NBER WORKING PAPER SERIES

STOCK MARKET OVERVALUATION, MOON SHOTS, AND CORPORATE INNOVATION

Ming Dong
David Hirshleifer
Siew Hong Teoh

Working Paper 24142
http://www.nber.org/papers/w24142

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
December 2017

We thank Malcolm Baker, Justin Birru, Tao Chen, Tony Cookson, Henrik Cronqvist, Richard Crowley, Peter DeMarzo, Robin Greenwood, Jody Grewal, Michael Hirshleifer, Ming Huang, Mark Kamstra, Byoung Kang, Jung-Wook Kim, Dongmei Li, Adrien Matray, Chris Polk, Eric So, Sheridan Titman, John Wei, and Mike Weisbach for helpful comments, Zheng Sun for help with the mutual fund flow measure, conference and seminar participants at the China International Conference in Finance in Shenzhen, Financial Accounting and Reporting Section Meeting in Charlotte, NBER Behavioral Finance meeting, Ohio State University Alumni conference, Hong Kong Polytechnic University, INSEAD, McMaster University, Nanyang Technological University, Singapore Management University, University of Glasgow, University of Iowa, University of Notre Dame, University of Roma, USC, UT Austin, University of Vienna, and Washington University, and the National Center for the Middle Market (USA) and the Social Sciences and Humanities Research Council (Canada) for financial support. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

Stock Market Overvaluation, Moon Shots, and Corporate Innovation
Ming Dong, David Hirshleifer, and Siew Hong Teoh
NBER Working Paper No. 24142
December 2017
JEL No. D22,D23,D25,G14,G3,G31,G32,G4,G41,O32

ABSTRACT

We test how market overvaluation affects corporate innovative activities and success. Estimated stock overvaluation is very strongly associated with R&D spending, innovative output, and measures of innovative novelty, originality, and scope. R&D is much more sensitive than capital investment to overvaluation. The effects of misvaluation on R&D come more from a non-equity channel than via equity issuance. The sensitivity of R&D and innovative output to misvaluation is greater among growth, overvalued, and high turnover firms. This evidence suggests that market overvaluation may have social value by increasing innovative output and by encouraging firm to engage in 'moon shots.'

Ming Dong
Schulich School of Business
York University
4700 Keele Street
Toronto, Ontario, CANADA M3J 1P3
mdong@schulich.yorku.ca

David Hirshleifer
The Paul Merage School of Business
University of California, Irvine
4291 Pereira Drive
Irvine, CA 92697
and NBER
david.h@uci.edu

Siew Hong Teoh
The Paul Merage School of Business
University of Irvine
Irvine, CA 92697-3125
steoh@uci.edu

1. Introduction

Both efficient and inefficient market theories imply that higher stock prices will be associated with higher corporate investment. This includes both the creation of tangible assets through capital expenditures, and the creation of intangible assets through research and development (R&D). Under the Q-theory of investment (Tobin 1969), higher stock price efficiently reflects stronger growth opportunities, so high valuation firms invest more to exploit better opportunities. If the incremental investment of a high-valuation firm is for innovative purposes, as reflected in R&D expenditures, the firm should achieve greater innovative output, in the form of new discoveries, techniques, or products.

Similar effects arise when markets are inefficient and investors misvalue different firms differently. Under what we call the *misvaluation hypothesis of innovation*, firms respond to market overvaluation by engaging more heavily in innovative activities, resulting in higher future innovative output. We will further argue that overvaluation encourages more risky and creative forms of innovation.

One way that equity overvaluation can stimulate investment—innovative or otherwise—is by encouraging the firm to raise more equity capital (Stein 1996; Baker, Stein, and Wurgler 2003; Gilchrist, Himmelberg, and Huberman 2005) to exploit new shareholders.[1] If firms are inclined to invest the additional funds, overvaluation encourages innovative investment. For example, if the market overvalues a firm's new investment opportunities, the firm may commit to additional investment in order to obtain favorable terms for new equity (or risky debt) financing.

[1] Several authors provide evidence suggesting that firms time new equity issues to exploit market misvaluation, or manage earnings to incite such misvaluation—see, e.g., Ritter (1991), Loughran and Ritter (1995), Teoh, Welch, and Wong (1998a, 1998b), Teoh, Wong, and Rao (1998), Baker and Wurgler (2000), Henderson, Jegadeesh, and Weisbach (2006) and Dong, Hirshleifer, and Teoh (2012). There is also evidence that overvaluation is associated with greater use of equity as a means of payment in takeovers (Dong et al. 2006), as predicted by the model of Shleifer and Vishny (2003).

There are pathways other than the financing channel by which overvaluation can affect innovation. For example, managers of an overvalued firm may feel insulate from board or takeover discipline, and therefore may be more willing to engage in risky innovative activity—a governance channel. Managers who desire publicity may also be attracted to ambitious, glamorous and attention-grabbing projects.

There is also a possible catering channel. Managers who prefer high current stock prices may spend heavily, even at the expense of long-term value, to cater to investor optimism about those investment opportunities that investors find appealing (Stein 1996; Jensen 2005; Polk and Sapienza 2009). We expect such incentives to be especially strong for innovative spending, as innovative activities are exciting to investors and especially hard for the market to value. Current overvaluation may be an indicator that such catering is likely to be effective. Also, managers may be motivated to maintain high stock prices (Jensen 2005), possibly in part because high prices serve as a reference point for investor perceptions (Baker, Pan, and Wurgler 2012; Li and Yu 2012; George, Hwang, and Li 2017).

Two other behavioral mechanisms can also induce an association between misvaluation and innovative activity. Managers themselves may share in the positive sentiment of investors that is the source of overvaluation. If, for example, managers overestimate innovative growth opportunities, the firm will undertake more such activity. Second, managers may be rational and cognizant of overvaluation, but the positive sentiment of consumers, suppliers or potential employees may improve the firm’s opportunities in factor and product markets, making innovative activity more profitable. We refer to these two mechanisms as shared sentiment effects.

These considerations motivate testing whether misvaluation predicts innovative input, in the form of R&D expenditures, and innovative output, in the form of patents and patent citations. Understanding how misvaluation affects R&D and resulting innovative output is important, since R&D is a key source of technological innovation (Hall, Jaffe, and Trajtenberg 2005), and is a major component of aggregate corporate investment (higher than capital expenditures since 1997 in our sample).

It is also important to understand how misvaluation affects the ambitiousness and creativity of firms' innovative activities. When a firm is overvalued, management may have greater freedom to engage in 'moon shot' projects, where we define a moon shot as a risky project involving radical solutions to problems, breakthrough technology, and major scope for improving the welfare of customers. In particular, overvaluation can relax financing constraints on such projects, and can allow an ambitiously innovating firm to maintain a high stock price. Overvaluation can therefore help offset the limiting effect of managerial risk aversion on undertaking the riskiest forms of innovation. Indeed, since innovative activities tend to create positive externalities, overvaluation may sometimes be welfare-improving, as suggested by Keynes (1931), Gross (2009) and Shleifer (2000).

We therefore measure both the amount of innovative output—number of patents or patent citations—and the nature of the innovative activity. To evaluate the effects of misvaluation on the nature of innovation, we test whether overvaluation—especially in the extreme—is associated with three aspects of innovativeness defined in previous literature. *Innovative novelty* is the number of citations per patent (Seru 2014). *Innovative originality* is defined as the extent to which a patent cites previous patents spanning a wide range of technology classes; *innovative scope* is the extent to which a patent is cited by future patents spanning a wide range of technology classes (Trajtenberg, Henderson, and Jaffe 1997).[2] We use the term *inventiveness* to refer collectively to these three aspects of innovation; we consider projects with very high expected inventiveness to be 'moon shots.'

We illustrate with three examples. First, just prior to fiscal year 2000, NetApp, a multinational storage and data management company, had a very high price relative to estimated fundamentals (using a measure we describe below), and had other indications of overvaluation such as heavy recent equity issuance. In fiscal 2000, it ranked in the top quintile in our sample for R&D, patents, patent citations, and in the patent-based measures of inventiveness that we examine.

Two current examples (outside our sample period) also suggest that it is still very interesting to explore whether irrational investor enthusiasm promotes moon-shot innovation: the Tesla and SpaceX businesses of celebrity entrepreneur Elon Musk. Tesla aims to disrupt the automobile industry with electric vehicles affordable to the average consumer. Cornell and Damodoran (2014) and Cornell (2016) perform case valuation analyses of the approximately 7-fold run-up in Tesla during a period of under a year during 2013-14, and conclude that this is hard to justify as a rational response to news.

Musk's SpaceX, although not literally in the business of moon shots, comes close, as its purpose is to monetize space travel, with a long-term goal of colonization of Mars. SpaceX is a private firm valued at $21 billion as of 10/16/17 (Sorkin 2017). Gornall and Strebulaev (2017) point out that the valuations of many unicorns such as SpaceX are grossly inflated owing to

[2] For a given total citation count, greater novelty suggests that a firm's patents are important rather than being 'least publishable units;' see Seru (2014). Regarding originality, a patent that draws upon knowledge from a wide range of technology areas is indicative of an innovation that deviates more from current technological trajectories. Drawing upon diverse technologies may also reflect the firm's ability to recombine technologies in an original way. Previous literature refers to what we call "scope" as "innovative generality." For applications of innovative originality and scope, see also Hall, Jaffe, and Trajtenberg (2001), Lerner, Sørensen, and Strömberg (2011), Custodio, Ferreira, and Matos (2013), and Hirshleifer, Hsu and Li (2017). Section 2 discusses in more depth the motivation for and estimation of the three dimensions of innovation inventiveness.

valuations being based upon recently-issued shares with special cash flow rights.[3]

A key challenge for estimating the relationship between innovative activity or output to misvaluation is that valuation is endogenous: firms with excellent opportunities for innovative investment should rationally have high prices. We address this issue by using measures of misvaluation which are designed to purge, as much as possible, this rational component of valuation.

Specifically, we use two measures of misvaluation from previous literature (described in more detail in Section 2.3). The first, *VP*, is the ratio of 'intrinsic value' (*V*) to market price *P*. *V* is a forward-looking measure of fundamental value derived from the residual income model of Ohlson (1995) using analyst forecasts of future earnings. A key advantage of *V* as a measure of fundamental value, relative, for example, to book value, is that *V* incorporates earnings growth prospects. As such, it filters such prospects from market price, except insofar as such prospects are associated with misvaluation rather than just growth (as discussed in more depth in Section 2).[4]

The second misvaluation measure, *MFFlow*, is not based on market price. It uses mutual fund hypothetical sales of stocks as a function of investor outflows, following Edmans, Goldstein, and Jiang (2012) (building on Coval and Stafford (2007)). These papers find that mutual fund outflows lead to selling pressure on stocks held in the funds, thereby temporarily

[3] Since these 'valuations' are not based on market prices for common shares, such 'overvaluation' need not imply any investor misperception. However, it almost surely does. It is common for managers and other employees in innovative start-ups to receive option compensation for their efforts, and these investors typically lack the financial sophistication needed to adjust reported firm valuations for subtle biases. Indeed, according to Strebulaev, "These financial structures and their valuation implications can be confusing and are grossly misunderstood not just by outsiders, but even by sophisticated insiders. Strebulaev also points out that "SpaceX's value actually fell in 2008" during a period when its reported valuation increased (Sorkin 2017).

[4] *V* is also invariant with respect to accounting choice, and avoids problems with long-horizon terminal value calculations that are present in discounted cash flow models of fundamental value (Feltham and Ohlson 1995; Cornell 2013). *VP* has been applied in a number of studies to the prediction of subsequent returns (Frankel and Lee 1998; Lee, Myers, and Swaminathan 1999), repurchases (D'Mello and Shroff 2000), takeover-related behaviors (Dong et al. 2006), and new issues (Dong, Hirshleifer, and Teoh 2012).

depressing the prices of fund stock holdings for non-fundamental reasons. We also perform tests that use *MFFlow* as an instrumental variable to test for the effects of variation in *VP* that derives from exogenous variations in misvaluation.

Although both misvaluation proxies are designed to remove the contaminating effects of growth prospects that are unrelated to misvaluation,[5] as a failsafe we include several controls for such opportunities in all our tests (see Section 3.1). If market participants tend to overvalue firms with good growth prospects, the inclusion of growth controls in our regressions will eliminate some of the misvaluation effect we seek to measure. This leads to conservative inferences. Nevertheless, the effects of misvaluation that we document are strong.

In testing the relation between misvaluation and intangible investment in the form of R&D, as a benchmark for comparison, we also examine the relation between misvaluation and tangible investments in the form of capital expenditures. In addition to these tests, and the tests mentioned above of the relation between misvaluation and innovative output and inventiveness, we perform two further types of tests. First, we estimate whether the relation between misvaluation and innovative spending operates more through equity issuance versus other mechanisms such as shared sentiment or direct catering to investor misperceptions. Second, to test hypotheses about when misvaluation effects will be most important, we examine how the sensitivity of innovative activities to misvaluation varies with growth, turnover, and misvaluation.

We find that overvaluation has a very strong and robust association with higher intangible investments and resulting outputs (R&D, patents, and patent citations). For example,

[5] We do not expect *VP* to be uncorrelated with a firm's growth opportunities, since investors may misvalue such opportunities. Rather, its use of a forward-looking fundamental goes far to filter out a *mechanical* relationship between growth opportunities and *VP*. This is in sharp contrast with other valuation ratios such as book-to-market or Tobin's Q.

the sensitivity of R&D to misvaluation (variables scaled by their standard deviations) is much larger than the sensitivity to book-to-price, and is larger or comparable to the sensitivity to growth in sales and cash flow. Furthermore, the sensitivity of R&D to misvaluation is about 4-8 times greater than the sensitivity of capital expenditures to misvaluation using either of our mispricing proxies.[6]

One reason to expect misvaluation to be more important for innovative spending than for capital expenditures is that, under the misvaluation hypothesis, measured misvaluation should be most strongly related to the form of investment that investors are most prone to misvaluing. Intangible investments such as R&D have relatively uncertain payoff, and therefore are harder to value than ordinary capital expenditures.[7] So, intangible projects will tend to present managers with greater opportunities for funding with overvalued equity, and for catering to project misvaluation.

Another reason why we expect misvaluation to have a stronger effect on innovative than routine expenditures is that industry- or market-wide overvaluation can help solve externality problems in innovation; a breakthrough by one firm can open opportunities for other firms. Network externalities in technology adoption and innovation have been emphasized, for example, in Katz and Shapiro (1986), and is a common explanation offered for the rise of centers of innovation such as Silicon Valley. Thus, the misvaluation hypothesis predicts a stronger relation between misvaluation and R&D expenditures than between misvaluation and capital

[6] A previous literature examines the effects of misvaluation on equity issuance and on capital expenditures. With respect to R&D, Polk and Sapienza (2009) use the firm characteristic of high versus low R&D as a conditioning variable in some of their tests of the relation between misvaluation and capital expenditures. Baker, Stein, and Wurgler (2003) examine several measures of investment, one of which is the sum of capital expenditures and R&D, but do not examine whether misvaluation affects capital expenditures and R&D differently.

[7] Psychological evidence suggests that biases such as overconfidence will be more severe in activities (such as long-term research and product development) for which feedback is deferred and highly uncertain; see, e.g., Einhorn (1980). In the investment model of Panageas (2005), investment is most affected by market valuations when the disagreement about the marginal product of capital is greatest. Furthermore, there is evidence that greater valuation uncertainty is associated with stronger behavioral biases in the trades of individual investors (Kumar 2009).

expenditures.

With regard to inventiveness, we find that overvaluation is strongly associated with greater innovative novelty, originality, and scope. The patents of overvalued firms are heavily cited, draw from a wider range of technology classes, and are cited by patents in a greater range of technology classes. So misvaluation affects the quality as well as the quantity of innovative activity.

Furthermore, we find that the relations of misvaluation with innovative inputs, outputs, and inventiveness measures are highly nonlinear. The effects of misvaluation on innovative activity measures are especially strong among the top quintile of the most overvalued firms. These findings collectively suggest that highly overvalued firms are more prone to engage in 'moon shot' projects that have very high inventiveness and expected innovative output. This strong convexity also suggests that misvaluation effects do not just average out. The possibility of either under- or overvaluation may on average increase innovative activity and inventiveness, potentially increasing welfare.[8]

The potentially positive effect of overvaluation on innovation tends to contrast with the adverse effects of overvaluation in inducing questionable capital expenditures (Polk and Sapienza 2009) and acquisitions (Dong et al. 2006). Although we cannot be sure that the benefits of higher innovation are worth the cost, these findings reinforce other evidence that behavioral biases, such as managerial overconfidence, sometimes promote innovation (Hirshleifer, Low, and Teoh 2012).

To assess the relative importance of equity-financing versus other channels through which misvaluation can affect innovation, we conduct a path analysis of the R&D and capital

[8] In discussing what he viewed as a period of overvaluation by many firms, Keynes (1931) wrote that "[w]hile some part of the investment which was going on … was doubtless ill judged and unfruitful, there can, I think, be no doubt that the world was enormously enriched by the constructions of the quinquennium from 1925 to 1929..."

expenditure responses to misvaluation; see Baderstcher, Shanthikumar and Teoh (2017). Using either of our misvaluation proxies, we find over two thirds of the total effect of misvaluation on both R&D and capital spending derives from the non-equity channel.

The evidence that overvaluation induces firms to raise cheap equity capital to finance intangible investment is consistent with the models of Stein (1996) and Baker, Stein, and Wurgler (2003). The evidence that misvaluation effects operate outside the equity channel is consistent with both the catering theory of Jensen (2005) and Polk and Sapienza (2009), and with the shared sentiment effects discussed above. The larger magnitudes of the non-equity channel suggest that catering and/or shared sentiment effects of misvaluation may be particularly strong.

With regard to the fourth issue, we dig more deeply into the misvaluation effect by considering interactors which, under different hypotheses, should strengthen or weaken the sensitivities of innovative spending and outcomes to misvaluation. We interact our misvaluation measures with indicators for firms in the highest quintile for growth opportunities, equity catering pressure as proxied by share turnover, or (as already mentioned earlier) overvaluation itself.

We find that R&D spending, innovative output, and the three types of innovative inventiveness are more strongly positively associated with overvaluation among growth firms. This suggests that overvalued firms can more persuasively cater to investors via R&D, or issue equity to finance R&D, when they have good growth prospects; that such increased innovative expenditure of growth firms leads to commensurate innovative output; and that the effects of misvaluation on inventiveness are especially important among growth firms.

Polk and Sapienza (2009) propose that the sensitivity of investment to misvaluation should be higher when managers have a stronger focus on short-run stock prices, as proxied by share turnover, because undertaking an overvalued project can temporarily increase stock price. We find that the sensitivity of innovative output and inventiveness to misvaluation is greatest in the top turnover quintile. This is not the case for the sensitivity of R&D to misvaluation. These findings suggest that greater catering to investor misperceptions or high sentiment among high turnover firms takes the form of undertaking more inventive ('moon shot') projects rather than by increasing R&D.

Finally, we expect misvaluation effects on innovation to be non-linear, with the strongest marginal effects on innovation occurring among the most overvalued firms. Fixed costs of issuing equity, lumpy investment projects, within-firm knowledge spill-overs, and positive network externalities in innovation all imply convexity in the relation of innovative activities and outputs to misvaluation (see Section 2.4 for details). Consistent with this hypothesis, we find that R&D, innovative output, and inventiveness are far more sensitive to misvaluation in the top overvaluation quintile. For example, the effect of overvaluation on novelty, originality or scope is 4-7 times greater in the most overvalued quintile when compared with the effect in the full sample. In other words, extreme overvaluation is associated with 'moon shots'—projects that are exceptionally innovative.

A previous literature tests whether market valuations affect investment by examining whether stock prices have incremental predictive power above and beyond proxies for the quality of growth opportunities such as cash flow or firm profitability (Barro 1990; Blanchard, Rhee, and Summers 1993; Morck, Shleifer, and Vishny 1990; Welch and Wessels 2000). Bhagat and Welch (1995) find a weak link between past returns and R&D expenditures among U.S. firms. Most of these studies are focused on capital expenditures rather than innovative activity, and these studies do not distinguish the Q-theory of investment from the misvaluation hypothesis.

Several studies on misvaluation effects on capital expenditures use different misvaluation proxies.[9] Other studies use different strategies to identify the effects of stock misvaluation.[10] Our approach differs from these papers in focusing on misvaluation effects on *innovation*, including *innovative outcomes*; and in our measures of misvaluation. Finally, a large literature investigates the economic factors that drive innovation (see, e.g., Acharya and Xu (2017) and references therein). Building on this research, our paper additionally describes how market misvaluation affects innovation.

2. Data, Empirical Measures and Test Design

Our sample includes U.S. firms listed on NYSE, AMEX, or NASDAQ that are covered by CRSP and COMPUSTAT and are subject to the following restrictions. We require firms to have the earnings forecast data from I/B/E/S, in addition to possessing the necessary accounting items, for the calculation of the residual income model value to price (*VP*) ratio. Consequently, our sample starts from 1976 when I/B/E/S reporting begins. We also construct mutual fund flows measure (*MFFlow*) from CDA/Spectrum and CRSP. Finally, we exclude financial firms (firms with one-digit SIC of 6) and utility firms (two-digit SIC of 49). Our final sample has a total of 62,815 firm-year observations with non-missing equity misvaluation measures between 1976 and 2012. Our misvaluation measures, *VP* and *MFFlow*, are described below.

---

[9] These include CAPM alpha (Morck, Shleifer and Vishny 1990), discretionary accruals (Polk and Sapienza 2009), dispersion in analyst forecasts of earnings (Gilchrist, Himmelberg, and Huberman 2005), and mutual fund flows (Camanho 2015). Baker, Stein, and Wurgler (2003) examine the relation between financial constraints and valuations in determining investment.

[10] Chirinko and Schaller (2001, 2012) develop structural models of stock prices under efficient markets, in order to measure market misvaluation and its effect on corporate investment in the U.S. and Japan. Campello and Graham (2013) decompose Tobin's Q into fundamental and non-fundamental parts by regressing Q on accounting performance measures, and compare how capital investment responds to the non-fundamental portion of the stock price between constrained and unconstrained firms during the tech bubble. Past studies have also used mutual fund fire sales to measure equity undervaluation and find that undervalued firms cut capital expenditures (Hau and Lai 2013) or R&D (Parise 2013). Using structural models, Alti and Tetlock (2014) and Warusawitharana and Whited (2015) find that equity misvaluation influences investment decisions.

We examine the relation between firm innovation (innovative input as measured by R&D, and innovative output and efficiency variables described below) and the misvaluation level of the firm's equity. We relate a firm's innovation activity during each fiscal year to the firm's misvaluation measure calculated at the end of the preceding fiscal year. For example, for a firm with December fiscal year end, the misvaluation measure is calculated at the end of December 2010 and the innovation activity is measured for the fiscal year ending in December 2011.

Our sample includes firms with different fiscal year-ends. To line up firms in calendar time for the cross-sectional analysis, we use June as the cut-off. We allow for a four- month gap from the fiscal year end for the accounting data to be publicly available. Under this timing convention, for calendar year t, we include firms with fiscal year ends no later than February of year t, and no earlier than March of year $t-1$. Note, therefore, that for the majority of firms, the investment expenditures actually occur one calendar year prior. For example, for year 2011, the investment expenditures for firms with December fiscal year end (the majority of firms) actually occur between January and December of 2010, and the misvaluation measure is calculated in December 2009. The timing for innovative output is similar.

2.1 Measures of Innovative Output and Inventiveness

Patent and citation data are constructed from the November 2011 edition of the patent database of Kogan, Papanikolaou, Seru, and Stoffman (see Kogan et al. 2016). This database covers U.S. patent grants and patent citations up to 2010. Patents are included in the database only if they are eventually granted. Furthermore, there is on average a two-year lag between patent application and patent grant. Since the latest year in the database is 2010, we end our observations of patents and citations in 2008 to reduce measurement bias caused by the application-grant period lag. Since we require non-missing observations of our misvaluation measure (*VP*), our data of patents and citations all start from 1976.

Following the innovation literature, we use two measures of innovative output. The first and simplest measure is the number of patents applied by the firm each year (*Pat*). However, simple patent counts imperfectly capture innovation success as patent innovations vary widely in their technological and economic importance. Following Hall, Jaffe, and Trajtenberg (2001, 2005)), we measure the importance of patents by their citation counts using the sum of citations received by patents applied for each year, adjusted by technological class and year fixed effects (*Cites*). In our regression tests, we use log transformed values of *Pat* and *Cites* to limit the effects of extreme outliers.

We use three measures of innovative inventiveness. Following Seru (2014), *Novelty* is the average (technological class and year adjusted) citations per patent. It is a natural way to capture the importance of the innovations generated by the firm.

Following Trajtenberg, Henderson, and Jaffe (1997), we define *Originality* of a patent as one minus the Herfindahl concentration index for the fraction of citations made by the patent to patents in other technological classes. Thus, if a patent cites previous patents that span a wide (narrow) set of technologies, the originality score will be high (low). This is based on the idea that innovation is a process of recombinant search (e.g., Schumpeter 1934; Basalla 1988; Romer 1990; Weitzman 1998; Singh and Fleming 2010). Under this view, useful new ideas come from combining existing ones in novel ways. An example is the discovery of the double helix structure of DNA by James Watson and Francis Crick. Crick's knowledge of X-ray crystallography helped Watson understand the famous X-ray diffraction image of DNA as a double helix structure.

Also following Trajtenberg, Henderson, and Jaffe (1997), *Scope* of a patent is defined as one minus the Herfindahl index across technological classes of future citations of the patent.[11] This reflects the extent to which a patent has a wide influence. It is a natural way of measuring the extent to which an innovation is broad in scope, making it is useful in a wide range of different technological applications. Each of the three inventiveness measures is firm-level average over the patents' respective inventiveness scores.[12]

2.2 Investment and Control Variables

We measure firms' investment activities using the following accounting data from COMPUSTAT annual files: Research and Development expenditures (item XRD) and capital expenditures (item CAPX). Our investment variables, *RD* and *CAPX*, are scaled by previous year total assets (item AT).[13] All ratio variables, include the ones described below, are winsorized at the 1st and 99th percentile to mitigate the influence of outliers. Table 1 reports summary statistics of the investment and innovation variables.

We do not delete a firm-year observation simply because a certain variable is missing. We need equity issuance to examine the equity channel of the effect of misvaluation on investment. We measure firms' equity issuance using accounting data from the COMPUSTAT annual files. Following Baker and Wurgler (2002), equity issuance (*EI*) is measured as the change in book equity minus the change in retained earnings [ΔBook Equity (COMPUSTAT

---

[11] We verified our test results using patent and citation variables constructed from the 2006 edition of the NBER patent database (Hall, Jaffe, and Trajtenberg 2001, 2005). Results using the smaller NBER patent data are similar to those reported in the paper when we keep the same sample period, with somewhat lower significance levels.

[12] The innovative output (*Pat* and *Cites*) and inventiveness (*Novelty*, *Originality*, and *Generality*) variables are measures of R&D productivity in any particular fiscal year, even though the granting and citations occur in years subsequent to that fiscal year.

[13] Some studies use net plant, property, and equipment (PP&E) or total assets scalings. However, this paper includes non-manufacturing firms for which intangible assets are especially important, and compares the effects of misvaluation on the creation of intangible assets through R&D with the effect on tangible asset creation through capital expenditures. A scaling that reflects both kinds of assets seems most appropriate for this purpose.

item CEQ) + ΔDeferred Taxes (item TXDB) − ΔRetained Earnings (item RE)] scaled by lagged assets. This is a net issuance variable. The payment of a dividend out of retained earnings does not affect the measures, since the reduction in book equity is offset by the reduction in retained earnings.

In the multivariate tests, we also control for other investment determinants. These control variables include growth rate in sales in the past three years (*GS*), cash flow [item IB + item DP + item XRD] scaled by lagged assets [missing XRD is set to zero], to control for the ability of the firm to generate cash from operations to fund investment. We include leverage (*Leverage*) defined as (item DLTT + item DLC)/(item DLTT + item DLC + item SEQ). Finally, we control for firm age and size (lagged total assets) because DeAngelo, DeAngelo, and Stulz (2010) find that mature firms are less likely to issue new equity. Following DeAngelo, DeAngelo, and Stulz (2010), we define *Age* as the number of years between the listing date and the beginning of fiscal year, truncated at 50 (results are not sensitive to this truncation). Summary statistics of these control variables are reported in Table 1.

2.3 Mispricing Proxies

We use two misvaluation proxies. *VP* is the ratio of fundamental value to price, and *MFFlow* is the mutual fund outflow price pressure measure. We first describe the procedure for calculating *VP*.

The estimation procedure for *VP* is detailed in Appendix A. The residual income value *V* is estimated as the sum of book value of equity, the discounted analyst forecasted return on equity in the next two years in excess of the firm’s cost of capital and the analyst forecasted return on equity in the third year in excess of the firm’s cost of capital discounted as a perpetuity, where the discount rate is the firm’s cost of equity capital. Book equity is measured at the end of the prior fiscal year and negative observations are deleted. Lee, Myers, and Swaminathan (1999) report that the quality of their *V* estimates is not sensitive to the choice of forecast horizon beyond three years. The predictive ability of *VP* has been found to be robust to alternative cost of capital models (Lee, Myers, and Swaminathan 1999) and to whether the discount rate is allowed to vary across firms (D'Mello and Shroff 2000).[14]

Dong et al. (2006), Dong, Hirshleifer and Teoh (2012) provide more detailed motivation for our choice of *VP* as the misvaluation proxy over other measures. There is strong support for *VP* as an indicator of mispricing. It is a stronger return predictor than *BP* (Lee, Myers, and Swaminathan 1999, Frankel and Lee 1998, Ali, Hwang, and Trombley 2003). *VP* is a ratio of equity rather than total asset misvaluation, and equity misvaluation rather than total misvaluation is more likely to matter for innovation spending decisions. Because R&D spending is not a tangible investment that can be used as collateral for borrowing, it is more likely to be funded from equity than from debt.

The residual income value also has several important advantages over book value as a fundamental measure. It is designed to be invariant to accounting treatments (to the extent that the 'clean surplus' accounting identity obtains; see Ohlson (1995)), making *VP* less sensitive to such choices. Crucially, unlike *BP*, *VP* does not have a mechanical relation with R&D. Accounting rules require expensing R&D which reduces book values, but the market capitalizes the R&D so that high R&D firms tend to have low *BP*. In contrast, since *V* incorporates analyst forecasts of future earnings, *V* reflects the future-profit-creation side of R&D expenditures, not just the expense side. Furthermore, since *V*, like market price and unlike book value, reflects

[14] The present value of residual incomes beyond year three is captured in the terminal value. The value in the residual income model is less sensitive to errors in terminal value estimates than in dividend or cash flow discounting models. For example, D'Mello and Shroff (2000) found that in their sample of repurchasing firms, firms' terminal value was on average 11% of their total residual income value, whereas using a dividend discount model the terminal value was 58% of total value.

future growth prospects, the *VP* ratio filters out growth effects contained in *BP* that are unrelated to mispricing. If market participants overvalue firms with good growth prospects, *VP* is designed to capture that misvaluation, and therefore can be correlated with growth prospects. However, unlike *BP*, *VP* is not mechanically increased by the sheer fact that a firm is growing (i.e., that the market foresees increasing future profits).

It is possible that in the process of filtering out extraneous information, some genuine information about mispricing is also filtered out from *VP*, which would reduce the ability of our tests to detect misvaluation effects. In this sense our tests using *VP* are conservative.

In our sample, the correlation of *BP* with *VP* is fairly low, 0.22. Thus, *VP* potentially offers useful independent information beyond *BP* regarding misvaluation. This is to be expected, as much of the variation in book-to-price arises from differences in growth prospects or in managerial discipline that do not necessarily correspond to misvaluation.

On the other hand, there may still be growth effects left in *VP*. If this problem were severe we would expect our measure to have a high absolute correlation with *Q*. In our sample, the correlation with *Q* is not especially strong (−0.28). We include *BP*, sales growth, or analyst long-term earnings growth forecasts as controls to further soak up possible remaining growth effects that are in *VP* to focus on the component of misvaluation that is unrelated to growth.

The second misvaluation measure, *MFFlow*, is derived from mutual fund outflows (Coval and Stafford 2007; Edmans, Jiang, and Goldstein 2012). The motivation for this measure is that outflows put immediate pressure on fund managers to sell the underlying fund holdings to meet redemptions, causing temporary downward price pressure on the stocks held within the fund. To ensure that the outflow measure is unrelated to fund manager's private information about the underlying securities, Edmans, Jiang, and Goldstein (2012) refine the measure of Coval and Stafford (2007) by focusing on the *hypothetical* trades made by a fund assuming it trades in equal proportion to its current holdings. Appendix B details the calculation of *MFFlow*.

In validation of their proxy, Edmans, Jiang, and Goldstein (2012) find that stocks with large mutual fund outflows have lower contemporaneous stock returns, and that these low returns are later reversed. Therefore, a large outflow indicates undervaluation of stocks held by the fund. Inflows are more likely than outflows to reflect private information if fund managers wait to allocate inflows to stocks that they believe have better prospects.[15] We therefore follow Edmans, Jiang, and Goldstein (2012) and include outflows only. Several other papers employ mutual fund price pressure measure in studying the effect of misvaluation on capital or R&D investment (e.g., Dessaint et al. (2015); see also Hau and Lai (2013), Parise (2013) and Camanho (2015) for related price pressure measures).

As argued in Edmans, Jiang, and Goldstein (2012), the *MFFlow* measure likely reflects an exogenous source of mispricing that is unrelated to firm characteristics such as extent of innovative activity. It is possible in general that fund flows are correlated with news that relates to firms' investment strategies. However, the Edmans, Jiang and Goldstein approach of using hypothetical fund flows helps alleviate this concern. For example, a firm might have strong growth opportunities, but this does not explain why the funds that hold this firm would receive unusually high inflows. Similarly, an entire industry might have strong investment opportunities, but, following Edmans, Goldstein and Jiang (2012), we exclude funds that specialize in a given industry. Our results are also robust to the inclusion of analyst long-term growth forecasts in the

[15] Several studies, such as Jeng, Metrick, and Zeckhauser (2003) and Lakonishok and Lee (2001) find that insider buying reflects private information but insider selling does not, and even recent work that identifies information in insider selling (Ali and Hirshleifer 2017) finds that buying is much more informative. Furthermore, individual investors are more likely to buy attention-grabbing stocks than sell such stocks (Barber and Odean 2008), consistent with the tendency of buying triggered by viewpoint-changing events.

regressions to further control for growth opportunities.

The premise of the catering hypothesis is that current overvaluation measures are associated with a stronger intentions by managers to undertake innovative activities that captures the imagination of investors in order to maintain overvaluation. Several mechanisms can induce such an association. First is that overvaluation may reflect overvaluation by investors of the firm's innovative opportunities. A second mechanism is that overvaluation, perhaps induced mechanically via mutual fund flows, causes investors to draw a favorable *inference* about the firm's opportunities from the current stock price. A third mechanism relates to managerial incentives. As argued by Jensen (2005), managers highly value avoiding drops in stock prices, and leading to agency problems of overvalued equity. Specifically, even if current overvaluation is not driven by overvaluation of innovative opportunities, managers may be motivated by high stock prices to develop opportunities that the market is likely to overvalue.

Sentiment that is shared between managers, investors, and stakeholders should also induce a positive association between overvaluation and innovative activity. If both managers and investors overvalue innovative opportunities, the firm will undertake such projects. If stakeholders share this optimism, this makes them more willing to make firm-specific investments, which further increases the benefits to managers of undertaking innovative projects that, for example, benefit from customer or supplier networks. Even if the stock is overvalued for mechanical reasons such as high *MFFlow* that are unrelated to preexisting overoptimism, managers (and investors) may draw an optimistic inferences from the high market price, encouraging innovative activities.

All the mechanisms discussed here relating to catering and shared sentiment are likely to be intensified if investors place special attention on unusually high stock prices. Several empirical papers document an investor focus on 52-week highs, and some of these papers provide evidence that this influences managerial behavior.[16]

Other misvaluation proxies used in past studies include discretionary accruals (Polk and Sapienza 2009) and dispersion in analyst forecasts of earnings (Gilchrist, Himmelberg, and Huberman 2005).[17] The intuitions for these variables as misvaluation proxies are appealing. However, it is also useful to test for misvaluation effects using a more inclusive measure of misvaluation such as *VP,* which is designed to measure the overall misvaluation of the firm's equity rather than the components of misvaluation coming from earnings management or disagreement. But the more important difference between our paper and previous work is our focus on innovation.

Table 1 reports summary statistics for the two misvaluation proxies as well as *BP*. The benchmark for fair valuation for *BP* and *VP* is not equal to 1. Book is an historical value that does not reflect growth, and residual income model valuations have been found to be too low on average. We retain negative *V* values caused by low earnings forecasts relative to the cost of equity capital, because such cases should also be informative about overvaluation; negative and low values of *VP* indicate overvaluation and large values of *VP* indicate undervaluation. For consistency we also use *BP* rather than *P/B.* Removing negative *VP* observations (about 6% of the sample) tends to reduce statistical significance levels in our tests without materially altering the results. *MFFlow* observations are set to be positive reflecting outflows, so the variable is

[16] See, e.g., Baker, Pan, and Wurgler (2012), Li and Yu (2012), Birru (2015), and George, Hwang, and Li (2017).

[17] Polk and Sapienza find that discretionary accruals are positively related to investment and that this effect is stronger among firms with higher R&D intensity (which are presumably harder to value correctly), and among firms that have high share turnover (a measure of the degree to which current shareholders have short time horizons). This suggests that managers invest in order to boost the short-term stock price, a 'catering' policy. Polk and Sapienza also find that capital expenditures negatively predict returns (see also Titman, Wei, and Xie (2004)), consistent with high-investment firms being overvalued. Gilchrist, Himmelberg, and Huberman (2005) find that greater dispersion in analyst forecasts of earnings is associated with higher aggregate equity issuance and capital expenditures.

decreasing with overvaluation, just as is *VP*.[18]

When mutual funds have zero or close to zero holdings of a stock, *MFFlow* would equal zero. Since such a value does not indicate stock overvaluation, we set zero *MFFlow* observations to missing. Consequently, our measure of *MFFlow* has a considerably stronger price pressure effect than that documented in Edmans, Goldstein, and Jiang (2012). For example, the highest-*MFFlow* decile experiences a market-adjusted return of roughly −12% about two quarters after the *MFFlow* measurement. In contrast, Edmans, Goldstein, and Jiang (2012) document a peak price pressure of about −6.5% market-adjusted return for the decile with the highest outflows.

2.4 Conditioning Variables

We expect that the effect of misvaluation on innovation will be stronger among firms with high growth opportunities. For agency reasons, overvalued growth firms may be especially prone to catering investors to maintain a high stock price and raising equity capital to finance investments that investors are overoptimistic about (Jensen 2005). Furthermore, project scale economies should be more relevant to firms with strong potential growth opportunities. Our primary measure of growth prospects is the sales growth rate in the past three years (*GS*), but our results are robust to using *BP* or analyst long-term growth forecasts to control for growth.

Polk and Sapienza (2009) test a catering theory that the investment sensitivity to misvaluation will be higher when there is a higher fraction of short-term investors. They document that the sensitivity of capital expenditures to misvaluation is higher for stocks with high share turnover. We measure turnover using monthly trading volume as a percentage of total

[18] *MFFlow* exerts a downward *shock* to misvaluation, but it is greater for some firms than others. We expect low-*MFFlow* firms (low notional sales) to have a higher distribution of total overvaluation in the sense of First Order Stochastic Dominance. In particular, such firms contain a higher frequency of very high overvaluation than firms with high *MFFlow*. So crucially, the measure captures variation in misvaluation even within the deep *over*valuation range, not just in the undervaluation range.

number of shares outstanding. Following LaPlante and Muscarella (1997), we divide the NASDAQ trading volume by a factor of 2.

Finally, we expect misvaluation to have a stronger marginal effect on innovative investment among overvalued firms (implying an increasing convex relation of investment to overvaluation), for several reasons. First, when there are fixed costs of issuing equity, overvalued firms should be more likely to issue than undervalued firms. A marginal shift in misvaluation does not change the scale of equity issuance for a firm that refrains from issuing equity at all. So among undervalued firms, we expect a relatively small effect on issuance and investment of a reduction in the undervaluation. A similar point holds if projects have a minimum efficient scale. In contrast, when overvaluation is sufficient to induce project adoption, greater overvaluation encourages greater scale of issuance and investment. Alternatively, managers of overvalued firms may be particularly anxious to undertake overvalued investments in order to cater to optimistic investor perceptions (Jensen 2005).

Second, when there are positive complementarities in innovation, overvaluation will tend to have a nonlinear increasing effect on innovation; the sensitivity of innovative spending to incremental valuation is greater when valuation is high, owing to the larger base of innovative activities to build upon, or to the need for a critical mass in the size of the customer or supplier base that is oriented toward the innovation. When such complementarities cross the boundaries of firms, they are called network externalities (Katz and Shapiro 1986). For example, with knowledge spill-over effects, the process of making useful discoveries can contribute to future discoveries across firms.[19]

[19] It has long been argued that network externalities are a crucial aspect of innovative activity, because building a large enough customer and/or supplier base is often crucial for the viability of an innovation. This is true, to mention just a few examples, of television, telephony, email and social networking sites. This need for a set of relevant suppliers or demanders often leads to externalities across firms.

Finally, when a firm has positive NPV innovative projects with a high probability of failure but also with potential for a big win, risk-averse managers may bypass them for fear of losing their jobs. However, overvaluation, especially extreme overvaluation, can insulate managers from career concerns if such overvaluation is associated with overly favorable assessments of managerial skill. Such overvaluation can therefore encourage undertaking risky innovative projects.

2.5 Time Patterns in Capital Expenditures, R&D and Valuations

Table 2 reports yearly descriptive information for our sample during 1976-2012. Capital expenditures are relatively stable over time, but there is a marked decrease after 2001, suggesting that companies generally cut capital spending after the burst of the stock market bubble. This decrease in *CAPX* is coupled with a drastic drop in cash flow in 2002 (untabulated). R&D activities, on the other hand, have wider variations but generally increase over time, and decline slightly after 2001. As mentioned in the introduction, after 1996, *RD* overtakes *CAPX* as the larger component of corporate investment, growing much larger toward the end of the sample period. These facts emphasize the importance of examining *RD* in addition to *CAPX*.

Table 2 also shows that overall, the median *VP* (0.57) is higher than the median *BP* (0.45), suggesting, as expected, that residual earnings add value to stocks on average. *VP* has a higher median than *BP* each year in the sample except for the following periods: years after the collapse of the technology bubble (most of 2002-2005) and the financial crisis years of 2008-2010. In previous studies, average *VP* is less than one because of measurement error in estimating fundamental value. However, this measurement error is likely common to all firms. Evidence discussed earlier that *VP* is a strong positive predictor of future return after standard controls is consistent with variations in *VP* capturing differences in misvaluation, with lower *VP* associated with greater overvaluation.[20] The time-series average percentage deviation from the mean *VP* of the lowest (highest) *VP* quintile is 99.7% (116.0%), indicating substantial variation in valuation across firms.

Past research has explored whether R&D predicts future abnormal returns. The results are somewhat mixed, with some studies findings positive return predictive power and some finding no significant effect. The misvaluation hypothesis does not have a clear-cut prediction about whether R&D will positively or negatively predict returns, so such tests do not get at the issues explored in our study.

Even if, as hypothesized, misvaluation affects R&D, we expect much variation in R&D to derive from other sources, notably including rational managerial responses to growth opportunities. Existing theories suggest that such variation can induce misvaluation. As suggested by Lev and Sougiannis (1996) and formally modelled in (Hirshleifer and Teoh 2003; Hirshleifer, Lim, and Teoh 2011), high R&D firms may be undervalued, if investors form expectations based upon earnings without adjusting for the fact that R&D, an economic investment which generates future cash flows, is expensed. In contrast, as we suggest here, high R&D may derive from overvaluation, and therefore be associated with overvaluation. A general sample will include both sources of variation in R&D, making the prediction for future returns ambiguous. So whether R&D predicts returns does not provide a test of whether misvaluation induces innovative activity.

3. Results

We first report regression tests of the relation between innovative input and output

[20] In unreported tests, we confirm that *VP* strongly and positively predicts future returns in our sample after controlling for variables such as size, *BP*, and momentum.

measures with misvaluation, including the relation between capital expenditure and misvaluation for comparison in Table 3. Table 4 presents results for the relation between misvaluation and innovation inventiveness (novelty, originality and scope). We further perform tests to evaluate whether misvaluation effects on innovation operate through equity issuance or through other channels using a path analysis in Table 5. In addition, we have predictions about how several conditioning variables interact with the misvaluation-innovation relations. For example, we expect the sensitivity of R&D to misvaluation to be stronger among growth firms and among the most overvalued firms. These results are presented in Tables 6-8. Since the majority of firms do not have positive patent and citation counts (Table 1), we also examine whether overvaluation increases the probability that a firm has a positive number of patents, or the likelihood of being an innovator. Finally, Table 9 addresses the issue of endogeneity (reverse causality and measurement error) in the relationship between overvaluation and innovation with 2-stage least square tests using fund flows to identify misvaluation.

3.1 The Relation between Misvaluation and Innovation

We report the regression test results in Table 3 for misvaluation effects on input and outputs of innovative activity and capital expenditures. The dependent variables are the measures of R&D expenditures (*RD*), capital expenditures (*CAPX*), patents (*Log(1+Pat)*), and citations (*Log(1+Cites)*). The independent variables in the regressions include either of the two misvaluation variables (beginning-of-year *VP* or *MFFlow*). The control variables include proxies for growth opportunities (either *BP* or 3 year sales growth *GS*), cash flow (*CF*) measured as net income before depreciation and R&D expense scaled by lagged assets, leverage (*Leverage*), the firm age truncated at 50 (*Age*), and log of lagged assets (*Size*). All independent variables (except for the indicator variables) are standardized to have a mean of zero and standard deviation of one. Following the innovation literature (e.g., Seru 2014; Tian and Wang 2014; Acharya and Xu 2017), we control for year and industry fixed effects using the 2-digit SIC industry classification of Moskowitz and Grinblatt (1999).[21] All standard errors in the regressions are simultaneously clustered by both firm and year.

We report four regression specifications for each dependent variable. Models (1) and (2) use *VP*, while models (3) and (4) use *MFFlow*, as the misvaluation proxy. Models (1) and (3) use the book-to-price ratio (*BP*) as the control for growth opportunities, while models (2) and (4) use the 3-year sales growth rate (*GS*). The use of *BP* as a growth control is likely conservative as it contains information about misvaluation. In subsequent tests, we report results using *GS* as the growth control even though our results are robust to controlling for *BP* as well.

The first set of columns examines the relationship of misvaluation with R&D. Column 1 shows a highly significant negative coefficient of −2.57 ($t = -14.86$). Since high *VP* indicates equity undervaluation, this finding indicates that greater overvaluation (or less undervaluation) is strongly associated with higher innovative expenditures. The effect of a one standard deviation increase in overvaluation increases R&D by over 30% relative to the R&D sample mean, is greater than the effect of a one standard deviation increase in cash flows, and far stronger than the effect of a one standard deviation decrease in *BP*.[22] Column 2, which uses *GS* as the control

[21] Past innovation studies generally do not include firm fixed effects, a procedure which has econometric justification. Imai and Kim (2016) observe that "the ability of fixed effects regression models to adjust for unobserved time-invariant confounders come at the expense of dynamic causal relationships between treatment and outcome." For example, in the innovation setting, controlling for firm invariant characteristics, such as managerial overconfidence, employee inventiveness, or consumer/other stakeholder affinity for the firm and its products, is problematic if these characteristics correlate with the firm's ability to exploit misvaluation. Furthermore, firm fixed effects are suitable to remove omitted variable bias arising from unobserved time-invariant confounders, but the relation between innovation and its determinants is likely to be time-varying.

[22] Although not reported, we also perform tests based upon univariate sorts by *VP* and bivariate sorts with *VP* and *BP* to control for growth opportunities. These sorts lead to generally similar conclusions as the regression tests. In particular, when we form 2-way portfolio sorts by *VP* and *BP*, we find R&D is more strongly associated with *VP*

for growth opportunities, indicates a similar sensitivity of R&D to *VP*; the R&D coefficient is −2.46 (t = −12.74). Columns 3 and 4 which use *MFFlow* to misvaluation offer a similar conclusion that R&D spending is positively associated with prior overvaluation, with an economic magnitude roughly comparable to the effects on R&D of growth prospects and cash flow.

We compare this finding with the results for capital expenditures in the next set of columns, to contrast the effect of misvaluation on intangible investment (R&D) with tangible investment. The effect for R&D is much stronger. For *CAPX* Column 1, capital expenditures are also decreasing with *VP*, but with a much lower magnitude of −0.31 (t = −3.76). The sensitivity of R&D to overvaluation varies from 4.4 times (model 4) to 8.3 times (model 1) that of capital expenditure.[23]

We next examine innovative output measures. *Log(1+Pat)* measures the firm's success in obtaining patents; *Log(1+Cites)* indirectly reflects the number and importance of the patents. The regressions again indicate significant misvaluation effects on innovative output using either measure of misvaluation or growth prospects, suggesting an increase in innovative output that is commensurate with the increased innovative input that is associated with stock overvaluation.[24] A one standard deviation increase in overvaluation (measured by *VP*) leads to a 0.1 increase of *Log(1+Pat)*; for a firm with a patent count of the sample mean (13.56), a one standard deviation

---

than by *BP*. As a specific example, at the beginning of fiscal 2002, Broadcom Inc., a wired and wireless communication solution provider, had a *VP* of 0.043 (in the top overvalued quintile of the sample) and a *BP* of 0.578 (in the value category because *BP* was above the sample median in that year). As other signs of stock overvaluation, the firm was in the top quintile of equity issuance (relative to lagged assets) in the prior fiscal year and bottom quintile of future 1-year market-adjusted return. It invested 19.7% in R&D as a portion of lagged assets, which is higher than both the yearly average R&D investment (8.6%) and the firm's capital expenditure (2.1%).

[23] A possible objection to tests of the effects of misvaluation on R&D versus CAPX is that the distinction between the two might be meaningless if there is accounting discretion in how expenditures are classified. However, our findings that the relation of misvaluation to R&D is very different from the misvaluation-CAPX relation indicates that despite possible discretion, the distinction between the two is economically valid.

[24] It may take some time for the investment in innovation to generate any output. We find that misvaluation also significantly predicts future patents and citations up to three years ahead, but the effect is strongest for the first year. These results are not tabulated for brevity.

of overvaluation would boost the patent count to 15.09, an increase of 1.53, or 11.3% of the sample mean number of patents (a more than 30% increase over the sample median patent count of 5 for firms with a positive patent count). A similar calculation suggests that for a firm with the mean *Cites* (12.28), a one standard deviation increase in overvaluation leads to an increase in the year and technology class adjusted citation count of 0.68, which is 5.5% of the sample mean.

Turning to innovative inventiveness, Table 4 shows regressions of innovative novelty, originality, and scope on stock misvaluation. We observe from these regressions that greater overvaluation is also associated with all three proxies for inventiveness. A one standard deviation increase in overvaluation leads to an increase of 14.2%, 11.8%, and 11.1% in *Novelty*, *Originality*, and *Scope*, respectively, relative to the sample mean values. This suggests that overvalued firms are more prone to engage in 'moon shot' projects.

The tests in Tables 3 and 4 are designed to remove the effects of growth opportunities as much as possible to focus sharply on misvaluation effects. We use two measures of misvaluation that are designed to be filter out the component of growth opportunities unrelated to misvaluation (*VP*), or to be exogenous to growth opportunities (*MFFlow*), and we include two further growth controls, *BP* or *GS*. As a further control for growth opportunities, in unreported robustness tests we also include analyst long-term earnings growth rate forecast (*LTG*). The need for long-term analyst forecasts reduces sample size. Nevertheless, the misvaluation results are robust. In addition, to address the concern that firms acquire innovation through takeovers, we remove all firms involved in acquisition activities in the prior three years; again all of our results remain robust.

The sample for the regressions using R&D is smaller, because R&D is missing in Compustat for many firms. Some studies retain observations with missing R&D and set its value in those cases to zero. A possible problem with this procedure is that some firms may deliberately avoid classifying investment in innovation as R&D to keep their rivals in the dark. However, a problem with dropping firm-year observations with missing R&D is that this omits large parts of the economy in which little research and development activity is going on; and that dropping such observations causes low R&D firms to flip in and out of the sample. In unreported tests, we find that our findings are robust to setting missing R&D values to zero (*VP* and *MFFlow* still significantly affect R&D, though the effects are slightly weaker) or to restricting the sample to non-zero R&D observations (where misvaluation effects on R&D are even stronger).

There are also perceptible differences between the earlier and later periods of our sample. In the earlier years there is higher inflation, which could affect the values of debts, inventories, and property, plant, and equipment (PP&E). In more recent years, many firms hold much higher levels of cash, which could distort the scaling of capital and R&D expenditures. In addition, in later years of the sample, there is a more severe truncation bias in the measurement of citations and inventiveness. In unreported tests, we find that our main findings are robust to splitting the sample into two roughly equal periods or ending the sample much earlier (such as ending in 2000).

Finally, the estimation of *VP* requires I/B/E/S earnings forecast data which limit our sample to relatively large firms. This raises the possibility that some young, innovative, and rapidly growing firms are missing from our sample. When we split the sample into large and small from based on median total assets, we find the misvaluation effects on innovation are significant in both samples but the effects are stronger among smaller firms, suggesting that the results we document may understate the misvaluation effects on innovation if additional small firms were included in the sample.

In sum, the results in Tables 3 and 4 suggest that R&D spending is sometimes motivated by overvaluation, not just fundamental business considerations. Jensen (2005) and Polk and Sapienza (2009) argue that equity overvaluation leads to substantial agency costs in the form of wasteful spending on capital expenditures. Our evidence indicates that the overvaluation effect on investment spending is even stronger for intangible expenditures (R&D) than for tangible capital expenditures. However, unlike overvaluation-driven capital expenditures, overvaluation-driven innovative spending on average converts into higher total innovative output as well as moon shots. Thus, overvaluation can potentially be beneficial for society, especially to the extent that more inventive innovations have positive spillover effects.[25]

3.2 Equity Financing versus Non-Equity Channels

There are theoretical arguments for why misvaluation should affect investment, either through equity issuance, risky debt issuance, or via catering or shared sentiment (Stein 1996; Baker, Stein, and Wurgler 2003; Gilchrist, Himmelberg, and Huberman 2005; Jensen 2005; Polk and Sapienza 2009; Badertscher, Shanthikumar and Teoh 2017).[26] (The risky debt financing channel is likely to be minor for innovation companies.) To estimate the extent to which the effect of misvaluation on innovative investment operates through the equity channel, we perform a path analysis following Badertscher, Shanthikumar, and Teoh (2017). Path analysis is a method of comparing an independent variable's direct effect on the dependent variable to the indirect

[25] In unreported tests we find that firms with high-inventiveness patents have high stock return volatility, consistent with the notion that moon shot projects risky.

[26] We expect misvaluation to be transient (e.g., on the order of a few years), yet we find it affects long-term investment in innovation (R&D). This is consistent with the catering theory, which is precisely about how transient variations in stock prices motivate actions that affect long-term value. This is because the manager cares about the short-term stock price. The financing channel is also influenced by transient mispricing, because, as is well-documented in the corporate finance literature, short-term financial constraints influence long-term investment. Indeed, financing constraints seem to be especially important for R&D activities (Li 2011).

effects that operate via intermediate variables. However, path analysis does not, in itself, necessarily provide clean identification of causation. To provide such identification for the path analysis, we focus on *MFFlow* as misvaluation proxy (even though our results are robust to using *VP* instead) and estimate the following regressions:

$$RD_{it} = a_1 + b_1\, MFFlow_{it} + c_1 EI_{it} + \theta_1\, \boldsymbol{X}_{1it} + u_{1it}$$

$$EI_{it} = a_2 + b_2\, MFFlow_{it} + \theta_2\, \boldsymbol{X}_{2it} + u_{2it},$$

where *i* indexes firms and *t* denotes years. All regressions include year and 2-digit SIC industry fixed effects in addition to the control variables in the vectors $\boldsymbol{X}_1$ and $\boldsymbol{X}_2$ (such as *GS, CF* or *ROA, Leverage, Age,* and *Size*). We conduct a similar path analysis for *CAPX*.

Panels A and B of Table 5 indicate the control variables for each regression. The estimated value of b_1 captures the non-equity effect of *MFFlow* on investment, and the estimated value of $b_2 \times c_1$ captures the effect of *MFFlow* through the equity channel. We interpret the non-equity effect as likely coming from either catering or shared sentiment.

Intuitively, since *MFFlow* is included in the first regression, the coefficient on *EI* will be the same as it would be if *EI* were orthogonalized with respect to *MFFlow*. In other words, the coefficient on *EI* gives the general relationship of equity issuance on investment. If the relation of equity issuance to investment is similar regardless of whether this issuance was induced by *MFFlow*, the effect of *MFFlow* operating through the equity channel is captured by the corresponding coefficient in the first equation, with the direct effect captured by the *MFFlow* coefficient. The second equation gives the coefficient needed to rescale the *EI* coefficient in the first equation to reflect the sensitivity of the financing variable to *MFFlow*.

Table 5 reports key coefficient estimates from the regressions. The percentages at the bottom of Panel C summarize the portion of the total effect of *MFFlow* that is through the equity issuance versus non-equity channels. The preponderance of the effect of *MFFlow* on R&D, 76.76%, of the total effect comes from the non-equity channel. The equity channel contributes the remaining 23.24% of the total effect. Similarly, most of the effect of *MFFlow* on *CAPX* is through non-equity channel (72.49%) rather than through the equity financing channel (27.51%). In unreported tests, using *VP* instead of *MFFlow* to measure mispricing, we obtain the same conclusion that non-equity is the primary channel through which stock misvaluation affects corporate investment, especially R&D spending. Thus, shared sentiment and/or catering effects are even more severe for intangible investments.

3.3 Convexity of Overvaluation Effects

Table 6 tests for non-linear effects of overvaluation on innovative investments and output. We test the hypothesis that misvaluation has a stronger marginal effect on innovation among overvalued firms by including an interaction between the *VP* ratio (or *MFFlow*) and an indicator for a firm being in the bottom *VP* or *MFFlow* (top overvaluation) quintile. For each dependent variable, model (1) uses *VP* and model (2) uses *MFFlow* as the misvaluation proxy. Since our results are robust to using either *BP* or *GS* as the proxy for growth opportunities, for brevity we use *GS* as the growth control here and in subsequent regressions. In each model, we test the hypothesis that misvaluation has as stronger marginal effect by including an interaction between misvaluation and an indicator for a firm being in the top overvaluation (bottom *VP* or bottom *MFFlow*) quintile.

Consistent with the hypothesis, the sensitivity of R&D expenditure to *VP* is much stronger among overvalued firms, with a large interaction coefficient of −6.53 ($t = -13.45$). In fact, this relationship only exists within the top overvaluation (bottom *VP*) quintile; the direct coefficient on *VP* is close to zero. Similarly, using *MFFlow* to measure misvaluation, R&D

shows a much higher sensitivity to misvaluation in the most overvalued, bottom *MFFlow* quintile, with an interaction coefficient of −4.87 (t = −8.12) which is about 5 times larger than the baseline coefficient of −0.96 (t = −6.49). A similar conclusion holds for innovative output and inventiveness using either of the misvaluation proxy. In the most overvalued quintile, the effect of overvaluation on innovative output (*Pat* and *Cites*) is 4.5-9.6 times greater, and the effect on inventiveness (*Novelty*, *Originality*, and *Scope*) is 3.9-7.1 times greater, than the baseline effect. These results indicate that overvaluation-driven R&D spending is rewarded by a commensurate increase in total innovative output, the propensity of firms to engage in 'moon shot' innovative activity.

In sharp contrast, there is no evidence that the sensitivity of *CAPX* to misvaluation is stronger among the most overvalued firms. In fact, in model (1), the coefficient on *VP*∗*LowVP* is a positive 0.34 (t = 2.46), indicating a somewhat weaker overvaluation effect on capital expenditure among the most overvalued firms. A possible interpretation is that there is a substitution effect between R&D and capital spending in the most overvalued firms. However, this result is not robust to using *MFFlow* to measure misvaluation as in model (2), which indicates an insignificant coefficient of *MFFlow***LowFlow*.

3.4 Effects of Growth and Turnover

Tables 7 and 8 describe tests of hypotheses about how growth and turnover affect the relation between misvaluation and innovative activity and output. For each independent variable, model (1) and (2) examine the interaction between misvaluation (measured by *VP* or *MFFlow*) and an indicator for the firm being in the high growth quintile (*HighGS*), and models (3) and (4) address the interaction effect between misvaluation and a high turnover indicator (*HighTurn*).

The R&D columns 1 and 2 show that R&D is much more strongly positively associated with overvaluation among growth firms than among other firms. This is consistent with the hypothesis that overvalued firms can more persuasively engage in either catering via R&D, or overvalued equity-financed R&D, when they have good growth prospects. Furthermore, Tables 7 and 8 show that the overvaluation effect on innovative output and inventiveness, are all stronger among high growth firms, indicating that the misvaluation-driven high innovative spending converts into fruitful innovative output among firms with high growth prospects.

Polk and Sapienza (2009) propose that the sensitivity of investment to misvaluation should be higher when managers have a stronger focus on short-run stock prices, because undertaking an overvalued project can temporarily increase stock price. Polk and Sapienza use turnover as a proxy for short-term focus by shareholders. The results in Table 7 confirm that the sensitivity of patents and citations to overvaluation is greater among high-turnover firms (top turnover quintile), even though the sensitivity of R&D to misvaluation is not stronger among high-turnover firms. Furthermore, Table 8 shows the sensitivity of innovative novelty, originality and scope to overvaluation is much stronger among high-turnover firms. This is consistent with catering taking the form of undertaking moon shot projects.

Returning to capital expenditure, there is no clear evidence that the effect of overvaluation on capital expenditure is stronger among high growth or high turnover firms; the interaction between misvaluation and *HighGS* or between misvaluation and *HighTurn* is not uniformly significant across the *CAPX* regressions. This is further evidence consistent with the hypothesis that overvaluation has a much stronger effect on the creation of intangible assets via R&D than on the creation of tangible assets via capital expenditures.

A possible objection to tests of how the interaction between misvaluation and growth or turnover is that high turnover or growth may themselves be proxies for overvaluation. If so, these interaction tests may be basically similar to the previous results that overvaluation effects are concentrated among the most overvalued firms. To address this point, in unreported tests we construct residual *GS* and residual turnover, where residual measures have overvaluation information filtered out. Specifically, we regress *GS* or turnover on misvaluation and misvaluation squared (misvaluation is either *VP* or *MFFlow*), and assign *HighGS* and *HighTurn* based on the residuals. Results continue to indicate that overvaluation affects innovative output and inventiveness most strongly among growth and high turnover firms, although the overvaluation effects on R&D (and CAPX) do not show elevated strength among these firms, with some evidence of weaker effects among high turnover firms. A possible interpretation is that catering is mainly done through inventiveness rather than from the amount of R&D. For example, if the market thinks the firm can do amazing things, the firm might not increase ordinary product development (the “D” in R&D), or even cut back on it, in order to focus attention on moon shots.[27]

3.5 Effect of Misvaluation on Patent Skewness

In unreported tests, we also examine whether overvaluation is positively associated with the probability that the firm has a positive number of patents. Logistic regressions indicate that overvaluation, especially extreme overvaluation, increases the probability that the firm has a positive patent count. I.e., this effect is convex in overvaluation. The interaction between overvaluation and proxies for growth and turnover positively affects the probability that the firm

[27] We also performed tests that condition the overvaluation-innovation relationship on financial constraints. Using the Kaplan-Zingales (1997) index to measure financial constraints, we find mixed results (unreported): while overvaluation has a stronger effect on CAPX among constrained firms using this measure (consistent with Baker, Stein, and Wurgler (2003) who argue that misvaluation affects investment through the equity channel which is strong when the firm is constrained), its effect on innovation is stronger among unconstrained firms, possibly because most of the effect on innovation operates through the non-equity channel.

has a positive patent count. Therefore, overvaluation increases the likelihood of the firm being an innovator. Since most firms have zero patents, getting a positive patent count is an indicator of going for a big win. So overvaluation encourages the kind of behavior, which, in the extreme, might be called a moon shot.

3.6 Using MFFlow as Instrument for Misvaluation in 2SLS Estimation

So far we have provided tests using *VP* and *MFFlow* as alternative misvaluation proxies. However, tests using *VP* face potential endogeneity, because measurement errors in *VP* and imperfect control for growth prospects (despite our inclusion of several growth controls) may induce a correlation between *VP* and the error term. Furthermore, a positive association between misvaluation and innovation may be a result of reserves causality because stock misvaluation may be caused by overvaluation by investors of opportunities for future firm innovation.

To address endogeneity in tests of the relation of *VP* to innovation, we employ a 2-stage least squares (2SLS) estimation using *MFFlow* as the instrumental variable (IV). Edmans, Goldstein, and Jiang (2012) argue that mutual fund outflows can act as a valid IV since fund flows can cause misvaluation, whereas it is unlikely that hypothetical sales of a single stock resulting from flows to an entire mutual fund are correlated with the fundamentals of the particular stock. They conclude that fund flows are likely to affect corporate decisions only through stock misvaluation.

In the first stage, we regress the endogenous variable, *VP*, on the IV, *MFFlow* and on the same controls as in the second stage (*GS, CF, Leverage, log(Age), Size,* and industry and year fixed effects controls). In the second stage, we regress the innovation variable of interest on the predicted *VP* from the first stage and the control variables. We report the second stage regression results in Table 9, along with the baseline OLS regressions for comparison.[28] The results confirm our earlier conclusions that *VP* affects R&D, innovative output, and innovative inventiveness. In fact, the 2SLS estimation of the *VP* effect is several times stronger than the OLS estimation.[29]

As discussed earlier, investors may overvalue growth, so it would not be surprising if true misvaluation were correlated with growth opportunities. To the extent that *MFFlow* serves as a good instrument for the component of misvaluation that is unrelated to growth opportunities, these results suggest that corporate innovation activities may respond especially strongly to this component of misvaluation. In other words, even overvaluation of a firm's assets-in-place can promote innovation. Furthermore, it suggests that the relationship between misvaluation and innovation is not driven by endogeneity.

4. Conclusion

We test how market overvaluation affects corporate innovative spending and success. As a reference for comparison, we compare the relationship to that between misvaluation and tangible investment (capital expenditures). We use R&D expenditures as a proxy for innovative spending, and patents or patent citations as measures of innovative output and success. We also employ patents-based measures of innovative novelty, originality and scope from previous literature to evaluate how misvaluation affects the propensity to engage in 'moon shot' projects, and the success of such efforts.

We use two proxies for equity misvaluation that are designed either to remove the effects

[28] The first stage regression, which shows a highly significant *MFFlow* coefficient and associated highly significant *F*-test of excluded instruments, is omitted for brevity. Also, since the predicted *VP* from the first stage cannot possess the mean and standard deviation of the original *VP*, we use the non-standardized values of all regression variables in the 2SLS estimation.

[29] The finding that instrumental variable point estimate indicates a larger economic effect of misvaluation than the OLS estimate is consistent with a downward bias in the OLS estimate of the effect of misvaluation. Chirinko and Schaller (2011) have a related discussion in the estimation of the effect of misvaluation on capital investment.

of growth prospects unrelated to the effects of mispricing, or to focus on variations in mispricing unrelated to growth prospects. Our first proxy for equity misvaluation is *VP*, the ratio of a residual income valuation, which discounts future earnings to value the firm's equity, to price. The second misvaluation measure uses hypothetical mutual fund outflows, following Edmans, Goldstein, and Jiang (2012). Extensive additional controls for growth opportunities are also included in the regression tests.

The tests reveal a strong positive association between equity overvaluation and subsequent R&D spending, patent and patent citation production, and inventiveness. Furthermore, these relationships are highly convex, so that top-quintile overvaluation promotes extremes of high innovative activity and inventiveness—'moon shots.' The effect of misvaluation operates partly via the association of misvaluation with equity issuance, and more strongly via the non-equity channel, which includes managerial catering to investor optimism about innovation, or alternatively overoptimism that is shared by managers, customers, suppliers, and/or employees as well as investors. Innovative activity and outcomes is more sensitive to misvaluation among growth firms. The sensitivity of innovative outcomes and inventiveness, but not R&D, is also greater among high turnover firms. These outcomes are consistent with catering or shared sentiment effects, especially in the form of taking more inventive projects.

Although each of our measures of misvaluation is imperfect, their ingredients and construction are extremely different. It is therefore notable that the results that come from these two misvaluation measures are extremely similar.

In sum, we find that strong evidence that high overvaluation is associated with greater innovative expenditures that are rewarded with high innovative output, and with a greater propensity of firms to engage in inventive projects. Overvaluation, especially among the most overvalued firms, encourages ‘moon shot’ activities.

There is a natural offsetting between the encouraging effect of overvaluation on innovation and the discouraging effect of undervaluation, since firms are sometimes overvalued and sometimes undervalued. However, our finding of a powerful convexity in the relation of innovative input, output, and inventiveness with misvaluation suggests that the positive effect is likely to predominate. So our findings suggest that ex ante, the possibility of misvaluation increases moonshots and innovation. If, as much research has argued, there are positive externalities in innovative activity, this suggests that the ex ante possibility of strong misvaluation may increase social welfare. This contrasts sharply with the usual presumption that greater market efficiency is welfare improving.

Appendix A. Calculation of Residual Income Value-to-Price (*VP*)

Our estimation procedure for *VP* is similar to that of Lee, Myers, and Swaminathan (1999). For each stock in month *t*, we estimate the residual income model (RIM) price, denoted by *V* (*t*). *VP* is the ratio of *V(t)* to the stock price at the end of month *t*. With the assumption of 'clean surplus' accounting, which states that the change in book value of equity equals earnings minus dividends, the intrinsic value of firm stock can be written as the book value plus the discounted value of an infinite sum of expected residual incomes (see Ohlson (1995)),

$$V(t) = B(t) + \sum_{t=1}^{\infty} \frac{E_t[\{ROE(t+i) - r_e\,(t+i-1)\}B(t+i-1)]}{[1+\ r_e(t)]^i},$$

where E_t is the expectations operator, *B*(*t*) is the book value of equity at time *t* (negative *B*(*t*) observations are deleted), *ROE*(*t* + *i*) is the return on equity for period *t* + *i*, and $r_e(t)$ is the firm's annualized cost of equity capital.

For practical purposes, the above infinite sum needs to be replaced by a finite series of *T* −1 periods, plus an estimate of the terminal value beyond period *T*. This terminal value is estimated by viewing the period *T* residual income as a perpetuity. Lee, Myers, and Swaminathan (1999) report that the quality of their *V* (*t*) estimates was not sensitive to the choice of the forecast horizon beyond three years. Of course, residual income *V* (*t*) cannot perfectly capture growth, so our misvaluation proxy *VP* does not perfectly filter out growth effects. However, since *V* reflects forward-looking earnings forecasts, a large portion of the growth effects contained in *BP* should be filtered out of *VP*.

We use a three-period forecast horizon:

$$V(t) = \frac{[f^{ROE}\ (t+1) - r_e(t)]B(t)}{1+ r_e(t)} + \frac{[f^{ROE}\ (t+2) - r_e(t)]B(t+1)}{[1+ r_e(t)]^2} + \frac{[f^{ROE}\ (t+3) - r_e(t)]B(t+2)}{[1+ r_e(t)]^2 r_e(t)},$$

where $f^{ROE}(t+i)$ is the forecasted return on equity for period *t* + *i*, the length of a period is one year, and where the last term discounts the period *t* + 3 residual income as a perpetuity.

Forecasted ROE's are computed as

$$f^{ROE}\ (t+i) = \frac{f^{EPS}\ (t+i)}{\bar{B}(t+i-1)},$$

where $\bar{B}(t+i-1)$ is defined as the average of *B* (*t* + *i* −1) and *B* (*t* + *i* −2), and where $f^{EPS}(t+i)$ is the forecasted EPS for period *t* + *i*. If the EPS forecast for any horizon is not available, it is substituted by the EPS forecast for the previous horizon and compounded at the long-term growth rate (as provided by I/B/E/S). If the long-term growth rate is not available from I/B/E/S, the EPS forecast for the first preceding available horizon is used as a surrogate for $f^{EPS}(t+i)$. We require that each of these f^{ROE}'s be less than 1.

Future book values of equity are computed as

$$B\,(t+i) = B(t+i-1) + (1-k)f^{EPS}(t+i),$$

where k is the dividend payout ratio determined by

$$k = \frac{D(t)}{EPS(t)},$$

and $D(t)$ and $EPS(t)$ are respectively the dividend and EPS for period t. Following Lee, Myers, and Swaminathan (1999), if $k < 0$ (owing to negative EPS), we divide dividends by (0.06 × total assets) to derive an estimate of the payout ratio, i.e., we assume that earnings are on average 6% of total assets. Observations in which the computed k is greater than 1 are deleted from the study.

The annualized cost of equity, $r_e(t)$, is determined as a firm-specific rate using the CAPM, where the time-t beta is estimated using the trailing five years (or, if there is not enough data, at least two years) of monthly return data. The market risk premium assumed in the CAPM is the average annual premium over the risk-free rate for the CRSP value-weighted index over the preceding 30 years. Any estimate of the CAPM cost of capital that is outside the range of 5%-20% is winsorized to lie at the border of the range. Previous studies have reported that the predictive ability of *VP* was robust to the cost of capital model used (Lee, Myers, and Swaminathan (1999)) and to whether the discount rate was allowed to vary across firms (D'Mello and Shroff (2000)).

Appendix B. Calculation of Mutual Fund Outflow Price Pressure (*MFFlow*)

We follow Edmans, Goldstein and Jiang (2012) to calculate the hypothetical mutual fund outflow price pressure measure. Quarterly mutual fund holdings data are obtained from CDA Spectrum/Thomson and mutual fund returns are from CRSP.

First, in each quarter *t*, we estimate mutual fund flows for all U.S. funds that are not specialized in a given industry using CRSP mutual funds data as

$$Outflow_{j,t} = \frac{TA_{j,t-1}\left(1 + R_{j,t}\right) - TA_{j,t}}{TA_{j,t-1}},$$

where $TA_{j,t}$ is the total asset value of fund *j* (= 1, …, *m*) at the end of quarter *t* and $R_{j,t}$ is the return of fund *j* in quarter *t*, computed by compounding monthly fund returns. $Outflow_{j,t}$ is therefore the total outflow experienced by fund *j* in quarter *t* as a percentage of its asset value at the beginning of the quarter.

Second, we calculate the dollar holdings of stock *i* by fund *j* at the end of quarter *t* using data from CDA Spectrum/Thomson. CDA Spectrum/Thomson provides the number of stocks held by all US funds at the end of every quarter. The total dollar value of the participation held by fund *j* in stock *i* at the end of quarter *t* in year t is

$$Share_{i,j,t} \times PRC_{i,t},$$

where $Share_{i,j,t}$ is the number of stocks *i* held by fund *j* at the end of quarter *t*, and $PRC_{i,t}$ is the price of stock *i* at the end of quarter *t*.

Third, we compute the quarterly mutual fund flow

$$QMfflow_{i,t} = \sum_{j=1}^{m} \frac{Outflow_{j,t} \times Share_{i,j,t} \times PRC_{i,t}}{VOL_{i,t}},$$

where the summation is only over funds *j* for which $Outflow_{j,t} \geq 0.05$, and where $VOL_{i,t}$ is the total dollar trading volume of stock *i* in quarter *t*. This variable corresponds to the hypothetical selling pressure of stock *i* by all mutual funds subject to large outflows.

Finally, we calculate the annual *MFFlow* for stock *i* in quarter *t* by recursively summing up *QMFFlow* across the four quarters up to quarter *t*.

References

Acharya, Viral, and Zhaoxia Xu, 2017, Financial dependence and innovation: The case of public versus private firms, *Journal of Financial Economics* 124, 223-243.

Ali, Ashiq, Lee-Seok Hwang, and Mark A. Trombley, 2003, Residual-income-based valuation predicts future stock returns: Evidence on mispricing versus risk explanations, *Accounting Review* 78, 377–396.

Ali, Usman, and David A. Hirshleifer, 2017, Opportunism as a managerial trait: Predicting insider trading profits and misconduct. *Journal of Financial Economics*, forthcoming.

Alti, Aydogan, and Paul C. Tetlock, 2014, Biased beliefs, asset prices, and investment: A structural approach, *Journal of Finance* 69, 325-361.

Badertscher, Brad, Devin Shanthikumar, and Siew Hong Teoh, 2016, Private firm investment public peer misvaluation, Working paper, University of California Irvine.

Baker, Malcolm, Xin Pan, and Jeffrey Wurgler, 2012. A reference point theory of mergers and acquisitions. *Journal of Financial Economics* 106, 49-71.

Baker, Malcolm, Jeremy C. Stein, and Jeffery Wurgler, 2003, When does the market matter? Stock prices and the investment of equity-dependent firms, *Quarterly Journal of Economics* 118, 969–1005.

Baker, Malcolm, and Jeffery Wurgler, 2000, The equity share in new issues and aggregate stock returns, *Journal of Finance* 55, 2219–2257.

Baker, Malcolm, and Jeffery Wurgler, 2002, Market timing and capital structure, *Journal of Finance* 57, 1–32.

Barber, Brad M., and Terrance Odean, 2008, All that glitters: The effect of attention and news on the buying behavior of individual and institutional investors, *Review of Financial Studies* 21, 785-818.

Barro, Robert J., 1990, The stock market and investment, *Review of Financial Studies* 3, 115–131.

Basalla, George, 1988, *The Evolution of Technology*, Cambridge University Press, Cambridge, MA.

Bhagat, Sanjai, and Ivo Welch, 1995, Corporate R&D investments: International comparisons, *Journal of Accounting and Economics* 19, 443–470.

Blanchard, Olivier, Changyong Rhee, and Lawrence Summers, 1993, The stock market, profit, and investment, *Quarterly Journal of Economics* 108, 115–136.

Camanho, Nelson, 2015, The effects of fund flows on corporate investment: A catering view, Working Paper, Catolica Lisbon School of Business & Economics.

Campello, Murillo, and John R. Graham, 2013, Do stock prices influence corporate decisions?

Evidence from the technology bubble, *Journal of Financial Economics* 107, 89-110.

Chirinko, Robert S., and Huntley Schaller, 2001, Business fixed investment and “bubbles”: The Japanese case, *American Economic Review* 91, 663–680.

Chirinko, Robert S., and Huntley Schaller, 2011, Fundamentals, Misvaluation, and Business Investment. *Journal of Money, Credit and Banking* 43, 1423–1442.

Chirinko, Robert S., and Huntley Schaller, 2012. Do bubbles lead to overinvestment? A revealed preference approach. In D. D. Evanoff, G. G. Kaufman, and A. G. Malliaris, eds., *New Perspectives on Asset Price Bubbles: Theory, Evidence, and Policy*, pp. 433–453. (Oxford University Press, New York, NY).

Cornell, Bradford, 2013, Discounted cash flow and residual earnings valuation: A comparison in the context of valuation disputes, *Business Valuation Review* 31, 10–20.

Cornell, Bradford, 2016, The Tesla run-up: A follow-up with investment implications, *Journal of Portfolio Management* 43, 1-4.

Cornell, Bradford, and Aswath Damodaran, 2014, Tesla: Analysis of a run-up, *Journal of Portfolio Management* 41, 139-151.

Coval, Joshua, and Erik Stafford, 2007, Asset fire sales (and purchases) in equity markets, *Journal of Financial Economics* 86, 479–512.

Custodio, Claudia, Miguel A. Ferreira, and Pedro P. Matos, 2013, Do general managerial skills spur innovation?, Darden Business School Working Paper.

DeAngelo, Harry, Linda DeAngelo, and Rene M. Stulz, 2010, Seasoned equity offerings, market timing, and the corporate lifecycle, *Journal of Financial Economics* 95, 275–295.

Dessaint, Olivier, Thierry Foucault, Laurent Fresard, and Adrien Matray, 2015, Ripple effects of noise on corporate investment. *Working Paper, University of Toronto*.

D’Mello, Ranjan, and Pervin K. Shroff, 2000, Equity undervaluation and decisions related to repurchase tender offers: An empirical investigation, *Journal of Finance* 55, 2399–2424.

Dong, Ming, David Hirshleifer, Scott Richardson, and Siew Hong Teoh, 2006, Does investor misvaluation drive the takeover market?, *Journal of Finance* 61, 725–762.

Dong, Ming, David Hirshleifer, and Siew Hong Teoh, 2012, Overvalued equity and financing decisions, *Review of Financial Studies* 25, 3645–3683.

Edmans, Alex, Itay Goldstein, and Wei Jiang, 2012, The real effects of financial markets: The impact of prices on takeovers. *Journal of Finance* 67, 933–971.

Einhorn, Hillel J., 1980, Overconfidence in judgment, *New Directions for Methodology of Social and Behavioral Science* 4, 1–16.

Frankel, Richard, and Charles M. C. Lee, 1998, Accounting valuation, market expectation, and the book-to-market effect, *Journal of Accounting and Economics* 25, 283–321.

George, Thomas J., Chuan-Yang Hwang, and Yuan Li, 2017, The 52-week high, Q theory and the cross section of stock returns, *Journal of Financial Economics*, forthcoming.

Gilchrist, Simon, Charles P. Himmelberg, and Gur Huberman, 2005, Do stock price bubbles influence corporate investment?, *Journal of Monetary Economics* 52, 805–827.

Gornall, Will, and Ilya Strebulaev, 2017, Squaring venture capital valuations with reality, Working Paper, University of British Columbia and Stanford University.

Gross, Daniel, 2009, Pop! Why bubbles are great for the economy. Harper Collins.

Hall, Bronwyn H., Adam Jaffe, and Manuel Trajtenberg, 2001, The NBER patent citations data file: Lessons, insights and methodological tools, *NBER Working Paper No.8498*, *University of California at Berkeley*.

Hall, Bronwyn H., Adam Jaffe, and Manuel Trajtenberg, 2005, Market value and patent citations, *RAND Journal of Economics* 36, 16–38.

Hau, Harald, and Sandy Lai, 2013, Real effects of stock underpricing, *Journal of Financial Economics* 108, 392-408.

Henderson, Brian J., Narasimhan Jegadeesh, and Michael S. Weisbach, 2006, World markets for raising new capital, *Journal of Financial Economics* 82, 63–101.

Hirshleifer, David A., Po-Hsuan Hsu, and Dongmei Li, 2017, Innovative originality, profitability, and stock returns. *Review of Financial Studies*, forthcoming.

Hirshleifer, David A., Sonya Lim, and Siew Hong Teoh, 2011, Limited investor attention and stock market misreactions to accounting information, *Review of Asset Pricing Studies* 1, 35-73.

Hirshleifer, David A., Angie Low, and Siew Hong Teoh, 2012, Are overconfident CEOs better innovators? *Journal of Finance* 67, 1457–1498.

Hirshleifer, David A., and Siew Hong Teoh, 2003, Limited attention, information disclosure, and financial reporting, *Journal of Accounting and Economics* 36, 337-386.

Imai, Kosuke, and In Song Kim, 2016, When should we use linear fixed effects regression models for causal inference with longitudinal data? Working Paper, Princeton University and Massachusetts Institute of Technology.

Jeng, Leslie A., Andrew Metrick, and Richard Zeckhauser, 2003, Estimating the returns to insider trading: A Performance-Evaluation Perspective, *Review of Economics and Statistics* 85, 453-471.

Jensen, Michael C., 2005, Agency costs of overvalued equity, *Financial Management* 34, 5–19.

Kaplan, Steven N., and Luigi Zingales, 1997, Do financial constraints explain why investment is correlated with cash flow? *Quarterly Journal of Economics* 112, 169–216.

Katz, Michael, and Carl Shapiro, 1986, Technology adoption in the presence of network externalities, *Journal of Political Economy* 94, 822–841.

Keynes, John Maynard, 1931, An economic analysis of unemployment, in *Collected Writings*, vol. XIII (Macmillan, London, 1973).

Kogan, Leonid, Dimitris Papanikolaou, Amit Seru, and Noah Stoffman, 2016, Technological innovation, resource allocation, and growth. *Quarterly Journal of Economics*, forthcoming.

Kumar, Alok, 2009, Hard-to-value stocks, behavioral biases, and informed trading, *Journal of Financial and Quantitative Analysis* 44, 1375–1401.

Lakonishok, Josef, and Inmoo Lee, 2001, Are Insider Trades Informative? *Review of Financial Studies*, 14, 79–111**.**

LaPlante, Michele, and Chris J. Muscarella, 1997, Do institutions receive comparable execution in the NYSE and Nasdaq markets? A transaction study of block trades, *Journal of Financial Economics* 45, 97–134.

Lee, Charles M.C., James Myers, and Bhaskaran Swaminathan, 1999, What is the intrinsic value of the Dow?, *Journal of Finance* 54, 1693–1741.

Lerner, Josh, Morten Sørensen, and Per Strömberg, 2011, Private equity and long-run investment: The case of innovation, *Journal of Finance* 66, 445–477.

Lev, Baruch, and Theodore Sougiannis, 1996, The capitalization, amortization, and value-relevance of R&D, *Journal of Accounting and Economics* 21, 107–138.

Li, Dongmei, 2011, Financial constraints, R&D investment, and stock returns, *Review of Financial Studies* 24, 2974-3007.

Li, Jun, and Jianfeng Yu, 2012, Investor attention, psychological anchors, and stock return predictability, *Journal of Financial Economics* 104, 401-419.

Loughran, Tim, and Jay Ritter, 1995, The new issues puzzle, *Journal of Finance* 50, 23–52.

Morck, Randall, Andrei Shleifer, and Robert W. Vishny, 1990, The stock market and investment: Is the market a sideshow, *Brookings Papers on Economic Activity* 1990, 157–202.

Moskowitz, Tobias J., and Mark Grinblatt, 1999, Do industries explain momentum?, *Journal of Finance* 54, 1249–1290.

Ohlson, James, 1995, Earnings, book values, and dividends in equity valuation, *Contemporary Accounting Research* 11, 661–687.

Panageas, Stavros, 2005, The neoclassical theory of investment in speculative markets, Working paper, University of Chicago.

Parise, Gianpaolo, 2013, Do underpriced firms innovate less? Swiss Finance Institute Research Paper No. 14-12.

Polk, Chris, and Paola Sapienza, 2009, The stock market and corporate investment: A test of catering theory, *Review of Financial Studies* 22, 187–217.

Ritter, Jay R., 1991, The long-run performance of initial public offerings, *Journal of Finance* 46, 3–27.

Romer, Paul M., 1990, Endogenous Technological Change, *Journal of Political Economy* 96, S71-S102.

Seru, Amit, 2014, Firm boundaries matter: Evidence from conglomerates and R&D activity, *Journal of Financial Economics* 111, 381–405.

Schumpeter Joseph A., 1934, *The Theory of Economic Development*, Harvard University Press: Cambridge, MA.

Shleifer, Andrei, 2000, Are markets efficient? No, arbitrage is inherently risky. *Wall Street Journal* CCXXXVI:A10.

Shleifer, Andrei, and Robert W. Vishny, 2003, Stock market driven acquisitions, *Journal of Financial Economics* 55, 2219-2258.

Singh, Jasjit, and Lee Fleming, 2010, Lone inventors as sources of breakthroughs: Myth or reality? *Management Science* 56, 41–56.

Sorkin, Andrew Ross, 2017, How valuable is a unicorn? Maybe not as much as it claims to be. *New York Times*, Oct. 16, 2017, https://www.nytimes.com/2017/10/16/business/how-valuable-is-a-unicorn-maybe-not-as-much-as-it-claims-to-be.html.

Stein, Jeremy, 1996, Rational capital budgeting in an irrational world, *Journal of Business* 69, 429–455.

Teoh, Siew Hong, Ivo Welch, and T. J. Wong, 1998a, Earnings management and the long-term market performance of initial public offerings, *Journal of Finance* 53, 1935–1974.

Teoh, Siew Hong, Ivo Welch, and T. J. Wong, 1998b, Earnings management and the underperformance of seasoned equity offerings, *Journal of Financial Economics* 50, 63–99.

Teoh, Siew Hong, T. J. Wong, and Gita Rao, 1998, Are accruals during an initial public offering opportunistic?, *Review of Accounting Studies* 3, 175–208.

Tian, Xuan, and Tracy Wang, 2014, Tolerance for Failure and Corporate Innovation, *Review of Financial Studies* 27, 211-255.

Titman, Sheridan, John K.C. Wei, and Feixue Xie, 2004, Capital investment and stock returns, *Journal of Financial and Quantitative Analysis* 39, 677–701.

Tobin, James, 1969, A general equilibrium approach to monetary theory, *Journal of Money, Credit, and Banking* 1, 15–29.

Trajtenberg, Manuel, Rebeca Henderson, and Adam Jaffe, 1997, University versus corporate patents: A window on the basicness of invention, *Economics of Innovation and New Technology* 5, 19–50.

Warusawitharana, Missaka, and Toni M. Whited, 2016, Equity market misvaluation, financing, and investment, *Review of Financial Studies* 29, 603–654.

Weitzman, Martin L., 1998, Recombinant growth, *Quarterly Journal of Economics* 113, 331–360.

Welch, Ivo, and David Wessels, 2000, The cross-sectional determinants of corporate capital expenditures, *Schmalenbach Business Review* 52, 103–136.

Table 1. Summary Statistics of Innovation Input and Outputs, Valuation, and Control Variables

The sample includes U.S. non-financial firms listed on NYSE, AMEX and NASDAQ with COMPUSTAT and I/B/E/S coverage during 1976-2012. Patent and citation counts data (November 2011 version) is provided by Kogan et al. (2013); we end the patent and citation data in 2008 to reduce truncation biases caused by the delay in patent approval and citation counts. Innovation input is R&D expenditure scaled by lagged total assets (*RD*). Capital expenditures scaled by lagged total assets (*CAPX*) is also reported. Variables for the patents applied for in a fiscal year include: number of patents (*Pat*); number of citations adjusted for the effects of year and technological class (*Cites*); *Novelty* measured by number of citations per patent; *Originality* and *Scope* are patent-citation quality measures as defined by Hall, Jaffe, and Trajtenberg (2001). *VP* is the residual-income-value to price ratio. *MFFlow* is the mutual fund price pressure measure following Edmans, Goldstein, and Jiang (2012). *BP* is the book equity to price ratio. *CF* is cash flow (income before extraordinary items + depreciation + *RD*) over the fiscal year scaled by lagged assets (missing *RD* is set to zero in the *CF* calculation). *Leverage* is defined as (long-term debt + current liabilities)/(long-term debt + current liabilities + shareholders' equity). *Age* is the number of years between the beginning of the fiscal year and the listing date of the firm in CRSP, truncated at 50. *GS* is the growth rate of sales in the 3 years prior to each fiscal year. *LTG* is the long-term analyst earnings growth rate forecast. Equity issuance (*EI*) and debt issuance (*DI*) are equity and debt issuances during the fiscal year constructed from the balance sheet scaled by lagged assets. *Turnover* is monthly trading volume scaled by the number of shares outstanding. Except for the innovation input and output variables, and cash flow (*CF*), and equity issuance (*EI*), which are measured over each fiscal year, all other control variables, valuation variables, and valuation sensitivity variables are measured in the month preceding the beginning of each fiscal year. We choose the most recent fiscal year accounting data available at the end of June each year so that each sample firm appears once for a particular year. Total assets and sales figures are in 2012 dollars. All ratio variables are winsorized at the 1st and 99th percentiles.

	N	Mean	Std Dev	Median	P1	P99
Innovation Input and Output Variables						
RD (%)	40248	8.26	12.33	4.02	0.00	60.53
CAPX (%)	63039	8.03	9.16	5.30	0.21	48.00
Pat	55195	13.56	88.38	0.00	0.00	261.00
Cites	54079	12.28	78.51	0.00	0.00	234.26
Novelty	54079	0.42	0.74	0.00	0.00	3.15
Originality	55115	0.18	0.25	0.00	0.00	0.79
Scope	54079	0.16	0.24	0.00	0.00	0.78
Valuation Variables						
VP	63724	0.63	0.56	0.57	-1.09	2.67
MFFlow (%)	48352	3.19	5.04	1.69	0.01	24.37
Control or Conditioning Variables for Innovation Regressions						
BP	63724	0.63	0.62	0.45	0.03	3.39
GS	55098	0.85	2.19	0.39	-0.63	10.69
CF (%)	63574	12.62	14.84	12.50	-36.41	54.89
Leverage	63724	0.27	0.23	0.24	0.00	0.84
Age	63724	15.02	13.62	10.67	0.42	50.00
Total Assets ($M)	63715	3395.57	18003.86	458.23	17.42	49266.07
LTG	47120	0.18	0.11	0.16	0.04	0.54
EI (%)	63622	7.36	30.06	1.01	-14.64	128.43
DI (%)	63715	7.58	22.64	2.87	-26.98	109.16
Turnover (%)	62482	9.17	10.14	5.69	0.34	48.41

Table 2. Corporate Investment, Innovative Output, and Equity Valuations by Year

This table reports the time pattern of selected variables. The yearly mean values are reported, except for the valuation ratios (*BP* and *VP*) for which the medians are shown. The sample includes U.S. non-financial firms listed on NYSE, AMEX and NASDAQ with COMPUSTAT and I/B/E/S coverage during 1976-2012. Patent and citation data is from Kogan et al. (2016) (November 2011 version); we end the patent and citation data in 2008 to reduce truncation biases.

Year	*N*	*RD* (%)	*CAPX* (%)	*Pat*	*Cites*	*Novelty*	*Originality*	*Scope*	*MFFlow* (%)	*Med. BP*	*Med. VP*
1976	397	3.19	9.47	30.02	28.55	0.62	0.23	0.27		0.78	0.96
1977	537	3.49	10.71	25.20	24.05	0.63	0.21	0.27		0.63	0.83
1978	638	3.44	12.01	21.02	19.82	0.56	0.21	0.24		0.72	0.95
1979	959	3.48	11.82	14.03	13.16	0.52	0.19	0.23		0.79	1.03
1980	1013	3.67	11.61	14.26	13.38	0.49	0.19	0.22		0.75	0.89
1981	1028	3.67	11.57	13.73	13.24	0.51	0.19	0.22	1.27	0.71	0.85
1982	1066	4.01	9.56	12.78	12.31	0.49	0.19	0.22	4.93	0.76	1.07
1983	1168	4.85	8.61	11.06	10.65	0.42	0.17	0.20	4.09	0.65	0.85
1984	1327	5.60	10.57	10.23	10.10	0.43	0.16	0.19	1.42	0.47	0.59
1985	1461	6.09	10.39	9.14	9.31	0.43	0.16	0.19	4.05	0.59	0.95
1986	1429	5.95	9.41	9.82	10.00	0.45	0.17	0.20	4.12	0.54	0.73
1987	1481	5.67	8.99	9.41	9.34	0.42	0.16	0.19	3.80	0.49	0.64
1988	1529	6.12	9.06	9.68	9.70	0.43	0.16	0.19	2.50	0.53	0.72
1989	1518	6.41	8.80	11.35	11.31	0.42	0.16	0.19	1.92	0.52	0.85
1990	1596	6.87	8.66	11.47	11.55	0.44	0.16	0.19	1.47	0.51	0.77
1991	1569	7.10	7.68	11.74	12.06	0.39	0.16	0.19	9.15	0.59	0.84
1992	1678	7.64	7.86	11.29	11.85	0.42	0.16	0.19	2.98	0.46	0.65
1993	1830	8.61	8.76	10.88	11.31	0.43	0.17	0.19	1.88	0.42	0.57
1994	1981	8.98	9.58	11.09	11.73	0.42	0.17	0.18	2.24	0.37	0.56
1995	2209	9.81	9.88	11.99	12.28	0.41	0.17	0.19	1.68	0.41	0.71
1996	2372	9.90	9.83	12.17	12.71	0.41	0.17	0.17	1.95	0.35	0.59
1997	2554	10.84	9.80	13.67	14.18	0.44	0.18	0.18	1.71	0.34	0.49
1998	2637	10.93	9.38	13.65	13.90	0.41	0.18	0.17	2.02	0.32	0.46
1999	2488	10.77	8.18	15.07	15.02	0.42	0.18	0.17	3.94	0.42	0.51
2000	2303	10.89	8.42	17.54	17.36	0.43	0.19	0.16	8.46	0.38	0.45
2001	2242	8.71	6.57	18.76	17.78	0.46	0.21	0.15	4.32	0.41	0.47
2002	2178	9.27	5.33	19.65	17.11	0.47	0.23	0.14	1.41	0.44	0.35
2003	2064	9.16	5.36	20.67	16.23	0.45	0.23	0.12	2.80	0.59	0.56
2004	2070	8.64	5.87	19.15	13.23	0.41	0.22	0.09	2.08	0.37	0.37
2005	2114	8.72	6.16	17.23	10.04	0.37	0.19	0.06	2.12	0.33	0.32
2006	2098	9.68	6.69	14.20	6.57	0.32	0.18	0.04	3.69	0.34	0.35
2007	2076	9.39	7.02	8.69	3.30	0.24	0.16	0.03	2.91	0.34	0.36
2008	2128	8.94	6.46	4.09	1.09	0.15	0.11	0.01	3.15	0.38	0.36
2009	2074	8.90	4.34						3.70	0.72	0.62
2010	1994	8.40	5.22						3.37	0.50	0.45
2011	1963	8.17	6.13						3.03	0.42	0.51
2012	1955	8.64	6.06						3.28	0.49	0.59
All	63724	8.26	8.03	13.56	12.28	0.42	0.18	0.16	3.19	0.45	0.57

Table 3. Regressions of Investments and Innovative Output on Stock Misvaluation

The variables are defined in Table 1. All independent variables are standardized to have a mean of zero and standard deviation of one. All regressions include 2-digit SIC industry fixed effects and year fixed effects. *T*-statistics are reported in parentheses. Standard errors are clustered by firm and year. The sample includes U.S. non-financial, non-utility firms listed on NYSE, AMEX and NASDAQ with COMPUSTAT and I/B/E/S coverage during 1976-2012. The patent and citation (*Pat* and *Cites*) data sample period is 1976-2008.

	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
	RD				*CAPX*				*Log(1+Pat)*				*Log(1+Cites)*			
VP	-2.57	-2.46			-0.31	-0.42			-0.09	-0.10			-0.04	-0.05		
	(-14.86)	(-12.74)			(-3.76)	(-3.66)			(-5.53)	(-4.95)			(-7.10)	(-5.95)		
MFFlow			-1.35	-1.27			-0.25	-0.29			-0.07	-0.07			-0.03	-0.03
			(-6.75)	(-6.51)			(-3.26)	(-3.37)			(-5.59)	(-5.48)			(-6.21)	(-6.12)
BP	-0.42		-0.72		-1.09		-0.97		-0.05		-0.05		-0.02		-0.02	
	(-2.75)		(-3.73)		(-8.36)		(-7.23)		(-4.02)		(-3.40)		(-3.55)		(-3.30)	
GS		0.88		1.04		0.58		0.54		0.03		0.03		0.02		0.02
		(5.49)		(5.49)		(4.35)		(4.13)		(4.39)		(3.40)		(5.24)		(4.44)
CF	1.35	1.92	1.28	1.87	1.57	2.04	1.50	1.87	0.12	0.17	0.13	0.18	0.05	0.07	0.06	0.08
	(5.50)	(8.62)	(4.86)	(6.90)	(10.34)	(11.64)	(9.85)	(11.55)	(9.49)	(11.67)	(7.76)	(9.91)	(9.60)	(11.72)	(7.84)	(9.89)
Leverage	-1.49	-1.18	-1.60	-1.37	0.70	0.62	0.55	0.51	-0.18	-0.18	-0.22	-0.21	-0.08	-0.08	-0.09	-0.08
	(-13.18)	(-10.78)	(-11.85)	(-10.27)	(7.82)	(6.32)	(6.02)	(5.56)	(-11.58)	(-11.41)	(-11.35)	(-10.85)	(-12.60)	(-12.02)	(-11.87)	(-11.28)
Log(Age)	-0.86	-0.84	-1.44	-1.25	-1.09	-0.75	-0.93	-0.57	0.09	0.19	0.10	0.15	0.04	0.08	0.04	0.06
	(-7.03)	(-5.17)	(-9.23)	(-6.61)	(-10.34)	(-5.11)	(-7.34)	(-3.62)	(5.94)	(6.94)	(4.39)	(4.97)	(5.43)	(6.83)	(3.81)	(4.70)
Size	-2.86	-2.36	-3.33	-2.89	0.11	0.13	0.01	-0.01	0.66	0.69	0.70	0.72	0.24	0.25	0.24	0.25
	(-11.33)	(-10.38)	(-12.14)	(-11.24)	(0.99)	(1.12)	(0.09)	(-0.13)	(19.10)	(19.61)	(17.39)	(17.54)	(20.07)	(20.65)	(18.20)	(18.42)
Intercept	7.19	6.96	7.54	7.32	7.60	7.32	7.26	7.21	-0.13	-0.21	-0.16	-0.19	-0.09	-0.11	-0.08	-0.10
	(38.81)	(51.92)	(47.78)	(49.69)	(35.97)	(36.99)	(36.86)	(33.60)	(-6.88)	(-9.73)	(-6.98)	(-7.48)	(-12.35)	(-14.18)	(-9.47)	(-9.08)
N	40,206	34,658	31,084	27,982	62,954	54,445	47,839	43,253	55,048	47,295	40,692	36,598	53,935	46,296	39,714	35,701
R^2	0.3271	0.3233	0.3135	0.3099	0.1301	0.1275	0.1229	0.1182	0.3909	0.4103	0.3977	0.4109	0.3590	0.3797	0.3648	0.3799

Table 4. Regressions of Innovative Inventiveness on Stock Misvaluation

The variables are defined in Table 1. All independent variables are standardized to have a mean of zero and standard deviation of one. *Novelty, Originality*, and *Scope* are in percentage. All regressions include 2-digit SIC industry fixed effects and year fixed effects. *T*-statistics are reported in parentheses. Standard errors are clustered by firm and year. The sample includes U.S. non-financial, non-utility firms listed on NYSE, AMEX and NASDAQ with COMPUSTAT, I/B/E/S, and patent-citation data coverage during 1976-2008.

	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
	Novelty				*Originality*				*Scope*			
VP	-6.13	-5.98			-2.06	-2.12			-1.88	-1.77		
	(-9.54)	(-7.64)			(-7.27)	(-6.21)			(-8.96)	(-6.93)		
MFFlow			-3.53	-3.22			-1.10	-1.08			-1.26	-1.18
			(-5.88)	(-5.87)			(-4.14)	(-4.25)			(-5.83)	(-5.77)
BP	-1.79		-2.83		-0.60		-1.04		-0.34		-0.55	
	(-2.64)		(-3.56)		(-2.11)		(-2.88)		(-1.41)		(-1.69)	
GS		3.18		3.72		0.56		0.77		0.63		0.77
		(5.73)		(5.82)		(3.25)		(3.92)		(3.92)		(4.21)
CF	5.74	7.37	6.10	7.62	1.73	2.31	1.61	2.26	1.87	2.36	1.87	2.34
	(7.87)	(10.41)	(6.87)	(8.81)	(7.51)	(10.44)	(5.35)	(8.29)	(6.89)	(8.06)	(5.44)	(6.66)
Leverage	-7.38	-6.68	-7.84	-7.20	-2.60	-2.47	-3.01	-2.78	-2.72	-2.61	-2.88	-2.67
	(-11.80)	(-10.95)	(-10.96)	(-10.07)	(-11.22)	(-10.55)	(-10.60)	(-9.90)	(-11.91)	(-11.13)	(-10.34)	(-10.12)
Log(Age)	1.24	3.52	-0.01	1.50	1.63	2.66	1.57	2.21	1.41	2.51	1.38	1.92
	(1.50)	(3.33)	(-0.01)	(1.31)	(5.98)	(6.55)	(3.84)	(4.55)	(4.91)	(6.34)	(3.49)	(4.46)
Size	12.76	12.85	12.32	12.70	5.28	5.26	5.23	5.28	4.87	4.79	4.46	4.49
	(14.67)	(14.04)	(12.50)	(12.70)	(17.26)	(16.20)	(14.31)	(14.33)	(12.14)	(11.40)	(9.60)	(9.35)
Intercept	-2.73	-2.83	0.05	0.59	2.57	2.28	3.08	3.05	-5.33	-6.18	-4.62	-5.04
	(-4.11)	(-3.49)	(0.06)	(0.57)	(8.72)	(7.42)	(10.75)	(8.97)	(-13.29)	(-12.94)	(-8.51)	(-8.24)
N	53,935	46,296	39,714	35,701	54,968	47,228	40,633	36,544	53,935	46,296	39,714	35,701
R^2	0.1328	0.1432	0.1352	0.1426	0.1904	0.1963	0.1896	0.1950	0.2220	0.2368	0.2321	0.2455

Table 5. Path Analysis of the Effects of Misvaluation on R&D or Capital Investment

This analysis is based on a sample during 1976-2012. The variables in Panel A are defined in Table 1. In Panel B, *ROA* is operating income before depreciation and R&D expenses scaled by total assets for the prior fiscal year, and *ΔCR* is change in the current ratio (total current assets divided by total current liabilities). All variables are not standardized. All regressions include industry and year fixed effects. *T*-statistics are reported in parentheses. Standard errors are clustered by firm and year. We follow Badertscher, Shanthikumar, and Teoh (2016) to break the total effect of *MFFlow* on investment into two parts: the direct catering effect, and the indirect effect through the equity issuance channel.

Panel A. Investment (*RD* or *CAPX*) regression

	RD	*CAPX*
MFFlow	-19.8209	-4.1831
	(-5.66)	(-2.47)
EI	0.1399	0.0370
	(11.88)	(8.79)
GS	0.3003	0.2100
	(4.04)	(3.57)
CF	0.1244	0.1273
	(9.18)	(12.31)
Leverage	-6.1409	2.2727
	(-10.91)	(5.72)
Log(Age)	-0.9448	-0.4831
	(-6.09)	(-3.41)
Size	-1.1609	0.0820
	(-9.68)	(1.17)
Intercept	15.5566	5.2773
	(18.29)	(12.69)
N	27,952	43,183
R^2	0.4305	0.1307

Panel B. Equity Issuance (*EI*) regression

	EI
MFFlow	-42.8982
	(-8.55)
GS	1.0358
	(7.62)
ROA	-0.1717
	(-5.63)
ΔCR	3.3164
	(4.00)
Leverage	-3.8942
	(-2.84)
Log(Age)	-1.4671
	(-4.56)
Size	-2.2261
	(-12.95)
Intercept	28.2340
	(14.53)
N	42,381
R^2	0.1207

Panel C. Path analysis results for the effects of *MFFlow* on *RD* or *CAPX*.

(1) Direct Effect of *MFFlow* on Investment					
MFFlow → *RD*	Coefficient	*T*-stat	*MFFlow* → *CAPX*	Coefficient	*T*-stat
	-19.8209	(-5.66)		-4.1831	(-2.47)
(2) Indirect Effect of *MFFlow* on Investment via Equity Channel					
MFFlow → *EI*	-42.8982	(-8.55)	*MFFlow* → *EI*	-42.8982	(-8.55)
EI → *RD*	0.1399	(11.88)	*EI* → *CAPX*	0.0370	(8.79)
Equity Path Effect	-6.0015		Equity Path Effect	-1.5872	
(3) Total *MFFlow*			Total *MFFlow*		
Effect on RD	-25.8224		Effect on *CAPX*	-5.7703	
% Direct Path	76.76%		% Direct Path	72.49%	
% Equity Path	23.24%		% Equity Path	27.51%	

Table 6. Regressions of Innovative Input, Output and Inventiveness on Stock Misvaluation: Interaction with Overvaluation

The variables are defined in Table 1. The misvaluation measure (*VP* or *MFFlow*) is interacted with an overvaluation indicator. *LowVP* (*LowFlow*) is an indicator variable for the lowest *VP* (*MFFlow*) quintile. All independent variables are standardized to have a mean of zero and standard deviation of one. *Novelty*, *Originality*, and *Scope* are in percentage. All regressions include 2-digit SIC industry fixed effects and year fixed effects. *T*-statistics are reported in parentheses. Standard errors are clustered by firm and year. The sample includes U.S. non-financial, non-utility firms listed on NYSE, AMEX and NASDAQ with COMPUSTAT and I/B/E/S coverage during 1976-2012. The patent and citation data (*Pat*, *Cites*, *Novelty*, *Originality*, and *Scope*) sample period is 1976-2008.

	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
	RD		*CAPX*		*Log(1+Pat)*		*Log(1+Cites)*		*Novelty*		*Originality*		*Scope*	
VP	-0.19		-0.53		-0.04		-0.02		-3.09		-1.08		-0.93	
	(-0.98)		(-5.00)		(-1.96)		(-2.86)		(-4.04)		(-3.56)		(-3.70)	
*VP*LowVP*	-6.53		0.34		-0.19		-0.07		-9.23		-3.33		-2.67	
	(-13.45)		(2.46)		(-7.38)		(-6.89)		(-7.00)		(-7.38)		(-5.74)	
MFFlow		-0.96		-0.28		-0.05		-0.02		-2.51		-0.85		-0.87
		(-6.49)		(-3.30)		(-5.48)		(-6.17)		(-5.77)		(-4.13)		(-5.70)
*MFFlow*LowFlow*		-4.87		-0.24		-0.43		-0.16		-12.21		-4.03		-5.29
		(-8.12)		(-1.09)		(-5.52)		(-5.81)		(-4.50)		(-3.74)		(-6.16)
GS	0.78	1.00	0.58	0.54	0.03	0.02	0.02	0.02	3.00	3.60	0.50	0.73	0.58	0.71
	(5.36)	(5.26)	(4.40)	(4.13)	(3.86)	(2.96)	(4.81)	(4.16)	(5.46)	(5.75)	(2.90)	(3.81)	(3.61)	(3.97)
CF	2.56	1.94	2.01	1.87	0.19	0.18	0.08	0.08	8.13	7.77	2.59	2.31	2.58	2.40
	(11.97)	(7.36)	(11.16)	(11.58)	(12.61)	(10.54)	(12.54)	(10.43)	(11.21)	(9.13)	(11.59)	(8.69)	(8.50)	(6.97)
Leverage	-1.23	-1.37	0.63	0.51	-0.19	-0.21	-0.08	-0.08	-6.81	-7.19	-2.51	-2.78	-2.65	-2.66
	(-11.31)	(-10.81)	(6.45)	(5.56)	(-11.66)	(-10.99)	(-12.28)	(-11.42)	(-11.19)	(-10.12)	(-10.78)	(-9.97)	(-11.27)	(-10.25)
Log(Age)	-0.63	-1.19	-0.77	-0.57	0.20	0.16	0.08	0.06	3.82	1.64	2.77	2.25	2.60	1.98
	(-4.28)	(-6.11)	(-5.22)	(-3.60)	(7.30)	(5.26)	(7.17)	(4.94)	(3.66)	(1.43)	(6.96)	(4.66)	(6.64)	(4.68)
Size	-1.92	-2.71	0.11	-0.01	0.70	0.74	0.25	0.26	13.39	13.07	5.45	5.41	4.94	4.65
	(-9.74)	(-11.56)	(0.92)	(-0.06)	(19.98)	(18.05)	(21.15)	(19.20)	(14.77)	(13.41)	(16.80)	(14.72)	(11.70)	(9.86)
Intercept	5.42	7.08	7.39	7.20	-0.22	-0.21	-0.12	-0.10	-3.46	0.17	2.05	2.92	-6.37	-5.22
	(30.98)	(44.31)	(36.20)	(33.58)	(-10.25)	(-8.17)	(-14.29)	(-9.77)	(-3.94)	(0.17)	(6.61)	(8.47)	(-12.51)	(-8.61)
N	34,658	27,982	54,445	43,253	47,295	36,598	46,296	35,701	46,296	35,701	47,228	36,544	46,296	35,701
R^2	0.3690	0.3177	0.1277	0.1182	0.4127	0.4144	0.3819	0.3827	0.1454	0.1437	0.1987	0.1960	0.2384	0.2475

Table 7. Regressions of Investments and Innovative Output on Stock Misvaluation: Interaction with Growth or Turnover

The variables are defined in Table 1. The misvaluation measure (*VP* or *MFFlow*) is interacted with growth (*GS*) or share turnover (*Turnover*). *HighGS* (*HighTurn*) is an indicator variable for the highest *GS* (*Turnover*) quintile. All independent variables are standardized to have a mean of zero and standard deviation of one. All regressions include 2-digit SIC industry fixed effects and year fixed effects. *T*-statistics are reported in parentheses. Standard errors are clustered by firm and year. The sample includes U.S. non-financial, non-utility firms listed on NYSE, AMEX and NASDAQ with COMPUSTAT and I/B/E/S coverage during 1976-2012. The patent and citation (*Pat* and *Cites*) data sample period is 1976-2008.

	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
	RD				*CAPX*				*Log(1+Pat)*				*Log(1+Cites)*			
VP	-2.20		-2.45		-0.42		-0.34		-0.09		-0.08		-0.04		-0.04	
	(-11.13)		(-12.96)		(-3.81)		(-3.19)		(-4.27)		(-4.62)		(-4.90)		(-5.40)	
*VP*HighGS*	-1.35				-0.02				-0.06				-0.04			
	(-4.44)				(-0.10)				(-3.49)				(-5.49)			
*VP*HighTurn*			0.06				0.19				-0.08				-0.03	
			(0.25)				(1.22)				(-2.72)				(-2.98)	
MFFlow		-1.25		-1.08		-0.23		-0.16		-0.07		-0.05		-0.03		-0.02
		(-6.50)		(-6.08)		(-2.79)		(-2.22)		(-5.28)		(-4.98)		(-5.85)		(-5.60)
*MFFlow*HighGS*		-0.23				-0.58				-0.03				-0.02		
		(-0.97)				(-2.11)				(-1.19)				(-2.00)		
*MFFlow*HighTurn*				-1.25				-0.51				-0.24				-0.09
				(-2.97)				(-2.19)				(-4.84)				(-4.76)
GS	0.77	1.03	0.79	0.96	0.57	0.52	0.48	0.47	0.03	0.03	0.03	0.02	0.02	0.02	0.01	0.01
	(4.89)	(5.46)	(4.99)	(5.18)	(4.41)	(3.99)	(4.00)	(3.80)	(3.53)	(3.28)	(3.68)	(2.67)	(4.28)	(4.29)	(4.44)	(3.68)
CF	1.92	1.86	1.88	1.81	2.04	1.87	1.93	1.82	0.17	0.18	0.17	0.17	0.07	0.08	0.07	0.07
	(8.68)	(6.90)	(8.77)	(7.02)	(11.65)	(11.53)	(11.85)	(11.44)	(11.69)	(9.92)	(11.95)	(10.26)	(11.76)	(9.91)	(11.99)	(10.12)
Leverage	-1.17	-1.37	-1.20	-1.35	0.63	0.51	0.57	0.51	-0.18	-0.21	-0.19	-0.21	-0.08	-0.08	-0.08	-0.08
	(-10.66)	(-10.30)	(-10.88)	(-10.69)	(6.30)	(5.61)	(6.26)	(5.65)	(-11.39)	(-10.82)	(-11.16)	(-10.78)	(-11.98)	(-11.24)	(-11.82)	(-11.24)
Log(Age)	-0.84	-1.25	-0.83	-1.12	-0.75	-0.57	-0.67	-0.49	0.19	0.15	0.19	0.16	0.08	0.06	0.07	0.06
	(-5.21)	(-6.59)	(-5.22)	(-5.53)	(-5.11)	(-3.59)	(-4.53)	(-3.13)	(7.00)	(4.99)	(6.99)	(5.23)	(6.92)	(4.73)	(6.90)	(5.02)
Size	-2.36	-2.89	-2.57	-3.11	0.13	-0.01	-0.07	-0.21	0.69	0.72	0.69	0.71	0.24	0.25	0.24	0.24
	(-10.43)	(-11.24)	(-10.39)	(-11.51)	(1.12)	(-0.09)	(-0.58)	(-1.74)	(19.62)	(17.55)	(18.92)	(17.66)	(20.67)	(18.43)	(19.69)	(18.34)
Turnover			0.66	0.58			0.73	0.63			0.03	0.02			0.02	0.02
			(3.49)	(2.58)			(6.61)	(6.05)			(0.99)	(0.56)			(1.90)	(1.44)
Intercept	6.93	7.31	6.73	7.02	7.32	7.19	6.97	6.88	-0.21	-0.19	-0.24	-0.22	-0.11	-0.10	-0.14	-0.12
	(51.87)	(49.43)	(49.21)	(41.70)	(37.01)	(33.90)	(41.13)	(36.60)	(-9.80)	(-7.53)	(-6.41)	(-4.73)	(-14.34)	(-9.13)	(-8.95)	(-6.30)
N	34,658	27,982	33,945	27,982	54,445	43,253	53,286	43,253	47,295	36,598	46,152	36,598	46,296	35,701	45,155	35,701
R^2	0.3253	0.3099	0.3276	0.3137	0.1275	0.1187	0.1273	0.1243	0.4106	0.4109	0.4132	0.4127	0.3803	0.3800	0.3844	0.3823

Table 8. Regressions of Innovative Novelty, Originality and Scope on Stock Misvaluation: Interaction with Growth or Turnover

The variables are defined in Table 1. The misvaluation measure (*VP* or *MFFlow*) is interacted with growth (*GS*) or share turnover (*Turnover*). *HighGS* (*HighTurn*) is an indicator variable for the highest GS (turnover) quintile. All independent variables are standardized to have a mean of zero and standard deviation of one. *Novelty*, *Originality*, and *Scope* are in percentage. All regressions include 2-digit SIC industry fixed effects and year fixed effects. *T*-statistics are reported in parentheses. Standard errors are clustered by firm and year. The sample includes U.S. non-financial, non-utility firms listed on NYSE, AMEX and NASDAQ with COMPUSTAT, I/B/E/S, and patent-citation data coverage during 1976-2008.

	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
	Novelty				*Originality*				*Scope*			
VP	-4.55		-4.91		-1.72		-1.89		-1.40		-1.54	
	(-5.99)		(-6.17)		(-5.20)		(-5.43)		(-5.42)		(-5.79)	
*VP*HighGS*	-7.60				-2.18				-1.95			
	(-7.82)				(-7.21)				(-5.85)			
*VP*HighTurn*			-4.31				-1.31				-1.29	
			(-3.41)				(-3.40)				(-3.28)	
MFFlow		-2.84		-2.22		-1.00		-0.85		-1.07		-0.96
		(-5.59)		(-4.92)		(-3.86)		(-3.76)		(-5.37)		(-5.54)
*MFFlow*HighGS*		-4.19				-0.95				-1.18		
		(-3.23)				(-1.93)				(-3.43)		
*MFFlow*HighTurn*				-8.40				-2.97				-4.01
				(-4.61)				(-4.88)				(-4.49)
GS	2.64	3.54	2.68	3.19	0.40	0.73	0.47	0.67	0.49	0.72	0.59	0.71
	(5.09)	(5.72)	(5.21)	(5.36)	(2.38)	(3.71)	(2.95)	(3.53)	(3.04)	(3.98)	(3.80)	(3.95)
CF	7.35	7.62	6.96	7.27	2.30	2.26	2.25	2.20	2.35	2.34	2.34	2.31
	(10.43)	(8.83)	(10.03)	(8.57)	(10.52)	(8.31)	(10.07)	(8.08)	(8.10)	(6.67)	(8.20)	(6.79)
Leverage	-6.57	-7.16	-6.74	-7.06	-2.44	-2.77	-2.49	-2.74	-2.58	-2.66	-2.65	-2.63
	(-10.75)	(-10.07)	(-11.25)	(-10.34)	(-10.41)	(-9.87)	(-10.71)	(-9.96)	(-11.03)	(-10.08)	(-11.03)	(-10.01)
Log(Age)	3.63	1.53	3.79	2.09	2.69	2.22	2.71	2.31	2.54	1.93	2.46	1.99
	(3.46)	(1.35)	(3.52)	(1.78)	(6.65)	(4.58)	(6.38)	(4.63)	(6.46)	(4.51)	(6.18)	(4.69)
Size	12.83	12.72	12.04	11.67	5.25	5.29	5.14	5.12	4.78	4.50	4.76	4.45
	(14.02)	(12.74)	(12.06)	(10.83)	(16.20)	(14.36)	(14.61)	(12.96)	(11.42)	(9.35)	(11.41)	(9.60)
Turnover			3.55	3.23			0.55	0.39			0.08	-0.13
			(3.83)	(3.31)			(1.52)	(1.02)			(0.34)	(-0.55)
Intercept	-3.08	0.48	-6.78	-3.67	2.22	3.03	1.67	2.45	-6.25	-5.07	-6.20	-5.08
	(-3.81)	(0.46)	(-4.80)	(-2.15)	(7.14)	(8.87)	(3.11)	(3.82)	(-13.11)	(-8.31)	(-9.64)	(-6.68)
N	46,296	35,701	45,155	35,701	47,228	36,544	46,085	36,544	46,296	35,701	45,155	35,701
R^2	0.1447	0.1429	0.1469	0.1457	0.1973	0.1951	0.1975	0.1963	0.2377	0.2457	0.2394	0.2471

Table 9. 2SLS Regressions of Innovative Input, Output and Inventiveness on Stock Misvaluation

In column (1), we report the baseline OLS regression using *VP* directly as the misvaluation proxy. In column (2), we report the second-stage regression results of the 2SLS procedure; we omit results of the first-stage in which *VP* is regressed on the instrumental variable (*MFFlow*) and control variables. Variables are defined in Table 1. All variables are not standardized. *Novelty*, *Originality*, and *Scope* are in percentage. All regressions include industry and year fixed effects. *T*-statistics are reported in parentheses. Standard errors are clustered by firm and year in the OLS and by firm in the 2SLS regressi

	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
	RD		*CAPX*		*Log(1+Pat)*		*Log(1+Cites)*		*Novelty*		*Originality*		*Scope*	
	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
VP	-4.39	-18.53	-0.75	-4.39	-0.17	-1.00	-0.08	-0.46	-10.63	-45.69	-3.77	-15.18	-3.14	-16.71
	(-12.74)	(-12.53)	(-3.66)	(-5.49)	(-4.95)	(-8.39)	(-5.95)	(-8.52)	(-7.64)	(-7.18)	(-6.21)	(-6.12)	(-6.93)	(-7.20)
GS	0.38	0.19	0.26	0.19	0.01	-0.00	0.01	0.00	1.41	0.92	0.25	0.11	0.28	0.07
	(5.49)	(2.50)	(4.35)	(4.67)	(4.39)	(-0.72)	(5.24)	(0.44)	(5.73)	(3.12)	(3.25)	(1.19)	(3.92)	(0.84)
CF	11.77	15.83	13.76	13.63	1.15	1.35	0.50	0.59	50.01	58.82	15.63	17.82	15.99	18.47
	(8.62)	(13.42)	(11.64)	(20.37)	(11.67)	(14.19)	(11.72)	(14.88)	(10.41)	(11.27)	(10.44)	(10.94)	(8.06)	(12.44)
Leverage	-5.46	-0.06	2.74	3.58	-0.82	-0.61	-0.34	-0.22	-29.60	-17.06	-10.93	-7.36	-11.58	-6.39
	(-10.78)	(-0.08)	(6.32)	(7.86)	(-11.41)	(-7.33)	(-12.02)	(-6.63)	(-10.95)	(-4.76)	(-10.55)	(-5.23)	(-11.13)	(-5.05)
Log(Age)	-0.76	-0.10	-0.68	-0.33	0.17	0.18	0.07	0.07	3.16	3.55	2.39	2.73	2.26	2.53
	(-5.17)	(-0.51)	(-5.11)	(-2.77)	(6.94)	(7.30)	(6.83)	(7.30)	(3.33)	(3.47)	(6.55)	(6.94)	(6.34)	(7.32)
Size	-1.29	-1.16	0.08	0.05	0.40	0.42	0.14	0.14	7.39	7.35	3.02	3.07	2.75	2.60
	(-10.38)	(-11.23)	(1.12)	(0.81)	(19.61)	(20.57)	(20.65)	(22.28)	(14.04)	(13.19)	(16.20)	(14.85)	(11.40)	(14.17)
Intercept	18.36	22.06	6.14	7.33	-1.88	-2.81	-0.56	-0.99	-3.81	-38.71	-9.34	-16.48	-0.55	-20.90
	(19.59)	(26.45)	(14.70)	(14.78)	(-12.57)	(-20.69)	(-9.68)	(-22.91)	(-0.98)	(-10.71)	(-6.45)	(-11.46)	(-0.22)	(-16.76)
N	34,658	27,982	54,445	43,253	47,295	36,598	46,296	35,701	46,296	35,701	47,228	36,544	46,296	35,701
R^2	0.3233	0.0527	0.1275	0.0701	0.4103	0.3534	0.3797	0.3072	0.1432	0.1036	0.1963	0.1651	0.2368	0.1867
1st stage F-stat (p-value)		0.0000		0.0000		0.0000		0.0000		0.0000		0.0000		0.0000