow			0.001	0.001
			(0.53)	(0.61)
D x Lag Ind. M2B				-0.001**
				(-2.08)
N	62,765	62,765	62,765	62,765
R^2	0.255	0.258	0.269	0.269

These tables use segments data for the full sample; the sample covers the period 1991-2015. Dependent variables include the segment capital expenditures normalized by average assets (Panel A) and the change in investment capital expenditures normalized by average assets (Panel B). Independent variables include variables CIO, Lag CAPX (Panel A), Lag CI (Panel B), control variables (Lag LogA, Lag Prof., Lag Lev., Lag M2B, Firm Age, Cash Flow and Lag Ind. M2B), diversification dummy "D" and interaction terms between the dummy variable and all independent variables. CIO is the change in investment opportunities for the segment; change in expected return on assets at the Fama-French (1991) industry level. Lag CAPX is the lagged capital expenditures of the segment normalized by its average total assets. Lag CI is the lagged change in the capital expenditures normalized by average assets. Lag LogA is the natural logarithm of lagged assets of the segment expressed in millions of dollars. Lag Prof. is the lagged profitability of the firm and is expressed as the ratio of EBIT to total sales. Lag Lev. is the lagged leverage of the firm and is expressed as the ratio of total debt to total assets. Lag M2B is the lagged Market to Book ratio. Firm Age is the number of years since the firm was added to the COMPUSTAT industrial files. Cash Flow is the sum of net cash flow from operating activities, other financing activities and the exchange rate effect scaled by average assets and by the number of firm's segments. Lag Ind. M2B is the lagged Fama-French (1991) industry Market to Book ratio. D is a dummy variable equal to one if the segment-year observation is for a segment of a multi-segment firm and zero otherwise. T-statistics are provided below the coefficients in the table. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 24: Effect of Favorable changes in investment opportunities on investment behavior (CIO > 0)

Panel A: Dependent Variable is Capital expenditures normalized by average assets (CAPX)

Variable	(1)	(2)	(3)	(4)
CIO	0.028	0.003	0.005	-0.001
	(0.90)	(0.10)	(0.17)	(-0.03)
Lag CAPX	0.363***	0.328***	0.328***	0.328***
	(51.87)	(46.53)	(46.81)	(46.79)
Lag LogA		-0.008***	-0.007***	-0.007***
		(-12.23)	(-10.77)	(-10.79)
Lag Prof.		0.000	0.000	0.000
		(0.15)	(0.09)	(0.08)
Lag Lev.		-0.017***	-0.016***	-0.016***
		(-9.13)	(-8.80)	(-8.79)
Lag M2B		0.003***	0.003***	0.003***
		(12.84)	(12.51)	(12.19)
Firm Age		-0.001***	-0.001***	-0.001***
		(-8.30)	(-9.37)	(-9.36)
Cash Flow			0.019***	0.019***
			(5.68)	(5.70)
Lag Ind. M2B				0.000
				(0.83)
D	0.013***	-0.011**	-0.016***	-0.017***
	(7.00)	(-2.16)	(-3.07)	(-3.11)
D x CIO	0.147***	0.169***	0.168***	0.167***
	(3.62)	(4.21)	(4.22)	(4.15)
D x Lag CAPX	-0.312***	-0.289***	-0.275***	-0.275***
	(-31.22)	(-29.06)	(-27.80)	(-27.81)
D x Lag LogA		0.002***	0.004***	0.004***
		(3.52)	(5.35)	(5.38)
D x Lag Prof.		0.060***	0.055***	0.055***
		(8.12)	(7.45)	(7.47)
D x Lag Lev.		-0.001	-0.001	-0.001
		(-0.16)	(-0.32)	(-0.32)
D x Lag M2B		0.004***	0.004***	0.004***
		(4.52)	(4.50)	(4.31)
D x Firm Age		0.000	0.000**	0.000**
		(-1.59)	(-2.25)	(-2.25)
D x Cash Flow			-0.010***	-0.010***
			(-3.04)	(-3.06)
D x Lag Ind. M2B				0.000
				(0.53)
N	37,001	37,001	37,001	37,001
R^2	0.069	0.095	0.105	0.105
Firm F. E.	Yes	Yes	Yes	Yes

Panel B: Dependent Variable is Change in Capital expenditures normalized by average assets (CI)

Variable	(1)	(2)	(3)	(4)
Intercept	-0.003***	-0.002	-0.002	0.000
	(-4.51)	(-1.26)	(-1.33)	(-0.13)
CIO	0.006	-0.020	-0.014	0.005
	(0.17)	(-0.53)	(-0.37)	(0.14)
Lag CI	-0.318***	-0.321***	-0.312***	-0.312***
	(-57.69)	(-58.33)	(-57.28)	(-57.27)
Lag LogA		-0.001***	-0.001***	-0.001***
		(-3.90)	(-4.53)	(-4.67)
Lag Prof.		0.000	0.000	0.000
		(-0.87)	(-1.17)	(-1.17)
Lag Lev.		-0.004**	-0.003**	-0.003**
		(-2.56)	(-2.01)	(-2.16)
Lag M2B		0.001***	0.001***	0.001***
		(5.65)	(5.13)	(5.48)
Firm Age		0.000***	0.000***	0.000***
		(5.66)	(5.54)	(5.46)
Cash Flow			0.012***	0.012***
			(4.21)	(4.08)
Lag Ind. M2B				-0.001**
				(-2.05)
D	0.043***	0.046***	0.040***	0.043***
	(34.78)	(13.45)	(11.81)	(11.19)
D x CIO	0.189***	0.211***	0.206***	0.211***
	(2.87)	(3.20)	(3.16)	(3.18)
D x Lag CI	-0.706***	-0.709***	-0.691***	-0.691***
	(-89.55)	(-89.85)	(-88.36)	(-88.36)
D x Lag LogA		0.000	0.001**	0.001**
		(-0.18)	(2.29)	(2.31)
D x Lag Prof.		0.061***	0.045***	0.044***
		(8.98)	(6.60)	(6.55)
D x Lag Lev.		-0.006*	-0.004	-0.005
		(-1.78)	(-1.42)	(-1.46)
D x Lag M2B		0.002**	0.001	0.001
		(2.30)	(1.04)	(1.44)
D x Firm Age		0.000***	0.000***	0.000***
		(-6.13)	(-6.62)	(-6.62)
D x Cash Flow			0.002	0.003
			(0.82)	(0.94)
D x Lag Ind. M2B				-0.001**
				(-2.08)
N	35,604	35,604	35,604	35,604
R^2	0.326	0.330	0.347	0.347

These tables use segments data for the full sample to assess the change in investment behavior following favorable changes in investment opportunities at the industry level (CIO>0). The sample covers the period 1991-2015. Dependent variables include the segment capital expenditures normalized by average assets (Panel A) and the change in investment capital expenditures normalized by average assets (Panel B). Independent variables include variables CIO, Lag CAPX (Panel A), Lag CI (Panel B), control variables

(Lag LogA, Lag Prof., Lag Lev., Lag M2B, Firm Age, Cash Flow and Lag Ind. M2B), diversification dummy "D" and interaction terms between the dummy variable and all independent variables. CIO is the change in investment opportunities for the segment; change in expected return on assets at the Fama-French (1991) industry level. Lag CAPX is the lagged capital expenditures of the segment normalized by its average total assets. Lag CI is the lagged change in the capital expenditures normalized by average assets. Lag LogA is the natural logarithm of lagged assets of the segment expressed in millions of dollars. Lag Prof. is the lagged profitability of the firm and is expressed as the ratio of EBIT to total sales. Lag Lev. is the lagged leverage of the firm and is expressed as the ratio of total debt to total assets. Lag M2B is the lagged Market to Book ratio. Firm Age is the number of years since the firm was added to the COMPUSTAT industrial files. Cash Flow is the sum of net cash flow from operating activities, other financing activities and the exchange rate effect scaled by average assets and by the number of firm's segments. Lag Ind. M2B is the lagged Fama-French (1991) industry Market to Book ratio. D is a dummy variable equal to one if the segment-year observation is for a segment of a multi-segment firm and zero otherwise. T-statistics are provided below the coefficients in the table. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 25: Effect of Unfavorable changes in investment opportunities on investment behavior (CIO < 0)

Panel A: Dependent Variable is Capital expenditures normalized by average assets (CAPX)

Variable	(1)	(2)	(3)	(4)
CIO	0.050*	0.005	0.006	0.016
	(1.91)	(0.20)	(0.21)	(0.60)
Lag CAPX	0.366***	0.334***	0.335***	0.334***
	(60.08)	(54.45)	(54.56)	(54.54)
Lag LogA		-0.007***	-0.006***	-0.006***
		(-11.59)	(-10.25)	(-10.35)
Lag Prof.		0.000*	0.000**	0.000**
		(1.86)	(2.39)	(2.29)
Lag Lev.		-0.020***	-0.020***	-0.020***
		(-10.30)	(-10.06)	(-9.99)
Lag M2B		0.004***	0.004***	0.003***
		(15.19)	(14.66)	(13.58)
Firm Age		-0.001***	-0.001***	-0.001***
		(-8.77)	(-9.68)	(-9.59)
Cash Flow			0.021***	0.021***
			(7.01)	(7.11)
Lag Ind. M2B				0.001**
				(2.57)
D	-0.003*	-0.028***	-0.030***	-0.031***
	(-1.65)	(-5.90)	(-6.36)	(-6.29)
D x CIO	0.043	0.045	0.046	0.042
	(1.25)	(1.32)	(1.34)	(1.22)
D x Lag CAPX	-0.067***	-0.048***	-0.045***	-0.045***
	(-7.17)	(-5.14)	(-4.81)	(-4.84)
D x Lag LogA		0.003***	0.004***	0.004***
		(5.12)	(6.42)	(6.53)
D x Lag Prof.		0.011*	0.007	0.008
		(1.92)	(1.32)	(1.39)
D x Lag Lev.		-0.002	-0.003	-0.003
		(-0.52)	(-0.81)	(-0.81)
D x Lag M2B		0.005***	0.005***	0.005***
		(5.69)	(5.67)	(5.38)
D x Firm Age		0.000	0.000	0.000
		(-1.21)	(-1.50)	(-1.52)
D x Cash Flow			-0.015***	-0.015***
			(-4.91)	(-5.03)
D x Lag Ind. M2B				0.000
				(0.53)
N	35,044	35,044	35,044	35,044
R^2	0.132	0.158	0.160	0.161
Firm F. E.	Yes	Yes	Yes	Yes

Panel B: Dependent Variable is Change in Capital expenditures normalized by average assets (CI)

Variable	(1)	(2)	(3)	(4)
Intercept	-0.005***	-0.001	-0.002	-0.003
	(-9.11)	(-0.84)	(-0.92)	(-1.32)
CIO	0.006	0.026	0.024	0.029
	(0.17)	(0.77)	(0.71)	(0.85)
Lag CI	-0.188***	-0.190***	-0.190***	-0.190***
	(-36.59)	(-37.08)	(-37.08)	(-37.08)
Lag LogA		-0.002***	-0.002***	-0.002***
		(-6.59)	(-6.94)	(-6.82)
Lag Prof.		0.000	0.000	0.000
		(0.53)	(0.77)	(0.70)
Lag Lev.		-0.005***	-0.004***	-0.004**
		(-2.95)	(-2.63)	(-2.53)
Lag M2B		0.001***	0.001***	0.001***
		(5.75)	(5.41)	(4.79)
Firm Age		0.000***	0.000***	0.000***
		(7.32)	(7.16)	(7.21)
Cash Flow			0.009***	0.009***
			(3.10)	(3.18)
Lag Ind. M2B				0.000
				(1.06)
D	0.025***	0.021***	0.021***	0.023***
	(21.60)	(6.49)	(6.55)	(6.38)
D x CIO	0.081	0.062	0.064	0.058
	(1.46)	(1.12)	(1.16)	(1.04)
D x Lag CI	-0.373***	-0.377***	-0.377***	-0.377***
	(-45.52)	(-45.74)	(-45.74)	(-45.74)
D x Lag LogA		0.001**	0.001***	0.001**
		(2.43)	(2.58)	(2.50)
D x Lag Prof.		0.002	0.002	0.002
		(0.88)	(0.91)	(0.90)
D x Lag Lev.		-0.002	-0.003	-0.003
		(-0.70)	(-0.90)	(-0.98)
D x Lag M2B		0.003***	0.003***	0.004***
		(3.86)	(3.98)	(4.13)
D x Firm Age		0.000***	0.000***	0.000***
		(-5.05)	(-4.92)	(-4.98)
D x Cash Flow			-0.009***	-0.010***
			(-3.14)	(-3.23)
D x Lag Ind. M2B				-0.001
				(-1.16)
N	27,161	27,161	27,161	27,161
R^2	0.143	0.148	0.149	0.149

These tables use segments data for the full sample to assess the change in investment behavior following unfavorable changes in investment opportunities at the industry level (CIO<0). The sample covers the period 1991-2015. Dependent variables include the segment capital expenditures normalized by average assets (Panel A) and the change in investment capital expenditures normalized by average assets (Panel B). Independent variables include variables CIO, Lag CAPX (Panel A), Lag CI (Panel B), control variables

(Lag LogA, Lag Prof., Lag Lev., Lag M2B, Firm Age, Cash Flow and Lag Ind. M2B), diversification dummy "D" and interaction terms between the dummy variable and all independent variables. CIO is the change in investment opportunities for the segment; change in expected return on assets at the Fama-French (1991) industry level. Lag CAPX is the lagged capital expenditures of the segment normalized by its average total assets. Lag CI is the lagged change in the capital expenditures normalized by average assets. Lag LogA is the natural logarithm of lagged assets of the segment expressed in millions of dollars. Lag Prof. is the lagged profitability of the firm and is expressed as the ratio of EBIT to total sales. Lag Lev. is the lagged leverage of the firm and is expressed as the ratio of total debt to total assets. Lag M2B is the lagged Market to Book ratio. Firm Age is the number of years since the firm was added to the COMPUSTAT industrial files. Cash Flow is the sum of net cash flow from operating activities, other financing activities and the exchange rate effect scaled by average assets and by the number of firm's segments. Lag Ind. M2B is the lagged Fama-French (1991) industry Market to Book ratio. D is a dummy variable equal to one if the segment-year observation is for a segment of a multi-segment firm and zero otherwise. T-statistics are provided below the coefficients in the table. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 26: Effect of changes in investment opportunities at the segment and complementary segment level on segment's investment behavior in multi-segment firms

Panel A: Dependent Variable is Capital expenditures normalized by average assets (CAPX)

Variable	(1)	(2)	(3)	(4)
CIO	0.125***	0.107***	0.111***	0.107***
	(4.56)	(3.92)	(4.09)	(3.97)
Comp. CIO	0.037	0.005	-0.018	-0.020
	(0.76)	(0.10)	(-0.37)	(-0.42)
Lag CAPX	0.134***	0.124***	0.135***	0.135***
	(19.36)	(17.93)	(19.57)	(19.49)
Lag LogA		-0.003***	0.000	0.000
		(-5.05)	(0.27)	(0.32)
Lag Prof.		0.042***	0.037***	0.037***
		(5.74)	(5.09)	(5.14)
Lag Lev.		-0.018***	-0.019***	-0.019***
		(-4.28)	(-4.32)	(-4.33)
Lag M2B		0.009***	0.009***	0.009***
		(9.67)	(9.78)	(9.34)
Firm Age		-0.001***	-0.001***	-0.001***
		(-8.99)	(-10.98)	(-11.03)
Cash Flow			0.009***	0.009***
			(18.62)	(18.60)
Lag Ind. M2B				0.002**
				(2.10)
N	22,730	22,730	22,730	22,730
R^2	0.017	0.030	0.045	0.045
Firm F. E.	Yes	Yes	Yes	Yes

Panel B: Dependent Variable is Change in Capital expenditures normalized by average assets (CI)

Variable	(1)	(2)	(3)	(4)
Intercept	-0.003***	0.002	-0.003	0.000
	(-5.04)	(0.71)	(-1.11)	(-0.15)
CIO	0.201***	0.195***	0.197***	0.201***
	(5.57)	(5.41)	(5.53)	(5.62)
Comp. CIO	0.038	0.031	-0.012	-0.008
	(0.57)	(0.46)	(-0.18)	(-0.11)
Lag CI	-0.679***	-0.681***	-0.665***	-0.665***
	(-82.73)	(-82.96)	(-81.67)	(-81.68)
Lag LogA		-0.002***	-0.001***	-0.001***
		(-5.18)	(-2.93)	(-2.97)
Lag Prof.		0.008***	0.004*	0.004
		(2.81)	(1.66)	(1.62)
Lag Lev.		-0.004	-0.002	-0.002
		(-1.61)	(-0.80)	(-0.88)
Lag M2B		0.002**	0.001	0.001
		(2.27)	(0.72)	(1.05)
Firm Age		0.000***	0.000**	0.000***
		(2.82)	(2.12)	(2.08)
Cash Flow			0.012***	0.012***
			(21.76)	(21.74)
Lag Ind. M2B				-0.002*
				(-1.72)
N	19,428	19,428	19,428	19,428
R^2	0.262	0.264	0.281	0.282

These tables use segments data from the multi-segment firms' sample. The sample covers the period 1991-2015. Dependent variables include the segment capital expenditures normalized by average assets (Panel A) and the change in investment capital expenditures normalized by average assets (Panel B). Independent variables include variables CIO, Comp. CIO, Lag CAPX (Panel A), Lag CI (Panel B) and control variables (Lag LogA, Lag Prof., Lag Lev., Lag M2B, Firm Age, Cash Flow and Lag Ind. M2B). CIO is the change in investment opportunities for the segment; change in expected return on assets at the Fama-French (1991) industry level. Comp. CIO is the average change in investment opportunities of the complementary segments in the multi-segment firm. Lag CAPX is the lagged capital expenditures of the segment normalized by its average total assets. Lag CI is the lagged change in the capital expenditures normalized by average assets. Lag LogA is the natural logarithm of lagged assets of the segment expressed in millions of dollars. Lag Prof. is the lagged profitability of the firm and is expressed as the ratio of EBIT to total sales. Lag Lev. is the lagged leverage of the firm and is expressed as the ratio of total debt to total assets. Lag M2B is the lagged Market to Book ratio. Firm Age is the number of years since the firm was added to the COMPUSTAT industrial files. Cash Flow is the sum of net cash flow from operating activities, other financing activities and the exchange rate effect scaled by average assets and by the number of firm's segments. Lag Ind. M2B is the lagged Fama-French (1991) industry Market to Book ratio. T-statistics are provided below the coefficients in the table. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

ESSAY 3:
THE DIVERSIFICATION DISCOUNT:
ARE CONTROL MECHANISMS LESS EFFECTIVE IN DIVERSIFIED FIRMS?

1. Introduction

The issue of corporate diversification is one of the most covered topics in finance literature; numerous studies examine the motives for corporate diversification and its benefits and costs. Martin and Sayrak (2001) document three main "waves of research" in the continuous debate concerning the added value of corporate diversification. While a large body of finance literature studies corporate diversification and its effect on firm value, few studies examine the effect of governance characteristics on the value of diversified relative to single-segment firms. One of these characteristics is CEO power, which reflects the CEO's ability to influence the board of directors and a lack of internal control. Powerful CEOs are less likely to be challenged when making corporate policy decisions and can successfully resist replacement efforts from the board. Another governance characteristic is the ownership of monitoring institutions in the firm, where low ownership by monitoring institutions may again lead to CEOs that are less likely to be challenged by their shareholders and the board. Although existing literature has examined the effects of CEO power and institutional ownership on firm value, there is little research examining the effects of these two variables on the diversification discount.[32]

[32] See for example Rechner and Dalton (1991), Boyd (1995), Daily and Johnson (1997), David, Kochhar, and Levitas (1998), Bushman, Chen, Engel, and Smith (2004), Bainbridge (2005), Adams, Almeida, and Ferreira (2005), Liu, and Jiraporn (2010), and, Bebchuk, Cremers, and Peyer (2011)

This paper proposes that, due to the complex operational and informational structure in diversified firms, internal and external governance control mechanisms may be less effective compared to those in single-segment firms, leading to lower firm value for diversified relative to single-segment firms. We examine the issue of corporate diversification from this governance control perspective, and ask the question of whether the effectiveness of governance control mechanisms differs between multi-segment and single-segment firms. A lack of internal and external controls on the CEO should lead to more pronounced agency problems between the CEO and the firm's shareholders and may result in value destruction. To the extent that CEO decisions, such as optimal allocation of internal funds, are more difficult to monitor in diversified firms, we expect the negative effect of weak internal and external governance controls on firm value to be more pronounced in diversified firms.

Corporate diversification is a natural consequence of firm growth, where the availability of resources allows the firm to benefit from investment opportunities in other industries that yield a higher rates of return (Gomes and Livdan 2002). When new investment opportunities in a given industry are exhausted because of competition, firms are left with two main options: to transfer a large part of their earnings to shareholders or to invest in more promising industries mainly through mergers and acquisitions. Based on this rationale, corporate diversification is expected to enhance value especially with the firm's ability to channel funds across different divisions to the most promising ones (Stein 1997). Therefore, shareholders will seek diversification whenever it adds value to their holdings. However, the decision to diversify or to allocate funds between different investment opportunities is taken by their agents. Because CEOs take investment decisions that maximize their own utility, their decisions may not be optimal for shareholders. Consequently, diversification may lead to value destruction if CEOs diversify to obtain private benefits.

Denis, Denis, and Sarin (1997) conclude that diversification strategies are mainly motivated by agency problems, while Amihud and Lev (1981) argue that CEOs' incentives to reduce their personal risk motivate them to diversify the firm in multiple lines of business. Moreover, managing a larger firm brings the CEO more power and prestige (Jensen 1986) and even a higher compensation (Jensen and Murphy 1990). Furthermore, Aggarwal and Samwick (2003) state that CEOs in diversified firms are able to extract more private benefits compared to those in single firms. Shareholders and CEOs have different incentives to diversify so that diversification is most likely to add value when it is driven by shareholders' incentives rather than by the CEO's personal incentives. Control mechanisms in firms should help better align CEO decisions with the incentives of shareholders.

Internal control in corporations is delegated by shareholders to the board of directors. To protect shareholders' interests, the board is granted a wide range of rights. These rights include selecting, evaluating and rewarding the top management team based on firm performance. The board also plays an integral role in strategic decision-making process and provides access to information and resources outside the firm (Pfeffer, and Salancik, 2003). However, the fundamental role of the board is to monitor CEOs' actions and to ensure that CEOs are taking the necessary strategic decisions to maximize shareholders wealth (Fama, and Jensen, 1983). Consequently, the board is considered "the shareholders first line of defense against incompetent management" (Weisbach, 1988). In theory, the board has all the required tools to protect shareholders' interests as it has the right to hire, compensate, and fire managers (Fama, and Jensen, 1983). Based on these privileges, the board is potentially the most powerful player in organizations.

However, the board of directors may not be active in its monitoring role under some circumstances. For instance, the board may be less involved in controlling the CEO of a highly performing firm (Daily and Johnson, 1997). Lorsch and MacIver (1989) report that the board is only active in its monitoring role when firms are experiencing bad performance; a time when the board of directors itself is under a lot of pressure from shareholders. Outstanding firm performance may put CEO power on the rise as the CEO may receive most of the credit for such performance and may be rewarded accordingly (Garvey and Milbourn 2003). The CEO will gain even more power at the expense of the board given the low level of resistance of a satisfied board. This type of power may impose one of the main threats on internal control: once a CEO becomes powerful it becomes more difficult for the board to fight back even when later on firm performance starts to deteriorate.

CEOs have an incentive to seek non-pecuniary benefits to maximize their own utility, (Jensen, and Meckling, 1976). Because power is a form of such benefits, CEOs will always strive for more power. Power will give them the ability to design and implement their own strategies with little resistance from the board. In fact, most CEOs try to minimize directors' involvement in major strategic decisions and to obstruct any potential challenges to their decisions (Rosenstein, 1987; Zahra and Pearce, 1989). Furthermore, the presence of a powerful CEO will signal "the absence of separation of decision management and decision control" (Fama and Jensen 1983, p. 314). Therefore, more CEO power reflects a lack of internal control on CEOs' actions. Shleifer and Vishny (1989) state that firms run by a "one man show" are less likely to be takeover targets as their CEOs have enough power to reject any takeover attempt. Moreover, because powerful CEOs are less likely to be replaced, they are less concerned about the impact of their decisions on shareholder welfare. In contrast, a high level of internal control implies that critical decisions are taken by a coalition of executives and that the CEO is unable to solely enforce any strategic change in the firm (Boumosleh 2007). Such low CEO power may also imply the ability of the firm to replace its existing CEO as at least one executive in that coalition will represent a good replacement option.

Shleifer, and Vishney (1989) explain how managers take investment decisions that make them valuable to shareholders and costly to replace, and how corporate diversification helps managers achieve this goal. While CEOs have incentives to diversify their firms beyond the level that maximizes shareholders' wealth (Jensen, 1988), powerful CEOs are better positioned to implement such preferences (Rose, and Shepard, 1994). Denis, Denis, and Sarin (1996) state that: "managers may maintain a diversification strategy even if doing so reduces shareholder wealth. Under this hypothesis, managers will reduce diversification only if pressured to do so by internal or external monitoring mechanisms". The authors find that the level of diversification is negatively related to managerial equity ownership and to the equity ownership of outside blockholders. Unlike the authors who use blockholders' ownership as a proxy for external control, we use institutional ownership as a proxy for external control. The monitoring role of institutional investors may limit agency costs and enhance firms' value. However, the complex operational and informational structure in diversified firms may restrict their role.

We find evidence that diversified firms suffer more from the lack of internal control when compared to single-segment firms. Specifically, the negative effect of CEO power on firm value is significantly more pronounced in diversified firms than in single-segment firms. We also find evidence of the relevance of external control mechanisms in diversified firms. While external control is positively correlated with firm value, its effect differs significantly across single and diversified firms; institutional ownership effect on firm value is weaker in diversified firms. This result suggests that institutional investors' monitoring role is restricted under complex structures such as those in diversified firms.

Our paper adds to the literature examining the effects of corporate diversification on firm value (Berger, and Ofek 1995; Denis, Denis, and Yost, 2002; Fauver, Houston, and Naranjo 2003; Akbulut, and Matsusaka 2008; Kuppuswamy, and Villalonga 2015). It also adds to a large body of literature in finance and organizational theory that investigates the effect of CEO power on firm value (Mallette, and Fowler, 1992; Daily, and Dalton, 1994; Adams, Almeida, and Ferreira, 2005; Masulis, Wang, and Xie, 2007; Liu, and Jiraporn, 2010; Bebchuk, Cremers, and Peyer 2011, Hoechle, Schmid, Walter, and Yermack 2012).

The rest of the paper is organized as follows. Section 1 discusses the effect of control mechanisms on single-segment and on multi-segment firms. Section 2 summarizes related literature on corporate diversification. Section 3 contains our samples and the methodology we use to construct our measures of firm value and of internal and external controls. In Section 4 we present the results from our empirical analysis. Finally, we conclude in Section 5.

2. Literature Review

Corporate diversification gained momentum in late 1960s as the first conglomerate merger wave took place. Lewellen (1971) shows how the coinsurance effect leads to a better debt capacity for diversified firms which allows them to benefit from higher leverage levels and better interest tax shields. Majd, and Myers (1987) reveal that as long as one or more segments of a multi-segment firm suffer losses in given period, the multi-segment firm will pay less tax than its segments would pay separately as stand-alone firms due to the tax code's asymmetric treatment of gains and losses.

Stulz (1990) suggests that corporate diversification alleviates the underinvestment problem as segments' cash flows are imperfectly correlated. Stein (1997) shows how the incentives of CEOs in multi-segment firms are aligned with those of shareholders and how CEOs efficiently manage firms' internal capital market. He argues that even with the presence of agency costs at the CEO level, CEOs in multi-segment firms still have an incentive to invest in the most promising projects. Fauver, Houston, and Naranjo (2003) find that corporate diversification adds more value when external capital markets are less developed and segmented from international markets.

Despite all of these potential benefits, the diversification trend was reversed as firms entered an era of refocusing in 1980s as documented by Bhagat, Shleifer, and Vishny (1990), and Comment, and Jarrell (1995).[33] This reversal was mainly due to a belief that corporate diversification destroys value.[34] Lang, and Stulz (1994) were the first to introduce the "diversification discount" term to identify this phenomenon, and many later studies find that diversified firms sell at a market discount when compared to specialized stand-alone firms

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[33] Comment and Jarrell reveal that single-segment firms increased from 38.1% of publicly listed firms in 1979 to 55.7% in 1988, and conclude that the reduction in the level of corporate diversification results in an increase in firm value.

[34] Other possible reasons for this reversal were discussed; Shleifer and Vishny (1991) conclude that the looser antitrust policy in 1980s has allowed firms to refocus on their core line of business through horizontal mergers and acquisitions. Liebeskind, and Opler (1994) argue that this fact was driven by the intensifying global competition.

(Servaes 1996; Lins, and Servaes, 1999; Denis, Denis, and Yost, 2002). Berger and Ofek (1995) reveal that the discount reached an average of 13% to 15% over the period 1986-1991, and that this discount is correlated with the inefficient allocation of resources – investments in low Q segments. Diversified firms inefficient investment in projects with lower Tobin's Q was a result of agency problems (Rajan, Servaes, and Zingales, 2000) and to the rent-seeking behavior of divisional managers (Scharfstein, and Stein, 2000).

On the other hand, many recent studies note that corporate diversification creates value, and that diversified firms sell at a market premium rather than a market discount. In a study on the plant level, Maksimovic and Phillips (2002) find that conglomerates are no less or even more productive than focused firms. Akbulut and Matsusaka (2008), after analyzing the effects of 4,764 mergers over the period 1950-2006, conclude that corporate diversification improves corporate performance and leads most of the time to value creation. Some studies even link the diversification discount to changes in economic conditions supporting the idea of a cyclical trend favoring or disfavoring a diversification strategy (Hovakimian, 2011; Kuppuswamy and Villalonga, 2015; Almeida, Kim and Kim, 2015).

Meanwhile, large academic literature on corporate diversification stresses the relevance of corporate governance and agency problems in determining the diversification discount. Lins and Servaes (1999) find that international differences in corporate governance explains the variation in the diversification discount across different countries. The authors find no significant diversification discount in Germany, where higher insiders' ownership enhanced corporate diversification value. Sautner and Villalonga (2010) also report similar findings in Germany. Jiraporn, Kim, Davidson, and Singh (2006) conclude that when shareholders rights are more restricted, firms tend to diversify unwisely leading to value destruction. Hoechle, Schmid, Walter, and Yermack (2012) find that the diversification discount is affected to a large extent by corporate governance variables. The authors estimate that poor corporate governance explains around 20% of the diversification discount. Finally, Ammann, Hoechle, and Schmid (2012) emphasize the importance of corporate governance in determining the diversification discount and state that the diversification discount may be due to agency problems rather than to cross-subsidization of divisions.

3. Hypotheses Development

We develop three main hypotheses. In the first hypothesis, we link the diversification discount to the level of corporate diversification. The second hypothesis states that the negative effect of CEO power on firm value is more pronounced in diversified firms than in single-segment firms. Our third hypothesis relates higher firm value to higher external control measures and predicts that effect to be less pronounced in diversified firms.

3.1. Diversification Level and the value of the firm

As many studies find that corporate diversification leads to value loss, we expect diversified firms to suffer from a diversification discount. Such discount will be positively correlated with higher diversification levels as measured by the number of reported segments or by the level of activities' dispersion among existing segments. The following hypothesis replicates prior research and is only included as a comparison:

Hypothesis 1: *Excess value is negatively related to diversification level: Corporate diversification leads to value destruction.*

3.2. Internal control and the value of the firm

Powerful CEOs have strong incentives to sustain and to consolidate their power; powerful CEOs minimize board possible opposition through hiring individuals likely to support them (Pfeffer, 1981). Therefore, they select directors who are demographically similar to them (Westphal, and Zajac, 1995) and who have played a passive role on other boards (Zajac and

Westphal, 1996).[35] Demographically similar boards will be less likely to challenge CEOs' decisions and more likely to grant them a higher compensation (Westphal, and Zajac, 1995). On the other hand, Wade, O'Reilly and Pollock (2006) find that powerful CEOs not only increase their own salaries but their subordinates' salaries as well.

Rechner and Dalton (1991), find that CEO power proxied by CEO duality is negatively related to firm performance. Moreover, firms managed by powerful CEOs are more likely to go bankrupt (Hambrick, and D'Aveni, 1992; Daily, and Dalton, 1994) and to adopt "poison pills" (Mallette, and Fowler, 1992). These firms also have higher costs of debt and lower credit ratings (Liu, and Jiraporn, 2010). Bebchuk, Cremers, and Peyer (2011), find that higher CEO power is associated with lower firm value as measured by Tobin's Q, lower accounting profitability, lower acquisitions quality and lower turnover following bad performance.

On the other hand, some studies find that the effect of CEO power on firm performance is weak and insignificant (Chaganti, Mahajan, and Sharma, 1985; Boyd, 1995; Daily, and Johnson, 1997). Adams, Almeida, and Ferreira (2005), reveal that the variability in firms' performance as measured by stock performance is directly related to CEO power as more powerful CEO can make extreme decisions. However, the authors find that firms managed by powerful CEOs do not have on average a worse performance compared to other firms. In fact, they show that powerful CEOs are not only the worst performers, but the best performers as well.

Previous studies on the effect of CEO power on different measures of firm performance show mixed results. One of the reasons behind these mixed findings is that researchers have considered the effect of various measures of CEO power on different proxies of firm performance.

[35] Westphal and Zajac (1995) find that the opposite is also true: "powerful boards not only constrain the ability of CEOs to recruit similar new directors, but such boards are also more likely to appoint new directors who reflect their own demographic profile".

Another factor behind the mixed results is due to the complex relationship between CEO power and firms performance (Daily, and Johnson, 1997). CEO power may start to build based on lagged firm performance where CEOs can easily implement necessary changes to increase their power (Adams, Almeida, and Ferreira, 2005). However, as power accumulates and CEOs become more powerful, the negative effect of CEO power on firm performance is revealed.

When CEOs are able to advance their own agenda with less regards to shareholders' interests, they may take sub-optimal strategic decisions. Such decisions may drag a negative effect on firm performance leading therefore to a negative market reaction in the long-term. Consequently, we expect CEO power to have a negative effect on firm value (H2a).

CEO power effect on firm value can be moderated by some other factors. For example, Haleblian and Finkelstein (1993) find that the negative effect of CEO power is more pronounced in a turbulent environment (the computer industry) than in a stable one (natural gas distribution). Boyd (1995) finds that CEO power is even beneficial in high complexity environments and under conditions of resource scarcity. Another major effect is corporate diversification; diversification intensifies the negative effect of CEO power on firm value as diversification itself is a form and a result of CEO power.

Powerful CEOs are not only more likely to make acquisitions, but they are much more likely to make diversifying acquisitions (Finkelstein, 1992; Brown, and Sarma, 2007). Diversification allows CEOs to build large corporate empires (Jensen, and Meckling, 1976), to reduce managerial risk (Amihud, and Lev, 1981), and to even accumulate more power. Moreover, operating in multiple industries increases the operational and informational complexity of CEOs' job as they have to deal with different lines of business and to efficiently allocate firm resources to its unrelated segments (Finkelstein, and Hambrick, 1989; Bushman, Engel, and Smith, 2004).

Consequently, CEOs in diversified firms are able to extract a higher compensation relative to their counterparts in single firms (Rose, and Shepard, 1994).[36]

CEOs diversify their firms in a way that mainly fits their own level of knowledge and expertise which allows them to entrench themselves against any possible future replacement (Shleifer and Vishny, 1989). Therefore, they become more difficult to replace when compared to those in stand-alone firms. As each diversified firm is different from the others, few outsiders will have the expertise and required skills to replace its current CEO. Rose and Shepard (1994) find that while most new CEOs are insiders, diversified firms are less likely to hire an outsider CEO compared to single firms (14% vs. 18%). Although CEOs in diversified firms are more likely to be replaced by an insider rather than an outsider, there may be some indicators that even this possibility is less likely to occur. When decision-making is concentrated in the hand of the CEO rather than in the hand of a coalition of top executives, the CEO is most likely to take decisions that reflects her own preferences and is less likely to be replaced.

As CEOs are able to accumulate much more power in diversified firms and as strategic decisions in these firms, such as internal capital allocation, may lead to more severe consequences when compared to those in single firms, we believe that the negative effect of CEO power is much more pronounced in diversified firms (H2b).

Hypothesis 2a: *Less internal control and high CEO Power lead to value destruction: Higher CEO Power, Lower Excess Value.*

Hypothesis 2b: *The negative effect of CEO Power is more severe in diversified firms.*

[36] Rose, and Shepard (1994) report that CEOs' compensation in diversified firms is on average 13 to 17% higher than that of their counterparts in single firms, all else equal. However, the authors link this compensation premium to a higher ability of diversified firms' managers.

3.3. External control and the value of the firm

Ownership structure has had radical changes in the recent years with the emergence of institutional investors as the major players in the US stock market. As institutional ownership has increased, institutions' role has as well evolved from passive to active (Gillan and Starks, 2000). Due to their significant holdings, institutional owners have the motivation "to enhance the value of their investment by undertaking costly monitoring activities" as their benefits will outweigh potential monitoring costs (Gillan and Starks, 2007). Moreover, their concentrated voting power allows them to be more influential on managerial performance (Bainbridge, 2005). Therefore, we expect institutional ownership to increase firm value. (H3a)

Bushman, Chen, Engel, and Smith (2004) argue that diversified firms will benefit more from costly monitoring activities compared to single firms as the former faces more complex operational and informational environments. Although diversified firms have a more dispersed institutional ownership, diversified firms' institutional investors may still seek an active control role compared to individual investors (David, Kochhar, and Levitas, 1998).[37] However, diversification represents an indirect form of CEO power and the firm may be heavily diversified as a consequence of decisions made by powerful CEOs. Moreover, CEOs in diversified firms have an expertise advantage and a higher informational advantage over the board members, especially if the firm operates in completely unrelated industries. Therefore, the influence of institutional owners and their effect on firm value may be weaker. (H3b)

***Hypothesis 3a**: Higher external control (institutional ownership) leads to higher excess value.*

***Hypothesis 3b**: The effect of institutional on firm value is weaker in diversified firms.*

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[37] Diversified firms are significantly larger than single firms and have a more disperse investors' base; median firm size for diversified firms is $420 million compared with only $191 million for single firms.

4. Data and Variables

4.1. Data and Methodology

In this section, we describe the samples used in our paper and the methodology we apply to compute the excess value and our control measures.

4.1.1. Diversified Firms Sample:

The primary sample of diversified firms covers all the firms over the period 1996-2011 on the active and research files of the COMPUSTAT segment database. COMPUSTAT segment files contain data on firms' segments whose sales, assets or profits represent at least 10% of the firm's aggregate totals.[38] Following Berger and Ofek (1995) and others, we exclude firm-years observations with at least one segment in the financial services industry (SIC 6000-6999) or in utilities (SIC 4900-4999) or with missing or undetermined SIC codes. We also exclude American Depository Receipts (ADRs). Furthermore, we exclude firms whose annual total sales are less than $20 million to prevent distortions caused by small firms. We also require the availability of all segments' sales for a firm to be included in the final sample as segments' sales are used in the computation of our dependent variable "Excess Value."

We also limit our diversified firms sample to firms having more than one segment at the 3-digit SIC code level.[39] We exclude multi-segment firms with related segments because transferring prices and asset allocation between related segments' within a firm makes it difficult

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[38] Until 1997, all publically U.S. traded firms were required by the FASB (SFAS 14) to report segments' data for both business and geographical segments meeting the 10% criteria. In 1998, SFAS 131 superseded SFAS 14; this new regulation requires firms to use their segment breakdown in reporting segments' data to reflect the way they organize business activities internally.

[39] For example, a firm, with two segments in 7243 and 7248 SIC code industries, is considered a multi-segment firm with related segments (same 3-digit code 724) and is therefore excluded from our diversified firms' sample. While a multi-segment firm, with segments in 2851 and 7451 SIC codes, is considered a diversified firm as the segments are different at the 3-digit code level (285 and 745).

to accurately assign sales to a particular segment (Ozbas and Scharfstein, 2010).[40] Consequently, segment sales may be underestimated or overestimated leading therefore to misevaluation of firms' excess value. Moreover, the diversification discount has been mainly linked to unrelated diversification rather than related diversification where synergy and economies of scale can add value to the firm (Westphal and Fredrickson, 2001). We also require that the sum of segments' sales (obtained from COMPUSTAT segments file) is within 10% of total firm' sales (obtained from COMPUSTAT industrial file). Segments' sales are then adjusted based on their weights to sum up to total firm' sales reported on COMPUSTAT industrial file. These procedures limit our sample to 23,205 segments observations at the 4-digit code level.

Table 28 represents the distribution of multi-segment firms in our sample by the number of 4-digit code segments. 64.63% of the firm-years observations are for two-segment firms, 25.51% for 3-segment firms, 6.78% for 4-segment firms and 2.15% are for 5-segment firms. Only 0.93% of the observations are for 6 or more segment firms. Table 29 provides descriptive statistics for segments' observations at the 4-digit code level. The median segment in the "Diversified Firms Sample" has \$175 million of assets and \$201 million of sales, while the median segment in the "Governance Sample" has \$591 million of assets and \$706 million of sales.

Segment observations correspond to 9,302 firm-years observations for 2,159 different firms. Of these firms, 503 firms have only a 1-year observation and 15 firms have 16 complete observations that cover the entire sample period. Table 30 represents summary statistics of the diversified firms' samples. The average firm in the "Diversified Firm Sample" has \$4.2 billion of assets and \$3.6 billion of annual sales. The average age of diversified firms in the sample is 23

[40] Ozbas, and Scharfstein (2010) use a different method to determine the relatedness between two segments within a firm. They use the Input-Output Benchmark Survey of the Bureau of Economic Analysis as they consider it to be more reliable for that purpose.

years. Furthermore, the average number of segments that a firm operates is about 2.5 at the 4-digit code. The average level of diversification in our sample is relatively low (1.8), with the 95th percentile corresponding to 2.9. On average, institutional investors own 42% of the shares outstanding. In comparison, diversified firms in the “Governance Sample” are significantly older (average, 34 years) bigger in size (average, $7.1 billion) and in sales volume (average, $6.5 billion) and has higher institutional ownership (average, 63%).

4.1.2. Single-Segment Firms Sample:

This sample includes all single-segment firms (or “single firms”) over the period 1996-2011 on COMPUSTAT data files. A single-segment firm is defined as a firm reporting financial data on exactly one segment at the 4-digit code. Financial firms (SIC 6000-6999), utility firms (SIC 4900-4999) as well as firms with incomplete data are excluded from the sample. We also exclude small firms with less than $20 million of annual sales.

Table 31 represents summary statistics of the single firms’ samples. The average firm in the “Single Firms Sample” has $1.6 billion of assets, $1.4 billion of annual sales; these values are about one third of those of diversified firms. Single firms are on average younger than diversified firms (15 years for the “Single Firms Sample” and 21 years for the “Governance Sample”). The leverage level for single firms is lower than that of diversified firms (44% versus 48%). Finally, single firms are less likely to be managed by powerful CEOs than diversified firms (18% versus 20%).

4.1.3. All Firms Sample:

This sample includes single-segment firms as well as diversified firms. A dummy variable is added to the sample to differentiate single firms from diversified firms. The sample size is 40,421 firm-years.

4.1.4. Governance Samples:

We get executive compensation data from ExecuComp and corporate governance data from RiskMetrics. We merge those two data files with our full sample, and we require observations in the new sample to have complete data for the main variables in our analysis. This requirement reduces the number of firm-years observations for diversified firms, single firms and all firms samples to 2,277, 6,396 and 8,673 respectively.[41] Compared to firm-year observations in our initial samples, governance samples' firms are bigger and have higher institutional ownership.

4.2. Variables Description

4.2.1. Measuring Excess Value:

In order to measure the diversification discount or the loss in value due to diversification, we use the excess value measure introduced by Berger and Ofek (1995). The excess value is calculated through two main steps; in the first step, we calculate the imputed value of the sum of a firm's segments as stand-alone firms and then we calculate the excess value measure as the natural log of the ratio of a firm's actual value to its imputed value.

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[41] We do not require complete data availability for all variables to maximize the sample size.

We calculate the imputed value for each segment by multiplying the median ratio of firm value to sales, for single-segment firms in the same industry, by segment's sales.[42] The industry median ratios are based on the narrowest SIC grouping that includes at least five single firms with at least $20 million in total sales and sufficient data for computing the ratios. We compute the median ratios at the 4-digit, 3-digit, 2-digit and 1-digit SIC codes whenever we have sufficient data for at least five single firms in a given industry. Then, we multiply the sales of each segment by its corresponding median industry ratio to compute the imputed values. The priority is given to the 4-digit SIC codes, therefore if there is no median ratio at that level we proceed to the 3-digit level first and then to the following SIC code levels if needed. If the problem persists (no median ratio at the 1-digit level), we drop all the firm-year observations for that firm and not only its segment observation. Finally, we sum up the imputed values of the segments to get the imputed value of the firm for a given year.

The formula we use to compute the imputed value is illustrated below:

$$I(V) = \sum_{i=1}^{n} AI_i * \left(Ind_i(V/AI)_{mf}\right)$$

where

- $I(V)$: Imputed value of the sum of a firm's segments as stand-alone firms
- AI_i : Sales segment i's value of the accounting item (sales, assets, or EBITT) used in the valuation multiple
- $Ind_i(V/AI)_{mf}$: Multiple of total capital to an accounting item (sales, assets, or EBIT) for the median single-segment firm in segment i's industry.

[42] Berger and Ofek (1995) introduce three different multipliers through using different accounting items (sales, assets, and EBIT). The authors find that the diversification discount persists while using any of these multipliers over the period 1986-1991. For simplicity, we use only one of these multipliers (sales multiplier) in our paper.

- n: Total number of segments

Then, we compute the excess value measure as the natural log of a firm's actual value to its imputed value as can be shown in the following formula:

$$EV = \ln\big(V/I(V)\big),$$

where

- EV: Firm's excess value
- V: Firm's market value (market value of common equity plus book value of debt).

This excess value measure will determine the gain or loss in value from corporate diversification. Therefore, if the market value of the diversified firm is greater than the market value of its separate segments, the ratio will be greater than one and we will have a positive excess value or a diversification premium. The diversification discount will arise in the opposite case where the value of the diversified firm is less than the aggregate value of its separate segments treated as stand-alone firms. In this case, the diversification will lead to value destruction and the excess value of diversification will be negative.

4.2.2. Measuring the level of diversification:

We use three variables to measure the level of diversification of multi-segment firms, the number of segments and the diversification level. N3D is the number of 3-digit code segments operated by the multi-segment firm and N4D is the number of 4-digit code segments operated by the multi-segment firm. As the number of segments of a multi-segment firm does not fully reflect the level of diversification in such firms, we use an additional variable, DIVLEVEL.[43] DIVLEVEL

[43] A two-segment firm, with equal sales-weights (50% for each segment), is more diversified than a three-segment firm where the largest segment represents 80% of total sales while the remaining two represent 10% each. The diversification level for the first firm is 2, while that of the second firm stands at 1.5152.

is equal to the inverse of Herfindahl index of segments' sales-weights.[44] DIVLEVEL measures the level of dispersion of firm's total sales within its existing segments; a higher level of sales' dispersion corresponds to a higher level of diversification.[45] This variable ranges from a minimum of one (the lowest level diversification, the case of a completely focused firm) to a maximum of 10 (the maximum level of diversification, firm operating in 10 different segments with 10% sales weight for each).[46] In addition to these variables, we add a dummy variable, D, to the "all firms sample". D is equal to one for diversified firms and zero otherwise.

4.2.3. Measuring internal control

While Pfeffer (1981) defines power as "the capability of one social actor to overcome resistance in achieving a desired objective or result," Yukl (2006) defines it as the ability to influence others. However, the most used definition of CEO power in recent research has been that of Finkelstein (1992), and Haleblian and Finkelstein (1993), "the capacity of individual actors to exert their will."[47] In our paper, we define CEO power as the ability of CEOs to solely determine and control firms' strategy in a way that reflects their own preferences with little or no regards for the consequences of decisions they take on their positions. In this context, strategic decisions will be mainly taken by the CEO rather than by a coalition of top executives. Our definition is basically similar to that of Adams, Almeida, and Ferreira (2005) where they define powerful CEOs as "those who can consistently influence key decisions in their firms, in spite of potential opposition from

[44] The inverse of the sum of segments' sales weights squared.
[45] The actual level of sales dispersion within a diversified firm cannot be fully captured based on Compustat segments data as diversified firms are not required to report segments with sales below 10% of total sales.
[46] Theoretically speaking, the maximum level of diversification can be even more than 10 points as diversified firms can report more than 10 segments as the requirement is to have segments' sales, assets or profits above the 10% mark. However, based on our sample the maximum level of diversification is only 6.81.
[47] See for example, Brown and Sarma (2007), and, Haynes and Hillman (2010).

other executives". The authors highlight that CEO power is negatively related to the number of decision-makers in the firm.

Finkelstein (1992) identifies four CEO power dimensions: Structural, Ownership, Expert and Prestige Power. According to our definition of CEO power and following most of earlier research, we mainly rely on structural power measures (Adams, Almeida, and Ferreira, 2005; Jiraporn, Liu, and Kim, 2012).[48] We build a measure of CEO power based on board structure (CEO holds the titles of chair and president) and composition (CEO is the only insider). As we separately consider diversified firms, we indirectly include another measure of CEO power; the expert power which is more relevant in diversified firms.

4.2.3.1.<u>Board Structure</u>

While the CEO title itself is an indicator of considerable formal power, holding the titles of chair and president confers even greater power (Jensen, and Meckling, 1976; Ocasio, 1994). Interestingly, holding multiple titles not only implies a strong formal power but also reflects some unobservable informal power (Pfeffer, 1978; Finkelstein, and D'aveni, 1994). This informal power allows the CEO to grab those additional titles that grant her superior power over the board of directors. In this case, CEO decisions are less likely to be challenged and the CEO is less likely to be replaced by the board.

Many studies use duality (CEO is also the chair of the board) as the main proxy or at least as one of the measures of CEO power.[49] The chair is usually the most powerful director other than the CEO; he sets the agenda and determines what information directors receive prior to board

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[48] Structural power or legitimate power is based on formal organizational structure and hierarchy (Hambrick 1981).
[49] See Morck, Shleifer, and Vishny (1989), Zahra and Pearce (1989); Finkelstein (1992), Westphal and Zajac (1993), Finkelstein and D'aveni (1994), Cannella and Shen (2001), Adams, Almeida, and Ferreira (2005), O'Connor, Priem, Coombs and Gilley (2006), Wade, O'Reilly and Pollock (2006), and Morse, Nanda and Seru (2011) among others.

meetings. He also evaluates CEO decisions and plays an important role in strategic decision-making. Consequently, duality will weaken the board’s monitoring role. In fact, it creates “a conflict of interest in which a CEO who is responsible for the overall strategic management of a firm is also in a position to evaluate the effectiveness of that strategy” (Finkelstein and D'aveni 1994, p. 1082). Moreover, duality implies that decision-making power is concentrated in the hands of the CEO as the chair is usually the most likely to play an integral role in decision making along the CEO (Adams, Almeida, and Ferreira, 2005). Given that duality grants CEO more power and control to take decisions, the president title strengthen her position against any replacement attempts from the board of directors and strengthen the assumption that she is the ultimate decision maker in the firm.

Most new CEOs are “internal candidates promoted through planned successions” (Xuan 2009, p. 4927). This process begins with the identification of an heir well before the actual succession takes place (Cannella, and Shen, 2001). Heirs, who usually hold the position of president (Dechow, and Sloan, 1991; Naveen, 2006), are involved in strategic decision making prior to becoming CEOs as a part of the grooming process (Adams, Almeida, and Ferreira, 2005). If another executive is holding the president title, he will be well positioned to replace the CEO in case of poor performance. However, when the CEO holds the president title, this implies that there is no clear successor yet to replace her. Therefore, the president CEO has more power to resist any replacement efforts from the board of directors. Moreover, the president CEO is more likely to be the sole strategic decision maker in the firm.

4.2.3.2.<u>*Board Composition*</u>

The board composition plays an important role in empowering internal control in organizations. There is a large agreement among researchers and practitioners that boards should be mostly represented by outsiders (Fama and Jensen, 1983; Jensen, 1993; Zajac, and Westphal, 1996). As outsiders are more independent of the CEO, they are better positioned to control and monitor her decisions compared to insiders (Fama, and Jensen, 1983). Moreover, strong outsiders' presence on the board is positively correlated with higher firm value (Byrd, and Hickman, 1992; Borokhovich, Parrino, and Trapani, 1996). Outsider-dominated boards are also more likely to dismiss a CEO following poor performance (Weisbach, 1988; Boeker, 1992). Government regulators and institutional investors have successfully pushed for an increase in board dependence (Joseph, Ocasio, and McDonnell, 2014).

As outsiders have less firm-specific information compared to insiders, they rely heavily on information provided by the CEO (Lorsch, and MacIver, 1989; Pearce, and Zahra, 1991; Boyd, 1994). If the CEO holds some critical information during boards' meetings, outsiders' monitoring role will be jeopardized (Zahra, and Pearce, 1989). In this case, the role of insiders other than the CEO will prevail as another source of information during board meetings.

Although insiders do not play a strong direct monitoring role and are less likely to challenge the CEO decisions in board meetings (Fredrickson, Hambrick, and Baumrin, 1988; Hoskisson, Johnson, and Moesel, 1994), they still play a critical role through providing valuable firm-specific information to other board members (Fama, and Jensen, 1983; Baysinger, and Hoskisson, 1990). Hence, the presence of insiders other than the CEO is essential to guarantee strong internal control. The ideal board combination should include both outsiders and insiders. On one hand, the higher ratio of outsiders implies higher internal control. Conversely, the complete absence of insiders other than the CEO will have a counter-effect reducing the effectiveness of boards' monitoring role. As information is a major source of power in firms (Pfeffer, 1981), having the CEO as the only insider on the board of directors will grant her an informational advantage over other board members. Even if board members participate in major decisions, those decisions will be taken based on the type and content of information brought by the CEO. Consequently, this control of information will give the CEO enough power to completely control decision-making within the firm.

CEO power resulting from board composition is even higher in diversified firms as the CEO enjoys the potential of holding a greater informational advantage about the firm and its different divisions (Barkema and Pennings, 1998). For example, if board members are unable to clearly learn about investment opportunities in two different divisions, they may be misled by the information presented by the CEO. Consequently, the CEO will take investment allocation decisions that reflect her own interests rather than those of shareholders. Thus, even if outside directors are more likely to challenge CEO decisions, they will only challenge her based on information she brings on to the table.

4.2.3.3.<u>CEO Power Variables</u>

We use Execucomp and RiskMetrics data files to create a CEO power measure as a proxy for internal control, where a higher CEO power implies lower internal control. CEO is considered powerful if she is the only insider on the board of directors and if she is the president and the chairman of the board of directors at the same time. Consequently, CEO power is a dummy variable equal to one if the CEO is powerful and zero otherwise. Our CEO power measure is similar to the one used by Morck, Shleifer, and Vishny (1989), Adams, Almeida, and Ferreira (2005), and Hoechle, Schmid, Walter, and Yermack (2012).

4.2.4. Measuring external control:

We get institutional ownership data for all common stocks traded on NYSE, AMEX, and NASDAQ through 13F filings from Thomson Financial. For each firm we compute the average number of shares held by institutions for a given year, and then we divide it by the average number of shares outstanding for that same year. The resulting ratio represents institutional ownership measure “IO”. Higher institutional ownership as measured by higher “IO” value implies a higher level of external control.

5. Empirical Results

5.1. Diversification Level and the value of the firm

First, we study the effect of corporate diversification on firm value and we test the sensitivity of excess value to diversification level. We check the effect of the diversification level on firm value by regressing excess firm value on different measures of diversification and a vector of control variables. We therefore estimate

$$EV_{it} = \alpha + \beta C_{it} + \gamma D_{it} + \varepsilon_{it}$$

where EV_{it} is the excess value of firm i in year t, D_{it} represents the diversification measures for firm i in year t, and C_{it} is a vector of control variables. To control for firms characteristics we use five variables; LogA, FIRMAGE, Leverage, Profitability, and Sales Growth. LogA is the natural logarithm of total assets measured in millions of US dollars. FIRMAGE is the number of years since the firm was added to COMPUSTAT industrial files. Leverage is the ratio of total debt to total assets. PROF is the profitability of the firm and is expressed as the ratio of EBIT (Earnings Before Interest and Tax) to total sales. Finally, Sales Growth is the annual change in total sales.

Table 33 shows the results of OLS regressions for "all firms" sample (Panel A) and for "Governance Sample" (Panel B). We use N3D, and N4D, DIVLEVEL and the dummy variable D as proxies for diversification level in columns (1), (2), (3) and (4) respectively. Although firms in the "Governance Sample" have higher firm value than those in the "All Firms Sample", the effect of diversification does not change significantly across the two different groups. The results in both panels are qualitatively and quantitatively similar. In the first regression, the coefficient of dummy variable, D, is significantly negative in both panels (–0.108 and – 0.116). This result confirms that diversified firms are selling at a discount when compared to stand-alone firms. Furthermore, the coefficients of N3D and N4D are both significantly negative implying that excess value is negatively related to the number of reported segments whether at the 3-digit code or 4-digit code level. When the number of segments at the 3-digit code level reported by a firm increases by one, the excess value of the firm decreases on average by 5.9% (Governance Sample) to 6.8% (All Firms Sample).

Finally, the coefficient of DIVLEVEL is significantly negative (–0.086 and – 0.063) implying that excess value is negatively related to the level of dispersion of total sales within existing segments. When total sales in a two-segment firm in the "All Firms Sample" become more dispersed, segment sales become 50% for each segment instead of 10% for one segment and 90% for the other, excess value of the multi-segment firm will decrease by 6.71%.[50] These results imply that diversified firms lose value because of diversification and that this value loss increase with the level of diversification as measured by higher number of segments or higher dispersion of firm activities across existing segments. The coefficients of control variables are all significant with firm' size, profitability and sales growth positively related to excess value while firm age and leverage are negatively related to excess value.

5.2. Internal Control Effect

In this section, we test the effect of internal control on firms' value we regress excess value on CEO power, diversification dummy and a vector of control variables. We therefore estimate

$$EV_{it} = \alpha + \beta C_{it} + \gamma POWER_{it} + \delta DC_{it} + \lambda DPOWER_{it} + \mu D + \varepsilon_{it}$$

where EV_{it} is the excess value of firm i in year t, $POWER$ is a dummy variable equal to one if the CEO is the only insider on the board of directors and if she also holds the chair and president

[50] In this case as the level of sales dispersion increase, the diversification level increases from 1.219512 to 2. This 0.7805 increase in the diversification level will result in a 0.0671 loss in excess value (-0.086×0.7805).

titles. D is a dummy variable equal to one for diversified firms and zero otherwise and C_{it} is a vector of control variables (LogA, FIRMAGE, Leverage, Profitability, Sales Growth and Tobin's Q).

Table 34 includes the results of four OLS regressions using the "Governance Sample". Although we expect CEO power to be negatively correlated with firm value, we are more interested in any significant difference that may exist between the coefficients of CEO power in diversified and single firms. The coefficients of POWER variable are significantly negative in the four regressions. Therefore, we can conclude that, all else being equal, firms run by powerful CEOs are more likely to sell at a market discount. This result is consistent with Hypothesis (H2a) about the negative relationship between low internal control (high CEO power) and firm value. With the lack of internal control, powerful CEOs decisions are more likely to reflect their own preferences rather than those of shareholders and are less likely to be challenged by the board of directors. Consequently, powerful CEOs may take suboptimal decisions that result in value destruction. Moreover, the coefficient of interaction term DPOWER is significantly negative which implies that diversified firms suffer more from CEO power than single firms do. While single firms managed by powerful CEOs sell at a 3.1% discount, diversified firms managed by powerful CEOs sell at an 8.8% discount. This result supports the belief that agency costs are more severe in diversified firms (H2b).

5.3. External Control Effect

To test the effect of external control on the value of firms we regress excess value on institutional ownership, diversification dummy and a vector of control variables. We therefore estimate

$$EV_{it} = \alpha + \beta C_{it} + \gamma X_{it} + \delta DC_{it} + \lambda DX_{it} + \mu D + \varepsilon_{it}$$

where EV_{it} is the excess value of firm i in year t, X_{it} represents external control (IO) for firm i in year t, D is a dummy variable equal to one for diversified firms and zero otherwise, and C_{it} is a vector of control variables (LogA, FIRMAGE, Leverage, Profitability, Sales Growth and Tobin's Q).

Table 35 includes the results of four OLS regressions for the "Governance Sample". The results show that the coefficients of external control measure are all positive and consistently significant in the four regressions, which imply a positive effect of institutional ownership on firm value (H3a). The coefficient of the interaction term between the diversification dummy and institutional ownership is significantly negative in all models implying that the effect of institutional ownership is significantly weaker in diversified firms when compared to single firms. These results indicate that the role of institutional investors is less evident in more complex structures such as in diversified firms (H3b).

To check whether our results vary across different groups of institutional investors, we use Bushee (2004) classification of institutional investors. Each year, institutional investors are classified into one of three groups: transient, dedicated, and quasi-indexer. "Transient Institutions" are characterized with high portfolio turnover and small stake sizes. "Dedicated Institutions" are characterized by stable ownership and large stake sizes. "Quasi-Indexer Institutions are characterized by high ownership stability and small stake sizes.

In table 36, we report the results of 6 OLS regressions where we use separately each class of institutional investors as a proxy for external control. The results show that ownership levels of all classes of institutional investors are positively correlated with firm value. However, these results vary significantly across different classes of institutions. The coefficient of transient institutions ownership is significantly the highest among the three groups while that of quasi-indexer institutions ownership is significantly the lowest. The coefficient of the interaction term between the diversification dummy and institutional ownership is significantly negative for both transient and quasi-indexer institutional investors groups, while it is not significantly different than zero for the dedicated institutional investors groups. These results imply that the monitoring role of dedicated institutional investors is not affected by the complex structure of diversified firms, as their positive effect on firm value does not significantly vary between single and diversified firms.

6. Conclusion

In this paper, we try to explain the diversification discount from the “control” perspective by showing that diversified firms suffer more from the lack of internal control and benefit less from strong external control as measured by institutional ownership.

When shareholders have more control over critical decisions such as diversification and investments allocation (low CEO power and high institutional ownership), we anticipate corporate diversification to add value to firms on average. However, when CEOs have more power and external control mechanisms are less effective, CEOs are more likely to take decisions that result in value loss for shareholders. The consequences of such decisions will be much more pronounced in more complex structures such as in diversified firms.

We find evidence that diversified firms suffer more from the lack of internal control when compared to single firms; the negative effect of CEO power on firm’s excess value is significantly more pronounced in diversified firms. This result implies that agency costs are more severe in diversified firms when compared to single firms. While external control as measured by institutional ownership is positively correlated with firm value, the effect differs significantly across single and diversified firms. While institutional ownership effect is significantly positive in single firms, the effect is insignificant for diversified firms. These results suggest that institutional investors’ role is more restricted under complex operational and informational structure. Finally, we find that the monitoring role of dedicated institutional investors is less likely to be affected by such restrictions, as the positive effect of their ownership levels on firm value does not vary significantly between single and diversified firms.

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Table 27: Variables Description

Variable	Description
Excess value	The natural log of the ratio of a firm's actual value to its imputed value
Assets	Total assets expressed in millions of dollars.
LogA	Natural logarithm of total assets expressed in millions of dollars.
Sales	Total sales expressed in millions of dollars.
Sales Growth	Annual sales growth rate
FIRMAGE	The number of years since the firm was added to the COMPUSTAT industrial files.
Leverage	The ratio of total debt to total assets.
Tobin's Q	The market value of equity plus the book value of debt divided by the book value of assets.
N3D	The number of 3-digit code segments operated by the multi-segment firm.
N4D	The number of 3-digit code segments operated by the multi-segment firm.
DIVLEVEL	Diversification level or the level of dispersion of firm' total sales within its existing segments which is equal to the inverse of the Herfindahl index of segments' sales-weights.
D	Dummy variable equals one if the firm is diversified and zero otherwise.
IO	The ratio of institutional ownership to total shares outstanding.
CEOCHAIRPR	Dummy variable equal to one if the CEO is also the chairman of the boards of directors and the president of the firm, and zero otherwise.
ONLYINSIDER	Dummy variable equal to one if the CEO is the only insider on the board of directors and zero otherwise.
POWER	Dummy variable equal to one if the CEO is powerful (CEO is only insider and holds the chairman and president titles) and zero otherwise.
HIO	Dummy variable equal to one if the institutional ownership in a given firm is higher than the median institutional ownership across all firms and zero otherwise.

Table 28: Distribution of diversified firms' observations by number of reported segments

Number of Segments	Number of Segment-years	Number of Firm-years	Percentage
2	9,596	4,798	65.69%
3	5,430	1,810	24.78%
4	1,968	492	6.74%
5	720	144	1.97%
More than 5	384	60	0.82%

Distribution of a sample of 7,304 diversified firms with total assets with total assets of more than $20 million and with no segments in the financial or the utility industry over the period 1996-2011 by number of reported segments at the 4-digit SIC level.

Table 29: Segments' characteristics: Descriptive Statistics

Panel A: Diversified Segments (Diversified Firms Sample)

Variable	N	Mean	Std. Dev.	5%	Median	95%
Assets (millions)	18,083	1,669.16	6,571.23	3.01	175.12	7,359.17
Sales (millions)	18,098	1,563.89	5,765.45	4.26	201.14	6,904.00

Panel B: Diversified Segments (Governance Sample)

Variable	N	Mean	Std. Dev.	5%	Median	95%
Assets (millions)	5,853	2,370.11	7,550.33	31.52	591.48	9,570.62
Sales (millions)	5,859	2,501.35	6,630.72	34.30	705.72	10,176.00

Summary statistics for the characteristics of at the 4-digit SIC code level segments with total assets of more than $20 million and with no segments in the financial or the utility industry over the period 1996-2011. Assets represents the book value of total assets in millions of dollars. Sales represents the value of annual sales expressed in millions of dollars. Panel A covers the "Diversified Firms Sample" while Panel B covers the "Governance Sample".

Table 30: Diversified Firms Characteristics: Descriptive Statistics

Panel A: Diversified Firms (Diversified Firms Sample)

Variable	N	Mean	Std. Dev.	5%	Median	95%
Excess Value	7,323	-0.11	0.55	-1.03	-0.10	0.82
Assets (millions)	7,323	4,682.90	15,038.04	25.40	643.15	22,843.00
Sales (millions)	7,313	3,888.51	11,219.45	30.13	612.68	18,784.00
FIRMAGE	7,323	23.07	15.92	4.00	18.00	52.00
Leverage	7,323	0.48	0.25	0.16	0.46	0.86
PROF	7,323	0.06	0.17	-0.13	0.07	0.24
Tobin’s Q	7,323	1.61	0.88	0.81	1.37	3.13
Sales Growth	7,279	0.06	0.30	-0.31	0.07	0.44
DIVLEVEL	7,323	1.76	0.64	1.04	1.67	2.92
N3D	7,323	2.38	0.72	2.00	2.00	4.00
N4D	7,323	2.48	0.79	2.00	2.00	4.00
CEOCHAIRPR	2,429	0.32	0.47	0.00	0.00	1.00
ONLYINSIDER	2,932	0.47	0.50	0.00	0.00	1.00
POWER	2,280	0.20	0.40	0.00	0.00	1.00
IO	7,323	0.42	0.31	0.00	0.30	0.94

Panel B: Diversified Firms (Governance Sample)

Variable	N	Mean	Std. Dev.	5%	Median	95%
Excess Value	2,280	-0.01	0.46	-0.78	-0.02	0.75
Assets (millions)	2,280	7,136.06	18,108.59	283.24	2,026.98	29,901.00
Sales (millions)	2,280	6,495.51	12,928.96	304.07	1,941.90	26,014.00
FIRMAGE	2,280	33.87	16.08	8.00	36.00	57.00
Leverage	2,280	0.44	0.16	0.18	0.44	0.68
PROF	2,280	0.10	0.11	-0.01	0.09	0.23
Tobin’s Q	2,280	1.70	0.79	0.94	1.49	3.09
Sales Growth	2,277	0.04	0.22	-0.27	0.06	0.32
DIVLEVEL	2,280	1.89	0.70	1.07	1.79	3.07
N3D	2,280	2.48	0.76	2.00	2.00	4.00
N4D	2,280	2.58	0.83	2.00	2.00	4.00
CEOCHAIRPR	2,280	0.32	0.46	0.00	0.00	1.00
ONLYINSIDER	2,280	0.49	0.50	0.00	0.00	1.00
POWER	2,280	0.20	0.40	0.00	0.00	1.00
IO	2,280	0.63	0.25	0.28	0.69	0.97

Summary statistics for the characteristics of diversified firms in our All firms sample (Panel A) and Governance Sample (Panel B); Excess value represents the natural log of the ratio of a firm’s actual value to its imputed value. Assets represents the book value of total assets in millions of dollars. Sales represents the value of annual sales expressed in millions of dollars. FIRMAGE represents the number of years since the firm was added to the COMPUSTAT industrial files. Leverage represents the ratio of total debt to total assets. PROF represents the profitability of the firm and is expressed as the ratio of EBIT (Earnings Before Interest and Tax) to total sales. Tobin's Q is the market value of equity plus the book value of debt divided by the book value of assets. Sales Growth is the annual change in sales. N3D represents the number 3-digit segments operated by the multi-segment firm. N4D represents the number 4-digit segments operated by the multi-segment firm. DIVLEVEL or Diversification Level is the inverse of the Herfindahl index of segments' asset-weights; a higher index value corresponds to a higher level of diversification. CEOCHAIRPR is a dummy variable equal to one if the CEO is the chairman of the boards of directors and the president of the firm, and zero otherwise. ONLYINSIDER is a dummy variable equal to one if the CEO is the only insider on the board of directors and zero otherwise. POWER is a dummy variable equal to one if the CEO is powerful (CEO is only insider and holds the chairman and president titles) and zero otherwise. IO is the ratio of institutional ownership to total shares outstanding.

Table 31: Single Firms Characteristics: Descriptive Statistics

Panel A: Single Firms (Single Firms Sample)

Variable	N	Mean	Std. Dev.	5%	Median	95%
Excess Value	33,367	-0.02	0.58	-1.02	0.00	1.00
Assets (millions)	33,367	1,620.16	6,132.87	21.99	221.40	7,086.00
Sales (millions)	33,364	1,425.20	5,168.45	26.18	200.73	6,283.30
FIRMAGE	33,367	14.50	11.14	4.00	11.00	39.00
Leverage	33,367	0.44	0.35	0.11	0.39	0.90
PROF	33,367	0.01	0.34	-0.43	0.06	0.31
Tobin’s Q	33,367	2.02	1.82	0.77	1.54	4.80
Sales Growth	33,142	0.08	0.47	-0.36	0.10	0.52
DIVLEVEL	33,367	1.00	0.00	1.00	1.00	1.00
N3D	33,367	1.00	0.00	1.00	1.00	1.00
N4D	33,367	1.00	0.00	1.00	1.00	1.00
CEOCHAIRPR	6,884	0.27	0.45	0.00	0.00	1.00
ONLYINSIDER	9,238	0.50	0.50	0.00	1.00	1.00
POWER	6,397	0.18	0.38	0.00	0.00	1.00
IO	33,367	0.41	0.31	0.00	0.32	0.96

Panel B: Single Firms (Governance Sample)

Variable	N	Mean	Std. Dev.	5%	Median	95%
Excess Value	6,397	0.14	0.51	-0.73	0.10	1.02
Assets (millions)	6,397	3,511.46	8,881.59	156.92	971.36	15,122.00
Sales (millions)	6,396	3,521.50	8,367.58	122.39	944.19	14,454.71
FIRMAGE	6,397	21.14	13.30	7.00	16.00	48.00
Leverage	6,397	0.39	0.20	0.11	0.38	0.72
PROF	6,397	0.09	0.22	-0.11	0.10	0.34
Tobin’s Q	6,397	2.22	1.53	0.93	1.77	5.05
Sales Growth	6,395	0.05	0.65	-0.29	0.09	0.36
DIVLEVEL	6,397	1.00	0.00	1.00	1.00	1.00
N3D	6,397	1.00	0.00	1.00	1.00	1.00
N4D	6,397	1.00	0.00	1.00	1.00	1.00
CEOCHAIRPR	6,397	0.27	0.45	0.00	0.00	1.00
ONLYINSIDER	6,397	0.50	0.50	0.00	0.00	1.00
POWER	6,397	0.18	0.38	0.00	0.00	1.00
IO	6,397	0.67	0.26	0.29	0.74	0.98

Summary statistics for the characteristics of single firms in our All firms sample (Panel A) and Governance Sample (Panel B); Excess value represents the natural log of the ratio of a firm’s actual value to its imputed value. Assets represents the book value of total assets in millions of dollars. Sales represents the value of annual sales expressed in millions of dollars. FIRMAGE represents the number of years since the firm was added to the COMPUSTAT industrial files. Leverage represents the ratio of total debt to total assets. PROF represents the profitability of the firm and is expressed as the ratio of EBIT (Earnings Before Interest and Tax) to total sales. Tobin's Q is the market value of equity plus the book value of debt divided by the book value of assets. Sales Growth is the annual change in sales. N3D represents the number 3-digit segments operated by the multi-segment firm. N4D represents the number 4-digit segments operated by the multi-segment firm. DIVLEVEL or Diversification Level is the inverse of the Herfindahl index of segments' asset-weights; a higher index value corresponds to a higher level of diversification. CEOCHAIRPR is a dummy variable equal to one if the CEO is the chairman of the boards of directors and the president of the firm, and zero otherwise. ONLYINSIDER is a dummy variable equal to one if the CEO is the only insider on the board of directors and zero otherwise. POWER is a dummy variable equal to one if the CEO is powerful (CEO is only insider and holds the chairman and president titles) and zero otherwise. IO is the ratio of institutional ownership to total shares outstanding.

Table 32: Correlation Matrix

	EV	LogA	FRIMAGE	Leverage	PROF	Tobin's Q	Sales Growth	POWER	IO	D
EV	1.000									
LOGA	0.042	1.000								
	0.000									
FRIMAGE	-0.109	0.420	1.000							
	<.0001	<.0001								
Leverage	-0.139	0.259	0.139	1.000						
	<.0001	<.0001	<.0001							
PROF	0.099	0.166	0.065	-0.101	1.000					
	<.0001	<.0001	<.0001	<.0001						
Tobin's Q	0.453	-0.071	-0.154	-0.110	0.219	1.000				
	<.0001	<.0001	<.0001	<.0001	<.0001					
Sales Growth	0.018	0.028	-0.034	-0.001	0.117	0.092	1.000			
	0.089	0.010	0.001	0.895	<.0001	<.0001				
POWER	-0.032	0.019	0.043	-0.017	0.018	0.005	-0.001	1.000		
	0.003	0.074	<.0001	0.121	0.090	0.634	0.934			
IO	0.099	0.072	-0.045	-0.119	0.113	0.076	0.044	0.003	1.000	
	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	0.779		
D	-0.132	0.208	0.370	0.124	0.003	-0.165	-0.008	0.022	-0.076	1.000
	<.0001	<.0001	<.0001	<.0001	0.752	<.0001	0.444	0.039	<.0001	

Pearson correlation matrix between the Excess Value, firm characteristics variable (LOGA, FIRMAGE, Leverage, PROF, Tobin's Q and Sales Growth), one measure of diversification (D), one measure of internal control (POWER) and one measure of external control (IO). Excess value represents the natural log of the ratio of a firm's actual value to its imputed value. LOGA represents the natural logarithm of total assets expressed in millions of dollars. FIRMAGE represents the number of years since the firm was added to the COMPUSTAT industrial files. Leverage represents the ratio of total debt to total assets. PROF represents the profitability of the firm and is expressed as the ratio of EBIT (Earnings Before Interest and Tax) to total sales. Tobin's Q is the market value of equity plus the book value of debt divided by the book value of assets. Sales Growth is the annual change in sales. POWER is a dummy variable equal to one if the CEO is powerful (CEO is only insider and holds the chairman and president titles) and zero otherwise. IO is the ratio of institutional ownership to total shares outstanding. D is a dummy variable equal to one if the firm is diversified and zero other wise.

Table 33: Effect of Diversification on Firm Value

Panel A: All Firms Sample

Variable	Dependent Variable: EV (Excess Value)			
	(1)	(2)	(3)	(4)
Intercept	-0.394***	-0.332***	-0.336***	-0.312***
	(-40.02)	(-31.88)	(-32.69)	(-27.12)
LOGA	0.096***	0.097***	0.097***	0.096***
	(60.52)	(60.75)	(60.90)	(60.26)
FIRMAGE	-0.006***	-0.006***	-0.006***	-0.006***
	(-26.65)	(-26.80)	(-26.79)	(-27.26)
leverage	-0.182***	-0.183***	-0.183***	-0.185***
	(-21.94)	(-22.05)	(-22.05)	(-22.33)
PROF	-0.094***	-0.095***	-0.095***	-0.095***
	(-10.55)	(-10.70)	(-10.69)	(-10.74)
Sales Growth	0.092***	0.092***	0.092***	0.092***
	(15.02)	(15.00)	(15.00)	(14.95)
D	-0.108***			
	(-14.62)			
N3D		-0.068***		
		(-14.56)		
N4D			-0.066***	
			(-15.16)	
DIVLEVEL				-0.086***
				(-11.95)
N	40,421	40,421	40,421	40,421
R^2	0.105	0.105	0.105	0.104

Panel B: Governance Sample

Variable	Dependent Variable: EV (Excess Value)			
	(1)	(2)	(3)	(4)
Intercept	0.007	0.057**	0.052*	0.069**
	(0.27)	(2.05)	(1.88)	(2.39)
LOGA	0.048***	0.049***	0.049***	0.047***
	(11.22)	(11.42)	(11.56)	(11.16)
FIRMAGE	-0.004***	-0.004***	-0.004***	-0.004***
	(-9.38)	(-9.73)	(-9.63)	(-10.40)
leverage	-0.364***	-0.369***	-0.370***	-0.374***
	(-12.62)	(-12.81)	(-12.83)	(-12.95)
PROF	0.325***	0.324***	0.324***	0.329***
	(9.12)	(9.08)	(9.06)	(9.20)
Sales Growth	0.087***	0.086***	0.087***	0.086***
	(3.31)	(3.27)	(3.29)	(3.26)
D	-0.116***			
	(-9.05)			
N3D		-0.059***		
		(-7.88)		
N4D			-0.059***	
			(-8.38)	
DIVLEVEL				-0.063***
				(-5.89)
N	8,672	8,672	8,672	8,672
R^2	0.066	0.064	0.065	0.061

These tables contain OLS regressions using the "all firms sample" (Panel A) and the "Governance Sample" (Panel B); the sample covers the period 1996-2011. The dependent variable is the excess value of the firm. Independent variables include control variables (Log of Assets, Firm age, Leverage, Profitability and Sales Growth), in addition to one measure of corporate diversification; dummy variable D (1), Number of 3-Digit segments (2), Number of 4-Digit segments (3) and Diversification Level (4). Excess value represents the natural log of the ratio of a firm's actual value to its imputed value. LOGA is the natural logarithm of total assets expressed in millions of dollars. FIRMAGE represents the number of years since the firm was added to the COMPUSTAT industrial files. Leverage represents the ratio of total debt to total assets. PROF represents the profitability of the firm and is expressed as the ratio of EBIT (Earnings Before Interest and Tax) to total sales. Sales Growth is the annual change in sales. D is a dummy variable equal to one for diversified firms and zero otherwise. N3D represents the number 3-digit segments operated by the multi-segment firm. N4D represents the number 4-digit segments operated by the multi-segment firm. DIVLEVEL or Diversification Level is the inverse of the Herfindahl index of segments' asset-weights; a higher index value corresponds to a higher level of diversification.

Table 34: Effect of Internal Control (CEO Power) on Excess Value

Variable	Dependent Variable: EV (Excess Value)			
	(1)	(2)	(3)	(4)
Intercept	0.035	0.016	-0.383***	-0.409***
	(1.26)	(0.51)	(-14.25)	(-13.19)
LOGA	0.040***	0.051***	0.049***	0.061***
	(9.46)	(9.99)	(12.62)	(13.37)
FIRMAGE	-0.005***	-0.005***	-0.003***	-0.003***
	(-12.02)	(-9.49)	(-7.84)	(-6.36)
Leverage	-0.359***	-0.416***	-0.304***	-0.381***
	(-12.45)	(-12.87)	(-11.63)	(-13.00)
PROF	0.335***	0.240***	-0.007	-0.069**
	(9.36)	(6.41)	(-0.21)	(-2.06)
Sales Growth	0.087***	0.122***		
	(3.27)	(4.05)		
Tobin's Q			0.157***	0.151***
			(43.99)	(40.19)
POWER	-0.041***	-0.031**	-0.046***	-0.031**
	(-3.08)	(-2.18)	(-3.78)	(-2.17)
D		-0.211***		-0.108*
		(-3.13)		(-1.67)
D x LOGA		-0.030***		-0.042***
		(-3.17)		(-5.01)
D x FIRMAGE		0.003***		0.002**
		(4.04)		(2.54)
D x Leverage		0.374***		0.414***
		(5.25)		(6.39)
D x PROF		0.844***		0.535***
		(7.01)		(4.87)
D x Sales Growth		-0.202***		
		(-3.26)		
D x Tobin's Q				0.054***
				(4.17)
D x POWER		-0.057**		-0.057**
		(-2.10)		(-2.13)
N	8,672	8,672	8,672	8,672
R^2	0.059	0.077	0.230	0.241

This table contains OLS regressions using the “Governance Sample”; the sample covers the period 1996-2011. The dependent variable is the excess value of the firm; independent variables include control variables (Log of Assets, Firm age, Leverage, Profitability, Sales Growth and Tobin’s Q), internal control variable (POWER), diversification dummy (D) and interaction terms between dummy variable D and all independent variables. LOGA is the natural logarithm of total assets expressed in millions of dollars. FIRMAGE represents the number of years since the firm was added to the COMPUSTAT industrial files. Leverage represents the ratio of total debt to total assets. PROF represents the profitability of the firm and is expressed as the ratio of EBIT (Earnings Before Interest and Tax) to total sales. Sales Growth is the annual change in sales. Tobin’s Q is the market value of equity plus the book value of debt divided by the book value of assets. D is a dummy variable equal to one for diversified firms and zero otherwise. POWER is a dummy variable equal to one if the CEO is powerful (CEO is only insider and holds the chairman and president titles) and zero otherwise. T-statistics are provided below the coefficients in the table. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 35: Effect of External Control (Institutional Ownership) on Excess Value

Variable	Dependent Variable: EV (Excess Value)			
	(1)	(2)	(3)	(4)
Intercept	-0.074**	-0.070**	-0.483***	-0.477***
	(-2.13)	(-2.00)	(-14.66)	(-14.46)
LOGA	0.053***	0.053***	0.060***	0.060***
	(10.40)	(10.40)	(13.14)	(13.15)
FIRMAGE	-0.005***	-0.005***	-0.003***	-0.003***
	(-9.83)	(-9.74)	(-6.02)	(-5.91)
Leverage	-0.413***	-0.415***	-0.370***	-0.372***
	(-12.69)	(-12.74)	(-12.59)	(-12.67)
PROF	0.109***	0.109***	-0.131***	-0.130***
	(3.74)	(3.76)	(-4.89)	(-4.87)
Sales Growth	0.000	0.000		
	(0.01)	(0.01)		
Tobin's Q			0.152***	0.152***
			(40.89)	(40.95)
POWER		-0.025**		-0.030**
		(-1.97)		(-2.12)
IO	0.138***	0.137***	0.107***	0.106***
	(5.94)	(5.93)	(5.09)	(5.08)
D	-0.130*	-0.126*	-0.046	-0.044
	(-1.77)	(-1.72)	(-0.66)	(-0.64)
D x LOGA	-0.026***	-0.026***	-0.039***	-0.038***
	(-2.82)	(-2.76)	(-4.62)	(-4.55)
D x FIRMAGE	0.003***	0.003***	0.002**	0.002**
	(4.12)	(4.05)	(2.28)	(2.20)
D x Leverage	0.331***	0.339***	0.382***	0.391***
	(4.62)	(4.73)	(5.88)	(6.02)
D x PROF	0.624***	0.631***	0.419***	0.423***
	(6.31)	(6.39)	(4.64)	(4.68)
D x Sales Growth	-0.042	-0.046		
	(-0.87)	(-0.96)		
D x Tobin's Q			0.058***	0.059***
			(4.58)	(4.65)
D x POWER		-0.060**		-0.058**
		(-2.01)		(-2.15)
D x IO	-0.135***	-0.132***	-0.115***	-0.112***

	(-2.88)	(-2.83)	(-2.73)	(-2.66)
N	8,672	8,672	8,672	8,672
R^2	0.070	0.071	0.242	0.244

This table contains OLS regressions using the "Governance Sample"; the sample covers the period 1996-2011. The dependent variable is the excess value of the firm; independent variables include control variables (Log of Assets, Firm age, Leverage, Profitability, Sales Growth and Tobin's Q), internal control variable (POWER), external control variable (IO), diversification dummy (D) and interaction terms between dummy variable D and all independent variables. LOGA is the natural logarithm of total assets expressed in millions of dollars. FIRMAGE represents the number of years since the firm was added to the COMPUSTAT industrial files. Leverage represents the ratio of total debt to total assets. PROF represents the profitability of the firm and is expressed as the ratio of EBIT (Earnings Before Interest and Tax) to total sales. Sales Growth is the annual change in sales. Tobin's Q is the market value of equity plus the book value of debt divided by the book value of assets. D is a dummy variable equal to one for diversified firms and zero otherwise. POWER is a dummy variable equal to one if the CEO is powerful (CEO is only insider and holds the chairman and president titles) and zero otherwise. IO is the ratio of institutional ownership to total shares outstanding. T-statistics are provided below the coefficients in the table. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 36: Effect of External Control on Excess Value by Type of Institutional Ownership

Variable	Dependent Variable: EV (Excess Value)					
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	-0.074**	-0.069**	-0.006	-0.001	-0.005	-0.001
	(-2.23)	(-2.09)	(-0.18)	(-0.04)	(-0.17)	(-0.03)
LOGA	0.055***	0.055***	0.055***	0.055***	0.056***	0.056***
	(10.94)	(10.94)	(10.85)	(10.85)	(11.05)	(11.05)
FIRMAGE	-0.004***	-0.004***	-0.005***	-0.005***	-0.005***	-0.005***
	(-8.91)	(-8.83)	(-10.23)	(-10.14)	(-10.16)	(-10.06)
Leverage	-0.417***	-0.419***	-0.427***	-0.429***	-0.443***	-0.445***
	(-12.93)	(-12.99)	(-13.03)	(-13.09)	(-13.70)	(-13.76)
PROF	0.116***	0.116***	0.120***	0.121***	0.124***	0.125***
	(4.01)	(4.03)	(4.13)	(4.15)	(4.28)	(4.30)
Sales Growth	0.001	0.001	0.001	0.001	0.002	0.002
	(0.08)	(0.08)	(0.14)	(0.15)	(0.17)	(0.18)
POWER		-0.024*		-0.025**		-0.025**
		(-1.92)		(-1.97)		(-2.01)
IO_{Active}	0.440***	0.440***				
	(9.62)	(9.61)				
$IO_{Quasi\text{-}Indexer}$			0.043*	0.043*		
			(1.89)	(1.87)		
$IO_{Dedicated}$					0.360***	0.360***
					(4.84)	(4.85)
D	-0.158**	-0.154**	-0.184***	-0.179**	-0.201***	-0.196***
	(-2.28)	(-2.21)	(-2.68)	(-2.59)	(-2.97)	(-2.90)
D x LOGA	-0.028***	-0.028***	-0.028***	-0.027***	-0.029***	-0.029***
	(-3.05)	(-2.98)	(-2.97)	(-2.90)	(-3.17)	(-3.10)
D x FIRMAGE	0.003***	0.003***	0.004***	0.004***	0.004***	0.004***
	(3.68)	(3.61)	(4.36)	(4.29)	(4.31)	(4.24)
D x Leverage	0.342***	0.350***	0.334***	0.341***	0.356***	0.364***
	(4.82)	(4.92)	(4.63)	(4.74)	(5.00)	(5.10)
D x PROF	0.618***	0.626***	0.616***	0.623***	0.607***	0.614***
	(6.28)	(6.36)	(6.22)	(6.30)	(6.14)	(6.22)
D x Sales Growth	-0.039	-0.043	-0.041	-0.045	-0.041	-0.045
	(-0.80)	(-0.89)	(-0.84)	(-0.93)	(-0.84)	(-0.92)
D x POWER		-0.062**		-0.060**		-0.060**
		(-2.07)		(-2.01)		(-2.01)
D x IO_{Active}	-0.270***	-0.265***				

	(-2.81)	(-2.76)				
D x $IO_{Quasi\text{-}Indexer}$			-0.085*	-0.085*		
			(-1.88)	(-1.89)		
D x $IO_{Dedicated}$					-0.192	-0.182
					(-1.33)	(-1.26)
N	8,672	8,672	8,672	8,672	8,672	8,672
R^2	0.074	0.075	0.058	0.058	0.062	0.063

This table contains OLS regressions using the "Governance Sample"; the sample covers the period 1996-2011. The dependent variable is the excess value of the firm; independent variables include control variables (Log of Assets, Firm age, Leverage, Profitability, Sales Growth and Tobin's Q), internal control variable (POWER), external control variable (IO), diversification dummy (D) and interaction terms between dummy variable D and all independent variables. LOGA is the natural logarithm of total assets expressed in millions of dollars. FIRMAGE represents the number of years since the firm was added to the COMPUSTAT industrial files. Leverage represents the ratio of total debt to total assets. PROF represents the profitability of the firm and is expressed as the ratio of EBIT (Earnings Before Interest and Tax) to total sales. Sales Growth is the annual change in sales. Tobin's Q is the market value of equity plus the book value of debt divided by the book value of assets. D is a dummy variable equal to one for diversified firms and zero otherwise. POWER is a dummy variable equal to one if the CEO is powerful (CEO is only insider and holds the chairman and president titles) and zero otherwise. We use Bushee (2004) Institutional Investor Classification to identify each institutional investors' category. Active or "Transient Institutions" are characterized with high portfolio turnover and small stake sizes. "Dedicated Institutions" are characterized by stable ownership and large stake sizes. "Quasi-Indexer Institutions are characterized by high ownership stability and small stake sizes. T-statistics are provided below the coefficients in the table. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.