Limits to Arbitrage and the Asset Growth Anomaly*

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Abstract

Several studies have documented that companies that increase capital investments or grow their total assets subsequently earn substantially lower risk-adjusted returns. Some studies attribute this phenomenon to investors' initial underreactions to overinvestments pursued by managers who are empire building. This paper examines the role of the limits to arbitrage in the negative relationship between capital investment or asset growth and subsequent stock returns. We hypothesize that if the negative relationship is due to investors' underreactions, the relationship should be more pronounced when there are more severe limits to arbitrage. Our empirical evidence appears to support our hypothesis.

JEL Classification: G14, G31, M41, M42

Keywords: Asset growth; Capital investment; Limits to arbitrage

Recent studies by Titman, Wei, and Xie (2004) and Cooper, Gulen, and Schill (2008), among others, have documented that companies that invest more or grow their total assets more earn lower subsequent risk-adjusted returns. This phenomenon is often referred to as the "capital investment anomaly" or the "asset growth anomaly."[1] Titman et al. (2004) and Chan et al. (2008) attribute this phenomenon to investors' initial underreactions to overinvestments pursued by managers who are empire building. In this paper, we examine how limits to arbitrage contribute to the asset growth anomaly. Limits to arbitrage hinder relevant information from being included in stock prices. Our main hypothesis is that if the underperformance of the stocks of high asset growth firms is due to investors' initial underreactions to information about adverse changes in firms' fundamentals, the underperformance should be greater when the arbitrage is riskier or more difficult to implement. As a result, we should observe that the asset growth anomaly is more profound among stocks that are associated with more severe limits to arbitrage.

Our intuition is motivated by recent developments in the study of behavioral finance. Several studies including Titman et al. (2004) attribute the asset growth anomaly to investors' initial underreactions. More specially, investors fail to include information about a firm's adverse fundamental changes (i.e., a possible value-destroying management team) into stock prices.[2] The literature on the limits to arbitrage initiated by De Long et al. (1990) and Shleifer and Vishny (1997), among others, argues that arbitrage is risky and costly and, therefore, financial markets might not be always informationally efficient as suggested by the no-arbitrage argument in classical finance theories. Since the degree of difficulty to arbitrage varies across stocks, it follows that information should be more quickly included in the prices of stocks that are easier to

[1] In this paper, we use the "capital investment anomaly" and the "asset growth anomaly" interchangeably.
[2] This is an extension of the agency cost argument of Jensen (1986).

arbitrage than in those that are not easy to arbitrage. Our main hypothesis is a direct implication of combining investor underreactions with limits to arbitrage.

We examine three major aspects of limits to arbitrage: arbitrage risk, information costs, and transaction costs. When arbitrage risk, information costs, or transaction costs are high, it is more difficult to arbitrage. In this paper, arbitrage risk is proxied by idiosyncratic stock return volatility. Information costs are inversely proxied by if a firm has a long-term S&P credit rating (a proxy for informed investors), the number of institutional investors holding the firm's shares (a proxy for shareholder sophistication), or the CRSP firm age (a proxy for information quality). Overall transaction costs are inversely proxied by share prices or the market value of equity (a proxy for overall transaction cost). Individual transaction costs are inversely proxied by the percentage of outstanding shares held by institutional investors (a proxy for short-sale constraints), bid-ask spreads, the Amihud's (2002) illiquidity (a proxy for illiquidity), or the dollar trading volume (a proxy for liquidity).

The analysis of our data from 1971 to 2007 consistently shows that subsequent risk-adjusted returns of higher asset growth firms are relatively more negative when there are more severe limits to arbitrage. Most importantly, the underperformance of the stocks of high asset growth firms is not necessary. When stocks have low arbitrage risk or when companies have S&P credit ratings, we find that stocks of these high asset growth firms do not underperform. Our results suggest that limits to arbitrage delay the incorporation of information about negative fundamental changes into stock prices. We also find that the asset growth anomaly is stronger when there are more severe limits to arbitrage. In addition, the return spread between low and high asset growth firms is mostly driven by the underperformance of high asset growth firms. Moreover, the anomaly is insignificant among firms that have low arbitrage risk and it is very weak among firms that have S&P credit ratings. Our results are consistent with the explanation that investors' initial underreactions to overinvestments pursued by managers who are empire building lead to the asset growth anomaly. The relation between limits to arbitrage and the asset growth anomaly remain significant even after controlling for factor risks and firm-characteristics exposures.

Our paper contributes to the literature in several ways. First of all, our study introduces a set of strict empirical tests of the hypothesis that investors' initial underreactions lead to the asset growth anomaly. We provide evidence that supports our hypothesis that the underperformance of stocks of high asset growth firms is more profound when limits to arbitrage are more severe. Our results not only support the investors' underreaction hypothesis but also establish limits to arbitrage as the major reason that the anomaly is not arbitraged away. Secondly, our evidence leads to further understanding of the broader nature of the efficiencies of financial markets. Some investors may be psychologically biased and underreact to adverse changes in firms' fundamentals. Our results suggest that arbitrageurs are willing to eliminate mispricing only when associated arbitrage trades have low risk. However, when limits to arbitrage are not trivial, arbitrageurs are unwilling to eliminate stock price inefficiencies immediately. Our evidence further suggests that the persistence of inefficiency depends on the degree of difficulty to arbitrage.

The remainder of this paper proceeds as follows. The next section describes the relevant literature and develops our hypothesis. Section II describes our sample. Section III investigates the role of limits to arbitrage in the asset growth anomaly based on portfolio analysis. Section IV examines the relationship between limits to arbitrage and the asset growth anomaly using regression analysis to control for exposure to firm characteristics. Section V concludes the paper.

I. Hypothesis Development and Explanatory Variables

A. Literature Review and Hypothesis Development

Companies that substantially increase capital investments or grow their assets subsequently achieve significantly negative risk-adjusted returns subsequently. Fairfield, Whisenant and Yohn (2003) find that future stock returns are negatively related to changes in long-term net operating assets. Hirshleifer et al. (2004) document that stocks of firms with higher levels of net operating assets scaled by lagged total assets earn lower future stock returns. Richardson, Sloan, and Tuna (2006) show that the levels of net operating assets scaled by total assets have predictive power for subsequent stock returns. Titman et al. (2004) find that abnormal levels of capital expenditures are negatively associated with subsequent stock returns. Cooper et al. (2008) use total asset growth to measure a firm's overall capital investment growth and asset expansion. They show that the composite growth measure has a stronger predictive power for future stock returns than do the individual measures studied in the prior literature.

Some studies attribute the above phenomenon to investors' initial underreactions to firms' overinvestments pursued by managers who are empire building. Titman et al. (2004) demonstrate that the anomaly is stronger among firms with higher investment discretion as indicated by their higher free cash flow or their lower leverage. However, the anomaly is insignificant when hostile takeovers are prevalent. In addition, a substantial return spread also clusters around subsequent earnings announcements. Chan et al. (2008) document that the anomaly is driven only by the underperformance of the stocks of high asset growth firms and the anomaly is stronger when past profitability is poorer and corporate governance is weaker.[3]

[3] Others have attempted to explain the asset growth anomaly by the risk channel (for example, Anderson and Garcia-Feijóo (2006)) or the equity mispricing channel (for example, Polk and Sapienza (2008)). Chan et al. (2008)

Investors' mis-reactions mean that some relevant information is not reflected in stock prices, which leads to arbitrage opportunities. The opportunities for profit attract smart rational investors to arbitrage and their arbitrage activities include the information in stock prices. In an ideal setting where these arbitrage opportunities are riskless, obvious, and costless to exploit, prices should reflect all relevant information and the underreaction should not happen in the first place. However, in a realistic market, arbitrage is risky and costly. Implementable arbitrage opportunities are limited. Rational investors might arbitrage the market but the speed at which information is being included in stock prices should be negatively associated with the severity of the limits to arbitrage.

De Long et al. (1990) argue that arbitrage is risky because unpredictable trades of irrational traders might cause prices to diverge. Arbitrageurs, especially capital constrained ones, might have to prematurely liquidate their arbitrage positions upon margin calls and suffer losses (Shleifer and Vishny (1997)). Liu and Longstaff (2004) further argue that, when arbitrage opportunities are risky, even optimized arbitrage trades typically are loss making before prices converge. As a result, when the risk of arbitrage is higher, arbitrage opportunities are less attractive to arbitrageurs.

Information availability and certainty lead investors to find arbitrage opportunities. When information is sparse, imprecise, or even ignored, arbitrage opportunities may become less obvious. For example, Zhang (2006) shows that price continuations, such as momentum and drifts after analyst forecast revisions or earnings announcements, which are often attributed to behavioral biases among investors, are stronger when information is more uncertain. These findings suggest that information with more uncertainty flows into prices more slowly.

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document that when firms grow their assets either by mergers and acquisitions, increases in plant, property, and equipment, increases in other current assets or increases in other long-term assets, future abnormal stock returns are negative. The observations remain the same no matter whether the growth is financed by equity or debt.

Transaction costs hinder arbitrage activities. Trade barriers such as liquidity, short-sale constraints and the risk of short squeezes might render arbitrage positions difficult to implement. [4] Furthermore, trading expenses might reduce the profitability of arbitrage opportunities, decreasing their attractiveness to rational arbitrageurs. For example, Mashruwala et al. (2006) find that transaction costs impose barriers for arbitrageurs to exploit accrual mispricing as documented by Sloan (1996).

We combine limits to arbitrage with investors' initial underreactions and test the role of limits to arbitrage in the asset growth anomaly. Our main hypothesis is that if the underperformance of the stocks of high asset growth firms is due to investors' initial underreactions to information about firms' adverse fundamental changes, the underperformance should be more profound when there are more severe limits to arbitrage. Therefore, we hypothesize that *the negative relationship between asset growth and stock returns should be more pronounced when there are more severe limits to arbitrage*.

There are several studies that link limits to arbitrage to stock price anomalies. For example, Ali et al. (2003) use the argument of limits to arbitrage to show that the book-to-market anomaly is consistent with equity mispricing. They find that the book-to-market effect is stronger for stocks with higher idiosyncratic return volatility, higher transaction costs, and lower investor sophistication.[5] Mashruwala et al. (2006) examine the role of the limits to arbitrage in the accrual

[4] Arbitrage positions almost always involve shorting some assets and longing some other assets.

[5] However, Fama and French (1993, 1997) suggest that the book-to-market anomaly represents compensation for risk related to financial distress. On the other hand, Lakonishok, Shliefer, and Vishny (1994), La Porta, Lakonishok, Shleifer, and Vishny (1997), and Skinner and Sloan (2002) argue that the anomaly is due to mispricing. Specifically, investors make errors in their expectations about future earnings performance as they extrapolate past earnings trends to the future. Ali et al.'s (2003) results complement the mispricing explanation.

anomaly.[6] They document that the accrual anomaly is concentrated in firms with high idiosyncratic stock return volatility and is found in low-price and low-volume stocks.

Our study is distinct from these studies. The anomaly we examine and the anomalies studied in the above papers have diverse natures. The asset growth anomaly is a phenomenon that is largely hypothesized to be caused by investor underreactions to changes in firms' fundamentals. Empirically, this phenomenon is asymmetrically driven by firms with high asset growth but not by firms with low asset growth. Even if prevalent behavioral explanations, such as extrapolation biases, are warranted, the controversial book-to-market anomaly and the accrual anomaly are phenomena largely hypothesized to be caused by mispricing due to errors in expectations about future earnings. Empirically, these anomalies are symmetrically driven by firms with high book-to-market ratios or accruals as well as by firms with low book-to-market ratios or accruals.

Although Polk and Sapienza (2008) show that capital expenditures and discretionary accruals are positively correlated, Wei and Xie (2008) show that the two variables contain non-overlapping information about future stock returns. Furthermore, Titman et al. (2008) show that the asset growth anomaly remains significant even after controlling for discretionary accruals or book-to-market equity. Consequently, the role of limits to arbitrage in the book-to-market anomaly documented by Ali et al. (2003) or in the accrual anomaly documented by Mashruwala et al. (2006) may not necessarily hold in the asset growth anomaly. Therefore, our study is necessary to improve our understanding of whether limits to arbitrage play any role in the asset growth anomaly. We also investigate the roles of credit rating and information quality, which are not studied by Ali et al. (2003) or Mashruwala et al. (2006).

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[6] Sloan (1996) shows that the accrual anomaly is consistent with mispricing. In this case, investors make errors in expectations about future earnings performance as they overweight accruals and underweight cash flows despite data suggesting that cash flows are more persistent than accruals.

B. Measures of Asset Growth and Limits to Arbitrage

Following Cooper et al. (2008), we use total asset growth (*TAG*) as a composite measure of capital investment growth and asset expansion. TAG_t is calculated as the percentage of growth of total assets (COMPUSTAT item 6) from fiscal year $t-1$ to fiscal year t. Following Titman et al. (2008), we also use residual asset growth (*AGR*) and predicted asset growth (*AGP*) as complementary measures to asset growth.[7]

We examine three major aspects of limits to arbitrage: arbitrage risk, information costs, and transaction costs. When arbitrage risk, information costs, or transaction costs are high, limits to arbitrage are severe. Because arbitrageurs are typically poorly diversified, idiosyncratic return volatility adds substantially to the total volatility of their portfolios. In addition, unlike systematic volatility, idiosyncratic return volatility does not compensate arbitrageurs for higher expected returns. Therefore, expected idiosyncratic return volatility would be very important to arbitrageurs, when they consider mispriced stocks to exploit arbitrage. As in Pontiff (1996), Wurgler and Zhuravskaya (2002), and Mashruwala et al. (2006), we use idiosyncratic stock return volatility (*IVOL*) to proxy for arbitrage risk or noise trader risk. We measure *IVOL* as the standard deviation of the residual values from the following time-series market model:

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[7] Following Titman et al. (2008), we measure residual asset growth (AGR_t) as the residual value from the following regression equation:

$$TAG_{k,t} = a_0 + a_1 \frac{CF_{k,t}}{NFA_{k,t-1}} + a_2 Q_{k,t-1} + \varepsilon_{k,t},$$

where CF_t is cash flow between fiscal year $t-1$ and fiscal year t and is calculated as income before extraordinary items (COMPUSTAT item 8) plus depreciation (COMPUSTAT time 14). NFA_{t-1} is net fixed assets (COMPUSTAT item 9) at the end of fiscal year $t-1$ and is used as a control for cash flow variation due to size differences across firms. *CF/NFA* is a proxy for financial constraints. *Q* is the ratio of the market value to the book value of assets at the end of fiscal year $t-1$. The market value of assets is the book value of assets (COMPUSTAT item 6) plus the market value of common equity minus the sum of the book value of common equity (COMPUSTAT item 60) and balance sheet deferred taxes (COMPUSTAT item 74). *Q* is a proxy for investment opportunities. We estimate the equation cross-sectionally every year at the end of June (results using the fixed-effect model are similar). *AGR* measures the amount of asset growth beyond financial constraints and investment opportunities and is a proxy for abnormal asset growth. Predicted asset growth (*AGP*) is the fitted value from the regression and is a proxy for normal growth.

$$R_{k,t} = b_0 + b_1 R_{M,t} + \varepsilon_{p,t}, \qquad (1)$$

where R_t is the monthly return on stock k and R_M is the monthly return on a market index.[8] We estimate equation (1) for every year in the dataset with 36 months of returns prior to the end of June of year t.

We investigate three categories of information costs: credit rating, shareholder sophistication, and information quality. Credit rating agencies monitor listed firms and disseminate their analysis and opinions to the investing public. Ederington and Yawitz (1987) claim that credit analysts have inside information, such as minutes of board meetings, profit breakdowns by products, and new product plans, etc., that is not available to stock analysts. In addition, credit analysts are more unbiased and objective in their firm analyses and information disclosure than are stock analysts because the incentives of stock analysts are linked to the investment banking business. Therefore, whether or not a firm has a long-term S&P credit rating (*RATING*) is a good proxy for if the firm is followed by informed investors. *RATING* is a dummy variable that equals one if a firm is rated, as indicated in COMPUSTAT, and equals zero otherwise.

Following Chen et al. (2002), Ali et al. (2003), Bartov et al. (2000), and Bhusan (1994), we use the number of institutional investors holding a firm's shares at the end of June of year t ($INST_N$) to proxy for shareholder sophistication. Barry and Brown (1985) argue that firms with longer histories have more information available to the market. Following this idea, Zhang (2006) uses firm age (*AGE*), measured as the number of years a stock appeared in CRSP at the end of year t, as an inverse proxy for information uncertainty. In addition, information available on older firms is more verifiable and is hence more accurate than is information available on younger firms.

[8] We use the S&P 500 index to proxy for the market index. Our results are similar when the proxy is the CRSP equally-weighted or value-weighted market portfolio.

Finally, we examine the overall transaction costs and three individual types of transaction costs. Bhardwaj and Brooks (1992) suggest that the bid-ask spread and the brokerage commission are inversely related to the stock price. Ball, Kothari, and Shanken (1995) use stock price as an inverse proxy for the bid-ask spread and illiquidity. Stoll (2000) shows that recent stock prices are inversely related to bid-ask spreads. Following this literature, we use share prices at the end of June of year *t* (*PRICE*) as inverse proxies for the composite transaction cost measure. We use the market value of equity at the end of June of year *t* (*SIZE*), calculated as the closing price (the average of the bid and ask prices if the closing price is not available) multiplied by the number of shares outstanding as a supplementary proxy for the composite transaction cost measure.

The first proxy for individual transaction costs is short-sale constraints. If the underperformance of stocks is due to investors' initial underreactions, stocks that are harder to sell short should exhibit more subsequent underperformance. It is easier for investors to borrow shares of stocks that have higher institutional ownership. For the same reason, these stocks are also less exposed to the risk of short squeezes (Dechow et al. (2001)). Following Nagel (2005), we use the percentage of outstanding shares held by institutional investors ($INST_H$) at the end of June of year *t* to inversely proxy for short-sale constraints. The second proxy for the individual transaction cost measure is the bid-ask spread (*BIDASK*), which is calculated as the time-series average of 2*((Ask − Bid)/(Ask + Bid)) at the end of each month over the 12 months prior to the end of June of year *t*, where Ask (Bid) is the asking (bid) price. It measures the trading cost associated with the compensation for dealers who make markets and provide liquidity.

The third proxy for the individual transaction cost is illiquidity. We use the Amihud's (2002) illiquidity ($ILLIQ_{RET}$) measure to proxy for the impact of order flow on the stock price. We add a complementary measure of illiquidity (*$ILLIQ_{RNG}$*) that replaces absolute daily returns in the numerator in *$ILLIQ_{RET}$* by the daily price range (high minus low) to reduce the overestimation of illiquidity on stocks that have zero daily returns. Finally, we use dollar trading volume (*DVOL*) as our last proxy for the individual transaction cost. *DVOL* is calculated as the time-series average of the monthly share trading volume multiplied by the monthly closing price over the 12 months prior to the end of June of year *t*. *DVOL* is an inverse proxy for price pressure and the time required to fill an order, which measures how quickly an investor can trade a large block of shares (Bhusan (1994)).

II. Sample Selection and Summary Statistics

We start with all domestic firms listed on NYSE, AMEX, and Nasdaq. Financial statement figures are from COMPUSTAT. Stock market data are from CRSP. Institutional holdings records are from CDA/Spectrum Institutional (13f) Holdings. As in Fama and French (1992, 1993), we exclude certificates, ADRs, SBIs, unit trusts, closed-end funds, REITs, and financial firms. We also require that a firm must have appeared in COMPUSTAT for two years in order to mitigate the potential survivorship or selection bias inherent in the way that COMPUSTAT adds firms to its database (Banz and Breen (1986)). Following Titman et al. (2004), we remove firms with less than $10 million in sales to exclude firms at an early stage of development. We delete firms that do not have the data necessary to compute variables of interest.

The sample consists of firm-level data from 1970 to 2007 and monthly stock returns from July of 1971 to December of 2007. The sample consists of 1,123,905 stock-month observations over the whole sample period.[9] Due to limitations in the databases, the sample involving

[9] Our sample is comparable to those in the literature. For example, we observe that only stock prices of firms in the highest total asset growth or abnormal asset growth rank (i.e., Decile 10) subsequently underperform. This is

institutional holdings starts from 1980 and contains 868,200 stock-month observations. Similarly, the sample involving bid-ask spreads starts from 1993 and contains 468,400 stock-month observations.

Panel A of Table I presents the characteristics of portfolios based on total asset growth deciles. High-growth firms (Decile 10) and low-growth firms (Decile 1) have more than 110% difference in total asset growth. High-asset-growth firms have much higher sales growth than low-asset-growth firms. High-asset-growth firms also have less financial constraints and more investment opportunities than do low-asset-growth firms. These observations are consistent with the findings that high-asset-growth firms also have higher predicted (i.e., normal) asset growth than do low-asset-growth firms. Firms in Decile 1 to Decile 8 grow at a rate below their normal levels while firms in Deciles 9 and 10 grow above their normal levels by 4.03% and 54.92%, respectively. Titman et al. (2004) interpret that high abnormal asset growth is an indication of corporate overinvestment and empire building by managers. Given this interpretation, it seems that high-asset-growth firms have probably overinvested. High-asset-growth firms also have lower book-to-market ratios, larger market values of equity, and higher net share issuance.[10]

[Place Table I here]

All firms have positive stock returns over the year prior to portfolio formation. However, low-growth firms have much lower prior year returns than do high-growth firms. It seems that the reduction in sales and unanticipated asset contraction of low-growth firms might have

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consistent with Chan et al. (2008) but is in contrast to Cooper et al. (2008), who find that stock prices of low-growth firms subsequently outperform. The sample in Chan et al. (2008) differs from that in Cooper et al. (2008) since the former exclude the decile of smallest stocks. Our sample also differs from that in Cooper et al. (2008) as we exclude firms at an early stage of development. Moreover, we control portfolio returns for factor risks using four factors while Cooper et al. (2008) use three factors.

[10] Firm-characteristics exposures proxied by lower book-to-market ratios, larger market values of equity, and higher net share issuance might cause lower subsequent returns on high growth firms. See for example, Daniel and Titman (1997), Daniel, Titman, and Wei (2001), and Daniel and Titman (2006). We find that these relationships hold in our sample. However, our conclusions are robust after controlling for these characteristics in our regression analysis.

disappointed investors. The higher prior-year returns might have caused high-growth firms to have lower book-to-market ratios and higher market values of equity. Over the first five years after portfolio formation, buy-and-hold annual returns are almost the same for stocks in Decile 1 to Decile 9, while annual returns on Decile 10 are considerably lower than those on other deciles. Holding a long position on low-growth firms and a short position on high-growth firms produces a significantly positive but declining annual return over the first three years. Annual returns over the fourth and fifth years are positive but no longer significant. These results suggest that subsequent underperformance of the stocks of high-growth firms does not reverse in the long-term, which is consistent with investors' initial underreactions.

Compared to stocks of low-growth firms, stocks of high-growth firms have lower arbitrage risk. A higher percentage of high-growth firms have S&P long-term credit ratings. High-growth firms also have more institutional shareholders. Although high-growth firms are on average three years younger than low-growth firms, the difference may not be economically significant in distinguishing their information quality. Finally, stocks of high-growth firms are less costly to trade than are stocks of low-growth firms.

The characteristics of total asset growth portfolios are different from those of book-to-market portfolios. For example, Ali et al. (2003) find that both high and low book-to-market firms contribute to the return spread in the book-to-market anomaly. Holding a long position on high book-to-market firms and a short position on low book-to-market firms produces a positive and increasing annual buy-and-hold return over the first three years. The characteristics of total asset growth portfolios are also quite different from those of accrual portfolios. For example, Mashruwala et al. (2006) show that both high- and low-accrual firms contribute to the return spread in the accrual anomaly. High- and low-accrual firms have similar arbitrage risk and book-to-market equity. Although high-accrual firms have higher stock prices, they have lower liquidity and market value of equity. It is not conclusive whether stocks of high-accrual firms are less or more costly to trade.

These results suggest that information revealed from sorting by total asset growth is not the same as information revealed by sorting by book-to-market ratios or accruals. Therefore, our results cannot be directly inferred ex-ante from the findings documented by Ali et al. (2003) or by Mashruwala et al. (2006). Our study allows us to understand the role of limits to arbitrage in the asset growth anomaly. Hence, our test results and conclusions should contribute significantly to the literature.

Panel B of Table I presents the sample correlation matrix among asset growth measures and limits to arbitrage proxies. Total asset growth is highly correlated with abnormal asset growth (87%) but it is only moderately correlated with normal asset growth (28%).[11] Total asset growth is not significantly correlated with the limits to arbitrage proxies except for the bid-ask spread, but its correlation with the bid-ask spread is low. The information cost proxies (*RATING*, $INST_N$, and *AGE*) are positively correlated with each other. However, the correlations are not extremely high, suggesting that these proxies might capture different aspects of information costs. Similarly, most of the positive correlations between transaction cost proxies are not extremely high, suggesting that these proxies capture different aspects of transaction costs.[12]

III. Limits to Arbitrage and the Asset Growth Anomaly: Portfolio Analysis

[11] Indeed, the results of all our empirical tests hold when total asset growth is replaced by residual asset growth but not by predicted asset growth.

[12] As our two measures of the Amihud (2002) illiquidity are highly correlated, we only report results based on Amihud's original measure. The results based on the modified measure are similar.

We group firms by total asset growth and the severity of limits to arbitrage. To test our hypothesis, we examine the subsequent stock returns on high-asset-growth firms as we vary the severity of the limits to arbitrage. We also examine the returns on low-growth firms. This serves two purposes. Firstly, stock returns, in general, might be related to our limits to arbitrage proxies.[13] We use returns on low-growth firms as a quasi control for these existing asset-pricing relationships. Secondly, we are also interested in understanding how the return spreads between high- and low-growth firms (Decile 1 – Decile 10) vary with the severity of limits to arbitrage. Examining the returns on both high- and low-growth firms also allows us to understand if high- or low-growth firms drive these co-variations.

Every year we form equally weighted portfolios at the end of June to ensure that investors have access to necessary accounting information. All stocks with available data are included regardless of when their fiscal year ends. In other words, we match monthly stock returns between July of year t and June of year t+1 with financial statement figures of the fiscal year that ends in calendar year t−1. Delisting returns are used to mitigate the survivorship bias.

We use two approaches to compute the risk-adjusted returns. Firstly, to control for firm characteristics (called the characteristics-adjusted return), we subtract the returns on the 25 matching Fama and French (1992) size-and-book-to-market benchmark portfolios from the raw stock returns. Secondly, to control for factor risks, we estimate the intercept (called the risk-adjusted return) from the following the Fama and French (1993) three-factor plus the Carhart (1997) momentum-factor regression:

$$R_{p,t} - R_{f,t} = \alpha_p + b_{p,Mkt} R_{Mkt,t} + s_{p,SMB} R_{SMB,t} + h_{p,HML} R_{HML,t} + m_{p,MOM} R_{MOM,t} + \varepsilon_{p,t}, \qquad (2)$$

[13] For example, Banz (1981) documents that, on average, stock returns on small firms are higher than returns on large firms. Amihud and Mendelson (1986) and Eleswarapu (1997) document that future stock returns increase as bid-ask spreads increase.

where R_p is the raw return on portfolio p and R_f is the risk-free rate. R_{Mkt}, R_{SMB}, and R_{HML} are returns on the market, size, and book-to-market factors, respectively, as constructed by Fama and French (1993). R_{MOM} is the return on the momentum factor in Carhart (1997). Factor returns and the risk-free rates are from Professor Kenneth French's website.

A. Portfolio Returns Sorted by Total Asset Growth and the Arbitrage Risk Proxy

To test the relationship between arbitrage risk and the asset growth anomaly, we sort stocks independently into total asset growth deciles and idiosyncratic stock return volatility terciles. A stock is included in a portfolio only if it has a complete 36-month return history prior to the portfolio formation so that the market model can be applied. The high- and low-growth groups contain 197,479 stock-month observations. Table II reports the results. The results support our hypothesis.

[Place Table II here]

More specifically, we find that the stocks of high-growth firms with low arbitrage risk (*IVOL*) do not underperform. The stocks of the remaining high-growth firms underperform and the underperformance is monotonically more pronounced when the arbitrage risk is higher. For example, the time-series averages of characteristics-adjusted returns on high-growth portfolios decline from -0.597% per month in Tercile 2 to -0.952% in Tercile 3. The result from high-growth firms is inconsistent with the prediction of the incomplete-information CAPM suggested by Merton (1987) but it is consistent with the empirical findings of Ang et al. (2006). In contrast, we observe that characteristics-adjusted returns on low-growth firms are higher when the arbitrage risk is higher. It seems that arbitrage risk might be priced for low-growth firms, which is consistent with Merton's (1987) incomplete-information CAPM but it is inconsistent with the finding of Ang et al. (2006) who find that stock returns are lower when idiosyncratic risk is higher. The results from other measures of returns are similar.

More importantly, we do not find the asset growth anomaly among stocks in the low-arbitrage-risk group. In addition, we observe that the anomaly is more profound as arbitrage risk increases. For example, the risk-adjusted return spread between high- and low-growth portfolios increases from 0.102% per month in Tercile 1 to 1.187% in Tercile 3, which is a difference of 1.085%. Further, the underperformance of high-growth firms makes up about 64% (=0.690/1.085) of this difference. The above results from other measures of returns are similar.

B. Portfolio Returns Sorted by Total Asset Growth and Information Cost Proxies

The second set of empirical tests investigates the relationship between the information cost and the asset growth anomaly. We sort stocks independently into total asset growth deciles and information cost terciles. The high- and low-growth groups contain 222,747 stock-month observations.[14] Panel A of Table III shows that the information cost plays a significant role in the anomaly. Firstly, having an S&P credit rating (*RATING*) significantly eliminates the negative effect of high asset growth on subsequent stock returns. We find that stocks of high-growth firms that are rated do not underperform, while stocks of high-growth firms that are not rated substantially underperform.[15] For example, the time-series average of characteristics-adjusted

[14] For the sample involving institutional holdings, the high- and low-growth groups contain 173,640 stock-month observations.

[15] On average, there are 609 rated firms and 2,038 unrated firms at portfolio formation. The rated firms are about 25 years old and the unrated firms are around 13 years old. Hence an unrated firm is not likely to be an IPO. A typical rated firm has book assets of $4,463 million and market capitalization of $4,099 million. A typical unrated firm has book assets of $459 million and market capitalization of $397 million. Although individual unrated firms are smaller than individual rated firms, the total market capitalization of unrated firms makes up about 34% of the market capitalization of all firms in our sample. The average book-to-market ratio of rated firms is around 0.95 and that of nonrated firms is about 1.11. Although the difference in the book-to-market ratio is significant, the difference does not seem to be economically meaningful. There is no evidence that, relative to rated firms, unrated firms are in particular distress or lack growth opportunities.

returns on the unrated high-growth portfolio is -0.989% per month. If the credit rating is a proxy for risk, our results from high-growth firms appear to be inconsistent with the risk argument. In contrast, we do not find any significant relationship between stock returns of low-growth firms and whether or not the firms are rated.

[Place Table III here]

We observe that the asset growth anomaly is only marginally significant among firms that are rated. On the other hand, we find that the anomaly is strong among firms that are unrated. For example, the risk-adjusted return spread between high- and low-growth portfolios increases from 0.397% per month in the rated group to 1.220% in the unrated group with a difference of 0.823%. The underperformance of high-growth firms contributes a dominant portion of this difference.

Secondly, Panel B of Table III indicates that higher shareholder sophistication ($INST_N$) weakens the negative effect of high asset growth on subsequent stock returns. Stocks of high-growth firms underperform but the underperformance is monotonically less severe when the number of institutional shareholders ($INST_N$) increases. For example, the time-series average of characteristics-adjusted returns of high-growth portfolios increases from -1.216% per month in Tercile 3 to -0.549% in Tercile 1. If shareholder sophistication is a proxy for information risk, stock returns are expected to be higher when the number of institutional shareholders is fewer. Our result from high growth firms appears to be inconsistent with the risk argument. In contrast, the stock returns of low growth firms are higher when the number of institutional shareholders is fewer but the relationship is not significant. For this group of firms, the result seems to be consistent with the risk argument.

Some institutional investors, such as mutual funds and pension funds, are mandated to hold long-only positions. These investors might be more capable of observing corporate overinvestment and understanding its implications. However, due to institutional restrictions, they are constrained from substantially unloading high-growth firms from their portfolios or shorting stocks of high-growth firms. On the one hand, the existence of institutional shareholders reduces the information cost. On the other hand, their existence suppresses the corrective reaction to firms' overinvestment. All these outcomes may explain the underperformance of high-growth firms even when shareholder sophistication is high.

Panel B of Table III also documents that the asset growth anomaly is weaker as shareholder sophistication increases. For example, the average spread in characteristics-adjusted returns between high- and low-growth portfolios decreases from 1.507% per month in Tercile 3 to 0.824% in Tercile 1 with a difference of 0.683%. The underperformance of high-growth firms makes up about 98% (=0.666/0.683) of this difference in the asset growth anomaly.

Thirdly, better information quality also weakens the negative effect of high growth on subsequent stock returns. Panel C of Table III shows that the underperformance of the stocks of high-growth firms is less severe when the age of the firms increases. For example, the time-series average of characteristics-adjusted returns of high-growth portfolios increases from -0.859% per month in Tercile 3 to -0.422% in Tercile 1. If firm age is a proxy for information quality or information risk, stock returns are expected to be higher when firms are younger. We do observe that stock returns of low-growth firms are marginally higher for young firms than for old firms but only for risk-adjusted returns.[16] In contrast, for high-growth firms, stock returns are substantially higher for old firms than for young firms, which is inconsistent with the risk argument.

[16] In contrast, Zhang (2006) finds that stocks of young firms earn lower raw returns than do stocks of old firms. However, the difference is not significant.

More importantly, we find that the asset growth anomaly is weaker as information quality improves. For example, the average spread in characteristics-adjusted returns between high- and low-growth portfolios decreases from 1.103% per month in Tercile 3 to 0.458% in Tercile 1 with a difference of 0.645%. The underperformance of high-growth firms contributes about 68% (=0.436/0.645) of this difference in the asset growth anomaly.

The above results are robust to other measures of returns. In summary, the information-risk component of limits to arbitrage plays an important role in the negative relationship between asset growth and subsequent stock returns. In general, the greater the information risk, the more pronounced the asset growth anomaly.

C. Portfolio Returns Sorted by Total Asset Growth and Transaction Cost Proxies

To test the relationship between transaction costs and the asset growth anomaly, we sort all stocks independently into total asset growth deciles and transaction cost terciles. The high- and low-growth groups contain 222,747 stock-month observations.[17] Table IV, in general, confirms our hypothesis. More specifically, higher transaction costs strengthen the negative effect of high asset growth on subsequent stock returns. Panels A and B of Table IV show that stock returns of high-growth firms underperform and the underperformance is monotonically more severe as stock prices or market values of equity decrease. For example, the time-series average of characteristics-adjusted returns on the high-growth portfolio decreases from -0.338% per month in stock price (*PRICE*) Tercile 1 to -1.295% in stock price Tercile 3.

[Place Table IV here]

[17] For the sample involving institutional holdings, the high- and low-growth groups contain 173,640 stock-month observations. For the sample involving bid-ask spreads, the high- and low-growth groups contain 93,680 stock-month observations.

Cooper et al. (2008) find that, over the period from 1968 to 2002, total asset growth is negatively related to future stock returns for small (30^{th} NYSE market equity percentile), medium (70^{th} NYSE market equity percentile) and large firms. They also show that the asset growth effect is stronger among small firms. Fama and French (2008) also find that, over the period from 1963 to 2005, asset growth is negatively related to future stock returns for microcap (20^{th} NYSE market cap percentile) and small firms (50^{th} NYSE market cap percentile) and the effect is stronger among microcap firms. However, Fama and French (2008) find that asset growth is negatively but not statistically significantly related to future stock returns for big firms. While both findings are consistent with our limits-to-arbitrage hypothesis, our results appear to be a bit more consistent with those of Cooper et al. (2008).

Prior studies (for example, Banz (1981)) document that stocks of small firms earn higher returns than stocks of large firms. We do observe that small low-growth firms earn higher returns than larger low-growth firms, but the difference is insignificant. The results for low-growth firms with different stock prices are similar. However, among high-growth firms, stock returns are relatively higher for large or high-price firms than for small or low-price firms. The result seems to be inconsistent with the argument that small or low-price firms are riskier than large or high-price firms.

We observe that the asset growth anomaly is stronger as transaction costs increase. For example, the spread in characteristics-adjusted returns between high- and low-growth portfolios increases from 0.320% per month in stock price Tercile 1 to 1.544% in stock price Tercile 3, resulting in a difference of 1.224%. The underperformance of high-growth firms makes up about 71% (=0.873/1.224) of this difference in the asset growth anomaly.

Panel C to Panel F of Table IV show similar results for individual transaction cost proxies. Asset-pricing theory suggests that stock returns are expected to be higher to compensate for the risk proxied by transaction costs. We indeed observe that stock returns of low-growth firms are higher when the short-sale constraint ($INST_H$), the bid-ask spread (*BIDASK*), or the illiquidity ($ILLIQ_{RET}$ or *DVOL*) is higher. [18] However, these relationships are not significant.[19] In contrast, we find that the underperformance of the stocks of high-growth firms are monotonically more severe when the short-sale constraint ($INST_H$), the bid-ask spread (*BIDASK*), or the illiquidity ($ILLIQ_{RET}$ or *DVOL*) is higher.

More importantly, we find that the asset growth anomaly is stronger as the individual transaction cost rises. Among the individual transaction cost proxies, the bid-ask spread provides the strongest conditional information: the risk-adjusted return spread between high- and low-growth firms is 2.426% per month in the high bid-ask spread group and it is only 1.118% in the low bid-ask spread group. The short-sale constraint provides the next strongest conditional information, followed by the two liquidity measures.

The above results are robust to other measures of returns. In summary, our results from Tables II-IV are consistent with the combination of investors' underreactions to overinvestments and limits to arbitrage. The underreaction-to-overinvestment argument predicts that overinvestment firms should earn negative subsequent risk-adjusted returns. The limits-to-

[18] Unreported results based on $ILLIQ_{RNG}$ are similar to those based on $ILLIQ_{RET}$. An alternative measure to dollar trading volume is share turnover. Recent studies (for example, Hong and Stein (2003)) interpret share turnover as a proxy for differences in opinion among investors. Suppose that there is a certainty level of short-sale constraints to any stock. According to Miller (1977), higher differences in opinion about a firm lead to more overvaluation of its stock. Stocks with higher share turnover earn lower future returns, which are driven by corrections to equity overvaluations. Unreported results confirm that stock returns of both high- and low-growth firms decrease in share turnover. Therefore, we are not confident in drawing conclusions on our limits-to-arbitrage hypothesis using test results based on grouping by share turnover.

[19] For example, Amihud and Mendelson (1986) and Eleswarapu (1997) document that stock returns increase in bid-ask spreads. Brennan, Chordia and Subrahmanyam (1998) and Datar, Naik and Radcliffe (1998) document a liquidity premium. On the other hand, Amihud (2002) documents an illiquidity premium.

arbitrage argument predicts that the underperformance of overinvestment firms and the outperformance of underinvestment firms should be stronger when limits to arbitrage are more severe. The results from Tables II-IV for both overinvestment and underinvestment firms are, in general, consistent with the predictions of both arguments. In addition, the combination of investors' underreactions to overinvestments and limits to arbitrage implies that the asset growth anomaly is more profound when limits of arbitrage are more severe. Our results from Tables II-IV also strongly support this hypothesis.

IV. Fama-MacBeth Regression Tests

Table I shows that high-growth firms have lower book-to-market ratios, larger market values of equity, and higher net share issuance. Prior studies (i.e., Fama and French (1992) and Daniel and Titman (2006)) show that firms that are exposed to these characteristics might cause lower subsequent stock returns. In this section, we test our hypothesis while simultaneously controlling for all these firm characteristic exposures. Our multivariate regression tests are based on the following Fama-Macbeth (1973) type regressions:

$$R_{k,t} = c_0 + c_1 TAG_{k,t-1} + c_2 TAG_{k,t-1} \times X_{k,t} + Controls + \varepsilon_{k,t}\,, \qquad (3)$$

where $R_{k,t}$ is the monthly raw return on stock k between July of year t and June of year t+1 (or between July and December for year 2007). X is one of our measures for the severity of limits to arbitrage. To maximize our sample period, X is taken to be *IVOL*, *RATING*, *AGE*, *lnPRICE*, or *lnSIZE*.[20] *Controls* are *lnSIZE*, *lnBM*, and *NS*. *SIZE* is the market value of equity at the end of

[20] Results are similar when we include the interaction term $TAG \times NS$. Coefficient estimates on the interaction terms with the other limits to arbitrage proxies have the correct signs but are rather noisy. This may due to shorter sample periods or the linearity assumption being too restrictive. Since most proxies for limits to arbitrage are correlated with each other (see Table I), when we include all the interaction terms in an equation, the coefficient estimates on all interaction terms have the expected signs but are insignificant due to multicollinearity problems. Therefore, we only include the interaction terms one at a time.

June of year t. Book-to-market equity (*BM*) is the book value of equity according to Fama and French (1993) at the end of fiscal year $t-1$ divided by the market value of equity at the end of December of year $t-1$. Net share issuance (*NS*) is the natural logarithm of the ratio of the split-adjusted shares outstanding at the end of fiscal year $t-1$ to those at $t-2$. *lnPRICE*, *lnSIZE*, and *lnBM* are the natural logarithm of *PRICE*, *SIZE*, and *BM*, respectively. We adjust the standard deviations of the coefficient estimates for autocorrelations in the times-series averages of the monthly estimates according to Newey and West (1984).

Results in Panel A of Table V show that our previous conclusions are robust. We find that the characteristic exposure to higher market value of equity does not significantly predict lower future stock returns.[21] On the other hand, the characteristic exposure to lower book-to-market ratios or higher net share issuance predicts lower future stock returns. Moreover, after controlling for exposure to firm characteristics, we still find that stock returns are negatively related to total asset growth. Most importantly, the negative effect of total asset growth on future stock returns is significantly stronger when arbitrage risk, information costs, or transaction costs are higher as indicated by the significant coefficients on the interaction terms with expected signs.

[Place Table V here]

The equity financing channel as the explanation for the asset growth anomaly argues that the observed asset growth effect is driven by the correction of previous equity underpricing and overpricing.[22] Equity issuance has been documented as a good proxy for overvaluation of equity

[21] In a sample without excluding stocks that do not have a full 36-month history of past returns and without using subsequent delisted returns, we find that the characteristic exposure to higher market value of equity significantly predicts lower future stock returns. Our results hold in an alternative specification where monthly raw stock returns are replaced by monthly stock returns in excess of the returns on the 25 matching Fama and French (1992) size-and-book-to-market benchmark portfolios and where *NS* is the only control variable.

[22] Stein (1996), Baker, Stein, and Wurgler (2003), and Chirinko and Schaller (2004), among others, have argued that corporate investment decisions are linked to equity mispricing. For instance, an equity-dependent firm is likely to increase capital investment when its stocks are overpriced. Daniel and Titman (2006) document a negative relationship between equity issuance and stock returns. Furthermore, Baker and Wurgler (2002) document that

(Daniel and Titman (2006)) and stock repurchases as a good proxy for undervaluation (Ikenberry, Lakonishok, and Vermaelen (1995)). However, we still find that stock returns are inversely related to total asset growth even after controlling for net share issuance in our multivariate tests. The result suggests that the equity financing channel may not be a sole contributor to the asset growth anomaly. Moreover, we do not find convincing evidence (unreported) that the risk-return argument helps us better understand the asset growth anomaly.[23]

The rest of Table V reports results for two subsample periods from 1971 to 1989 and from 1990 to 2007 in Panel B and Panel C, respectively. While the effect of arbitrage risk (*IVOL*) is strong in the earlier subsample period, it becomes much weaker in the later subsample period. The effects of credit rating (*RATING*) and information quality (*AGE*) are rather stable across the two subsample periods. Furthermore, the effect of transaction costs (*PRICE* or *SIZE*) seems to be weak in the earlier subsample period but it becomes much stronger in the later subsample period. While some of the coefficient estimates are noisier in the subsample periods than are those in the full sample period, all have the expected signs. Overall, the subsample results are consistent with our previous conclusions from the whole sample results.

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managers do have the ability to time secondary equity offerings to take advantage of overpricing in their firm's equity. Polk and Sapienza (2008) provide evidence that capital expenditures and equity mispricing are positively correlated. This line of research suggests that the observed asset growth effect is driven by corrections of previous equity underpricing and overpricing.

[23] For example, Berk, Green, and Naik (1999) suggest that firms that invest more are essentially exercising growth options. These firms become fundamentally less risky as there are more assets-in-place and less intangibles. Li, Livdan, and Zhang (2007) argue that firms increase capital investment when future business prospects are less risky. Anderson and Garcia-Feijóo (2006) document that firms with lower book-to-market ratios or larger market values of equity invest more and vice versa. Furthermore, firms that invest more are likely to experience decreases in book-to-market ratios and increases in market values of equity. These authors interpret these characteristics shifts as proxies for reductions in risk exposures. Xing (2008) shows that the loadings of the 25 Fama-French (1992) size-and-book-to-market portfolios on the investment factor, which is the return spread between high- and low-growth firms, are similar to the loadings on the value risk factor. However, we find that book-to-market equity is negatively associated with total asset growth (*TAG*) and normal asset growth (*AGP*), but not with abnormal asset growth (*AGR*). Market values of equity increase with *TAG* and *AGP*, but only marginally with *AGR*. It seems that the asset growth component that drives future stock returns (i.e., *AGR*) is not related to the reduction in fundamental risk. Instead, it is the component that does not drive future stock returns (i.e., *AGP*) that is related to the reduction in fundamental risk. Moreover, future stock return volatility does not decrease in *TAG*, *AGP*, or *AGR*.

V. Conclusion

Recent literature finds that there is a negative effect of corporate investment growth or asset expansion on future abnormal stock returns, which is often referred to as the "asset growth anomaly." In this paper, we investigate the role of limits to arbitrage in this asset growth anomaly. We consider three aspects of limits to arbitrage, namely arbitrage risk, information costs, and transaction costs.

We find evidence that each of the measures for limits to arbitrage plays a significant role in the underperformance of the stocks of high asset-growth firms. Our results consistently show that firms that grow their assets substantially underperform more significantly when limits to arbitrage are more severe. Most importantly, underperformance is not necessary. When stocks have low arbitrage risk or when firms have an S&P credit rating, we observe that stocks of high-asset-growth firms do not underperform the market. These findings suggest that limits to arbitrage delay the flow of information about fundamental changes into stock prices. We also find that the asset growth anomaly is stronger when limits to arbitrage are more severe. The profitability of a strategy that utilizes the asset growth anomaly is mostly driven by the underperformance of the stocks of high-growth firms. Moreover, the anomaly is insignificant among firms that have low arbitrage risk and is very weak among firms that have S&P credit ratings. Our results are consistent with investors' initial underreactions to overinvestments pursued by managers who have the tendency to build empires and with limits to arbitrage.

Empirical findings on the relationship between the asset growth anomaly and firm size in the recent literature are mixed. Cooper et al. (2008) find that the anomaly exists among all size firms, but the anomaly is weaker among large firms. In contrast, Fama and French (2008) document that asset growth is negatively but not statistically significantly related to future stock returns for big firms. While both results are consistent with our limits-to-arbitrage hypothesis, our results appear to be a bit more consistent with the findings by Cooper et al. (2008). We also find that firm size is negatively correlated with several aspects of the degree of difficulty to arbitrage. Therefore, it is not unreasonable to interpret firm size as a proxy for limits to arbitrage, albeit the signal might be noisy. If the big firms in Fama and French (2008) are sufficiently easy to arbitrage (for example, this group of companies has low arbitrage risk or has an S&P credit rating), it is not surprising to find that the anomaly is not observed among this class of firms.

It is always interesting to examine what causes a price anomaly and why the anomaly is not arbitraged away. Although we do not explain what causes the asset growth anomaly in the first place, we do document the reason for why the asset growth anomaly is not arbitraged away. It is the limits to arbitrage. The results are consistent with the argument by Shleifer and Vishny (1997) that when arbitrage is risky and costly, arbitrageurs stay away from engaging in arbitrage activities that take advantage of mispriced securities. Future research will focus on what causes the asset anomaly in the first place.

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Table I
Descriptive Statistics

At the end of June of each year, stocks are sorted into deciles based on total asset growth (*TAG*), which is the percentage change in total assets from fiscal year $t-2$ to fiscal year $t-1$. *TAG* is a proxy for overall corporate investment growth. Panel A reports the time-series averages of various attributes of equally-weighted portfolios based on the *TAG* ranking, the difference in each attribute between the bottom-growth portfolio and top-growth portfolio, and the *t* statistics of the differences. *CF/NFA* is the cash flow from fiscal year *t* divided by net fixed assets at the end of fiscal year $t-1$ and is a proxy for financial constraints. *Q* is the ratio of the market value to the book value of assets at the end of fiscal year $t-1$ and is a proxy for investment opportunities. Predicted asset growth (*AGP*) is the fitted value from the following cross-sectional regression:

$$TAG_{k,t} = a_0 + a_1 \frac{CF_{k,t}}{NFA_{k,t-1}} + a_2 Q_{k,t-1} + \varepsilon_{k,t},$$

where *AGP* is a proxy for normal corporate investment growth. Residual asset growth (*AGR*) is the residual value from the above regression and is a proxy for abnormal corporate investment growth. Sales growth (*SG*) is the percentage change in total revenue from fiscal year $t-2$ to fiscal year in $t-1$. The book-to-market ratio (*BM*) is the book value of equity at the end of fiscal year $t-1$ divided by the market value of equity at the end of December of year $t-1$. Net share issuance (*NS*) is the natural logarithm of the ratio of the split-adjusted shares outstanding at fiscal year end in $t-1$ to those in $t-2$. *PR* is the pre-formation annual stock return. *BHR1*, *BHR2*, *BHR3*, *BHR4*, and *BHR5* are the buy-and-hold annual return for the 1st, 2nd, 3rd, 4th, and 5th year post-formation, respectively. Idiosyncratic stock return volatility (*IVOL*) is the standard deviation of the return residuals from a 36-month market model estimated at the end of June of year *t* and it is a proxy for arbitrage risk. *RATED* is the percentage of firms that have S&P long-term credit ratings at the end of fiscal year $t-1$. The credit rating dummy (*RATING*) is a variable that equals 1 if the firm has the credit rating and 0 otherwise and it is proxy for coverage by informed investors. The number of institutional shareholders ($INST_N$) is the number of institutional investors holding the shares of the firm at the end of June of year *t* and it is a proxy for shareholder sophistication. Firm age (*AGE*) is the number of years a stock appeared in CRSP at the end of June of year *t* and it is a proxy for information quality. *PRICE* and *SIZE* are the dollar share price and the market value of equity, respectively, at the end of June of year *t* and are inverse proxies for overall transaction costs. Institutional shareholding ($INST_H$) is the percentage of outstanding shares held by institutional investors at the end of June of year *t* and is an inverse proxy for short-sale constraints. The bid-ask spread (*BIDASK*) is the past 12 months time-series average of 2((Ask−Bid)/(Ask+Bid)) at the end of June of year *t*. $ILLIQ_{RET}$ is Amihud's (2002) illiquidity measure and $ILLIQ_{RNG}$ is a modification of the measure based on the daily price range. Dollar trading volume (*DVOL*) is the past 12-month time-series average of monthly share trading volume multiplied by monthly closing prices at the end of June of year *t* and is a proxy for liquidity. Panel B reports the time-series averages of annual firm-level cross-sectional correlations among corporate investment growths, arbitrage risk, information costs, and transactions costs. Correlations significant at the 5% level are in bold. Firms with sales less than $10 million in fiscal year $t-1$ are excluded from the sample. The sample period is from 1971 to 2007, except that the sample period for $INST_N$ and $INST_H$ is from 1980 to 2007 and is from 1993 to 2007 for *BIDASK*. Buy-and-hold annual returns are calculated with the longest possible time period from 1971.

Table I Continued

Panel A: Portfolios characteristics

	TAG portfolio											
	1 (low)	2	3	4	5	6	7	8	9	10 (high)	1-10	*t*(1-10)
						Firm attributes						
TAG	-19.79%	-5.20%	-0.30%	3.02%	5.99%	9.11%	12.86%	18.26%	28.58%	92.11%	-111.90%	[-17.35]
CF/NFA	-20.49	-0.42	2.16	3.88	4.37	7.72	9.47	22.99	22.36	23.58	-44.07	[-3.82]
Q	1.18	1.15	1.19	1.21	1.29	1.37	1.46	1.61	1.81	2.20	-1.02	[-12.90]
AGP	4.56%	4.51%	5.48%	7.34%	10.47%	13.90%	16.26%	19.24%	24.55%	37.19%	-32.63%	[-2.60]
AGR	-24.36%	-9.72%	-5.78%	-4.31%	-4.48%	-4.79%	-3.41%	-0.99%	4.03%	54.92%	-79.27%	[-5.66]
SG	-5.82%	4.79%	8.01%	8.45%	9.59%	13.86%	63.52%	115.71%	27.48%	223.64%	-229.46%	[-3.03]
BM	1.41	1.44	1.35	1.24	1.12	1.03	0.95	0.85	0.78	0.71	0.70	[9.71]
NS	0.02	0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.05	0.15	-0.13	[-12.83]
						Stock returns (%)						
PR	10.89	14.53	17.21	16.79	18.08	17.75	18.52	20.91	21.41	22.80	-12.46	[-5.84]
BHR1	16.82	17.77	18.30	18.07	17.19	15.82	15.03	14.95	13.32	5.63	11.19	[4.49]
BHR2	16.17	16.44	18.99	16.51	16.76	16.40	15.34	15.09	13.08	9.52	6.65	[3.23]
BHR3	18.07	18.75	16.89	16.96	16.18	17.17	17.61	16.46	15.49	14.13	3.93	[2.16]
BHR4	16.99	18.33	17.84	17.00	15.82	16.20	15.87	15.96	16.18	14.39	2.61	[1.33]
BHR5	21.77	21.15	20.40	19.94	18.45	19.30	20.05	19.62	21.42	18.01	3.76	[1.59]
						Arbitrage risk						
IVOL	15.92%	12.75%	11.13%	10.24%	9.89%	9.89%	10.21%	10.97%	11.95%	13.87%	2.04%	[6.19]
						Information cost						
RATED	11.27%	18.08%	25.76%	29.71%	31.26%	31.47%	31.59%	28.73%	26.22%	22.05%	-10.77%	[-10.77]

Table I - Continued

$INST_N$	31	49	64	70	78	83	85	79	73	61	-31	[-6.88]
AGE	15	19	21	22	22	21	20	17	15	12	3	[6.49]
						Transaction cost						
PRICE	9.44	14.59	18.92	22.04	23.61	25.41	24.78	24.65	23.86	21.18	-11.74	[-16.48]
SIZE (\$$10^8$)	4.66	9.27	14.13	16.80	20.28	21.80	22.19	18.37	16.24	13.92	-9.26	[-4.40]
$INST_H$	20.80%	27.71%	30.69%	31.91%	33.03%	34.26%	35.40%	35.09%	34.89%	31.99%	-11.19%	[-10.12]
BIDASK	5.16%	4.06%	3.05%	2.84%	2.51%	2.39%	2.48%	2.36%	2.20%	2.14%	3.03%	[6.76]
$ILLIQ_{RET}$ (10^{-6})	1.60	0.84	0.53	0.32	0.23	0.23	0.24	0.23	0.21	0.19	1.40	[3.96]
$ILLIQ_{RNG}$ (10^{-6})	4.77	3.81	2.96	2.64	2.19	2.02	2.08	1.87	1.81	1.73	3.04	[7.57]
DVOL (10^7)	5.77	9.47	12.77	13.49	14.96	17.84	16.74	18.83	19.60	22.16	-16.39	[-3.60]

Panel B: Correlation matrix

	TAG	*AGP*	*AGR*	*IVOL*	*RATING*	*$INST_N$*	*AGE*	*PRICE*	*SIZE*	*$INST_H$*	*BIDASK*	*$ILLIQ_{RET}$*	*$ILLIQ_{RNG}$*
AGP	**0.28**												
AGR	**0.87**	-0.12											
IVOL	0.04	0.04	0.03										
RATING	0.02	0.03	0.00	**-0.33**									
$INST_N$	0.02	**0.16**	-0.05	**-0.32**	**0.40**								
AGE	-0.08	-0.10	-0.04	**-0.38**	**0.31**	**0.41**							
PRICE	0.06	0.18	-0.01	**-0.39**	**0.33**	**0.45**	**0.33**						
SIZE	0.02	0.14	-0.04	**-0.20**	**0.26**	**0.62**	**0.31**	**0.37**					
$INST_H$	0.03	0.09	-0.02	**-0.31**	**0.22**	**0.55**	**0.16**	**0.36**	0.11				
BIDASK	**-0.10**	**-0.16**	-0.05	**0.34**	**-0.30**	**-0.33**	**-0.17**	**-0.33**	**-0.14**	**-0.45**			
$ILLIQ_{RET}$	-0.06	-0.09	-0.03	0.21	-0.11	-0.09	-0.09	-0.15	-0.05	-0.15	**0.52**		
$ILLIQ_{RNG}$	-0.06	**-0.12**	-0.01	**0.14**	**-0.16**	**-0.14**	-0.11	-0.15	-0.08	**-0.19**	**0.43**	**0.63**	
DVOL	0.06	**0.21**	-0.02	**-0.18**	**0.28**	**0.63**	**0.30**	**0.41**	**0.81**	**0.17**	**-0.17**	-0.07	-0.11

Table II
Portfolio Returns by Total Assets Growth and the Arbitrage Risk Proxy

This table reports monthly portfolio returns sorted by the overall investment growth proxy and the arbitrage risk proxy. At the end of June of each year, stocks are sorted into deciles based on total assets growth and independently into terciles by the idiosyncratic stock return volatility. Total asset growth (*TAG*) is the percentage change in total assets from fiscal year $t-2$ to fiscal year $t-1$ and it proxies for overall corporate investment growth. Idiosyncratic stock return volatility (*IVOL*) is the standard deviation of the return residuals from a 36-month market model estimated at the end of June of year t and it proxies for arbitrage risk. Firms with sales less than $10 million in fiscal year $t-1$ are excluded from the sample. A stock is included in portfolio formation only if it has a complete 36-month return history in order to apply the market model. Stocks are held for one year. The raw portfolio return (*Raw*) is the time-series average of equally-weighted stock returns. The characteristics-adjusted portfolio return (*Adj*) is the time-series average of equally weighted stock returns in excess of the returns on 25 matching Fama and French (1992) size-and-book-to-market benchmark portfolios. The risk-adjusted portfolio return (α) is the estimated intercept from the following regression:

$$R_{p,t} - R_{f,t} = \alpha_p + b_{p,Mkt} R_{Mkt,t} + s_{p,SMB} R_{SMB,t} + h_{p,HML} R_{HML,t} + m_{p,MOM} R_{MOM,t} + \varepsilon_{p,t},$$

where R_p is the return on portfolio p and R_f is the risk-free rate; R_{MKT}, R_{SMB}, and R_{HML} are returns on the market, size, and book-to-market factors, respectively, in Fama and French (1993); R_{MOM} is the return on the momentum factor in Carhart (1997). The sample period is from 1971 to 2007. The high- and low-growth groups contain 197,479 stock-month observations Statistical significance at the 10%, 5%, and 1% levels are represented by *, ** and ***, respectively.

		TAG rank			
IVOL rank	Return (%)	1 (low)	10 (high)	1-10	*t*(1-10)
	Raw	1.127***	1.047***	0.080	[0.51]
1 (low)	*Adj*	-0.186	-0.117	-0.070	[-0.44]
	α	0.016	-0.086	0.102	[0.63]
	Raw	1.594***	0.584*	1.010***	[5.70]
2	*Adj*	0.270***	-0.597***	0.867***	[5.79]
	α	0.359***	-0.438***	0.797***	[4.67]
	Raw	1.576***	0.088	1.489***	[7.16]
3 (high)	*Adj*	0.366**	-0.952***	1.318***	[7.95]
	α	0.411*	-0.775***	1.186***	[5.80]
	Raw	0.450	-0.959***	1.408***	[6.43]
3-1	*Adj*	0.552**	-0.835***	1.388***	[6.32]
	α	0.395	-0.690***	1.085***	[4.79]

Table III
Portfolio Returns by Total Assets Growth and Information Costs Proxies

This table reports monthly portfolio returns sorted by the overall investment growth proxy and the information costs proxies. At the end of June of each year, stocks are sorted into deciles based on total assets growth and independently into two categories by credit rating dummy or terciles by the number of institutional shareholders or the firm age. Total asset growth (*TAG*) is the percentage change in total assets from fiscal year $t-2$ to fiscal year $t-1$ and it proxies for overall corporate investment growth. The credit rating dummy (*RATING*) is a variable that equals 1 if the firm has an S&P long-term credit rating at end of fiscal year $t-1$ and 0 otherwise and it proxies for coverage by informed investors. The number of institutional shareholder ($INST_N$) is the number of institutional investors holding the shares of the firm at the end of June of year t and it proxies for shareholder sophistication. Firm age (*AGE*) is the number of years a stock appeared in CRSP at the end of year t and it proxies for information quality. Firms with sales less than $10 million in fiscal year $t-1$ are excluded from the sample. Stocks are held for one year. The raw portfolio return (*Raw*) is the time-series average of equally-weighted stock returns. The characteristics-adjusted portfolio return (*Adj*) is the time-series average of equally weighted stock returns in excess of the returns on 25 matching Fama and French (1992) size-and-book-to-market benchmark portfolios. The risk-adjusted portfolio return (α) is the estimated intercept from the following regression:

$$R_{p,t} - R_{f,t} = \alpha_p + b_{p,Mkt} R_{Mkt,t} + s_{p,SMB} R_{SMB,t} + h_{p,HML} R_{HML,t} + m_{p,MOM} R_{MOM,t} + \varepsilon_{p,t},$$

where R_p is the return on portfolio p and R_f is the risk-free rate; R_{MKT}, R_{SMB}, and R_{HML} are returns on the market, size, and book-to-market factors, respectively, in Fama and French (1993); R_{MOM} is the return on the momentum factor in Carhart (1997). The sample period is from 1971 to 2007, except that the sample period for $INST_N$ is from 1980 to 2007. For the former, the high and low growth groups contain 222,747 stock-month observations. For the latter, the high- and low-growth groups contain 173,640 stock-month observations. Statistical significance at the 10%, 5%, and 1% levels are represented by *, ** and ***, respectively.

		TAG Rank			
	Return (%)	1 (low)	10 (high)	1-10	*t*(1-10)
		Panel A: Coverage by Informed Investors Proxied by *RATING*			
RATING					
1 (rated)	*Raw*	1.733***	1.128***	0.605***	[2.81]
	Adj	0.401**	0.025	0.376*	[1.96]
	α	0.490**	0.093	0.397*	[1.84]
2 (unrated)	*Raw*	1.475***	0.009	1.466***	[8.10]
	Adj	0.212*	-0.989***	1.202***	[8.46]
	α	0.395**	-0.826***	1.220***	[6.92]
2-1	*Raw*	-0.258	-1.119***	0.861***	[4.08]
	Adj	-0.189	-1.014***	0.825***	[4.06]
	α	-0.095	-0.918***	0.823***	[3.68]

Table III - Continued

Panel B: Shareholder Sophistication Proxied by $INST_N$					
$INST_N$					
	Raw	1.538***	0.513	1.025***	[4.48]
1 (more)	*Adj*	0.275*	-0.549***	0.824***	[4.02]
	α	0.326*	-0.472***	0.799***	[3.61]
	Raw	1.507***	0.096	1.411***	[6.26]
2	*Adj*	0.192	-0.956***	1.148***	[5.68]
	α	0.532**	-0.819***	1.351***	[5.71]
	Raw	1.740***	-0.148	1.888***	[7.41]
3 (less)	*Adj*	0.292*	-1.216***	1.507***	[6.57]
	α	0.700**	-0.900***	1.599***	[6.21]
	Raw	0.202	-0.661***	0.863***	[3.27]
3-1	*Adj*	0.016	-0.666***	0.683***	[2.75]
	α	0.373	-0.427*	0.801***	[2.97]
Panel C: Information Quality Proxied by *AGE*					
AGE					
	Raw	1.347***	0.744**	0.603***	[3.16]
1 (old)	*Adj*	0.036	-0.422***	0.458***	[2.82]
	α	0.1118	-0.403***	0.515***	[2.73]
	Raw	1.546***	0.220	1.326***	[6.13]
2	*Adj*	0.293**	-0.801***	1.094***	[6.46]
	α	0.344*	-0.701***	1.045***	[4.99]
	Raw	1. 489***	0.116	1.373***	[5.99]
3 (young)	*Adj*	0.244	-0.859***	1.103***	[5.89]
	α	0.520**	-0.685***	1.206***	[5.19]
	Raw	0.142	-0.628***	0.770***	[3.44]
3-1	*Adj*	0.209	-0.436**	0.645***	[3.06]
	α	0.409*	-0.282*	0.690***	[2.90]

Table IV
Portfolio Returns by Total Assets Growth and Transaction Costs Proxies

This table reports monthly portfolio returns sorted by the overall investment growth proxy and the transaction costs proxies. At the end of June of each year, stocks are sorted into deciles based on total assets growth and independently into terciles by the dollar share price, market value of equity, institutional shareholding, bid-ask spread, the Amihud's (2002) illiquidity, or dollar trading volume. Total asset growth (*TAG*) is the percentage change in total assets from fiscal year $t-2$ to fiscal year $t-1$ and it proxies for overall corporate investment growth. *PRICE* and *SIZE* are the dollar share price and the market value of equity, respectively, at the end of June of year t and they inversely proxy for overall transaction costs. Institutional shareholding ($INST_H$) is the percentage of outstanding shares held by institutional investors at the end of June of year t and it inversely proxies for short-sale constraints. Bid-ask spread (*BIDASK*) is the past 12-month time-series average of 2((Ask−Bid)/(Ask+Bid)) at the end of June of year t. $ILLIQ_{RET}$ is the Amihud's (2002) illiquidity measure. Dollar trading volume (*DVOL*) is the past 12-month time-series average of monthly share trading volume multiplied by the monthly closing price at the end of June of year t and it proxies for liquidity. Firms with sales less than \$10 million in fiscal year $t-1$ are excluded from the sample. Stocks are held for one year. The raw portfolio return (*Raw*) is the time-series average of equally weighted stock returns. The characteristics-adjusted portfolio return (*Adj*) is the time-series average of equally weighted stock returns in excess of the returns on 25 matching Fama and French (1992) size-and-book-to-market benchmark portfolios. The risk-adjusted portfolio return (α) is the estimated intercept from the following regression:

$$R_{p,t} - R_{f,t} = \alpha_p + b_{p,Mkt} R_{Mkt,t} + s_{p,SMB} R_{SMB,t} + h_{p,HML} R_{HML,t} + m_{p,MOM} R_{MOM,t} + \varepsilon_{p,t},$$

where R_p is the return on portfolio p and R_f is the risk-free rate; R_{MKT}, R_{SMB}, and R_{HML} are returns on the market, size, and book-to-market factors, respectively, in Fama and French (1993); R_{MOM} is the return on the momentum factor in Carhart (1997). The sample period is from 1971 to 2007, except that the sample period for $INST_H$ is from 1980 to 2007 and the sample period for *BIDASK* is from 1993 to 2007. The high- and low-growth groups contain 222,747, 173,640, and 93,680 stock-month observations, respectively. Statistical significance at the 10%, 5%, and 1% levels are represented by *, ** and ***, respectively.

Table IV - Continued

	Return (%)	TAG 1 (low)	TAG 10 (high)	TAG 1-10	*t*(1-10)
		Panel A: Overall Transaction Cost Inversely Proxied by *PRICE*			
PRICE					
	Raw	1.330***	0.678**	0.651***	[3.32]
1 (high)	*Adj*	0.080	-0.338***	0.418**	[2.43]
	α	0.100	-0.219*	0.320*	[1.90]
	Raw	1.343***	0.295	1.048***	[6.62]
2	*Adj*	0.117	-0.712***	0.830***	[5.95]
	α	0.226**	-0.620***	0.846***	[5.69]
	Raw	1.540***	-0.248	1.788***	[8.87]
3 (low)	*Adj*	0.263*	-1.295***	1.558***	[8.10]
	α	0.452*	-1.092***	1.544***	[7.39]
	Raw	0.210	-0.927***	1.137***	[4.38]
3-1	*Adj*	0.183	-0.957***	1.140***	[4.71]
	α	0.351	-0.873***	1.224***	[4.91]
		Panel B: Overall Transaction Cost Inversely Proxied by *SIZE*			
SIZE					
	Raw	1.570***	0.450	1.121***	[5.67]
1 (large)	*Adj*	0.260*	-0.553***	0.813***	[4.77]
	α	0.332**	-0.360***	0.692***	[3.84]
	Raw	1.174***	0.208	0.965***	[5.17]
2	*Adj*	0.107	-0.734***	0.840***	[5.12]
	α	0.121	-0.738***	0.859***	[4.42]
	Raw	1.632***	-0.242	1.873***	[8.04]
3 (small)	*Adj*	0.300**	-1.085***	1.386***	[7.12]
	α	0.551**	-1.169***	1.720***	[7.03]
	Raw	0.061	-0.691**	0.752***	[2.71]
3-1	*Adj*	0.040	-0.532***	0.572**	[2.44]
	α	0.220	-0.809***	1.028***	[3.76]

Table IV - Continued

Panel C: Short-sale Constraints Inversely Proxied by $INST_H$					
$INST_H$					
1 (high)	*Raw*	1.456***	0.597	0.859***	[4.09]
	Adj	0.150	-0.470***	0.619***	[3.48]
	α	0.240	-0.435***	0.676***	[3.34]
2	*Raw*	1.631***	0.072	1.559***	[6.59]
	Adj	0.269*	-0.934***	1.203***	[5.98]
	α	0.611***	-0.847***	1.458***	[6.06]
3 (low)	*Raw*	1.669***	-0.166	1.835***	[6.89]
	Adj	0.250	-1.258***	1.507***	[6.35]
	α	0.647**	-0.924***	1.571***	[5.75]
3-1	*Raw*	0.213	-0.763***	0.977***	[3.53]
	Adj	0.100	-0.788***	0.888***	[3.32]
	α	0.407	-0.488**	0.896***	[3.13]
Panel D: Transaction Cost Proxied by *BIDASK*					
BIDASK					
1 (low)	*Raw*	1.506**	0.346	1.160***	[3.13]
	Adj	0.368	-0.708***	1.076***	[3.10]
	α	0.800**	-0.318	1.118***	[2.90]
2	*Raw*	1.686**	0.209	1.476***	[3.90]
	Adj	0.396	-0.966***	1.362***	[3.99]
	α	0.789**	-0.748***	1.537***	[4.10]
3 (high)	*Raw*	2.169***	-0.412	2.582***	[7.10]
	Adj	0.688***	-1.609***	2.297***	[6.69]
	α	1.301***	-1.126***	2.426***	[6.83]
3-1	*Raw*	0.663	-0.758*	1.421***	[3.32]
	Adj	0.319	-0.901***	1.220***	[3.06]
	α	0.501	-0.808**	1.309***	[3.32]

Table IV - Continued

Panel E: Liquidity Inversely Proxied by $ILLIQ_{RET}$					
$ILLIQ_{RET}$					
	Raw	1.581***	0.332	1.249***	[5.82]
1 (low)	*Adj*	0.337**	-0.640***	0.978**	[5.24]
	α	0.447***	-0.400***	0.847***	[4.26]
	Raw	1.386***	0.256	1.1318**	[5.92]
2	*Adj*	0.198	-0.724***	0.922***	[5.23]
	α	0.338*	-0.675***	1.013***	[5.09]
	Raw	1.526***	-0.236	1.762***	[8.43]
3 (high)	*Adj*	0.225*	-1.360***	1.585***	[7.99]
	α	0.318	-1.264***	1.582***	[7.45]
	Raw	-0.056	-0.568**	0.513*	[1.92]
3-1	*Adj*	-0.113	-0.720***	0.607**	[2.48]
	α	-0.129	-0.864***	0.734***	[2.93]
Panel F: Liquidity Proxied by *DVOL*					
DVOL					
	Raw	1.402**	0.275	1.127***	[5.28]
1 (high)	*Adj*	0.151	-0.708**	0.859***	[4.62]
	α	0.572***	-0.410***	0.788**	[3.84]
	Raw	1.230**	0.171	1.059**	[4.91]
2	*Adj*	0.050	-0.860***	0.910***	[4.74]
	α	0.142	-0.924***	1.066**	[4.86]
	Raw	1.719***	0.138	1.581***	[7.51]
3 (low)	*Adj*	0.407***	-0.960***	1.367***	[6.91]
	α	0.378**	-0.953***	1.529***	[7.04]
	Raw	0.317	-0.138	0.455	[1.74]
3-1	*Adj*	0.256	-0.252	0.508**	[2.08]
	α	-0.194	-0.544*	0.738***	[2.87]

Table V
Fama-MacBeth Regression Test Results

This table reports the slopes of the Fama-MacBeth regression

$$R_{k,t} = c_0 + c_1 TAG_{k,t-1} + c_2 TAG_{k,t-1} \times X_{k,t} + Controls + \varepsilon_{k,t},$$

where R_k is the percentage monthly raw stock return between July of year *t* and June of year *t*+1 (or between July and December for year 2007). Total asset growth (*TAG*) is the percentage change in total assets from fiscal year *t*−2 to fiscal year *t*−1 and it proxies for overall corporate investment growth. *X* is either *IDIOVOL*, *RATING*, *AGE*, *lnPRICE*, or *lnSIZE*. *Controls* are *lnSIZE*, *lnBM*, and *NS*, which control for firm characteristics. Idiosyncratic stock return volatility (*IVOL*) is the standard deviation of the return residuals from a 36-month market model estimated at the end of June of year *t* and it proxies for arbitrage risk. The credit rating dummy (*RATING*) is a variable that equals 1 if the firm has an S&P long-term credit rating at the end of fiscal year *t*−1 and 0 otherwise and it proxies for coverage by informed investors. Firm age (*AGE*) is the number of years a stock appeared in CRSP at the end of year *t* and it proxies for information quality. *PRICE* and *SIZE* are the dollar share price and the market value of equity, respectively, at the end of June of year *t* and they inversely proxy for overall transaction costs. Book-to-market equity (*BM*) is the book value of equity according to Fama and French (1993) at the end of fiscal year ending in calendar year *t*−1 divided by the market value of equity at the end of December of year *t*−1. Net share issuance (*NS*) is the natural logarithm of the ratio of the split-adjusted shares outstanding at the end of fiscal year *t*−1 to the split-adjusted shares outstanding in year *t*−2. *lnPRICE*, *lnSIZE* and *lnBM* are the natural logarithm of *PRICE*, *SIZE*, and *BM*, respectively. Firms with sales less than $10 million in fiscal year *t*−1 are excluded from the sample. The regression is estimated cross-sectionally every month between 1971 and 2007 (Panel A), between 1971 and 1989 (Panel B), or between 1990 and 2007 (Panel C). *Est.* is the time-series averages of the cross-sectional slope estimates; and *t* statistics based on the Newey-West (1984) standard errors are in parentheses.

		TAG interacted with							
Slope	*TAG*	*IVOL*	*RATING*	*AGE*	*lnPRICE*	*lnSIZE*	*lnSIZE*	*lnBM*	*NS*
Panel A: The period from 1971 to 2007									
Est.	-0.420						-0.006	0.198	-1.312
	(-3.61)						(-0.11)	(2.28)	(-4.96)
Est.	0.241	-5.314					-0.015	0.191	-1.269
	(0.89)	(-2.01)					(-0.30)	(2.23)	(-4.91)
Est.	-0.551		0.800				-0.016	0.192	-1.324
	(-4.34)		(4.37)				(-0.32)	(2.20)	(-5.10)
Est.	-0.534			0.010			-0.010	0.193	-1.300
	(-3.61)			(2.06)			(-0.20)	(2.29)	(-4.93)
Est.	-1.266				0.298		-0.016	0.200	-1.223
	(-4.03)				(2.88)		(-0.32)	(2.29)	(-4.93)
Est.	-2.866					0.128	-0.018	0.1971	-1.316
	(-2.45)					(2.09)	(-0.37)	(2.23)	(-5.09)

Table V - Continued

Slope	*TAG*	*TAG* interacted with *IVOL*	*RATING*	*AGE*	*lnPRICE*	*lnSIZE*	*lnSIZE*	*lnBM*	*NS*
Panel B: The period from 1971 to 1989									
Est.	-0.501						0.055	0.297	-1.500
	(-2.33)						(0.72)	(2.21)	(-4.04)
Est.	0.470	-8.243					0.042	0.289	-1.453
	(1.18)	(-1.85)					(0.58)	(2.19)	(-3.88)
Est.	-0.604		0.814				0.044	0.294	-1.506
	(-2.58)		(3.25)				(0.60)	(2.18)	(-4.16)
Est.	-0.622			0.010			0.050	0.290	-1.470
	(-2.18)			(1.33)			(0.67)	(2.23)	(-3.95)
Est.	-1.285				0.251		0.047	0.299	-1.444
	(-2.25)				(1.35)		(0.62)	(2.20)	(-4.07)
Est.	-2.206					0.093	0.046	0.301	-1.500
	(-1.04)					(0.84)	(0.65)	(2.21)	(-4.20)
Panel C: The period from 1990 to 2007									
Est.	-0.336						-0.069	0.093	-1.114
	(-3.86)						(-1.18)	(0.91)	(-3.20)
Est.	-0.001	-2.223					-0.074	0.088	-1.076
	(-0.00)	(-1.43)					(-1.29)	(0.86)	(-3.16)
Est.	-0.495		0.786				-0.080	0.084	-1.131
	(-5.04)		(3.20)				(-1.37)	(0.82)	(-3.24)
Est.	-0.440			0.010			-0.073	0.090	-1.120
	(-6.56)			(1.78)			(-1.27)	(0.88)	(-3.15)
Est.	-1.245				0.347		-0.083	0.096	-0.989
	(-5.47)				(5.11)		(-1.47)	(0.93)	(-3.09)
Est.	-3.562					0.165	-0.085	0.088	-1.121
	(-4.88)					(4.39)	(-1.52)	(0.84)	(-3.21)