

Feedback and Firm Value

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Abstract

## Feedback and Firm Value

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This essay analyzes the potential real economic effects of a feedback mechanism on firms' real investment and financing policies. Using a matched sample method with option-listed firms between 1973 and 2009, I document some evidence consistent with the presence of the feedback effect described in Goldstein and Guembel (2008).



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## **DEDICATION**

to my sister, Michelle Geraldine Thavasi



## Chapter 1

### INTRODUCTION

A large body of evidence suggests that firms use information in prices to improve their investment policies (Dow and Gorton, 1997; Subrahmanyam and Titman, 1999, 2001; Luo, 2005; Chen et al., 2007). However, Goldstein and Guembel (2008), hereafter GG, present a model showing that market prices can sometimes convey misleading information, thereby distorting firms' real investment and financing policies. This study uses option introduction to test GG's model.

In GG's model, an uninformed investor short-sells a stock, thereby lowering the stock price. Market participants, which include the firms' managers and suppliers of new capital, optimally incorporate information from the stock price, but do not know what information signal an investor receives. As such, when they observe short-selling of a stock, market participants sometimes incorrectly infer negative information about an investment opportunity facing the firm, resulting in managers abandoning a potentially positive net present value (NPV) project. This lowers firm value, which the uninformed investor relies upon to unwind his short position at a profit. Given the nature of the uninformed investor's trading strategy, GG dub it *manipulation*. In their model, they show that the potential for manipulation is greater if: (i) the quality of investments faced by the firm is lower, (ii) the uncertainty of the investments faced by the firm is higher, and (iii) the probability that the investor gets an informative signal is higher.

Prior research shows that option introduction lowers short selling constraints (Miller,

1977; Jarrow, 1980; Diamond and Verrecchia, 1987). GG's model, in turn, predicts that reduced short selling constraints should impact a firm's real investment policy because it increases the potential for manipulative short-selling. Using a matched sample method, I find some evidence consistent with this prediction. I find that option listing reduces new equity issuance and future free cash flows. Though not as strong, I also find evidence that option listing reduces capital expenditures and total investment. I further find that these effects are stronger when the likelihood of manipulation is higher as proxied by the uncertainty of the investments the firm faces and the probability that an investor gets an informative signal; future free cash flows are affected by all three factors increasing the likelihood of manipulation. On the other hand, new debt issued seems largely immune to GG's feedback effect.

My study makes two contributions to the literature. First, like Durnev et al. (2004), Luo (2005) and Chen et al. (2007), my results provide some evidence of the real economic effects of another feedback mechanism from the financial market. Second, it offers another explanation for the negative cumulative abnormal returns (CARs) associated with option listing (Sorescu, 2000; Danielsen and Sorescu, 2001).

The rest of this essay is organized as follows. Chapter 2 provides an overview of GG's model. Chapter 3 reviews the aspects of the literature pertinent to my study. Chapter 4 presents the alternative hypotheses under GG. Chapter 5 describes my sample. Chapters 6 and 7 report the univariate and multivariate analyses respectively. Chapter 8 concludes.

## Chapter 2

### THE MODEL

In a rational expectations framework, GG show that when there is feedback generated by prices' influence on the real investment decision, uninformed investors have an incentive to short-sell despite knowing they are uninformed. Because market participants do not know what information an investor has received, when faced with a sufficiently high probability of informed trading, their optimal response to stock price movements will occasionally be mistaken. Occasionally abandoning a positive NPV project by mistake distorts firms' real investment policies, resulting in lower firm value.

#### 2.1 Set-Up

GG's model has four dates,  $t \in \{0, 1, 2, 3\}$ . There are three players: a risk-neutral investor who sometimes receives an informative signal, a noise trader, and the risk-neutral market maker. Let  $u_t \in \{-1, 0, 1\}$  and  $n_t \in \{-1, 0, 1\}$  denote the trades of the investor and the noise trader respectively. The market maker and the manager only observe total order flows,  $Q_t = u_t + n_t$ , and cannot always tell their constituent trades:  $Q_t \in \{-2, -1, 0, 1, 2\}$ .

At  $t = 0$ , the investor sometimes learns private information about two *ex-ante* equally likely states of the world determining the profitability of the investment opportunity,  $\omega \in \{h, l\}$ , where  $h$  is the signal for the high state and  $l$  is the signal for the low state of the world respectively.

The stock trades in  $t = 1, 2$ . The noise trader's trades are unrelated to the

realization of  $\omega$ . The market maker collects orders from the investor and the noise trader, and sets a price according to a zero-profit condition.

At  $t = 3$ , the manager, who may learn from the stock price, makes the investment decision; all uncertainty is resolved and payoffs are made.

The manager is faced with an investment opportunity requiring a fixed investment that could be financed by cash. The manager acts in the interest of the firm's shareholders and in an attempt to maximize firm value, chooses whether to invest.<sup>1</sup> The manager faces uncertainty regarding the quality of the investment opportunity. Firm value is  $V^+$  if the manager invests when  $\omega = h$ , and is  $V^-$  when  $\omega = l$ . GG assume that  $V^- < 0 < V^+$  such that the *ex ante* NPV of the project is  $\bar{V} = \frac{V^- + V^+}{2} > 0$ , and firm value is 0 if he does not invest, regardless the realization of  $\omega$ . The manager has no private information about  $\omega$ , so that absent any more information, he will choose to invest because  $\bar{V} > 0$ . He may use additional information in making his final decision that may include the firm's stock price and trades in the financial market, both of which may reflect the investor's information.

At  $t = 0$  with probability  $\alpha$ , the investor receives a perfectly informative signal,  $s \in \{h, l\}$ , regarding the state of the world,  $\omega$ ; he receives no signal with probability  $1 - \alpha$ . An investor is called positively informed if he receives a private signal of a high state of the world ( $s = h$ ). Similarly, he is called negatively informed or uninformed respectively if he receives a private signal of a low state of the world ( $s = l$ ) or no signal at all ( $s = \emptyset$ ).

Using information from the signal he receives, past prices and past quantities traded, the investor may wish to trade in the financial market. The investor submits orders of the same size as the noise trader or he does not trade at all:  $\{-1, 0, 1\}$ . The noise trader buys, sells, or does not trade with equal probabilities.<sup>2</sup> In each round of

<sup>1</sup>This assumption of the model excludes agency problems associated with investment policies.

<sup>2</sup>The noise trader in GG's model is the same as the uninformed trader in Diamond and Verrecchia (1987).

trade, orders are submitted simultaneously to the market maker who sets the price and absorbs order flows out of his inventory. The market maker sets the price equal to the expected asset value, given the information in past and present order flows.

## **2.2 Feedback and Manipulation**

In the no-feedback equilibrium, the uninformed investor does not trade at  $t = 1$  and may trade at  $t = 2$ . He does not trade at  $t = 1$  because selling (buying) without information pushes the price down (up) resulting in the expected price being lower (higher) than the unconditional expected value of the firm,  $\bar{V}$ .

The uninformed investor may trade in  $t = 2$  if only he, and not the other market participants, knows that he did not receive an informative signal. Because the market maker and the manager only observe total market orders, the uninformed investor is able to mask his identity by mimicking the trades of a negatively informed investor, i.e. short-selling, or those of a noise trader. Therefore, the market maker sets a price that reflects the possibility that the trade at  $t = 1$  was made by an informed investor and that the market will improve the efficiency of the investment decision, thereby increasing firm value. Because only he knows that he did not receive an informative signal, the uninformed investor has an incentive to short-sell because he also knows that the market will not improve the allocation of resources, and he may profit by selling at a price higher than the expected value of the firm.

With feedback, the uninformed investor also has an incentive to trade in  $t = 1$ . This is because, in addition to the avenue of profit just described in the no-feedback equilibrium, another avenue of profit emerges with feedback: the manager sometimes mistakenly cancels a positive NPV project at  $t = 2$ . Therefore, his manipulative strategy could begin with establishing a position in the stock at  $t = 1$  by selling it short. Then, by further short-selling the stock, he increases the likelihood that a potentially positive NPV project is mistakenly abandoned, resulting in lower firm

value. This distortion to the firm's real investment policy allows him to unwind his short positions at a profit.

For the distortion in the real investment policy to occur, there has to be a sufficiently high probability of an informed trade,  $\alpha$ , so that abstaining from the project is the manager's optimal response. In other words, the manipulation strategy is only profitable if the manager has sufficient reason to believe that the short-selling is initiated by an informed investor when in fact, it is initiated by the uninformed investor. This sufficiency condition for manipulation is given by:

$$\alpha > \frac{2\bar{V}}{\bar{V} + \Delta V} \quad (2.1)$$

where  $\Delta V = V^+ - \bar{V} = \bar{V} - V^-$  measures the uncertainty associated with the investment's prospects. Therefore, there are three scenarios under which feedback is stronger, making manipulation more likely:

1. When  $\bar{V}$  is lower.

In this case, the investment is itself less promising and therefore more likely to be abandoned.

2. When  $\Delta V$  is higher.

In this case, there is greater uncertainty over the prospects of the investment. As such, a low state of the world is more likely to lead to the cancellation of the project.

3. When  $\alpha$  is higher.

A higher probability of an informed investor initiating a trade ( $\alpha$ ) makes it more likely that the other market participants attribute trades to an informed investor when in fact, it may be an uninformed investor who is trading. A constructive way to think about  $\alpha$  is as a measure of additional information that the trades in the market provide market participants over the firm's fundamentals. For

example, the investor may have information regarding a competitor or better know the appropriate discount rate for the firm's cash flows. Alternatively, a capital provider such as a bank may use its role in the economy to learn information from the market.

The final key element of GG's model is why manipulation is only profitable via sell orders. This is because the only possible effect of manipulation on real investment policy is to distort it. In the case of manipulative short-selling, the manager incorrectly abstains from a positive NPV project, which reduces firm value, thereby allowing the uninformed investor to unwind his position at a profit. Manipulation is also not profitable in the case of buy orders because the value of the uninformed investor's holdings will decrease if uninformed buying results in managers sometimes accepting negative NPV projects. Therefore, manipulation is only profitable via sell orders.

## Chapter 3

### LITERATURE REVIEW

I review three aspects of the literature that are relevant to my study. The first covers feedback in the financial markets. Next, I consider the literature related to the impact of option listing on prices, and finally, I cover the literature on short-selling after option listing. These latter two aspects of the literature show why options and option listings provide an appropriate context to test for GG's feedback effect.

#### ***3.1 Feedback in Financial Markets***

Subrahmanyam and Titman (1999, 2001), Hirshleifer et al. (2006) and Goldstein and Guembel (2008) are some examples of theoretical models of feedback between stock prices and the firm's real investment policy.<sup>1</sup> The logic behind these models is as follows. Stock prices aggregate information from many different participants whose primary means of communication with the firm is the trading process. Therefore, stock prices may contain information managers do not have and this information may guide managers in making their corporate decisions, such as which real investments to take.

Feedback is only interesting to the extent that the empirical literature documents its effects on the real economy. There are mixed empirical results on feedback between financial markets and firms' real investment policies. For example, Morck et al. (1990) and Jennings and Mazzeo (1991) offer their results as evidence that prices and trades do not influence managers' investment decisions. Morck et al. (1990) find

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<sup>1</sup>Also see Dow and Gorton (1997), Dow and Rahi (2003) and Khanna and Sonti (2004).

evidence that the market is irrational and that managers use the financial markets to finance the firm's investment with the type of financing that is overpriced; they also find evidence consistent with the view that managers have superior information and do not learn from the market. Jennings and Mazzeo (1991) find no discernable relationship between the bidder's stock return around the initial merger and acquisition announcement and the bidder's later deal-closing and offer-revision decisions.

On the other hand, there are an increasing number of studies that document financial markets' effect on real economic activity. Barro (1990) finds that the stock market has far more explanatory power over contemporaneous and lagged values of cash-flow variables. With a much larger sample than Jennings and Mazzeo (1991) and a new test for learning, Luo (2005) finds evidence that the market's reaction to a merger and acquisition announcement predicts whether the company consummates the deal.<sup>2</sup> Also consistent with the notion of managers' learning, Chen et al. (2007) find a strong positive effect between their measures of private information in the stock price and the sensitivity of corporate investment to the price;<sup>3</sup> they find that information that managers already have at the time an investment decision is made may move the price but will not affect the outcome of the investment decision.

### ***3.2 Price Effect of Option Listing***

Black and Scholes (1973) assume complete markets without options and therefore treat options as redundant assets because their payoffs can be replicated exactly with the stock and a risk-free bond. Therefore, there would be no price effect associated with option listing in complete markets. In incomplete markets, Ross (1976) shows

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<sup>2</sup>He proposes a new test for learning that explicitly controls for the effect of investors' probability estimate of deal completion and the cross-sectional differences in deal quality.

<sup>3</sup>Their measures of private information are price nonsynchronicity (Roll, 1988) and the probability of informed trading (Easley et al., 1996).

that option listing may increase the investors' investment opportunity set.<sup>4</sup> Subsequent theoretical work predicts that equilibrium announcement returns associated with new option listing could be positive or negative. For example, Detemple (1990) shows that option introduction may have a negative price effect because in incomplete markets, the values of primary securities, such as stocks, are determined together with those of derivative securities. On the other hand, Detemple and Selden (1991) show that option introduction may have a positive price effect because it induces a stronger reaction from investors who place a higher likelihood on extreme realizations of a stock's payoff.

Empirically, both positive and negative CARs are associated with new option listings. For example, Branch and Finnerty (1981), Rao and Ma (1987), Conrad (1989) and Detemple and Jorion (1990) find positive CARs associated with option listing. Ho and Liu (1997) and Sorescu (2000) find negative CARs. Of particular interest is Sorescu (2000), who fits the CARs to a mean-switching model. He finds that the CARs associated with new listings before 1981 are drawn from a distribution with a positive mean and those after 1981 are drawn from a distribution with a negative mean.

### ***3.3 Short-selling after Option Listing***

Miller (1977) argues that absent short-selling, securities over which there is a divergence of opinion are bid up because the prevailing price primarily reflects the views of positively informed traders. When short-sale constraints are lifted sufficiently, the stock price may also reflect the views of the negatively informed investors. Assuming a downward sloping demand for stock,<sup>5</sup> negatively informed investors may short-sell the stock to the positively informed traders, effectively increasing the supply of

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<sup>4</sup>Also see arguments by Arditti and John (1980) and Hakansson (1982).

<sup>5</sup>For example, see Shleifer (1986), Jain (1987) and Lynch and Mendenhall (1997).

stock, which drives the price down to reflect the average valuation. This translates into higher expected returns before and lower realized returns after option listing. While in Miller’s partial equilibrium view, relaxing short-selling constraints for a single stock decreases its price, Jarrow (1980) shows that the price effect is ambiguous in the general equilibrium problem of eliminating short-selling constraints for all stocks throughout the economy because the price may also rise if the positively informed traders finance their additional demand for stocks by using the short-sale market.

Models like Miller (1977) show that attenuating short-selling constraints results in a predictable decrease in the underlying asset’s price. In the rational expectations model of Diamond and Verrecchia (1987), however, there is no such price effect because market participants take into account the costs of short-selling, which are high enough that uninformed traders<sup>6</sup> would find it too costly to short-sell. Miller (1977) and Diamond and Verrecchia (1987) both show that the informational efficiency of stock prices with short selling constraints is reduced relative to a frictionless stock market. They differ in their treatment of how sophisticated (“rational”) these investors are in their attempts to adjust for the asymmetric treatment of favorable and unfavorable information.

There is empirical evidence that investors use options to synthesize short positions. Figlewski and Webb (1993) find that constrained investors buy puts and write calls as a substitute for directly shorting a stock.<sup>7</sup> They also find that high (relative) short interest on a stock is associated with future underperformance of returns (Miller, 1977). Danielsen and Sorescu (2001) extend Jarrow (1980) to show that equilibrium prices are increasing in binding short-selling constraints. Therefore, in their model,

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<sup>6</sup>The uninformed investors in Diamond and Verrecchia (1987) are called noise traders in GG. Recall that the uninformed investor in GG is the only person who knows that he is uninformed. This important information is unknown to the market maker and the manager, who only observe total market orders.

<sup>7</sup>Even if investors switched from directly short-selling to synthesizing short positions with options, Figlewski and Webb (1993) argue that a decline in short interest is unlikely because the option market maker will nevertheless short-sell the stock to hedge himself.

attenuating short-selling constraints is associated with a negative price effect. They use their model to successfully explain the negative CARs associated with option listing documented in Sorescu (2000).

GG explicitly model a feedback effect that the extant literature has failed to investigate. Under this feedback effect, the informational efficiency of prices as it relates to the firm's real investment policy is reduced. Using their theoretical model, I test the hypothesis that option-listed firms may suffer the consequences of a negative feedback from the financial markets. The uninformed investors in GG's model could be part of the set of investors that may take equivalent short positions using options. Therefore, the underlying firm's real investment and financing policies may be distorted because options facilitate the uninformed investors' manipulative trades. I develop this idea into testable hypotheses in the next section.

## Chapter 4

### HYPOTHESES

My null hypothesis postulates that a reduction in short-selling constraints due to option listing results in a one-time price correction due to the potential entry of negatively informed investors (Miller, 1977), but there is no change to the option-listed firm's subsequent real investment or financing policies because there is no feedback from the stock price.

I explore alternative hypotheses from GG. In GG, the reduction in short-selling constraints due to option listing may increase the incentive of an uninformed investor to trade. Consequently, the option-listed stock's price may not be as informative because it is additionally influenced by the uninformed investors' trades, resulting in a potential distortion to the option-listed firms' real investment policy.

#### ***4.1 Hypothesis I: Under-Investment***

The alternative hypothesis under GG is that the managers of option-listed firms underinvest.<sup>1</sup> Both the null and alternative hypotheses can predict a permanent decrease in price due to option listing, but only under the alternative will this decrease cause underinvestment. Under the alternative, even if it may be optimal for the manager to downgrade his beliefs regarding the profitability of the project and abstain from it because of the price decrease he observes, this decision may sometimes be

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<sup>1</sup>Absent market frictions such as adverse selection or agency costs, a firm's manager is said to have invested efficiently if he undertakes projects with positive NPV. He under-invests if he passes up investment opportunities that are positive NPV. Similarly, he over-invests if he invests in negative NPV projects.

incorrect due to manipulation, resulting in an investment policy that reduces firm value.<sup>2</sup>

Therefore assuming no agency costs, managers of option-listed firms should at times underinvest.<sup>3</sup>

$H_0^I$ : Option-listed firms invest efficiently.

$H_1^I$ : Option-listed firms underinvest.

## 4.2 Hypothesis II: Access to New Capital

The alternative under GG is that option-listed firms raise less new capital. Price decreases due to sell orders are less informative of changes in fundamentals because they may have been initiated by an uninformed investor. Therefore, like the managers, when faced with a sufficiently high probability of an informed trade, suppliers of new capital may occasionally be mistaken in their optimal responses to the stock price. Alternatively, managers may refrain from approaching the capital markets to fund their projects because managers know that suppliers of new capital have the same information that they do: that the stock price is subject to manipulation and that the information the investor received cannot be determined by observing total market orders. Either way, the firm may not raise sufficient new capital to fund all of its positive NPV projects.

It is important to note that the notion of information asymmetry that GG rely on is different from others used to explain departures from the optimal level of investment.<sup>4</sup>

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<sup>2</sup>Recall that in GG's model, trading in the financial market increases firm value in expectation. If not, the manager would always ignore the financial market and the feedback effect is destroyed.

<sup>3</sup>GG assume no agency costs when they assume that the manager is acting to maximize shareholder wealth.

<sup>4</sup>In the neo-classical paradigm, such as Hayashi (1982), firms invest until the marginal benefit of capital investment equals its marginal cost, subject to adjustment costs of installing this new capital. Firms receive financing for positive NPV projects at the prevailing interest rate, and excess cash is returned to shareholders.

One reason in the other frameworks for such departures is the information asymmetry between managers and outsiders. Consequently, problems such as moral hazard and adverse selection affect the efficiency of capital investment and impede a firm's ability to access the capital markets. For example, managers in Myers and Majluf (1984) abstain from an investment because they are maximizing current shareholders' wealth, not outside shareholders'. In contrast, the information asymmetry in GG's model is between the investor, who knows if he did not receive an informative signal, and everyone else. Consequently, any learning that occurs using the price, whether by the manager or by new suppliers of capital, is worse than if there were no possibility of an uninformed investor trading.

Therefore assuming no agency costs, firms with options listed on their stock raise less new capital:

$H_0^{II}$ : Option-listed firms raise new capital as usual.

$H_1^{II}$ : Option-listed firms raise less new capital.

### **4.3 Hypothesis III: Free Cash Flow**

Under the alternative, GG's feedback effect results in the manager sometimes incorrectly abstaining from positive NPV projects. In so doing, he gives up future free cash flows that could have been generated by these projects, thereby reducing firm value. The uninformed speculator relies on this reduction in firm value to profit from his short position in the manipulation strategy.

Therefore assuming no agency costs, option-listed firms may have lower future free cash flows:

$H_0^{III}$ : The future free cash flows of option-listed firms are unaffected.

$H_1^{III}$ : The future free cash flows of option-listed firms are lower.

The next three chapters describe the research method I use to test these three alternative hypotheses.

## Chapter 5

### SAMPLE

I follow the literature and use a matched sample to analyze investment and financing policies of option-listed firms after options have been listed.<sup>1</sup> Option listing generates a set of sample firms and a set of firms that could have had options listed on their stock but did not. With the propensity score matching algorithm, I attempt to hold the determinants of option listing constant, thereby allowing me to better isolate the short-selling effects, and consequently the feedback effects, due to option listing.

In this chapter, I discuss my sample firms and how I choose the peer firms. I also replicate a portion of a table from Sorescu (2000), which documents negative CARs associated with option listing. This replication serves to check if the negative CARs associated with option listing that Sorescu (2000) documents are present in my data.

#### **5.1 Sample Firms**

My initial sample consists of almost all<sup>2</sup> newly option-listed firms between 1973 and 2009, with the date when options were first listed on the stock as the event date.<sup>3</sup> I

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<sup>1</sup>For example, see Loughran and Ritter (1997), Purnanandam and Swaminathan (2004) or Billett et al. (2006).

<sup>2</sup>I do not have data for 1998 and 1999 because they are not available. I obtained the most recent option listings from the Option Clearing Corporation's website. This website maintains data only beginning January 2000. Discussions with representatives from the Option Clearing Corporation's archival department suggest that they may have the data on forms that have been filed in their office, but they will not release them. Also, there are no observations for 1979 because of an SEC moratorium on new option listings.

<sup>3</sup>Instead of the announcement date, this literature uses option listing dates as the event date because earlier studies by Conrad (1989) and Detemple and Jorion (1990) do not find any valuation

collected a list of new option listings from two sources. First, for listings between April 1973 and July 1997,<sup>4</sup> I obtained a list of new option listings from Professors Stewart Mayhew and Vassil Mihov that were used in Mayhew and Mihov (2004). The second source is the Options Clearing Corporation's (OCC) website.<sup>5</sup> A new option listing is identified by the earliest recorded date of the option listing and a firm identifier, which is either the CUSIP or the ticker of the underlying stock. When an option is delisted and re-listed later, I only keep the first listing in my sample. Finally, I only use firms with share codes 10, 11 and 12. These share codes select all domestic and foreign firms listed on American exchanges. I include foreign firms listed on American exchanges because the GG theory would apply to all firms with a stock price that is susceptible to manipulation by the uninformed trader. Among other things, these share codes also exclude ETFs and closed-end funds because entities such as these do not have real investment policies that an uninformed trader could distort to benefit from a manipulative strategy. Finally, I exclude ADR's and financial firms.

## **5.2 Peer Firms**

I use the propensity score matching algorithm (PSM) developed in Rosenbaum and Rubin (1983) to select a peer for each of my sample firms. I begin by using the SEC's rules on the eligibility of firms to determine potential candidates for option listing in a given year that were not selected by the OCC. These rules are documented in Mayhew and Mihov (2004). I am able to impose all of the SEC restrictions as in Mayhew and Mihov (2004) except the public float requirement.<sup>6</sup> I assume that the

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effects associated with announcement dates.

<sup>4</sup>The first option was listed on April 26, 1973.

<sup>5</sup> [http://www.theocc.com/market/new\\_listings/archives/new\\_listings\\_archives.jsp](http://www.theocc.com/market/new_listings/archives/new_listings_archives.jsp)

<sup>6</sup>Mayhew and Mihov (2004) use Disclosure to obtain data for the number of shares held by insiders to satisfy the public float criterion. They ignore this condition for years before 1986 because Disclosure only starts reporting from 1986; they also hand collected data from proxy statements for the period after October 1991.

public float of a firm is  $(0.9 \times \text{Number of Shares Outstanding})$  because Mayhew and Mihov (2004) note that insiders hold an average of 10% of the firm. I exclude all potential peer firms that have an option listed in the year before and two years after each event year. Finally, I restrict my attention to potential peer firms with share codes 10, 11, and 12.

The propensity scores are computed using the model proposed in Mayhew and Mihov (2004):

$$\mathbf{1}^{OPT} = \zeta_0 + \zeta_1 VOLUME + \zeta_2 STD + \zeta_3 ABVOL + \zeta_4 ABSTD + \zeta_5 MTKCAP + \sum_i \psi_i \mathbf{1}_i + \epsilon \quad (5.1)$$

where  $\mathbf{1}^{OPT}$  is an indicator variable that is 1 for an option-listed firm and 0 for a potential peer firm with no options,  $VOLUME$  is the average daily trading volume, in millions of shares, over the 250 trading days prior to the 15th of the event month,  $STD$  is the annualized standard deviation of log daily returns, as a percentage, over the same period,  $ABVOL$  is the ratio of the 30-day to the 250-day average daily trading volume,  $ABSTD$  is the analogous measure for volatility,  $MTKCAP$  is the market capitalization of the firm in millions of 1996 dollars, and  $\mathbf{1}_i$  is an industry fixed effect using 2-digit SIC Codes.<sup>7,8</sup> In the PSM framework, this logit model uses trading volume, stock return volatility, firm size, and industry as covariates.

To find a match for a given sample firm, I first select all peers with propensity scores that are within 2.5% of the propensity score of this sample firm. A match is chosen as the peer firm with the smallest absolute difference in propensity scores.<sup>9</sup>

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<sup>7</sup>Mayhew and Mihov (2004) find that exchanges prefer stocks with higher trading volume and higher volatility, and for the earlier listings, higher market capitalization. I follow the definitions of variables in Mayhew and Mihov (2004).

<sup>8</sup>The quality of my matches is unaffected when I use NAICS instead of SIC codes.

<sup>9</sup>Let  $PS_i$  be the propensity score of the sample firm.  $\delta_j = |PS_i - \widehat{PS}_j|$ , where  $\widehat{PS}_j$  is the propensity score of the  $j^{th}$  potential peer;  $\widehat{PS}_j$  is within 2.5% of  $PS_i$ . The match for  $i$  is chosen as the firm with the smallest  $\delta$ .

The matches are chosen without replacement so that each sample firm has a unique match. I am able to find matches for 47% of the sample firms.<sup>10</sup>

Table (1) reports the annual distribution of sample firms and matched firms.

[Insert Table 1 here.]

There are no observations for 1979 because the SEC imposed a moratorium on new option listings. I was not able to get data for the period between August 1997 and December 1999.

Tables (2) to (6) report the summary statistics of the covariates of the sample firms, matched peers, and the differences in the values between the two classes of firms.

[Insert Tables 2-6 here.]

These tables show that I have achieved some success in selecting matches for my sample firms along the dimensions that affect the probability of option listing. The overall mean and median differences<sup>11</sup> of the standard deviation of returns and market capitalization are statistically zero. The overall median difference in volume is statistically zero though the overall mean difference in volume is significantly negative.<sup>12</sup> The overall mean and median difference in abnormal volume are significantly positive and the overall mean of abnormal standard deviation is significantly positive, though the overall median is statistically zero.

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<sup>10</sup>Searching within 1% of a sample firm's propensity score enables me to match 33% of my sample. Increasing 1% to 2.5% allows me to match 47% of my sample; increasing 1% to 5% allows me to match 52% of my sample. Because the increase in the fraction of my sample that I match is dramatic when I increase the interval from 1% to 2.5%, but is marginal when I double 2.5% to 5%, I choose 2.5% in the interest of having higher quality matches.

<sup>11</sup>Differences are defined as values of the peer firms subtracted from the values of the sample firms.

<sup>12</sup>Across the entire sample, the average sample firm had an average daily trading volume 79,000 shares lower than the peer firm.

### 5.3 Option Listing Returns

In this section, I replicate a portion of Table II (Page 493) in Sorescu (2000).<sup>13</sup>

Like Sorescu (2000), I use the market model to compute the CARs. Let  $T$  be the new option listing date, which is defined as the event date. The abnormal return for firm  $i$  on day  $t$  is  $AR_{i,t} = R_{i,t} - \hat{\alpha}_i - \hat{\beta}_i R_{m,t}$  where  $R_{i,t}$  is the return on firm  $i$  on day  $t$ ,  $R_{m,t}$  is the the combined, value-weighted NYSE-AMEX-Nasdaq index return on day  $t$ , and  $\hat{\alpha}_i$  and  $\hat{\beta}_i$  are the parameters of the market model estimated by OLS using data from  $[T - 60, T - 6]$ .

The CAR for firm  $i$  over the 3-day event window of  $[T - 1, T + 1]$  around  $T$ ,  $CAR_{i,3}$ , is:

$$CAR_{i,3} = \sum_{t=-1}^1 AR_{i,t}. \quad (5.2)$$

Table (7) reports the annual mean and median CARs for my matched sample firms and the sample of firms based on Sorescu's (2000) selection criteria.

[Insert Table 7 here.]

There is some evidence that the CARs associated with option listing in my matched sample of firms are negative. I find that the 3-day CARs associated with new option listing in my sample, treating each listing as an independent observation, are significantly negative though they are economically small.<sup>14</sup> The CARs in my (matched) sample are less negative than those selected using Sorescu's (2000) criteria. However, the CARs of the sample of firms using Sorescu's (2000) selection criteria are similar to his original study in sign, magnitude and the pattern of statistical significance.

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<sup>13</sup>Sorescu (2000) computes 11-day and 3-day CARs in a Brown and Warner (1985) event study. He computes the means and medians by year, first treating each option listing as independent, and then grouping them according to the day of listing and finally by overlapping windows.

<sup>14</sup>I have also done 11-day CARs and used portfolio groupings, and my results are similar to Sorescu (2000).

My replication departs from his original method primarily in firm selection. Recall that I only use firms with certain share codes that exclude, among other things, ETFs and closed-end funds, whereas he uses all domestic entities upon which options were listed. Furthermore, I am only using firms for which I was able to find a match, which resulted in excluding about 53% of all new option listings I have.<sup>15</sup>

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<sup>15</sup>The mean and median CAR are -0.007 and -0.006 and significant at the 1% level when I use all option-listed firms with share codes 10, 11 and 12, and not just the matched ones.

## Chapter 6

### UNIVARIATE TESTS

The univariate tests of my hypotheses are two difference tests. The first set of tests, which I refer to as difference-in-difference (DD) tests, are estimates of changes in peer-adjusted measures pre- and post-option listing. I refer to the second set of tests as difference-in-difference-in-difference (DDD) tests. The DDD estimates are differences of the DD estimates, sorted by proxies for the factors that increase the likelihood of manipulation.

#### 6.1 Measures

In this section, I describe the measures which I use in my tests of my various alternative hypotheses. The measures associated with underinvestment ( $H_1^I$ ) are capital expenditures ( $CAP$ ) and total investment ( $INV$ ) because they measure the investment activity of the firm:

$$CAP_t = \frac{\text{Capital Expenditure (DATA128)}_t}{\text{Total Assets (DATA6)}_t} \quad (6.1)$$

$$INV_t = \frac{\text{Capital Expenditure (DATA128)}_t + \text{R \& D Expense (DATA46)}_t + \text{Acquisitions}_t}{\text{Total Assets (DATA6)}_t} \quad (6.2)$$

All accounting data are from Compustat and the data item numbers are presented in parentheses; acquisitions data are from SDC. I assume that missing values for research

and development expense and acquisitions are zero.<sup>1</sup>

The measures associated with access to new capital ( $H_1^{II}$ ) are new debt ( $N\_D$ ) and new equity ( $N\_E$ ) issued:

$$N\_D_t = \frac{\text{New Debt (DATA111)}_t}{\text{Total Assets (DATA6)}_t} \quad (6.3)$$

$$N\_E_t = \frac{\text{New Equity (DATA108)}_t}{\text{Total Assets (DATA6)}_t}. \quad (6.4)$$

For uniformity with the multivariate tests, I use new debt and new equity issued separately and not their sum. Although GG are silent about whether the feedback effect would manifest in new debt or new equity, my prior is that new equity issued is the likelier candidate because equity holders' decisions on the firm are impacted by the stock price (Baker et al., 2003).

Finally, the measure associated with free cash flows ( $H_1^{III}$ ) is  $FCF$ :

$$FCF_t = \frac{\text{EBITDA (DATA13)}_t}{\text{Total Assets (DATA6)}_{t-2}}. \quad (6.5)$$

My computation of  $FCF$  differs from the literature. Free cash flow is typically defined as EBITDA less capital expenditures.<sup>2</sup> First, I exclude capital expenditures because under  $H_1^I$ , it could be separately influenced by feedback. Second, I scale EBITDA by  $\text{Total Assets}_{t-2}$  instead of  $\text{Total Assets}_t$ . Scaling it by  $\text{Total Assets}_t$  could result in an ambiguous effect due to feedback. To see why, recall from Equation (2.1) that manipulation is more likely when the *ex ante* NPV of the project is lower, implying

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<sup>1</sup>I randomly selected 50 sample firms from my matched sample that had missing values for research and development expense and looked up their 10-K filings on EDGAR. In 46 cases, missing values reported in Compustat were 0 in the 10-K filings; in the remaining 4 cases, Compustat reported a missing value for research and development expense in error.

<sup>2</sup>EBITDA is defined as net income plus depreciation, amortization of intangibles, interest expense, and taxes.

that less-promising projects are more likely to be abandoned under the GG feedback. Scaling EBITDA by Total Assets<sub>*t*</sub> results in a measure that is very similar to return on assets, which measures the *ex post* effectiveness of the investment. Because less-promising projects are more likely to be abandoned, an *ex post* measure of effectiveness could be higher for firms under the influence of feedback. Therefore, I attempt to skirt these problems by scaling by Total Assets<sub>*t-2*</sub> instead.

Table (8) reports the distribution of the number of observations for each of the measures across four relative years.<sup>3</sup>

[Insert Table 8 here.]

The number of missing observations increases through relative years due to firms being delisted or acquired and due to the absence of data for the later relative years for listings in 2008 and 2009.

Table (9) reports the medians separately for the sample and peer firms from the year before to two years after options have been listed.

[Insert Table 9 here.]

The medians of these measures for my sample firms are higher than those of my control firms for each of my measures, except for new debt issues, in (relative) years 1 and 2.<sup>4</sup> This suggests that the OCC may be picking firms that have higher values for these measures, or that Mayhew and Mihov's (2004) model, which I use to compute the propensity scores, may be picking control firms that have lower values for these measures.

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<sup>3</sup>Relative year 0 is the year in which an option is listed, making relative year 1 the year after an option is listed, and so on.

<sup>4</sup>In unreported results, I used the Wilcoxon-Mann-Whitney test to test if the peer-adjusted difference for each measure in each relative year is 0 against the two-sided alternative. Except for new debt issues, the test strongly rejects the null hypothesis with *p*-values less than 0.01; new debt issues are not statistically different from zero in every year. Clearly, my sample firms differ from my peer firms along these measures though they have been matched on the factors affecting the probability of option listing. This is less of an issue in my univariate tests than in my multivariate tests because my univariate tests focus on the changes in levels of these measures.

## 6.2 *Statistical Tests*

In all the coming difference tests, I follow the literature and report differences in medians because the distributions of my measures are typically skewed.<sup>5</sup> Furthermore, medians are better suited to picking up smaller effects, which the manipulation effects are theoretically expected to be. In GG's model, financial markets do not decrease the overall value of the firm lest market participants always ignore the financial market, thereby destroying the feedback. Therefore, the feedback effects cannot be too large or too frequent for the manipulation equilibrium to attain. Even so, the feedback effect is economically meaningful because it causes enough inefficiency in the real investment and financing policies of firms that the uninformed investor has an incentive to trade.

I differ from the literature in my statistical test of the difference in medians by using the Majority Preference (MP) test in Randles (2001) instead of the traditional Wilcoxon-Mann-Whitney (WMW) test.<sup>6</sup> The WMW tests for a difference in distributions but is tantamount to a test of the difference in the medians if the two distributions from which the data are drawn can be assumed to be the same. Except for the probability distribution of new debt issues, the distributions of my other variables of my sample firms and my control firms are different.<sup>7</sup> Therefore I use MP for my data instead. As Randles (2001) points out, the MP test is a more powerful test of the difference in medians than the WMW test because it assigns ties to the alternative. Furthermore, the MP test is also set up as a one-tailed test, which lends itself naturally to my alternative hypotheses.

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<sup>5</sup>See Purnanandam and Swaminathan (2004).

<sup>6</sup>See Appendix for details of the test. I thank Professor Andrew Siegel for recommending this test to me.

<sup>7</sup>In unreported results, I performed a Kolmogorov-Smirnov test for the difference in distribution functions for each of my measures in each of the relative years. Except for new debt issues, the  $p$ -values from the test for each of the remaining measures is less than 0.01.

### 6.3 Difference-in-Difference Tests: Pre- and Post-New Option Listing

GG's theory predicts that the feedback effect results in a permanent shock to the firm's real investment and financing policies. To test this, I estimate the difference of the peer-adjusted measures pre- and post-option listing: the DD estimate. Although the PSM controls for the aspects determining option listing, the DD estimate allows me to control for other firm fixed effects by using the sample firm and its matched peer together as a control.

For each relative year  $t \in \{0, 1, 2\}$ , the peer-adjusted value of each measure,  $M$ , is given by  $\widetilde{M}_t \equiv M_t - M_{peer,t}$ . Let  $\widehat{M}_t$  be the DD estimate between relative years  $t$  and 0, given by:<sup>8</sup>

$$\widehat{M}_t = \widetilde{M}_t - \widetilde{M}_0. \quad (6.6)$$

Under  $H_1^I$ , managers of option-listed firms underinvest because their firms' stock prices are subject to the manipulative trades of the uninformed investor. Therefore, under  $H_1^I$ , relative to their peers, option-listed firms have lower capital expenditures and total investment.  $\forall t > 0$ :

$$\widehat{CAP}_t < 0 \quad (6.7)$$

$$\widehat{INV}_t < 0. \quad (6.8)$$

Under  $H_1^{II}$ , suppliers of new capital decide against supplying capital to option-listed firms because their stock prices are subject to the manipulative trades of the uninformed investor. Therefore, under  $H_1^{II}$ , option-listed firms raise less new capital

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<sup>8</sup>As I discuss later, my results are similar when I define the DD estimate as  $\widetilde{M}_t - \widetilde{M}_{-1}$ .

than their matched peers.  $\forall t > 0$ :

$$\widehat{N\_D}_t < 0 \quad (6.9)$$

$$\widehat{N\_E}_t < 0. \quad (6.10)$$

Finally, under  $H_1^{III}$ , managers of option-listed firms are giving up future increases to free cash flow by underinvesting. Therefore, under  $H_1^{III}$ , option-listed firms will have lower free cash flows relative to their matched peers.  $\forall t > 0$ :

$$\widehat{FCF}_t < 0. \quad (6.11)$$

Table (10) reports the median DD estimates.

[Insert Table 10 here.]

There is some evidence consistent with the GG feedback effect in all the measures except for new debt issues.<sup>9</sup> Compared to their matched peers, option-listed firms see a greater reduction in capital expenditures in years 1 and 2 and in overall total investment in the year after options have been listed. My sample of option-listed firms also see a greater decrease in future free cash flows in the second year after option listing, suggesting that the effects of underinvestment manifest as early as the second year after option listing.

Compared to their matched peers, my sample firms see no change in the amount of new debt raised but see a greater reduction in the amount of new equity they raise in the years after options are listed. While GG are silent on whether the feedback effect would manifest via new debt or new equity, that an effect is only observed in new equity is consistent with the interpretation that equity holders' decisions on the firm depend to a greater extent on the stock price (Baker et al., 2003). Additionally, new

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<sup>9</sup>I have done a similar test with means (using a *t*-test) instead of medians and the results are unchanged.

equity holders may be withholding capital since I find some evidence that managers are foregoing future free cash flows by (inadvertently) underinvesting.

Because the feedback effect could potentially manifest in the year when options are listed, I also re-estimate all the differences defining the DD estimate as  $\widetilde{M}_t - \widetilde{M}_{-1}$ . In unreported results, I find that the DD estimates are essentially the same as the ones that I report in Table (10). For example, the DD estimates for *CAP* and *INV* using this definition are significantly negative in year 1 at the 1% and 5% levels respectively; the DD estimates for *N\_E* are significantly negative at the 1% level for relative years 1 and 2. Allied with this, I also conducted a robustness check by estimating the DD for the sum of *N\_D* and *N\_E*, using both definitions of the DD estimate. The differences are significantly negative at the 1% level, which are consistent with the results I report in Table (10).

#### **6.4 Difference-in-Difference-in-Difference: Likelihood of Manipulation**

In this section, I use DDD estimates to assess the relative importance of the factors affecting manipulation. Equation (2.1) sets out conditions under which manipulation is more likely: (i) when the quality of investments is lower, (ii) when the uncertainty of investments is greater, and (iii) when the probability that investors get informative signals is higher. With two proxies for each of these conditions, I sort the DD estimates into terciles to isolate the GG feedback.<sup>10</sup> Recall that the DD estimate for each measure is given by  $\widehat{M}_t = \widetilde{M}_t - \widetilde{M}_0$ . Let  $\tau$  be the tercile of the proxy for the sample firm, where  $\tau = 1$  is the lowest tercile, and  $\tau = 3$  is the highest tercile. Let  $\widehat{M}_t^\tau$  be the median difference-in-difference of  $M$  in tercile  $\tau$  of the proxy. For a given proxy, the DDD estimate is given by:

$$\overline{M}_t(proxy) = \widehat{M}_t^3 - \widehat{M}_t^1. \quad (6.12)$$

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<sup>10</sup>My results are unchanged having also used quartiles and quintiles.

### *Quality of Investments*

First, manipulation is more likely when the investments themselves are less promising. I use the market-to-book ratio,  $MtB$ , and sales growth,  $\Delta S_{i,t} = \frac{S_{i,t}}{S_{i,t-1}} - 1$ , to proxy for the promise of the investments faced by a firm (Biddle et al., 2009).

If GG are correct, the feedback should be stronger for firms that are faced with less promising investments in the years after option listing: lower  $MtB$  or lower  $\Delta S$ . That is, the DD estimates should be larger for higher values of  $MtB$  or  $\Delta S$ , and so the difference in the DD estimates between the highest and lowest tercile should be positive. Therefore, under the alternative,  $\forall t > 0$ :

$$\overline{M}_t(MtB) > 0 \tag{6.13}$$

$$\overline{M}_t(\Delta S) > 0. \tag{6.14}$$

Table (11) reports the median DDD estimates when sorted on proxies for the quality of the investments faced by the firms.

[Insert Table 11 here.]

For the most part, I fail to reject the null concerning the quality of investments affecting the likelihood of manipulation. Though I find very weak evidence that firms faced with lower quality investments raise lesser new debt, I find no evidence that the quality of investments affects any of my other measures.

### *Uncertainty of Investments*

Next, manipulation is more likely when firms face more uncertain investments. My proxies for the uncertainty of investments are  $\sigma(R)$ , measured as the annualized standard deviation of log returns over the 250 trading days prior to the 15th of the month (Mayhew and Mihov, 2004), and the standard deviation of the research and devel-

opment expense of the firm scaled by total assets over the 5 years leading up to an option listing,  $\sigma(RND) = \sigma(\{RND_{t-k}\}_{k=1}^5)$  (Biddle et al., 2009).<sup>11</sup>

The feedback effect will be stronger for firms faced with more uncertain investments: higher  $\sigma(R)$  or higher  $\sigma(RND)$ . That is, the DD estimates should be lower for higher values of  $\sigma(R)$  or  $\sigma(RND)$ , and so the difference in the DD estimates between the highest and lowest tercile should be negative. Therefore, under the alternative,  $\forall t > 0$ :

$$\overline{M}_t(\sigma(R)) < 0 \quad (6.15)$$

$$\overline{M}_t(\sigma(RND)) < 0. \quad (6.16)$$

Table (12) reports the median DDD estimates when sorted on proxies for the uncertainty of investments.

[Insert Table 12 here.]

There is some evidence that the uncertainty of investments influences the feedback effect associated with capital expenditures, new equity issues and future free cash flows. For example,  $\overline{CAP}_1(\sigma(R))$  and  $\overline{CAP}_2(\sigma(R))$  are significantly negative at the 5% level: compared to their peers, the sample firms faced with more uncertain investments see a greater reduction in their capital expenditures than those faced with less uncertain investments in both years after options have been listed. Some of the DDD estimates are also significantly negative for new equity raised and future free cash flows. This suggests that a manager or new equity holder is even more likely to avoid a highly uncertain, though positive, NPV project because of the additional uncertainty of the investments.

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<sup>11</sup>  $RND_t = \frac{DATA46_t}{DATA6_t}$ . To be consistent with my computation of total investments,  $INV$ , I have also replaced the missing observations of research and development expense with zeros. The reader may be concerned that this results in many values of  $\sigma(RND)$  being zero. This is not the case because in most 5-year intervals, there tend to be at least 2 to 3 years of non-zero research and development expense reported.

*Probability of being Informed*

Finally, manipulation is more likely when the probability that the investor gets an informative signal is higher. I use the probability of informed trading (*PIN*) of Easley et al. (1996)<sup>12</sup> to proxy for the information market participants have about the firm. My second proxy is the idiosyncratic risk of the firm.<sup>13</sup> Let  $\sigma(\epsilon)$  be the idiosyncratic risk of the firm, which is estimated using the market model with data from days  $-60$  to  $-6$  relative to the day of an option listing.<sup>14</sup>

Firms for which there is a higher probability that an investor will receive an informative signal are more susceptible to the feedback effect: higher *PIN* or higher  $\sigma(\epsilon)$ . The DD estimates should be lower for higher values of *PIN* or  $\sigma(\epsilon)$ , and so the difference in the DD estimates between the highest and lowest tercile should be negative. Therefore, under the alternative,  $\forall t > 0$ :

$$\overline{M}_t(PIN) < 0 \tag{6.17}$$

$$\overline{M}_t(\sigma(\epsilon)) < 0. \tag{6.18}$$

Table (13) reports the median DDD estimates when sorted on proxies for the informativeness of the financial market.

[Insert Table 13 here.]

There is some evidence that the probability that an investor receives an informative signal influences the feedback effect associated with new equity raised, and

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<sup>12</sup>This measure was computed and implemented in Duarte and Young (2009). I thank Professor Lance Young for supplying me with the annual *PIN* measures.

<sup>13</sup>Ferreira and Laux (2007) treat idiosyncratic risk as an index of the flow of private information to the market. They also find that the information contained in idiosyncratic risk is different from the information contained in the financial statements.

<sup>14</sup>I use this estimation interval to be consistent with the computation of the CARs in the previous chapter.

weak evidence that it affects future free cash flows. For example,  $\overline{N\_E}_1(PIN)$  is significantly negative at the 10% level, and  $\overline{N\_E}_1(\sigma(\epsilon))$  is significantly negative at the 1% level: when the probability that an investor gets an informative signal is higher, compared to their matched peers, my sample firms raise lesser new equity in the year after option listing. Because outside shareholders may have less information regarding the firm's investment opportunities, they may rely more heavily on the stock price for their decision (Baker et al., 2003). Therefore, they are less likely to invest in a firm whose stock price is subject to manipulation. This explanation also seems consistent with the (weak) evidence of a greater reduction in future free cash flows.

## **6.5 Summary**

My univariate tests report some evidence consistent with the GG feedback effect. In particular, the feedback acts through option-listed firms' capital expenditures and their total investment expenditures, the amount of new equity they raise and their future free cash flows; there is very weak evidence that their new debt issues are affected as well. There is little evidence, if any, that the feedback effect is being driven by proxies for the quality of their investments. There is evidence that feedback is influenced by proxies for the uncertainty of their investments and proxies for the probability that investors receive an informative signal, which have the strongest impact on new equity raised, and to lesser extents on future free cash flows and capital expenditures.

## Chapter 7

## MULTIVARIATE TESTS

Table (9) suggests that differences between option-listed firms and their peers remain despite having controlled for the determinants of option listing. Using the multivariate setting, I attempt to account for these differences and for other factors such as omitted variables, and year fixed effects. Each of the following sections describes the control variables chosen for the specific dependent variable(s) in question, the baseline multivariate model, its extensions and the predictions under the alternative hypotheses.

### 7.1 Hypothesis I: Under-Investment

To test Hypothesis I concerning underinvestment, I take the control variables from Fazzari et al. (1988) and Hovakimian and Titman (2006). Fazzari et al. (1988) have shown that cash flow from operations,  $CFO_t$ , which is measured as the sum of income before extraordinary items, depreciation and amortization, and scaled by beginning-period total assets,<sup>1</sup> is a significant determinant of a firm's investment policy.

Hovakimian and Titman (2006) have shown that voluntary asset sales ( $VAS$ )<sup>2</sup> are a significant determinant of a firm's real investment policy, especially if the firm is financially constrained. A financially unhealthy firm may need to sell its assets to accommodate its need for cash; a financially healthy firm also may voluntarily sell its assets to achieve higher operating efficiencies.

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<sup>1</sup> $CFO_t = (DATA18 + DATA14)_t / DATA6_{t-1}$ .

<sup>2</sup> $VAS_t = DATA107_t / DATA6_t$ .

The liquidity of the firm's internal resources may affect the firm's real investment policy because liquidity constrained firms have an incentive to hold cash. These firms may alter their real investment policy to accommodate their need to hold cash.<sup>3</sup> I control for this using financial slack,  $SLACK_t$ , computed as the sum of cash and short-term investments, and scaled by beginning-period total assets.<sup>4</sup>

Following Hovakimian and Titman (2006), I control for leverage using the coverage ratio,  $COVERAGE_t$ , which is measured as interest expense divided by EBITDA.<sup>5</sup> Lang et al. (1996) show that leverage may negatively affect investment expenditures because it reduces the amount of cash available for investment due to the problems associated with debt overhang (Myers, 1977). Alternatively, leverage may improve the quality of investments the firms take by reducing the effects of the free cash flow problem discussed in Jensen (1986).

Firm size and firm age control for a number things. They control for the differences between internal and external financing on a firm's investment demand because external funds are relatively more expensive for younger, growing firms.<sup>6</sup> Smaller firms may be more susceptible to adverse selection problems (Myers and Majluf, 1984) because there is less analyst coverage. Controlling for size takes into account that larger firms may be able to raise debt capital easier than smaller firms, and hence the possibility that the investments of smaller firms may be more sensitive to internal funds. Firm size,  $SIZE_t$ , is measured as the natural logarithm of the beginning-period book value of assets.<sup>7</sup> Firm age,  $AGE_t$ , is measured as the natural logarithm of the number of years a firm has been listed on the NYSE, AMEX, or OTC.

Like Hovakimian and Titman (2006), I control for financing frictions using divi-

<sup>3</sup>See Fazzari et al. (2000) or Kim et al. (1998).

<sup>4</sup> $SLACK_t = \text{DATA1}_t / \text{DATA6}_{t-1}$ .

<sup>5</sup> $COVERAGE_t = \text{DATA15}_t / \text{DATA13}_t$ .

<sup>6</sup>See Devereux and Schiantarelli (1990) and Oliner and Rudebusch (1992).

<sup>7</sup> $\ln(\text{DATA6}_{t-1})$ .

dends and bond ratings. Firms that have paid a dividend are less likely to be liquidity constrained:  $\mathbf{1}_t^{DIV}$ , which is an indicator variable that is 1 in year  $t$  if firm  $i$  paid a dividend. Firms with bond ratings are expected to have an easier time accessing external capital markets:  $\mathbf{1}_t^{BR}$ , which is an indicator variable that is 1 in year  $t$  if firm  $i$  had a bond rating.

I use year fixed effects to control for the aggregate business-cycle effects that may shift the intercept. Finally, the sample consists of the option-listed firms and their matched peers for the year before and two years following option listing. I omit year 0 because it is unclear if I should expect an effect then.<sup>8</sup>

The baseline model is:

$$\begin{aligned}
 INVESTMENT_{i,t+1} = & \alpha_0 + \alpha_1 \mathbf{1}_{i,t}^{OPT} \\
 & + \delta_1 CFO_{i,t} + \delta_2 VAS_{i,t} + \delta_3 SLACK_{i,t} \\
 & + \delta_4 COVERAGE_{i,t} + \delta_5 SIZE_{i,t} + \delta_6 AGE_{i,t} \\
 & + \delta_7 \mathbf{1}_{i,t}^{DIV} + \delta_8 \mathbf{1}_{i,t}^{BR} \\
 & + FE_t + \epsilon_{i,t+1}
 \end{aligned} \tag{7.1}$$

where  $\mathbf{1}_{i,t}^{OPT}$  is an indicator variable that equals one for an option listed firm in the years when its option is listed, and is zero for the firm in the year prior to its option listing, and is always zero for peer firms;  $FE_t$  is the year fixed effect. The alternative predicts:

$$\alpha_1 < 0. \tag{7.2}$$

As extensions, I interact  $\mathbf{1}_{i,t}^{OPT}$  with the various proxies for the factors affecting

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<sup>8</sup>The inferences are qualitatively unchanged if I include year 0.

the likelihood of manipulation, and estimate the following model:

$$\begin{aligned}
INVESTMENT_{i,t+1} = & \alpha_0 + \alpha_1 \mathbf{1}_{i,t}^{OPT} + \alpha_{2,L} \left( \mathbf{1}_{i,t}^{OPT} \times L_{i,t} \right) \\
& + \delta_1 CFO_{i,t} + \delta_2 VAS_{i,t} + \delta_3 SLACK_{i,t} \\
& + \delta_4 COVERAGE_{i,t} + \delta_5 SIZE_{i,t} + \delta_6 AGE_{i,t} \\
& + \delta_7 \mathbf{1}_{i,t}^{DIV} + \delta_8 \mathbf{1}_{i,t}^{BR} + \delta_9 L_{i,t} \\
& + FE_t + \epsilon_{i,t+1}
\end{aligned} \tag{7.3}$$

where  $L_{i,t}$  is the continuous variable that proxies for factors affecting the likelihood of manipulation,  $L \in \{MtB, \Delta S, \sigma(R), \sigma(RND), PIN, \sigma(\epsilon)\}$ . In each of these extensions, I include the particular  $L_{i,t}$  that is interacted with  $\mathbf{1}_{i,t}^{OPT}$  as a control variable to avoid omitted variable bias. For example, I also include  $MtB$  when I estimate the coefficient,  $\alpha_{2,MtB}$ .<sup>9</sup> The alternatives predict:

$$\alpha_{2,L} \begin{cases} > 0 & \text{Quality of Investments } [MtB, \Delta S] \\ < 0 & \text{Uncertainty of Investments } [\sigma(R), \sigma(RND)] \\ < 0 & \text{Probability of an Informative Signal } [PIN, \sigma(\epsilon)] \end{cases} . \tag{7.4}$$

Table (14) reports the correlation matrix of the control variables used in all the regressions associated with  $H_1^I$ .

[Insert Table 14 here.]

Generally, the correlations are consistent with the literature: larger firms have lower volatility, tend to be older and pay dividends.  $MtB$  and  $SIZE$  are negatively correlated: if  $MtB$  to some extent reflects the expected growth of the firm, then smaller and younger firms have much growth ahead of them and older, more estab-

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<sup>9</sup>In unreported results, I have also estimated models that simultaneously include linear combinations of all three proxies for the increase in the likelihood of manipulation. The pattern of the significance of the coefficients of interest is very similar.

lished firms have less growth ahead of them. That being said, I do not attempt to draw any causal relationships here.

Tables (15) and (16) report the coefficient estimates for the regressions involving capital expenditures (*CAP*) and total investment (*INV*) as dependent variables, referred to as the *CAP*-regressions and the *INV*-regressions respectively.

[Insert Tables 15-16 here.]

Some of the significant coefficients on the control variables are unexpectedly different from the literature. For example, the coefficients on slack (*SLACK*) are significantly negative in the *CAP*-regressions and not statistically significant in the *INV*-regressions. The coefficients are unexpectedly statistically negative on cash flow from operations (*CFO*) in the *INV*-regressions.

Finally, note that because I only have data for voluntary asset sales (*VAS*) for about 63% of my sample, I use fewer observations in these regressions.<sup>10</sup> I have re-estimated my model without *VAS* and the pattern of significance in my results is unchanged. Therefore, I have reported results including *VAS* for completeness.

I find almost no evidence that GG's feedback effect results in underinvestment by option-listed firms. The pattern of significance of the coefficients is the same for the *CAP*- and the *INV*-regressions. Unlike the univariate section, I fail to find evidence that only having options listed impacts investment policy:  $\alpha_1$  is not statistically significant. I also fail to find evidence that option-listed firms' real investment policies are affected by the quality of investments they face:  $\alpha_{2,MtB}$  and  $\alpha_{2,\Delta S}$  are not statistically significant. There is weak evidence that option-listed firms underinvest when the uncertainty of the investments they face is higher:  $\alpha_{2,\sigma(R)}$  is significantly negative at the 10% level but  $\alpha_{2,\sigma(RND)}$  is not statistically significant in both sets of regressions. I fail to find evidence that option-listed firms underinvest when the probability

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<sup>10</sup>For example, the baseline model for *CAP* uses 4914 firm-year observations when I include *VAS* instead of the 8063 observations that I would have used without *VAS*.

that investors get informative signals is higher:  $\alpha_{2,PIN}$  and  $\alpha_{2,\sigma(\epsilon)}$  are not statistically significant in both sets of regressions.

## 7.2 Hypothesis II: Access to New Capital

To test Hypothesis II regarding the option-listed firms' access to new capital in a multivariate setting, I select my control variables from Hovakimian et al. (2004). To control for the past price performance, I use the holding period return for the year prior to the issue,  $R_t$ .<sup>11</sup> To control for past profitability, I use return on assets,  $ROA_t$ ,<sup>12</sup> and net operating loss carried forward scaled by total assets,  $NOLC_t$ .<sup>13</sup>

I control for size with  $Sales_t$ , the natural logarithm of sales.<sup>14</sup> Larger firms may have higher target leverages because they have more established cash flows and are less likely to be financially distressed (Rajan and Zingales, 1995).  $Tan\_Assets_t$ ,<sup>15</sup> the tangible assets ratio, is measured as the ratio of net property, plant and equipment to total assets. Firms with higher tangible assets have more to offer as collateral, and therefore can access new capital easier because of lower bankruptcy costs (Titman and Wessels, 1988).

I use the current leverage ratio,  $Leverage_t$ ,<sup>16</sup> to control for the financial risk the firm faces. I use  $Ind\_Lev_t$ , which is the industry median leverage ratio where the

<sup>11</sup>The one-year holding period return is computed as the compound return for the prior 250 days from the option listing date.

<sup>12</sup> $ROA_t$  is the ratio of EBITDA to beginning-period total assets;  $ROA_t = DATA13_t/DATA6_{t-1}$ . While  $ROA$  may be susceptible to the feedback effect, it is less of a concern here because it is being used as an explanatory variable instead of a dependent variable. My results are robust to the exclusion of  $ROA$ .

<sup>13</sup> $NOLC_t = DATA52_t/DATA6_t$ .

<sup>14</sup> $\ln(DATA12_t)$ . I am using a different measure of firm size from the previous section because I am using control variables from a different study, namely Hovakimian et al. (2004), and consequently I am using their definitions.

<sup>15</sup> $Tan\_Assets_t = DATA8_t/DATA6_t$ .

<sup>16</sup> $Leverage_t = (DATA9+DATA34)_t/(DATA9+DATA34+DATA216)_t$ . This definition of leverage is also different from the one used in the previous section.

industries are identified using the 3-digit SIC codes, to account for potentially omitted variables.

Following Hovakimian et al. (2004), I control for managers' reluctance to issue equity if it dilutes the accounting measures of performance (Graham and Harvey, 2001) with  $\mathbf{1}_t^{EPS}$ ,<sup>17</sup> an indicator variable that is set to 1 if the issued equity dilutes the firm's earnings per share more than the issued debt. Finally, I include year fixed effects.

The baseline model is:

$$\begin{aligned}
 NEW\_CAPITAL_{i,t+1} = & \beta_0 + \beta_1 \mathbf{1}_{i,t}^{OPT} \\
 & + \delta_1 R_{i,t} + \delta_2 ROA_{i,t} + \delta_3 NOLC_{i,t} \\
 & + \delta_4 Sales_{i,t} + \delta_5 Tan\_Assets_{i,t} \\
 & + \delta_6 Leverage_{i,t} + \delta_7 Ind\_Lev_{i,t} + \delta_8 \mathbf{1}_{i,t}^{EPS} \\
 & + FE_t + \epsilon_{i,t+1}.
 \end{aligned} \tag{7.5}$$

where  $\mathbf{1}_{i,t}^{OPT}$  and  $FE_t$  are defined as before. The alternative predicts:

$$\beta_1 < 0. \tag{7.6}$$

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<sup>17</sup>The indicator variable is set to 1 when  $E/P > r_d(1 - \tau_C)$ , where  $E/P$  is the firm's earnings-to-price ratio [ $DATA72_t / (DATA199 \times DATA25)_t$ ],  $r_d$  is the yield on Moody's Baa rated debt obtained from the St. Louis Fed website, and the corporate tax rate is  $\tau_C$ , which is assumed to be 50% before 1987, and 34% thereafter.

The extensions are:

$$\begin{aligned}
NEW\_CAPITAL_{i,t+1} = & \beta_0 + \beta_1 \mathbf{1}_{i,t}^{OPT} + \beta_{2,L} \left( \mathbf{1}_{i,t}^{OPT} \times L_{i,t} \right) \\
& + \delta_1 R_{i,t} + \delta_2 ROA_{i,t} + \delta_3 NOLC_{i,t} \\
& + \delta_4 Sales_{i,t} + \delta_5 Tan\_Assets_{i,t} \\
& + \delta_6 Leverage_{i,t} + \delta_7 Ind\_Lev_{i,t} + \delta_8 \mathbf{1}_{i,t}^{EPS} + \delta_9 L_{i,t} \\
& + FE_t + \epsilon_{i,t+1}.
\end{aligned} \tag{7.7}$$

The alternatives predict:

$$\beta_{2,L} \left\{ \begin{array}{l} > 0 \text{ Quality of Investments } [MtB, \Delta S] \\ < 0 \text{ Uncertainty of Investments } [\sigma(R), \sigma(RND)] \\ < 0 \text{ Probability of an Informative Signal } [PIN, \sigma(\epsilon)] \end{array} \right. . \tag{7.8}$$

Table (17) reports the correlation matrix for the control variables used in these regressions.

[Insert Table 17 here.]

Again, the correlations are generally consistent with the literature. For example, the correlation between  $R$  and  $ROA$  is positive, and the correlation between  $Sales$  and  $NOLC$  is negative. Again, I do not attempt to draw any causal relationships from this table.

Tables (18) and (19) report the estimates for the regressions involving new debt issued ( $N\_D$ ) and new equity issued ( $N\_E$ ) as the dependent variables.

[Insert Tables 18-19 here.]

Though different control variables load in the  $N\_D$ -regressions than in the  $N\_E$ -regressions, the signs of some of these coefficients are consistent with the literature.

For example, the coefficients are not statistically significant for *ROA* in the *N\_D*-regressions, but are significantly negative in the *N\_E*-regressions. This is also not consistent with the literature. However, there are some coefficients that are consistent with the literature: the coefficients are significantly positive for *R* and for *Sales* for all of the *N\_D*-regressions, which is consistent with the literature.<sup>18</sup>

I find that new debt issued is largely unaffected by GG's feedback effect. I fail to find evidence that having options listed affects new debt issued:  $\beta_1$  is not statistically significant. I fail to find evidence that option-listed firms faced with better quality projects raise more new debt than their matched peers:  $\beta_{2,MtB}$  and  $\beta_{2,\Delta S}$  are not statistically significant. I fail to find evidence that new debt issued is affected by the uncertainty of the investments the firms face and by the probability that investors get an informative signal:  $\beta_{2,\sigma(R)}$ ,  $\beta_{2,\sigma(RND)}$ ,  $\beta_{2,PIN}$  and  $\beta_{2,\sigma(\epsilon)}$  are not statistically significant. New debt issued may be largely immune to the GG feedback effect because new creditors are ignoring the financial market (Morck et al., 1990).

Like in the univariate section, I find some evidence that GG's feedback affects new equity issued. There is strong evidence that option-listed firms raise less new equity than their matched peers:  $\beta_1$  is significantly negative at the 1% level. Furthermore, there is some evidence that option-listed firms raise less equity when faced with more uncertain investments:  $\beta_{2,\sigma(R)}$  and  $\beta_{2,\sigma(RND)}$  are significantly negative at the 1% and 10% levels respectively. There is strong evidence that option-listed firms raise less equity when there is a higher probability that investors receive informative signals:  $\beta_{2,PIN}$  and  $\beta_{2,\sigma(\epsilon)}$  are significantly negative at the 1% level. I fail to find evidence that the amount of new equity raised is affected by the quality of the investments facing them:  $\beta_{2,MtB}$  and  $\beta_{2,\Delta S}$  are not statistically significant. The significantly positive coefficient on *MtB* may be because firms are more likely to issue new equity when their future prospects are better (Baker and Wurgler, 2002). Although GG is silent

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<sup>18</sup>See Lang et al. (1996) and Hovakimian et al. (2004) among others.

on which of new debt or new equity will be affected by the feedback, my evidence suggests that new equity issued is the likely candidate.<sup>19</sup>

### 7.3 Hypothesis III: Free Cash Flow

Most of the control variables that I use to test Hypothesis III regarding future free cash flows in the multivariate setting are identical to ones I used to test  $H_1^I$  and  $H_1^{II}$ , and are for the same reasons.<sup>20</sup> I control for the size and age of the firm with  $Sales_t$  and  $AGE_t$  respectively.  $\mathbf{1}_{i,t}^{DIV}$  controls for firms that pay dividends tending to be more profitable (Fama and French, 2001). Because earnings tend to be autocorrelated (Fama and French, 2000), I also include the first lag of the dependent variable as a control. Finally, I use year fixed effects.

The baseline model is:

$$\begin{aligned} FCF_{i,t+1} = & \gamma_0 + \gamma_1 \mathbf{1}_{i,t}^{OPT} \\ & + \delta_1 Sales_t + \delta_2 AGE_t + \delta_3 \mathbf{1}_{i,t}^{DIV} + \delta_4 FCF_{i,t} \\ & + FE_t + \epsilon_{i,t+1} \end{aligned} \tag{7.9}$$

where  $\mathbf{1}_{i,t}^{OPT}$  and  $FE_t$  are defined as before. The alternative predicts:

$$\gamma_1 < 0. \tag{7.10}$$

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<sup>19</sup>I have also estimated these regressions model using the sum of  $N\_D$  and  $N\_E$  as the dependent variable, and as with the univariate section, my results are very similar to the results in the  $N\_E$ -regressions.

<sup>20</sup>See Fama and French (2000, 2001).

The extensions are:

$$\begin{aligned}
FCF_{i,t+1} = & \gamma_0 + \gamma_1 \mathbf{1}_{i,t}^{OPT} + \gamma_{2,L} \left( \mathbf{1}_{i,t}^{OPT} \times L_{i,t} \right) \\
& + \delta_1 Sales_t + \delta_2 AGE_t + \delta_3 \mathbf{1}_{i,t}^{DIV} + \delta_4 FCF_{i,t} + \delta_5 L_{i,t} \\
& + FE_t + \epsilon_{i,t+1}.
\end{aligned} \tag{7.11}$$

The alternatives predict:

$$\gamma_{2,L} \begin{cases} > 0 & \text{Quality of Investments } [MtB, \Delta S] \\ < 0 & \text{Uncertainty of Investments } [\sigma(R), \sigma(RND)] \\ < 0 & \text{Probability of an Informative Signal } [PIN, \sigma(\epsilon)] \end{cases} . \tag{7.12}$$

Table (20) reports the correlation matrix for the variables used in the regressions.

[Insert Table 20 here.]

Most of the correlations are identical to the ones in Tables (14) and (17). Again, I do not attempt to draw any causal relationships from these correlations.

Table (21) reports the estimates of the regression coefficients using future free cash flow ( $FCF$ ) as the dependent variable.

[Insert Table 21 here.]

The coefficients on the control variables are consistent with the literature. For example, the coefficients on *Sales* and on the previous period's free cash flow are statistically positive in all the regression models.<sup>21</sup>

I find strong evidence that GG's feedback effect results in lower future free cash flows possibly because managers are underinvesting. There is weak evidence that option-listed firms see lower future free cash flows:  $\gamma_1$  is significantly negative at the

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<sup>21</sup>See Fama and French (2000).

10% level. Unlike the univariate section, I find strong evidence that the quality of investments lowers future free cash flows as well:  $\gamma_{2,MtB}$  and  $\gamma_{2,\Delta S}$  are significantly positive at the 1% level. I also find strong evidence that option-listed firms see lower future free cash flows when the uncertainty of their investments is higher:  $\gamma_{2,\sigma(R)}$  and  $\gamma_{2,\sigma(RND)}$  are significantly negative at the 1% level. Finally, there is some evidence of lower future free cash flows when the probability that investors receive informative signals is higher:  $\gamma_{2,PIN}$  is not statistically significant and  $\gamma_{2,\sigma(\epsilon)}$  is significantly negative at the 1% level.

#### **7.4 Summary**

Taken together, the results from my multivariate analysis present some evidence of GG's feedback effect. Neither option-listed firms' real investment policies nor the amount of new debt they raise are strongly impacted by the feedback effect, if at all. However, there is strong evidence that GG's feedback effect impacts the amount of new equity raised. Though not on account of the quality of the investments they face, option-listed firms see a decrease in the amount of new equity issued when faced with highly uncertain investments and when the probability an investor gets an informative signal is higher. Finally, there is strong evidence that the future free cash flows of option-listed firms decrease. Option-listed firms also see a decrease in future free cash flows when faced with higher values of all the proxies for the increased likelihood of manipulation.

## Chapter 8

### CONCLUSION

Using option listing to proxy for a reduction in short-sale constraints, I test Goldstein and Guembel's (2008) model, in which firms' real investment and financing policies may be distorted by manipulative short-selling. Such distortions arise because prices play an allocative role in firms' investment decisions, sometimes giving an uninformed investor an incentive to trade despite knowing he is uninformed.

I find some evidence that option-listed firms suffer the consequences of GG's feedback effect in their investment policies, financing policies and future free cash flows. There is some evidence that managers may be using information from the financial markets when making real investment decisions for the firm (Luo, 2005; Chen et al., 2007). The results from my univariate tests suggest that managers reduce capital expenditures and total investment after option listing, especially when the uncertainty of the investments they face and the probability that investors have received an informative signal are higher. However, the evidence regarding underinvestment from the multivariate tests is not as strong.

GG are silent on whether their feedback effect impacts new issues of debt or equity but the evidence from my univariate and multivariate tests suggest that feedback only impacts new equity issued and that new debt issued is largely immune to it.

Finally, option-listed firms also see lower future free cash flows. My univariate tests offer some evidence that this may be due to under-investment, though the evidence of this from multivariate tests is not as strong.

Taken together, my findings are consistent with the current literature that documents the real economic effects due to feedback in the financial market (Durnev et al.,

2004; Luo, 2005; Chen et al., 2007). It also offers an alternative explanation for the negative CARs associated with option listing (Sorescu, 2000; Danielsen and Sorescu, 2001).

## TABLES

Table 1: Annual Distribution of Firms

This table reports the distribution of new option listings, eligible firms and matched firms between 1973 to 2009. There are no data for 1979 because of the moratorium imposed by the SEC; I was not able to obtain the data for 1998 and 1999. The SEC restrictions on the eligibility of firms are detailed in Table 1 of Mayhew and Mihov (2004). In addition to imposing these conditions, I also used only CRSP share codes 10, 11 and 12.

Year	Sample Firms	Eligible Firms	Matched Firms	% Matched
1973	24	98	5	21
1974	8	55	0	0
1975	70	101	14	20
1976	48	126	16	33
1977	14	133	5	36
1978	1	157	0	0
1979	N/A	N/A	N/A	N/A
1980	49	211	24	49
1981	9	297	4	44
1982	65	284	32	49
1983	24	453	10	42
1984	19	529	9	47
1985	59	617	27	46
1986	45	685	21	47
1987	93	735	45	48
1988	96	739	46	48
1989	72	674	33	46
1990	109	704	54	50
1991	123	946	53	43
1992	85	1009	41	48
1993	139	1038	67	48
1994	146	1147	72	49
1995	218	1238	107	49
1996	319	1405	159	50
1997	30	1295	14	47
1998	N/A	N/A	N/A	N/A
1999	N/A	N/A	N/A	N/A
2000	187	1682	81	43

Year	Sample Firms	Eligible Firms	Matched Firms	% Matched
2001	171	1825	83	49
2002	122	1549	59	48
2003	119	1370	50	42
2004	230	1281	113	49
2005	140	1205	68	49
2006	208	1197	100	48
2007	163	1194	77	47
2008	177	1178	89	50
2009	86	1174	36	42
Total	3468	28331	1614	47

Table 2: Summary Statistics of *VOLUME*

This table reports the summary statistics for the covariate *VOLUME*. *VOLUME* is the average daily trading volume, in millions of shares, over the 250 trading days prior to the 15th of the month. The difference is between sample and control firms.  $N$  is the number of observations.  $\mu$  is the mean;  $Q_{50}$  is the median. The mean and median difference are tested against a two-sided alternative using a  $t$ -test and a Wilcoxon-Mann-Whitney test respectively.

Year	Sample Firms			Control Firms			Difference		
	$N$	$\mu$	$Q_{50}$	$N$	$\mu$	$Q_{50}$	$N$	$\mu$	$Q_{50}$
1973	5	0.047	0.050	5	0.040	0.013	5	0.007	0.026
1975	14	0.030	0.029	14	0.037	0.022	14	-0.007**	0.004
1976	16	0.034	0.031	16	0.044	0.033	16	-0.010	-0.003
1977	5	0.022	0.016	5	0.018	0.020	5	0.004	-0.003*
1980	24	0.053	0.044	24	0.077	0.041	24	-0.023***	0.001
1981	4	0.053	0.058	4	0.062	0.040	4	-0.008	0.017
1982	32	0.042	0.037	32	0.051	0.023	32	-0.009	0.010***
1983	10	0.084	0.056	10	0.062	0.039	10	0.021	0.020
1984	9	0.103	0.108	9	0.099	0.047	9	0.004*	0.041
1985	27	0.172	0.117	27	0.187	0.096	27	-0.015	0.011
1986	21	0.143	0.117	21	0.130	0.081	21	0.013	0.026*
1987	45	0.152	0.112	45	0.115	0.037	45	0.037	0.075**
1988	46	0.109	0.095	46	0.119	0.040	46	-0.011***	0.057***
1989	33	0.114	0.076	33	0.062	0.029	33	0.052	0.051
1990	54	0.093	0.068	54	0.074	0.021	54	0.019	0.038
1991	53	0.129	0.094	53	0.095	0.035	53	0.035*	0.031
1992	41	0.108	0.109	41	0.091	0.025	41	0.017**	0.052
1993	67	0.155	0.090	67	0.120	0.035	67	0.035**	0.040
1994	72	0.133	0.115	72	0.110	0.042	72	0.022	0.068
1995	107	0.098	0.082	107	0.112	0.030	107	-0.013	0.045
1996	159	0.119	0.107	159	0.115	0.036	159	0.004	0.055**
1997	14	0.139	0.139	14	0.203	0.044	14	-0.064	0.076
2000	81	0.918	0.509	81	1.355	0.349	81	-0.437***	0.103
2001	83	0.382	0.174	83	0.680	0.040	83	-0.298***	0.116**
2002	59	0.155	0.148	59	0.201	0.028	59	-0.047	0.096
2003	50	0.330	0.222	50	0.874	0.079	50	-0.544*	0.100
2004	113	0.326	0.208	113	0.611	0.048	113	-0.285*	0.121***
2005	68	0.267	0.199	68	0.298	0.057	68	-0.031	0.116
2006	100	0.383	0.220	100	0.366	0.093	100	0.018	0.084
2007	77	0.324	0.176	77	0.595	0.061	77	-0.271	0.095
2008	89	0.283	0.232	89	0.197	0.054	89	0.086	0.158
2009	36	0.311	0.204	36	0.298	0.028	36	0.013	0.165***
Overall	1614	0.237	0.133	1614	0.316	0.044	1614	-0.079**	0.059

Note: \*\*\*, \*\*, \* are significance at 1%, 5%, and 10% respectively.

Table 3: Summary Statistics of *ABVOL*

This table reports the summary statistics for the covariate *ABVOL*. *ABVOL* is the ratio of the 30-day to the 250-day average daily trading volume.  $N$  is the number of observations. The difference is between sample and control firms.  $\mu$  is the mean;  $Q_{50}$  is the median. The mean and median difference are tested against a two-sided alternative using a  $t$ -test and a Wilcoxon-Mann-Whitney test respectively.

Year	Sample Firms			Control Firms			Difference		
	$N$	$\mu$	$Q_{50}$	$N$	$\mu$	$Q_{50}$	$N$	$\mu$	$Q_{50}$
1973	5	1.141	1.185	5	0.855	0.838	5	0.286	0.306
1975	14	1.078	1.107	14	1.047	0.965	14	0.031	-0.112***
1976	16	1.215	1.153	16	1.139	1.135	16	0.076	0.127
1977	5	0.938	1.000	5	0.902	0.898	5	0.036***	0.027
1980	24	1.392	1.272	24	1.250	1.153	24	0.142	0.060
1981	4	0.839	0.853	4	0.704	0.742	4	0.136***	0.059
1982	32	1.217	1.065	32	0.965	0.907	32	0.252	0.265***
1983	10	1.117	1.093	10	0.939	0.778	10	0.178*	0.205
1984	9	1.660	1.164	9	0.930	0.951	9	0.730	0.182
1985	27	1.292	1.197	27	1.232	1.121	27	0.059***	0.232
1986	21	1.387	1.138	21	0.983	0.817	21	0.404	0.356
1987	45	1.387	1.269	45	1.296	1.276	45	0.091	0.215**
1988	46	1.256	1.052	46	1.057	0.690	46	0.199**	0.444
1989	33	1.276	1.102	33	0.991	0.885	33	0.286	0.279
1990	54	1.306	1.167	54	1.020	0.859	54	0.286	0.352
1991	53	1.336	1.264	53	1.029	1.022	53	0.306	0.292**
1992	41	1.562	1.433	41	1.099	0.876	41	0.463***	0.495
1993	67	1.799	1.744	67	0.977	0.839	67	0.823	0.844
1994	72	1.457	1.315	72	0.844	0.730	72	0.612	0.428
1995	107	1.676	1.537	107	1.159	0.940	107	0.518	0.467*
1996	159	1.600	1.425	159	1.082	0.892	159	0.518	0.445
1997	14	1.484	1.401	14	0.987	0.905	14	0.497*	0.635
2000	81	1.588	1.332	81	0.777	0.736	81	0.811	0.626
2001	83	1.865	1.737	83	1.117	0.983	83	0.748	0.637
2002	59	1.700	1.581	59	1.212	1.129	59	0.488	0.405
2003	50	2.128	1.878	50	1.110	0.994	50	1.017***	0.710
2004	113	1.819	1.629	113	1.445	1.134	113	0.374	0.425
2005	68	1.975	1.745	68	1.233	1.020	68	0.741	0.615
2006	100	1.645	1.465	100	1.285	1.016	100	0.360	0.251
2007	77	1.505	1.392	77	1.338	1.123	77	0.167	0.255
2008	89	1.286	1.159	89	0.919	0.845	89	0.367*	0.360
2009	36	1.700	1.191	36	1.163	0.886	36	0.537	0.463
Overall	1614	1.576	1.378	1614	1.111	0.948	1614	0.466**	0.405*

Note: \*\*\*, \*\*, \* are significance at 1%, 5%, and 10% respectively.

Table 4: Summary Statistics of *STD*

This table reports the summary statistics for the covariate *STD*. *STD* is the annualized standard deviation, as a percentage, of log daily returns over the same period. The difference is between sample and control firms. *N* is the number of observations.  $\mu$  is the mean;  $Q_{50}$  is the median. The mean and median difference are tested against a two-sided alternative using a *t*-test and a Wilcoxon-Mann-Whitney test respectively.

Year	Sample Firms			Control Firms			Difference		
	<i>N</i>	$\mu$	$Q_{50}$	<i>N</i>	$\mu$	$Q_{50}$	<i>N</i>	$\mu$	$Q_{50}$
1973	5	0.286	0.301	5	0.251	0.237	5	0.035	0.047
1975	14	0.411	0.386	14	0.453	0.442	14	-0.043***	-0.027
1976	16	0.344	0.333	16	0.292	0.292	16	0.052	0.056
1977	5	0.262	0.226	5	0.245	0.225	5	0.016	-0.003***
1980	24	0.425	0.394	24	0.430	0.436	24	-0.005	-0.012
1981	4	0.498	0.559	4	0.392	0.337	4	0.105	0.114
1982	32	0.380	0.379	32	0.412	0.373	32	-0.031	0.026
1983	10	0.487	0.499	10	0.501	0.472	10	-0.014**	0.011
1984	9	0.381	0.403	9	0.447	0.469	9	-0.066	-0.018
1985	27	0.342	0.328	27	0.327	0.250	27	0.015	0.064
1986	21	0.377	0.354	21	0.418	0.393	21	-0.040	-0.007
1987	45	0.350	0.336	45	0.343	0.302	45	0.007	0.022
1988	46	0.464	0.405	46	0.395	0.359	46	0.069	0.083
1989	33	0.343	0.315	33	0.354	0.319	33	-0.012	0.008
1990	54	0.333	0.327	54	0.417	0.324	54	-0.085**	-0.029
1991	53	0.506	0.477	53	0.505	0.420	53	0.002	0.107*
1992	41	0.547	0.541	41	0.532	0.511	41	0.015	0.031
1993	67	0.539	0.478	67	0.525	0.476	67	0.014	0.040
1994	72	0.499	0.522	72	0.518	0.468	72	-0.020	0.013
1995	107	0.477	0.470	107	0.507	0.387	107	-0.030	0.045
1996	159	0.557	0.548	159	0.502	0.434	159	0.054	0.107
1997	14	0.532	0.572	14	0.394	0.297	14	0.138	0.155
2000	81	0.956	0.992	81	1.080	1.017	81	-0.124**	-0.110**
2001	83	0.753	0.698	83	0.749	0.666	83	0.003	0.039
2002	59	0.553	0.485	59	0.469	0.410	59	0.084	0.064**
2003	50	0.715	0.675	50	0.666	0.525	50	0.048	0.020
2004	113	0.583	0.566	113	0.533	0.473	113	0.050	0.076
2005	68	0.523	0.469	68	0.509	0.442	68	0.014	0.047
2006	100	0.476	0.451	100	0.505	0.417	100	-0.028***	0.025
2007	77	0.459	0.454	77	0.431	0.383	77	0.028	0.030
2008	89	0.549	0.533	89	0.716	0.646	89	-0.167***	-0.134***
2009	36	0.949	0.796	36	0.996	0.909	36	-0.047	-0.087*
Overall	1614	0.542	0.487	1614	0.547	0.455	1614	-0.005	0.026

Note: \*\*\*, \*\*, \* are significance at 1%, 5%, and 10% respectively.

Table 5: Summary Statistics of *ABSTD*

This table reports the summary statistics for the covariate *ABSTD*. *ABSTD* is the analogous measure for volatility of *ABVOL*.  $N$  is the number of observations. The difference is between sample and control firms.  $\mu$  is the mean;  $Q_{50}$  is the median. The mean and median difference are tested against a two-sided alternative using a  $t$ -test and a Wilcoxon-Mann-Whitney test respectively.

Year	Sample Firms			Control Firms			Difference		
	$N$	$\mu$	$Q_{50}$	$N$	$\mu$	$Q_{50}$	$N$	$\mu$	$Q_{50}$
1973	5	0.385	0.343	5	0.406	0.414	5	-0.021	-0.071
1975	14	0.312	0.304	14	0.288	0.309	14	0.024	0.022
1976	16	0.294	0.287	16	0.315	0.318	16	-0.021	0.001
1977	5	0.326	0.303	5	0.274	0.256	5	0.052	0.098
1980	24	0.352	0.346	24	0.301	0.300	24	0.051*	0.094
1981	4	0.317	0.321	4	0.313	0.307	4	0.004	0.009
1982	32	0.360	0.343	32	0.322	0.323	32	0.038	0.027*
1983	10	0.322	0.309	10	0.306	0.282	10	0.016	0.025
1984	9	0.387	0.370	9	0.341	0.352	9	0.046	0.036
1985	27	0.378	0.364	27	0.339	0.344	27	0.039	0.028
1986	21	0.396	0.393	21	0.357	0.348	21	0.039*	0.051
1987	45	0.336	0.316	45	0.330	0.315	45	0.006	-0.009**
1988	46	0.277	0.263	46	0.279	0.250	46	-0.001	0.000
1989	33	0.390	0.387	33	0.354	0.341	33	0.036	0.040
1990	54	0.401	0.377	54	0.404	0.393	54	-0.003	0.011
1991	53	0.338	0.330	53	0.330	0.324	53	0.008	-0.010
1992	41	0.346	0.346	41	0.359	0.350	41	-0.013***	0.011
1993	67	0.362	0.337	67	0.308	0.320	67	0.055	0.031
1994	72	0.340	0.320	72	0.360	0.350	72	-0.020*	-0.009
1995	107	0.373	0.361	107	0.317	0.311	107	0.056	0.044
1996	159	0.365	0.343	159	0.336	0.331	159	0.029	0.006
1997	14	0.377	0.352	14	0.351	0.380	14	0.026	0.010
2000	81	0.364	0.357	81	0.340	0.346	81	0.024	0.027
2001	83	0.376	0.374	83	0.346	0.335	83	0.030	0.040
2002	59	0.331	0.311	59	0.303	0.290	59	0.028***	0.032
2003	50	0.329	0.314	50	0.277	0.259	50	0.052	0.027
2004	113	0.333	0.323	113	0.334	0.324	113	-0.001	-0.008
2005	68	0.383	0.353	68	0.328	0.320	68	0.055**	0.033
2006	100	0.367	0.335	100	0.337	0.336	100	0.030	0.019
2007	77	0.369	0.363	77	0.348	0.346	77	0.021	0.014
2008	89	0.448	0.437	89	0.424	0.423	89	0.025**	0.026***
2009	36	0.325	0.281	36	0.317	0.313	36	0.008	-0.001
Overall	1614	0.361	0.344	1614	0.337	0.329	1614	0.024*	0.020

Note: \*\*\*, \*\*, \* are significance at 1%, 5%, and 10% respectively.

Table 6: Summary Statistics of *MKTCAP*

This table reports the summary statistics for the covariate *MKTCAP*. *MKTCAP* is the market capitalization of the firm in millions of 1996 dollars.  $N$  is the number of observations. The difference is between sample and control firms.  $\mu$  is the mean;  $Q_{50}$  is the median. The mean and median difference are tested against a two-sided alternative using a  $t$ -test and a Wilcoxon-Mann-Whitney test respectively.

Year	Sample Firms			Control Firms			Difference		
	$N$	$\mu$	$Q_{50}$	$N$	$\mu$	$Q_{50}$	$N$	$\mu$	$Q_{50}$
1973	5	6208.5	2300.0	5	5937.0	497.0	5	271.5	1656.5
1975	14	1561.0	928.6	14	1574.8	436.3	14	-13.8	166.8
1976	16	1043.9	649.9	16	1089.6	681.5	16	-45.7	-156.9
1977	5	551.4	594.9	5	569.6	554.6	5	-18.2	94.0
1980	24	1007.8	478.4	24	1641.0	562.6	24	-633.1	119.9
1981	4	995.8	797.3	4	1981.0	397.1	4	-985.2	256.9
1982	32	658.0	496.2	32	683.9	206.9	32	-25.9	183.6
1983	10	1030.0	333.0	10	283.3	231.0	10	746.7	117.1
1984	9	1259.0	993.2	9	635.0	153.4	9	624.0	498.3
1985	27	1547.2	820.7	27	2120.9	638.4	27	-573.7***	37.3
1986	21	1390.2	866.1	21	1234.3	406.6	21	156.0	146.2
1987	45	1823.9	1476.7	45	1680.0	384.4	45	143.9	1014.7
1988	46	973.8	701.6	46	1126.6	316.3	46	-152.8	243.9
1989	33	802.0	631.5	33	566.5	257.1	33	235.6	418.7
1990	54	854.8	643.4	54	652.8	161.2	54	202.0	342.5***
1991	53	729.0	504.1	53	675.3	210.6	53	53.7	257.2
1992	41	415.6	282.0	41	313.2	157.8	41	102.4	126.5
1993	67	579.1	395.7	67	504.1	140.6	67	75.0	137.4
1994	72	552.0	326.3	72	432.0	122.1	72	120.0	116.3
1995	107	605.4	342.8	107	618.4	217.0	107	-13.0	125.4
1996	159	603.5	314.8	159	778.5	193.8	159	-175.0	113.6
1997	14	673.0	305.0	14	1176.6	500.7	14	-503.6	-5.8
2000	81	4297.5	1243.5	81	5741.4	213.0	81	-1444.0***	647.3
2001	83	1666.7	559.4	83	2967.5	186.5	83	-1300.1	286.8
2002	59	992.5	564.4	59	771.3	240.9	59	221.2	253.3
2003	50	545.9	386.8	50	1480.4	235.8	50	-934.5*	189.3
2004	113	868.3	460.9	113	1147.6	176.4	113	-279.3	244.4
2005	68	722.6	414.8	68	758.2	210.5	68	-35.6	147.6
2006	100	832.9	504.5	100	985.4	293.2	100	-152.4	210.6
2007	77	1239.7	542.1	77	2218.9	217.2	77	-979.2	236.4
2008	89	1262.1	583.1	89	209.3	80.5	89	1052.8	424.1
2009	36	3102.2	348.8	36	1537.0	50.0	36	1565.2	215.1
Overall	1614	1140.2	490.8	1614	1294.8	212.8	1614	-154.5	218.2

Note: \*\*\*, \*\*, \* are significance at 1%, 5%, and 10% respectively.

Table 7: Means, Medians of 3-day Cumulative Abnormal Returns

This table reports the 3-day CARs from the replication of a portion of Table III in Sorescu (2000). CARs are computed using the market model with the method in Brown and Warner (1985). The parameters are estimated using OLS with data from  $[T - 60, T - 6]$ , where  $T$  is the option listing date; the 3 days used in the calculation of the CARs are  $[T - 1, T + 1]$ . The market return is the value-weighted NYSE-AMEX-NASDAQ index.  $N$  is the number of observations.  $\mu$  is the mean;  $Q_{50}$  is the median. I perform a one-tailed  $t$ -test of the mean being less than 0, and a one-tailed Majority Preference (Randles, 2001) test of the median being less than 0. There are no data for 1979 because of the moratorium imposed by the SEC; I was not able to obtain the data for 1998 and 1999. There are no matches for the listings in 1974 and 1978.

Year	Matched Sample			Sorescu's Sample		
	$\mu$	$Q_{50}$	$N$	$\mu$	$Q_{50}$	$N$
1973	0.011	0.008	5	0.008	0.005	25
1975	0.014	0.010	14	0.006	0.000	72
1976	0.004	0.000	16	0.008	0.003	49
1977	-0.007	-0.010	5	-0.012	-0.011	15
1980	0.005	-0.004	24	0.009*	0.000	51
1981	0.030	0.026	4	0.006	0.001	11
1982	-0.015*	-0.005*	32	-0.010*	-0.004	67
1983	-0.004	-0.009	10	0.004	-0.003	25
1984	-0.009	-0.017	9	-0.012	-0.016**	20
1985	0.007	-0.004	27	-0.001	-0.005	64
1986	0.012	0.003	21	0.003	-0.003	50
1987	0.006	-0.001	45	0.004	0.000	102
1988	0.008	-0.003	46	0.003	0.001	101
1989	-0.005*	-0.002	33	-0.006	-0.007**	84
1990	-0.001	0.001	54	0.000	-0.001	124
1991	0.001	0.005	53	-0.003	-0.001	145
1992	0.002	-0.006*	41	0.005	0.001	143
1993	-0.008***	-0.007*	67	-0.009**	-0.009***	208
1994	-0.002***	-0.008***	72	-0.005	-0.004*	217
1995	0.003	-0.001**	107	0.001	0.000	295
1996	-0.009	-0.013*	159	-0.010***	-0.013***	433
1997	-0.037**	-0.027**	14	-0.016	-0.018***	38
2000	0.013	0.009	81	-0.005	-0.009**	284
2001	-0.005*	0.001	83	-0.009*	-0.005***	258
2002	0.002	0.004	59	-0.005	-0.002	220
2003	-0.013*	-0.012*	50	-0.014*	-0.007***	166
2004	-0.017***	-0.010**	113	-0.013***	-0.007***	350
2005	-0.018**	-0.014**	68	-0.011***	-0.005***	283

Note: \*\*\*, \*\*, \* are significance at 1%, 5%, and 10% respectively.

Year	Matched Sample			Sorescu's Sample		
	$\mu$	$Q_{50}$	$N$	$\mu$	$Q_{50}$	$N$
2006	0.003	0.002	100	-0.006*	-0.001***	374
2007	-0.012***	-0.012***	77	-0.004	-0.004***	436
2008	-0.008	-0.007	89	-0.008**	-0.005*	308
2009	-0.020**	-0.020**	36	-0.020***	-0.014**	123
Overall	-0.002***	-0.001***	1614	-0.006***	-0.004***	5437

Note: \*\*\*, \*\*, \* are significance at 1%, 5%, and 10% respectively.

Table 8: Number of Observations

This table reports the distributions of the number of observations for each of my variables.  $n$  = number of observations that are not 0.  $k$  = number of observations that are 0.  $m$  = number of observations that are missing.  $p$  = fraction of sample that are missing. Note that in the computation of  $INV$ , missing values of research and development expense and acquisitions were filled in with zeros.  $CAP$  is the ratio of capital expenditure to total assets [DATA128/DATA6].  $INV$  is total investment, which is the ratio of the sum of capital expenditures, research and development [DATA146] expense and (cash and stock) acquisitions [from SDC] to total assets. Note that missing values of research and development expense and acquisitions were filled in with zeros.  $N\_D$  is the ratio of new debt issuances to total assets [DATA111/DATA6] and  $N\_E$  is the ratio of new equity issuances to total assets [DATA108/DATA6].  $FCF$  is the ratio of EBITDA, nett of capital expenditure and change in working capital, to total assets from 2 years ago [(DATA13 - DATA128 - DATA180)/(DATA6)].

Relative Year	CAP			INV			N_D			N_E			FCF							
	$n$	$k$	$m$	$p$	$n$	$k$	$m$	$p$	$n$	$k$	$m$	$p$	$n$	$k$	$m$	$p$				
Panel A: Sample Firms																				
-1	1527	20	69	0.04	1527	20	69	0.04	871	619	126	0.08	1377	158	81	0.05	1513	1	102	0.06
0	1497	17	102	0.06	1497	17	102	0.06	863	620	133	0.08	1369	137	110	0.07	1553	1	62	0.04
1	1438	13	166	0.10	1438	13	166	0.10	787	626	204	0.13	1308	136	173	0.11	1496	1	120	0.07
2	1342	14	259	0.16	1342	14	259	0.16	716	593	306	0.19	1197	148	270	0.17	1393	0	222	0.14
Panel B: Peer Firms																				
-1	1408	42	166	0.10	1408	42	166	0.10	841	570	205	0.13	1112	327	177	0.11	1520	0	96	0.06
0	1307	33	276	0.17	1307	33	276	0.17	759	549	308	0.19	1026	307	283	0.18	1418	0	198	0.12
1	1212	34	371	0.23	1212	34	371	0.23	698	516	403	0.25	921	318	378	0.23	1315	0	302	0.19
2	1100	34	481	0.30	1100	34	481	0.30	641	464	510	0.32	816	303	496	0.31	1181	0	434	0.27

Table 9: Median Values of Sample and Peer Firms

This table reports the median values of the sample and peer firms across 4 relative years; relative year 0 is the year in which a new option was listed. All the variables are defined as in Table (8). Peer firms are chosen using the propensity score matching algorithm, in which Equation (5.1) is used to compute the propensity scores.

Relative Year	Variables				
	<i>CAP</i>	<i>INV</i>	<i>N_D</i>	<i>N_E</i>	<i>FCF</i>
Panel A: Sample Firms					
-1	0.049	0.120	0.011	0.011	0.183
0	0.050	0.120	0.013	0.014	0.202
1	0.045	0.107	0.011	0.008	0.179
2	0.047	0.100	0.012	0.005	0.153
Panel B: Peer Firms					
-1	0.040	0.074	0.011	0.003	0.111
0	0.037	0.073	0.011	0.003	0.105
1	0.036	0.067	0.011	0.002	0.099
2	0.037	0.066	0.010	0.002	0.099

Table 10: Difference-in-Difference Tests

This table reports the median peer-adjusted differences between relative years. All the variables are defined as in Table (8). I estimate one-tailed tests of the difference in medians using Randles (2001). [*p*-values are reported in brackets.]

Relative Year	Median				
	<i>CAP</i>	<i>INV</i>	<i>N_D</i>	<i>N_E</i>	<i>FCF</i>
1	-0.002** [ 0.02]	-0.005** [ 0.02]	0.000 [> 0.99]	-0.001** [ 0.02]	-0.004 [ 0.11]
2	-0.002** [ 0.03]	-0.003 [ 0.23]	0.000 [ 0.97]	-0.002*** [ 0.00]	-0.015*** [ 0.00]

Note: \*\*\*, \*\*, \* are significance at 1%, 5%, and 10% respectively.

Table 11: Difference-in-Difference-in-Difference Tests: Quality of Investments

This table reports the median peer-adjusted differences between the highest and the lowest terciles based on proxies for the quality of investments, and between relative years; the highest tercile is 3 and the lowest tercile is 1.  $MtB$  is the market-to-book ratio, and sales growth is measured as  $\Delta S_{i,t} = \frac{S_{i,t}}{S_{i,t-1}} - 1$  (DATA12).

All the remaining variables are defined as in Table (8). I estimate one-tailed tests of the difference in medians using Randles (2001). [ $p$ -values are reported in brackets.]

Relative Year	Median				
	$CAP$	$INV$	$ND$	$NE$	$FCF$
	Panel A: $MtB$				
1	0.003 [ 0.11]	0.009 [ 0.18]	0.006 [ 0.27]	-0.006 [ 0.90]	-0.025 [ 0.96]
2	-0.003 [ 0.84]	0.013 [ 0.16]	0.016* [ 0.06]	-0.010 [ 0.98]	-0.058 [>0.99]
	Panel B: $\Delta(S)$				
1	-0.002 [ 0.72]	-0.016 [ 0.84]	-0.025 [ 0.97]	-0.006 [ 0.92]	-0.071 [>0.99]
2	-0.001 [ 0.59]	0.005 [ 0.25]	-0.034 [ 0.99]	-0.014 [>0.99]	-0.169 [>0.99]

Note: \*\*\*, \*\*, \* are significance at 1%, 5%, and 10% respectively.

Table 12: Difference-in-Difference-in-Difference Tests: Uncertainty of Investments

This table reports the median peer-adjusted differences between the highest and the lowest terciles based on proxies for the uncertainty of investments, and between relative years; the highest tercile is 3 and the lowest tercile is 1. Volatility is measured with  $\sigma(R)$ , the annualized standard deviation of log returns over the 250 trading days prior to the 15th of the month (Mayhew and Mihov, 2004). Standard deviation of research and development expense-to-total assets in the last five years,  $\sigma_i(RND) = \sigma(\{RND_{i,t-k}\}_{k=1}^5)$  (DATA46); note that missing values of research and development expense were filled in with zeros.

All the remaining variables are defined as in Table (8). I estimate one-tailed tests of the difference in medians using Randles (2001). [ $p$ -values are reported in brackets.]

Relative Year	Median				
	<i>CAP</i>	<i>INV</i>	<i>N_D</i>	<i>N_E</i>	<i>FCF</i>
	Panel A: $\sigma(R)$				
1	-0.004** [ 0.04]	-0.006 [ 0.17]	0.015 [ 0.96]	-0.009*** [ 0.00]	-0.036** [ 0.01]
2	-0.006** [ 0.04]	-0.002 [ 0.41]	0.000 [ 0.62]	-0.010** [ 0.01]	-0.051** [ 0.01]
	Panel B: $\sigma(RND)$				
1	0.000 [ 0.56]	0.001 [ 0.63]	0.004 [ 0.80]	-0.005** [ 0.03]	-0.024** [ 0.01]
2	-0.002 [ 0.34]	-0.003 [ 0.38]	-0.001 [ 0.44]	0.000 [ 0.58]	0.005 [ 0.65]

Note: \*\*\*, \*\*, \* are significance at 1%, 5%, and 10% respectively.

Table 13: Difference-in-Difference-in-Difference Tests: Probability an Investor gets an Informative Signal

This table reports the median peer-adjusted differences between the highest and the lowest terciles based on proxies for how informative the financial market is over the real economy, and between relative years; the highest tercile is 3 and the lowest tercile is 1. PIN is measured as in Easley et al. (1996).  $\sigma(\epsilon)$  is the idiosyncratic risk, estimated using the market model. All the remaining variables are defined as in Table (8). I estimate one-tailed tests of the difference in medians using Randles (2001). [ $p$ -values are reported in brackets.]

Relative Year	Median				
	<i>CAP</i>	<i>INV</i>	<i>N_D</i>	<i>N_E</i>	<i>FCF</i>
	Panel A: <i>PIN</i>				
1	0.003 [ 0.65]	-0.015 [ 0.35]	-0.004 [ 0.42]	-0.007* [ 0.07]	0.025 [ 0.94]
2	0.002 [ 0.66]	-0.007 [ 0.42]	-0.004 [ 0.50]	0.000 [ 0.54]	0.003 [ 0.58]
	Panel B: $\sigma(\epsilon)$				
1	-0.002 [ 0.46]	-0.007 [ 0.26]	0.009 [ 0.86]	-0.013*** [ 0.00]	-0.042** [ 0.01]
2	-0.005 [ 0.11]	0.003 [ 0.55]	0.002 [ 0.69]	-0.013*** [ 0.00]	-0.027 [ 0.10]

Note: \*\*\*, \*\*, \* are significance at 1%, 5%, and 10% respectively.

Table 14: Correlation Matrix for Independent Variables in Hypothesis I

This table reports correlations among the various control variables used in the regressions for Hypothesis I.  $CFO$  is the sum of income before extraordinary items, depreciation and amortization, scaled by beginning-period total assets [(DATA18 + DATA14)/DATA6].  $VAS$  is voluntary asset sales, scaled by beginning-period total assets (DATA107/DATA6).  $SLACK$  is the sum of cash and short-term investments, scaled by beginning-period total assets (DATA1/DATA6).  $COVERGAGE$  is interest expense, scaled by EBITDA (DATA15/DATA13).  $SIZE$  is the natural logarithm of total assets (DATA6).  $AGE$  is the natural logarithm of the number years a firm has been listed on the NYSE, AMEX, or OTC.  $1^{DIV}$  is 1 if the firm paid dividends and 0 otherwise.  $1^{BR}$  is 1 if the firm has a bond rating and 0 otherwise.  $MtB$  is the ratio of the market value to the book value of assets [(DATA6 + DATA24×DATA25)/(DATA6)]. Sales growth is measured as  $\Delta S_{i,t} = \frac{S_{i,t}}{S_{i,t-1}} - 1$  (DATA12). Volatility is measured with  $\sigma(R)$ , the annualized standard deviation of log returns over the 250 trading days prior to the 15th of the month (Mayhew and Mihov, 2004). Standard deviation of research and development expense-to-total assets in the last five years,  $\sigma_i(RND) = \sigma(\{RND_{i,t-k}\}_{k=1}^5)$  (DATA46); note that missing values of research and development expense was filled in with zeros. PIN is measured as in Easley et al. (1996).  $\sigma(\epsilon)$  is the idiosyncratic risk, estimated using the market model.

Variables	$CFO$	$VAS$	$SLACK$	$COVERGAGE$	$SIZE$	$AGE$	$1^{DIV}$	$1^{BR}$	$MtB$	$\Delta S$	$\sigma(R)$	$\sigma(RND)$	$PIN$	$\sigma(\epsilon)$
$CFO$	1.000													
$VAS$	-0.006	1.000												
$SLACK$	-0.191	-0.071	1.000											
$COVERGAGE$	0.001	0.018	-0.012	1.000										
$SIZE$	0.246	-0.010	-0.418	-0.004	1.000									
$AGE$	0.086	0.033	-0.303	0.001	0.343	1.000								
$1^{DIV}$	0.123	0.018	-0.336	0.015	0.491	0.398	1.000							
$1^{BR}$	0.073	0.041	-0.290	0.000	0.555	0.296	0.286	1.000						
$MtB$	-0.270	-0.046	0.339	-0.007	-0.285	-0.167	-0.154	-0.153	1.000					
$\Delta S$	-0.011	-0.008	0.003	-0.001	0.013	-0.008	0.010	0.014	0.004	1.000				
$\sigma(R)$	-0.246	0.030	0.304	-0.001	-0.449	-0.310	-0.388	-0.260	0.151	-0.009	1.000			
$\sigma(RND)$	-0.027	-0.011	0.051	-0.002	0.094	0.052	-0.014	0.034	0.017	0.002	0.016	1.000		
$PIN$	-0.169	0.064	0.043	-0.002	-0.497	-0.144	-0.244	-0.270	-0.058	-0.005	0.242	-0.074	1.000	
$\sigma(\epsilon)$	-0.223	0.042	0.280	-0.001	-0.473	-0.291	-0.384	-0.262	0.119	-0.011	0.891	0.007	0.261	1.000

Table 15: Multivariate Test of Capital Expenditures (CAP)

This table reports coefficient estimates of the regression models with capital expenditures as the dependent variable.  $\mathbf{1}^{OPT}$  is an indicator variable that is 1 for an option listed firm and 0 for a peer firm. All variables are defined as in Table (14). The likelihood of manipulation is increased by: (i) the lower the quality of investments (ii) the higher the uncertainty of the investments and (iii) the higher the probability that an investor gets an informative signal. [*t*-statistics are reported in brackets.]

Explanatory Variables	Coefficient	Likelihood of Manipulation	Baseline	0.0175 [0.82]	0.01530 [0.71]	0.01828 [0.83]	Extensions 0.01594 [0.94]	0.003053 [0.32]	0.01911 [0.30]
$\mathbf{1}^{OPT}$	$\alpha_1$		0.01544 [0.80]						
$\mathbf{1}^{OPT} \times MtB$	$\alpha_{2, MtB}$			-0.001876 [-1.10]					
$MtB$		(i)		0.003286*** [5.33]	0.000105 [0.26]				
$\mathbf{1}^{OPT} \times \Delta S$	$\alpha_{2, \Delta S}$				-0.0000296 [-0.08]				
$\Delta S$									
$\mathbf{1}^{OPT} \times \sigma(R)$	$\alpha_{2, \sigma(R)}$					-0.0060137* [-1.84]			
$\sigma(R)$		(ii)				-0.007281* [-1.72]			
$\mathbf{1}^{OPT} \times \sigma(RND)$	$\alpha_{2, \sigma(RND)}$						-0.000128 [-1.46]		
$\sigma(RND)$							0.0000275 [0.75]		
$\mathbf{1}^{OPT} \times PIN$	$\alpha_{2, PIN}$							0.08944 [1.08]	
$PIN$		(iii)						-0.1084 [-1.33]	
$\mathbf{1}^{OPT} \times \sigma(\epsilon)$	$\alpha_{2, \sigma(\epsilon)}$								-0.007497 [-1.22]
$\sigma(\epsilon)$									-0.008359 [-0.93]

Note: \*\*\*, \*\*, \* are significance at 1%, 5%, and 10% respectively.

Explanatory Variables	Coefficient	Likelihood of Manipulation	Baseline		Extensions				
<i>CFO</i>			0.0011429	0.00651***	0.0000966	-0.0002513	0.001065	0.062488***	0.0007109***
			[0.56]	[2.86]	[0.04]	[-0.11]	[0.52]	[4.96]	[-2.02]
<i>VAS</i>			0.2944***	0.3034***	0.2967***	0.3028***	0.2944***	0.2628***	0.3000***
			[9.43]	[9.72]	[9.48]	[9.62]	[9.43]	[4.63]	[9.56]
<i>SLACK</i>			-0.0675***	-0.0708***	-0.0677***	-0.06813***	-0.0671***	-0.07316***	-0.0667***
			[-13.22]	[-13.63]	[-13.03]	[-13.06]	[-13.06]	[-5.02]	[-12.99]
<i>COVERAGE</i>			-0.0000324	-0.00000323	-0.00000930	-0.0000396	-0.0000288	-0.0000691	-0.0000473
			[-0.08]	[-0.01]	[-0.02]	[-0.10]	[-0.07]	[-0.15]	[-0.12]
<i>SIZE</i>			0.0002649	0.0006757	0.0003	-0.000215	0.0002749	-0.004827***	-0.0004378
			[0.35]	[0.88]	[0.40]	[-0.27]	[0.36]	[-3.53]	[-0.55]
<i>AGE</i>			-0.004853***	-0.0004756***	-0.0004745***	-0.0005057***	-0.0004881***	-0.0002555***	-0.0005141***
			[-6.55]	[-6.42]	[-6.41]	[-6.71]	[-6.58]	[-2.61]	[-6.90]
<i>1DIV</i>			-0.0006764	-0.001581	-0.0007495	-0.002146	-0.0007301	-0.0117***	-0.0015425
			[-0.29]	[-0.69]	[-0.33]	[-0.92]	[-0.32]	[-3.05]	[-0.67]
<i>1BR</i>			-0.0054**	-0.004891*	-0.005577**	-0.0053*	-0.005358*	0.0051	-0.0054289**
			[-1.98]	[-1.78]	[-2.03]	[-1.90]	[-1.94]	[1.29]	[-1.97]
<i>R</i> <sup>2</sup>			0.1062	0.1130	0.1054	0.1048	0.1065	0.1069	0.1081
<i>N</i>			4914	4897	4874	4796	4912	1587	4914

Note: \*\*\*, \*\*, \* are significance at 1%, 5%, and 10% respectively.



Explanatory Variables	Coefficient	Likelihood of Manipulation	Baseline		Extensions			
<i>CFO</i>	-0.5409*** [-6.76]		-0.4668*** [-6.70]	-0.4237*** [6.64]	0.4721*** [6.53]	-0.5363*** [6.58]	-0.1854*** [-4.15]	-0.5449*** [-6.44]
<i>VAS</i>	0.0805 [0.60]		0.1637 [1.26]	0.1402 [1.11]	0.1687 [1.31]	0.08296 [0.62]	-0.01438 [-0.07]	0.1549 [1.16]
<i>SLACK</i>	-0.002006 [-0.09]		-0.03981* [-1.84]	0.02933 [1.40]	0.03455 [1.62]	-0.02185 [-1.00]	-0.06162 [-1.19]	0.001810 [0.08]
<i>COVERAGE</i>	0.0005755 [0.34]		0.0008656 [0.52]	0.0005243 [0.33]	0.000249 [0.15]	0.0004647 [0.27]	-0.0000447 [-0.03]	0.0003341 [0.20]
<i>SIZE</i>	-0.001444 [-0.44]		0.003022 [0.95]	-0.002699 [-0.88]	-0.006066* [-1.82]	-0.004572 [-1.40]	-0.00834* [-1.72]	-0.00966*** [-2.82]
<i>AGE</i>	-0.001068*** [-3.36]		-0.0009067*** [-2.93]	-0.001045*** [-3.94]	-0.001184*** [-3.83]	-0.001066*** [-3.37]	-0.0009929*** [-2.86]	-0.001336*** [-4.19]
<i>1<sup>DIV</sup></i>	-0.003297 [-0.33]		-0.01221 [-1.27]	-0.006345 [-0.86]	-0.01439 [-1.50]	0.0009748 [0.10]	-0.0224* [-1.64]	-0.01219 [-1.24]
<i>1<sup>BR</sup></i>	-0.02283* [-1.93]		-0.02050* [-1.78]	-0.01942* [-1.75]	-0.01830 [-1.60]	-0.0220* [-1.88]	-0.0112 [-0.79]	-0.0209* [-1.77]
<i>R</i> <sup>2</sup>	0.4775		0.5112	0.3342	0.3843	0.4859	0.0814	0.4893
<i>N</i>	4914		4897	4874	4796	4912	1587	4914

Note: \*\*\*, \*\*, \* are significance at 1%, 5%, and 10% respectively.

Table 17: Correlation Matrix for Independent Variables in Hypothesis II

This table reports correlations among the various control variables used in the regressions for Hypothesis II.  $R$  is the one-year holding period return, computed as the compound return over the prior 250 days from the date of an option listing.  $ROA$  is the ratio of EBITDA to the beginning-period total assets (DATA13/DATA6).  $NOLC$  is net operating loss carried forward, scaled by total assets (DATA52/DATA6).  $Sales$  is the natural logarithm of total sales (DATA12).  $Tan\_Assets$  is the ratio of net PPE to total assets (DATA8/DATA6).  $Leverage$  is the leverage ratio [(DATA9+DATA34)/(DATA9+DATA34+DATA216)].  $Ind\_Lev$  is the industry median leverage ratio, where industries are defined using the 3-digit SIC codes.  $\mathbf{1}^{EPS}$  is 1 if  $E/P > r_d(1 - \tau_C)$ , where  $E/P$  is the firm's earnings-to-price ratio [DATA72/(DATA199×DATA25)],  $r_d$  is the yield on Moody's Baa rated debt, and the corporate tax rate is  $\tau_C$ , which is assumed to be 50% before 1987, and 34% thereafter. and 0 otherwise. The last six variables are defined as in Table (14).

Variables	$R$	$ROA$	$NOLC$	$Sales$	$Tan\_Assets$	$Leverage$	$Ind\_Lev$	$\mathbf{1}^{EPS}$	$MtB$	$\Delta S$	$\sigma(R)$	$\sigma(RND)$	$PIN$	$\sigma(\epsilon)$
$R$	1.000													
$ROA$	0.031	1.000												
$NOLC$	0.018	-0.075	1.000											
$Sales$	-0.123	0.020	-0.355	1.000										
$Tan\_Assets$	-0.081	0.015	-0.051	0.239	1.000									
$Leverage$	-0.020	0.001	-0.019	0.062	0.057	1.000								
$Ind\_Lev$	-0.147	0.018	-0.072	0.283	0.178	0.095	1.000							
$\mathbf{1}^{EPS}$	-0.081	0.015	-0.079	0.315	0.038	0.029	0.255	1.000						
$MtB$	0.151	-0.062	0.397	-0.278	-0.112	-0.044	-0.174	-0.181	1.000					
$\Delta S$	-0.002	-0.013	-0.002	-0.000	-0.007	0.003	0.006	0.009	0.004	1.000				
$\sigma(R)$	0.110	-0.214	0.201	-0.487	-0.181	-0.061	-0.300	-0.289	0.151	-0.009	1.000			
$\sigma(RND)$	0.004	-0.000	0.004	0.089	-0.029	-0.010	-0.089	-0.045	0.017	0.002	0.016	1.000		
$PIN$	-0.033	-0.127	0.108	-0.470	-0.171	0.037	-0.115	-0.111	-0.058	-0.005	0.242	-0.074	1.000	
$\sigma(\epsilon)$	0.101	-0.019	0.072	-0.450	-0.172	-0.041	-0.302	-0.284	0.119	-0.011	0.891	0.007	0.261	1.000

Table 18: Multivariate Test of New Debt Issuance ( $N.D$ )

This table reports coefficient estimates of the regression models with new debt issuance as the dependent variable.  $\mathbf{1}_{i,t}^{OPT}$  is an indicator variable that is 1 for an option listed firm and 0 for a peer firm. All variables are defined as in Table (17). The likelihood of manipulation is increased by: (i) the lower the quality of investments (ii) the higher the uncertainty of the investments and (iii) the higher the probability that an investor gets an informative signal. [ $t$ -statistics are reported in brackets.]

Explanatory Variables	Coefficient	Likelihood of Manipulation	Baseline			Extensions			
$\mathbf{1}^{OPT}$	$\beta_1$		-0.001374 [-0.18]	0.01449 [1.33]	-0.001631 [-0.21]	0.1556 [1.02]	-0.00105 [-0.13]	-0.00204 [-0.06]	0.01435 [0.99]
$\mathbf{1}^{OPT} \times MtB$	$\beta_{2,MtB}$			-0.00688 [-0.81]					
$MtB$		(i)		0.0005643 [0.19]					
$\mathbf{1}^{OPT} \times \Delta S$	$\beta_{2,\Delta S}$				-0.0004891 [-0.07]				
$\Delta S$					0.001495 [0.24]				
$\mathbf{1}^{OPT} \times \sigma(R)$	$\beta_{2,\sigma(R)}$					-0.03225 [-1.25]			
$\sigma(R)$		(ii)				0.03098** [1.99]			
$\mathbf{1}^{OPT} \times \sigma(RND)$	$\beta_{2,\sigma(RND)}$						-0.0002816 [-0.90]		
$\sigma(RND)$							-0.0002632* [-1.74]		
$\mathbf{1}^{OPT} \times PIN$	$\beta_{2,PIN}$							0.1892 [1.13]	
$PIN$		(iii)						-0.1367 [-1.41]	
$\mathbf{1}^{OPT} \times \sigma(\epsilon)$	$\beta_{2,\sigma(\epsilon)}$								-0.03112 [-1.20]
$\sigma(\epsilon)$									0.03366** [2.40]

Note: \*\*\*, \*\*, \* are significance at 1%, 5%, and 10% respectively.



Table 19: Multivariate Test of New Equity Issuance ( $N_{E}$ )

This table reports coefficient estimates of the regression models with new equity issuance as the dependent variable.  $\mathbf{1}_{i,t}^{OPT}$  is an indicator variable that is 1 for an option listed firm and 0 for a peer firm. All variables are defined as in Table (17). The likelihood of manipulation is increased by: (i) the lower the quality of investments (ii) the higher the uncertainty of the investments and (iii) the higher the probability that an investor gets an informative signal. [ $t$ -statistics are reported in brackets.]

Explanatory Variables	Coefficient	Likelihood of Manipulation	Baseline	Extensions						
				0.03719 [1.44]	0.03057 [0.53]	0.01814 [0.33]	0.0342 [0.34]	-0.01589 [-1.52]	0.02224 [0.90]	
$\mathbf{1}^{OPT}$	$\beta_1$		-0.03305*** [8.19]							
$\mathbf{1}^{OPT} \times MtB$	$\beta_{2,MtB}$									
$MtB$		(i)		-0.00822 [0.27]						
$\mathbf{1}^{OPT} \times \Delta S$	$\beta_{2,\Delta S}$			0.02528*** [16.92]						
$\Delta S$					-0.0028 [-0.79]					
					0.01205 [0.76]					
$\mathbf{1}^{OPT} \times \sigma(R)$	$\beta_{2,\sigma(R)}$					-0.02322*** [-3.77]				
$\sigma(R)$		(ii)				-0.021857 [-0.75]				
$\mathbf{1}^{OPT} \times \sigma(RND)$	$\beta_{2,\sigma(RND)}$						-0.0001838* [-1.80]			
$\sigma(RND)$							0.000146 [1.81]			
$\mathbf{1}^{OPT} \times PIN$	$\beta_{2,PIN}$							-0.1571*** [-3.08]		
$PIN$		(iii)						-0.1416*** [-4.82]		
$\mathbf{1}^{OPT} \times \sigma(\epsilon)$	$\beta_{2,\sigma(\epsilon)}$								-0.02098*** [-2.90]	
$\sigma(\epsilon)$									-0.03124*** [-3.87]	

Note: \*\*\*, \*\*, \* are significance at 1%, 5%, and 10% respectively.

Explanatory Variables	Coefficient	Likelihood of Manipulation	Extensions					
			Baseline	0.0004532	0.0007068	-0.0001626	0.0004721	0.006763***
<i>R</i>	0.0005455 [0.34]		-0.0004532 [-0.30]	0.0007068 [0.45]	-0.0001626 [-0.10]	0.0004721 [0.30]	0.006763*** [2.89]	0.00003862 [0.23]
<i>ROA</i>	-0.2154*** [-19.67]		-0.2486*** [-23.28]	-0.2086*** [-19.02]	-0.2213*** [-20.24]	-0.2152*** [-19.59]	-0.07908*** [-5.96]	-0.2166*** [-19.78]
<i>NOIC</i>	0.006927*** [5.05]		0.00288*** [2.18]	0.007438*** [5.49]	0.007806*** [5.79]	0.006865*** [5.00]	0.02364*** [2.64]	0.007284*** [5.31]
<i>Sales</i>	-0.01395*** [-11.34]		-0.0086*** [-7.14]	-0.01362*** [-11.10]	-0.01330*** [-10.58]	-0.01427*** [-11.42]	-0.01048*** [-7.35]	-0.01517*** [-11.80]
<i>Tan_Assets</i>	0.0006424 [0.08]		0.01207 [1.50]	0.001804 [0.22]	0.002858 [0.35]	0.001862 [0.02]	-0.002447 [-0.34]	0.001310 [0.16]
<i>Leverage</i>	0.0012218 [0.93]		0.001566 [1.26]	0.001159 [0.90]	0.001222 [0.96]	0.001277 [0.97]	-0.01702*** [-2.80]	0.001089 [0.83]
<i>Ind_Lev</i>	-0.02599 [-1.52]		-0.01638 [-1.01]	-0.02626 [-1.56]	-0.02924* [-1.75]	-0.02411 [-1.40]	-0.01098 [-0.65]	-0.03142* [-1.84]
<b>1</b> <i>EPS</i>	0.00005 [0.01]		0.009747*** [2.46]	-0.0001157 [-0.03]	0.000904 [0.22]	0.0004928 [0.12]	-0.007796*** [-2.25]	-0.0009074 [-0.22]
<i>R</i> <sup>2</sup>	0.2387 4096		0.3113 4096	0.2480 4079	0.2434 4032	0.2399 4087	0.1431 1306	0.2415 4096
<i>N</i>								

Note: \*\*\*, \*\*, \* are significance at 1%, 5%, and 10% respectively.

Table 20: Correlation Matrix for Independent Variables in Hypothesis III

This table reports correlations among the various control variables used in the regressions for Hypothesis III.  $Sales$  is the natural logarithm of total sales (DATA12).  $AGE$  is the natural logarithm of the number years a firm has been listed on the NYSE, AMEX, or OTC.  $MtB$  is the ratio of the market value to the book value of assets [(DATA6 DATA60 + DATA24×DATA25)/(DATA6)].  $\mathbf{1}^{DIV}$  is 1 if the firm paid dividends and 0 otherwise.  $\mathbf{1}^{BR}$  is 1 if the firm has a bond rating, and 0 otherwise. The last six variables are defined as in Table (14).

Variables	$Sales$	$AGE$	$\mathbf{1}^{DIV}$	$FCF_t$	$MtB$	$\Delta S$	$\sigma(R)$	$\sigma(RND)$	$PIN$	$\sigma(\epsilon)$
$Sales$	1.000									
$AGE$	0.408	1.000								
$\mathbf{1}^{DIV}$	0.420	0.398	1.000							
$FCF_t$	0.026	0.020	0.019	1.000						
$MtB$	-0.278	-0.167	-0.155	-0.010	1.000					
$\Delta S$	-0.000	-0.008	0.010	-0.020	0.004	1.000				
$\sigma(R)$	-0.448	-0.305	-0.387	-0.042	0.151	-0.009	1.000			
$\sigma(RND)$	0.089	0.052	-0.014	-0.006	0.017	0.002	0.016	1.000		
$PIN$	-0.470	-0.145	-0.245	-0.036	-0.058	-0.005	0.242	-0.074	1.000	
$\sigma(\epsilon)$	-0.454	-0.292	-0.384	-0.038	0.119	-0.011	0.891	0.007	0.261	1.000

Table 21: Multivariate Test of Free Cash Flow (*FCF*)

This table reports coefficient estimates of the regression models with free cash flow as the dependent variable.  $\mathbf{1}_{i,t}^{OPT}$  is an indicator variable that is 1 for an option listed firm and 0 for a peer firm. All variables are defined as in Table (20). The likelihood of manipulation is increased by: (i) the lower the quality of investments (ii) the higher the uncertainty of the investments and (iii) the higher the probability that an investor gets an informative signal. [*t*-statistics are reported in brackets.]

Explanatory Variables	Coefficient	Likelihood of Manipulation	Baseline	Extensions						
				-0.03015 [-0.23]	0.03669 [0.34]	0.09616 [0.91]	0.04033 [0.63]	0.00959 [0.52]	0.09729 [0.85]	
$\mathbf{1}^{OPT}$	$\gamma_1$		-0.03305* [1.79]							
$\mathbf{1}^{OPT} \times MtB$	$\gamma_{2,MtB}$			0.03193*** [7.38]						
<i>MtB</i>		(i)		0.015242*** [5.07]	0.002636*** [5.79]					
$\mathbf{1}^{OPT} \times \Delta S$	$\gamma_{2,\Delta S}$				0.005548** [2.07]					
$\Delta S$										
$\mathbf{1}^{OPT} \times \sigma(R)$	$\gamma_{2,\sigma(R)}$					-0.1194*** [-3.68]				
$\sigma(R)$		(ii)				-0.0410* [-1.84]				
$\mathbf{1}^{OPT} \times \sigma(RND)$	$\gamma_{2,\sigma(RND)}$						-0.001723*** [-3.13]			
$\sigma(RND)$							-0.0002615 [-1.29]			
$\mathbf{1}^{OPT} \times PIN$	$\gamma_{2,PIN}$							0.04445 [0.48]		
<i>PIN</i>		(iii)						-0.03901 [-0.82]		
$\mathbf{1}^{OPT} \times \sigma(\epsilon)$	$\gamma_{2,\sigma(\epsilon)}$									-0.1349*** [-3.83]
$\sigma(\epsilon)$										-0.0136 [-0.58]

Note: \*\*\*, \*\*, \* are significance at 1%, 5%, and 10% respectively.

Explanatory Variables	Coefficient	Likelihood of Manipulation	Extensions						
			Baseline	0.0829****	0.08021****	0.06973****	0.08250****	0.007877****	0.07829****
<i>Sales</i>			0.0818**** [5.14]	0.0829**** [4.71]	0.08021**** [5.44]	0.06973**** [5.62]	0.08250**** [5.27]	0.007877**** [3.21]	0.07829**** [2.77]
<i>AGE</i>			-0.003054**** [-7.33]	-0.00295**** [-7.05]	-0.003068**** [-7.36]	-0.003033**** [-8.57]	-0.003030**** [-7.28]	-0.000403**** [-2.02]	-0.003273**** [-7.82]
<b>1</b> <i>DIV</i>			-0.0758**** [-6.03]	-0.07525**** [-5.97]	-0.07555**** [-6.01]	-0.07010**** [-5.86]	-0.07913**** [-6.28]	-0.0224**** [-3.01]	-0.08459**** [-6.59]
<i>FCF<sub>t</sub></i>			0.001759**** [4.41]	0.0017577**** [4.41]	0.001737**** [4.36]	0.001632**** [4.44]	0.001737**** [4.36]	0.06698**** [5.98]	0.001684**** [4.22]
<i>R</i> <sup>2</sup>			0.0987	0.1050	0.0969	0.1011	0.1005	0.5508	0.1011
<i>N</i>			8063	8024	8048	7875	8063	2569	8063

Note: \*\*\*, \*\*, \* are significance at 1%, 5%, and 10% respectively.

## Appendix A

**RANGLES (2001): MAJORITY PREFERENCE TEST**

Suppose  $X_1, X_2, \dots, X_n$  are independent observations such that:

$$p_+ = Pr[X_i > 0]$$

$$p_- = Pr[X_i < 0]$$

$$p_0 = Pr[X_i = 0]$$

for  $i = 1, 2, \dots, n$ . It will be convenient to think of each  $X_i$  as  $X_i = Y_i - Z_i$  where  $(Y_i, Z_i)$  are the paired outcomes of an accounting measure of a sample firm  $i$  and its matched peer.

To say that the sample firms, in general, have a lower value of the accounting measure than the peer firms is to say that  $p_- > p_0 + p_+$ . Therefore, the hypotheses are:

$$H_0 : p_- - p_+ \leq p_0 \tag{A.1}$$

$$H_1 : p_- - p_+ > p_0 \tag{A.2}$$

which can be re-written as:

$$H_0 : p_- \leq \frac{1}{2} \tag{A.3}$$

$$H_1 : p_- > \frac{1}{2}. \tag{A.4}$$

The symmetric case holds if one wanted to test if the sample firms had a higher value of the accounting measure:

$$H_0 : p_+ \leq \frac{1}{2} \tag{A.5}$$

$$H_1 : p_+ > \frac{1}{2}. \tag{A.6}$$

Randles (2001) refers to these formulations as the majority preference hypotheses. As we can see, these are one-sided tests, which lend themselves easily to the alternatives under GG. If  $\{X_i\}_{i=1}^n$  are iid, then this amounts to testing if the median of the

distribution of  $X$  is negative. The large sample  $p$ -value is given by:

$$P_{MP} = \begin{cases} \Phi\left(\frac{n_- - n_+ - n_0}{\sqrt{n}}\right) & \text{Z is preferred to Y} \\ \Phi\left(\frac{n_+ - n_- - n_0}{\sqrt{n}}\right) & \text{Y is preferred to Z} \end{cases} \quad (\text{A.7})$$

where  $n_+$  is the number of observations such that  $X_i > 0$ ,  $n_-$  is the number of observations such that  $X_i < 0$ ,  $n_0$  is the number of observations such that  $X_i = 0$ , and  $\Phi(\cdot)$  is the normal cdf.

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