How distorting are stock market valuations really to corporate investment?

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Abstract

We study mechanisms whereby stock market valuations may color corporate investment by using European firm-level data. We find that managers vicariously learn from stock prices when making investment decisions. Specifically, managers' propensity to learn increases in stock price informativeness. Moreover, the route of investor sentiment transmission to investment runs substantially through the catering channel. While opaque firms are more likely to cater, evidence for the equity issuance hypothesis is confined to large, transparent and constrained firms. Finally, rising bubbles are associated with vigorous investment episodes but unexpectedly neither the 2001-2003 recession nor the subprime crisis induced significant cuts in investment. (JEL G15; G31; G32)

Keywords: corporate investment; serendipitous information; vicarious learning; investor sentiment; growth opportunities.

There has been a long-running debate about the multifaceted interactions between financial markets and real economic activity. The debate has, however, recently been exacerbated by dramatic economic events resulting in increasing media and political proclivity for damning the putative real economic distortionary effects of the financial sector. In this vein, the subprime mortgage crisis is reported to have led to severe hardship marked by restrictions in the capacity and willingness of financial institutions to take on risk (Duchin, Ozbas and Sensoy, 2010). This negative shock to the supply and cost of external capital has preceded brisk economic contractions characterized, *inter alia*, by deep cuts in tech, employment and capital spending by corporations around the world (Campello, Graham and Harvey, 2010). Relatedly, numerous media accounts and academic studies ascribe egregious welfare-impairing episodes of unusually high corporate investment levels to overblown market expectations during the late 1990s (Shiller, 2000; Hall *et al.*, 2000; Chirinko and Schaller, 2011). The challenge, though, is that even advocates of the argument that the pricing of technology stocks in the late 1990s was a bubble would recognize that it has attracted a large number of creative entrepreneurs, thereby fostering innovation in this area (Shleifer, 2000 and Jerzmanowski and Nabar, 2008). Comparable arguments can certainly be made about the stock market boom of the 1920s. Doubtless, the crash of the bubble in 1929 has been the prelude to a prolonged depression and ensuing impoverishment. Does it still entail that the functioning of stock markets is intrinsically a source of disruption of economic processes? Addressing this issue for more than eight decades, Keynes (1931:347-348) cautioned that: "While some part of the investment which was going on … was doubtless ill judged and unfruitful, there can […] be no doubt that the world was enormously enriched by the constructions of the quinquennium from 1925 to 1929; its wealth increased in these five years by as much as in any other ten or twenty years of its history. […] A few more quinquennia of equal activity might, indeed, have brought us near to the economic Eldorado where all our reasonable economic needs would be satisfied."

Ignoring the desirability and feasibility of such Eldorado, one might make a cautious argument for government endeavors in developed economies over the last few years to democratize participation in the financial market arena (*e.g.*, through individual retirement accounts or 401(k) plans in the United States or

Riester plans in Germany) as well as for the asymmetric response to rising and bursting asset bubbles by monetary authorities. Puzzlingly, the view that there has been a decoupling of the financial sector from the real economy over the last few decades is no less popular among politics and academics (*e.g.*, Summers and Summers, 1989; Menkhoff and Tolksdorf, 2001). The concern that stock markets may have deteriorated over time in performing their social function (*i.e.* guiding capital allocation and spreading risk) is manifest in the notion that as financial markets become highly liquid, they increasingly attract transient investors, thus relegating fixed capital formation to a "by-product of the activities in a casino" (Keynes, 1936:158-159). The question thus arises as to the very nature of the real economic consequences of stock market valuations. Only conditional thereon could we convincingly ascertain whether, how and to what extent economic agents should care about stock market valuations when they make consumption and investment decisions.

This study examines the impact of stock market valuations on firm-level accumulation of fixed capital in a putatively sentiment-infected market setting. Indeed, corporate investment in fixed capital is generally considered a key determinant of aggregate fluctuations. Thus, examining pace and patterns of this variable adds to our understanding of real economic activity. To address this issue, we need to disentangle the various sources of stock price variations. And, inasmuch as investment, financing, fundamentals and market valuations are simultaneously determined, we rely on instrumental variables estimations to test whether, how and to what extent serendipitous information and investor sentiment-driven firm-specific and sector-wide stock valuations errors affect business fixed investment decisions, given the firm's long-run growth opportunities embedded in stock prices. Our sample covers 2,312 European unregulated and nonfinancial public companies and spans the period from 1991-2011. This sample allows us to additionally examine the impact of two major turning points when uncertainty was unusually high: the (crash of the) tech bubble and the subprime crisis. And, for European stock markets used to be more volatile than their US counterparts (Chirinko and Schaller, 2001), we expect our tests of the role of stock market valuations in directing investment decisions to be relatively more powerful. Furthermore, if mispricing is more likely in opaque information environments (Blanchard and Watson, 1982; Baker and Wurgler, 2006; Polk and Sapienza, 2009), we would expect, *c.p.*, the impact of investor sentiment on stock prices and thus on investment to be more pronounced in continental Europe than in the US and in the UK. However, the effect may be muted by the traditionally bank-based nature of the continental European financial systems. We do acknowledge that there has been over time a move towards market-based financial systems over the world (Guenther and Young, 2000). Finally, the use of a European sample is partly commanded by the fact that the role of the stock market in capital allocation is reportedly largely unknown in non-US markets (Jiang, Kim and Pang, 2011).

The dodged search in real consequences of stock markets is particularly appealing in light of the conflicting theoretical arguments and the ambiguous evidence produced by the extant empirical literature. If stock markets were completely divorced from the real sector of the economy, the voluminous research on market efficiency would be no more than intellectual gymnastics void of any social value. This conclusion follows from the argument that efficient stock markets should provide *quasi* noise-free signals for the intertemporal allocation of scarce resources within and between economies (Keynes, 1936; Summers and Summer, 1989). Likewise, the persisting disagreement among policy makers over whether and how stock prices should enter into the monetary reaction function of central banks (*e.g*., Bernanke and Gertler, 1999; Cecchetti *et al*. 2000; Bullard and Schaling, 2002; Rigobon and Sack, 2003; Roubini, 2006; Bohl, Siklos and Werner, 2007; Bhattacharya and Yu, 2008) would be vain.

We marshal three theoretical foundations to establish the link between stock market valuations and investment at firm-level.[1] Under conditions of symmetric information, efficient and frictionless capital markets, the first normative view posits that changes in asset market prices should merely mirror investors' rational expectations about future expected cash flows or proper discount rates, thereby constraining the stock market to a sideshow: the so-called passive informant hypothesis (Morck, Shleifer and Vishny, 1990). Characterizing the latter hypothesis as largely unsubstantiated, a second strand of the literature posits that stock markets may enhance the quality of managerial decisions through their superiority in producing, aggregating and disseminating costly and serendipitous information (Rock, 1986;

[1] Section 1 provides an in-depth analysis of these three different theoretical contributions.

Dow and Gorton, 1997; Subrahmanyam and Titman, 1999). One thorny issue inherent in this active role of stock markets is that the signals conveyed in stock prices may be noisy such that blindly following the market can be as harmful as ignoring it. As a result, learning from the market requires firms to actively communicate with outsiders, which incurs positive costs. Thus, the decision to learn from stock prices entails a tradeoff between perceived benefits and associated learning costs. Third, both empirical results and casual observation of happenings on international capital markets suggest that prices on these markets do not always reflect underlying economic fundamentals and are to some extent swayed by bouts of investor irrationality (Shiller, 1989; Seyhun, 1990). Undoubtedly, both the presence of investors with heterogeneous beliefs about a firm's prospects and curbs on trading (especially restrictions imposed on short-selling) cause stock prices to contain a speculative bubble (Miller, 1977). As a corollary of the stock price being an important ingredient in the determination of the shadow value of capital, the speculative bubble feeds through to q. And, because value-maximizing managers would invest basing upon q, investment decisions will passively reflect the less-than-rational beliefs currently held by investors. Given (partly) inefficient capital markets, many observers sympathize with Keynes' (1936) notion that "animal spirits" do at times populate financial markets and may have significant effects on real economic variables (*e.g.*, Moore and Schaller, 2002; Roubini, 2006). Notwithstanding, whether and to what extent investor sentiment-driven stock market valuation errors may have real economic implications hinges critically upon how economic agents and policy makers respond to them.

Insights gained from this study will expand our understanding of the functional efficiency of the European stock market in a number of ways. First, this study sheds light into the independent impact of managerial knowledge about the firm's long-run growth opportunities embedded in stock prices on the role of the stock market for the resource allocation process at firm level. We ask whether managers listen to the stock market when they choose among alternative capital investment programs. Second, if they do, does stock price informativeness dampen or enhance their propensity to follow the signals transmitted by the stock market? Indeed, for rational managers to learn from stock prices the investor private information contained in the stock price need be superior to that of the managers. The third main question we take to the data relates to real effects of sentiment-driven swings in stock prices. Specifically, we examine whether irrational gyrations in stock prices color business fixed investment decisions. If they do, what is the transmission path? How egregious is, if any, the harm ultimately wrought by investor sentiment shifts?

This paper is related to a number of distinct streams of the literature including (1) managerial learning hypothesis; (2) stock price informativeness and (3) investor sentiment-driven mispricing. The study will help assess whether and to what extent public complaints about resource misallocation in Europe as a result of stock market valuations are warranted. Though a number of prior studies have examined the sensitivity of investment to stock prices, much of that research (*e.g.*, Baker *et al.*, 2003) uses Tobin's average q (proxied by the market-to-book ratio or to a lesser extent the macro q) to proxy for the information about the firm's genuine prospects embedded in the stock price. Yet, as indicated heretofore, stock prices may contain both a fundamental component as well as a non-fundamental component. Thus, q may turn out to be a catch-all variable (Gilchrist, Himmelberg and Hubermann, 2005). By parsing out the market-to-book ratio in long-run growth opportunities and mispricing attributable to shifts in investor sentiment (as per Rhodes-Kropf, Robinson and Viswanathan, 2005), we are able to disentangle the real effects of fundamental growth options and serendipitous information contained in stock prices from potential distorting effects of putative stock market misvaluations on corporate investment.

Second, we are not interested in merely ascertaining the response of business fixed investment levels to the aforementioned three quantities (managerial knowledge about the firm's growth prospects embedded in stock prices, price informativeness and investor sentiment), but also in addressing the issue of investment efficiency. Shall the researcher interpret the documentation of a significant positive response of subsequent fixed capital formation to stock market swings as a desirable development or does it rather suggest looming risks? One such risk may pertain to overinvestment (Richardson, 2006) which is no less deleterious to shareholder value than underinvestment. To tackle the efficiency implication of the relationship between business fixed investment decisions and stock market valuations, we construct portfolio investment strategies based on corporate investment levels conditional on mispricing (see Section 4). If stock market valuation errors are welfare-enhancing, then a portfolio containing highly overvalued firms with high investment levels should outperform a portfolio composed of highly overvalued firms but with extremely low investment levels. The rationale behind this strategy is the assumption that floating overheated shares the proceeds of which flow to capital formation (or alternatively catering to investor sentiment) coupled with the existence of (good) investment opportunities would entail relaxation of binding financial constraints. Eventually, what could a firm do with a cash windfall if it had no investment opportunity? Potentially, these funds may flow to perks and other wasteful business practices. The extant literature documents a negative relationship between perks and stock price informativeness, suggesting that managers and controlling shareholders entertain opacity within the firm to better camouflage their empire building activities (Gul *et al*., 2011b). While mispricing is more likely to arise in opaque information environments (such as in hard-to-value firms or countries with poor protection of investors' property rights), whether it can turn out to be welfare-enhancing in the sense of relaxing binding financial constraints faced by productive entrepreneurs remains an empirical issue.[2]

Finally, to establish an empirical link between stock prices and corporate investment, we have manifestly couched the discussion in terms of unobservables, which calls for use of empirical proxies that are potentially measured with errors. Coupled with the simultaneous determination of investment, financing and fundamentals there is cause for concern that endogeneity may be an issue in our data. Notwithstanding, addressing endogeneity seems to be a road hardly travelled in the related empirical literature as is apparent in the work by Wang *et al.* (2009:55): "[They] simply follow a large earlier literature that has estimated investment-cash flow regressions without taking into account the endogeneity problem."[3] Though not a panacea, we use instrumental variables estimations to mitigate this source of methodological unease and correct the error structure for heteroscedasticity and within-firm clustering.

To foreshadow our results, we find that managers vicariously learn from stock prices when making investment decisions and their propensity to learn from the stock market increases in the amount of

[2] Olivier (2000) and Caballero, Farhi and Hammour (2006) offer inspiring analyses on the costs and benefits of stock market bubbles at the macroeconomic level.

[3] However, we are careful enough to mention that more recent papers do explicitly account for endogeneity (*e.g*., Bakke and Whited, 2010; Chirinko and Schaller, 2011). And, due to the insignificance of the coefficients of interest, the inferences drawn by Wang *et al*. (2009) do not appear to be distorted by the theoretical upward bias induced by the use of OLS in the presence of endogenous variables.

investor private information capitalized in stock prices. A one-standard deviation increase in price non-synchronicity leads to an increase of 3.26% in investment which represents an increase of about 48% relative to the sample average investment ratio. Also, financially constrained firms prove to learn the most from the stock market as the informativeness of their stock prices improves. Besides, we document the existence of overvaluation and episodes of excessive investor pessimism in the data. More important and at odds with the predictions of the financial arbitrage hypothesis, shifts in investor sentiment do matter for investment, whereby the route of transmission runs substantially through the catering channel. A one-standard deviation increase in investor sentiment-driven valuation errors boosts corporate investment by 10.23% (1.307 × 0.0783) through the catering channel, which represents an increase of 151% relative to the sample average investment ratio (6.8%). Corroborating the results by Polk and Sapienza (2009), we document that opaque firms (*i.e.* firms the stock price of which incorporates less investor private information) are more likely to cater. Although managers with long horizons would make optimal investment decisions even in sentiment-colored episodes, opaque firms would undertake unproductive capital projects while passing up profitable ones provided that their actions boost their stock price in the short run. Relying on the "sharing-the-blame" effect (see Scharfstein and Stein, 1990), catering would increase in managerial career concerns.

In rebuttal, evidence for the equity issuance hypothesis is confined to large, transparent and constrained firms and the economic magnitude of the effect is substantial. For this group of firms, investor sentiment-driven mispricing boosted corporate investment through the equity channel by approximately 5–12%. (*e.g.*, 5% = 0.042 × 0.0834/0.068). These results run counter to those by Bakke and Whited (2010) who report that larger firms generally do not issue new shares to exploit sky-inflated stock prices and subsequently channel the funds raised to capital projects. Given that small firms rely more heavily on equity finance relative to their large counterparts (as attested to in Panel A of Table 2, and Panel A of Figure 1) our results about the equity channel may appear counter-intuitive. Yet, we caution that our results only suggest that small firms are less able to exploit perceived mispricing than large firms via the equity issuance channel. A tentative reason is the existence of underwriting costs for seasoned equity issues and small firms are more likely to face greater costs of raising capital than for large firms (Duchin, Ozbas and Sensoy, 2010). Finally, rising stock price bubbles of the late 1990s are on average associated with vigorous investment episodes but unexpectedly neither the 2001-2003 recession nor the subprime crisis induces significant cuts in investment. These findings contradict those in Duchin, Ozbas and Sensoy (2010) and Campello, Graham and Harvey (2010) who collectively report declines in investment amid the subprime crisis. Our failure to document significant cuts in investment during the tech bubble-induced recession is puzzling. One possible interpretation, though, is that the real costs of the bursting tech bubble may have been dampened by the rapid and aggressive response of monetary authorities who nonetheless undertook nothing to pre-empt the rising bubble (Roubini, 2006). Only could we document marginally significant misevaluation-related investment declines for large, opaque firms. Similar trends are observable in Germany, Portugal and Switzerland (see Panel B of Table 5). Notwithstanding, Panel C of Figure 1 predisposes the reader to expect large cuts in investment after the bursting of the tech bubble. On the other hand, the lack of adverse effects on investment of the subprime crisis at the full sample level may mirror the various unorthodox bailouts particularly in the banking and automotive industry to contain collateral damages.

The dynamics of the empirical link between stock market valuations and fixed capital formation is clearly an important issue for investors, managers, policy makers and academics as well. An empirical finding of a positive relation between investment levels and the fundamental component of the market-to-book ratio implies that managers do learn from stock prices and as good Bayesians impound this new knowledge when they make fixed investment decisions. With due regard to investment efficiency, this evidence will open up the avenue for investor relations departments and regulators to encourage production and acquisition of firm-specific information and to increase market transparency. Of course, if managers systematically learn from misleading signals of the stock market, the costs may be insurmountable. In rebuttal, attesting to systematic managerial response to stock market mispricing raises at least two issues: (1) market pressure-induced managerial myopia and (2) equity concerns due to wealth transfer (*e.g.*, from new investors to incumbent shareholders). Many observers claim that attempts by firms to reverse bubble-induced investment excesses of the late 1990s were the root cause of the ensuing brisk economic recession in the US and in the rest of the world (see Roubini, 2006). Insofar, our study will provide insights into whether stock misvaluations cause distortions in corporate investment policies or merely orchestrate “the redistribution of wealth from noise traders to arbitragers and firms [...]” (Shleifer, 2000:178). Even in this latter scenario, there is cause for concern in view of the democratization of defined contribution plans. We conjecture that direct distortions to investment would result from catering and wealth redistribution would follow equity issues when investors are overconfident about the prospects of the firm. While trades in financial markets take place between consenting adults, our results suggest that private investors should be cautious when they invest their social security savings in sentiment-infected equity markets. This is because private investors are on average unsophisticated investors and may enrich arbitragers (including firms which aggressively cater to current sentiment).

If stock market activity induces real negative externalities (which cannot be completely ruled out given our results on investment efficiency in Section 4), what institutional changes are needed to mitigate the economic costs of mispricing? Summers and Summers (1989) made a cautious case for the introduction of a securities transfer excise tax to reduce diversion of human and capital resources into financial engineering. This issue has spurred a vivid debate in Europe since the subprime crisis but faces considerable political resistance. Alternative, central banks should have a symmetric response to rising and bursting bubbles to mitigate the “mopping up after” behavior-induced moral hazard (Roubini, 2006). Besides, it is questionable whether the widespread use of equity-linked compensation for executives measures up in a sentiment-infected stock market. Finally, a large body of recent research documents a positive correlation between the existence of well-developed financial markets and economic development of nations, inducing emerging and developing economies to make a move towards developing and/or reforming their capital markets particularly since the 1990s. If stock market activity systematically distorts capital allocation imposing huge negative externalities on the economy, these endeavors may turn out to be misguided policy proposals.

The next section reviews the related literature and outlines the three main testable predictions. We summarize the data and present our testing strategy in Section 2 and 3, respectively. Section 4 reports the results, and Section 5 concludes. The appendix defines the main variables used in the empirical analysis.

1. Hypothesis development

Should we expect a tight link between fixed capital formation decisions at firm level and stock market valuations? Should/Do managers follow the signals transmitted by the stock market when making investment spending decisions? Does stock price informativeness moderate or enhance managerial propensity to listen to stock market valuations?

There are two contrasting views to the normative part of this research question. The first school of thought reduces the stock market to a sideshow; that is, real economic activity is by no means affected by stock market valuations. This is because managers and controlling shareholders are assumed to be privy to superior information about the firm's genuine investment opportunities. Moreover, this line of thought assumes that managers only care about long-run fundamental values (not market values). As a corollary, managers interested in maximizing shareholder value should simply disregard short-run stock market valuations and invest until the marginal product of capital converges towards the risk-free interest rate ($q = 1$). This chord struck by Bosworth (1975) continues to vibrate sympathetically among scholars and ever since the evidence on excessive stock market volatility, which makes rational managers more reluctant to follow the market. Unfortunately, managers may successfully ignore stock market valuations only under at least two restrictive assumptions: (a) Shareholders never liquidate their position, *i.e.* they are locked in forever and (b) firms do not issue new shares since the only function of the stock market is to price existing projects. Clearly, both assumptions hardly obtain in reality. Shareholders do approach the market to trade either for liquidity needs or to realize capital gains based on any valuable information set in their possession. In the same vein, the stock market is a market in which firms act as monopolists in their own shares. In this setting, they issue new shares whose floatation prices may affect their capital formation decisions. However, the magnitude of the affect is a function of the equity-dependency of the focal firms.

Also, though new issues may matter for capital formation, they are not that central as continental European firms continue to finance a major proportion of their capital expenditures by private capital and internally generated funds (Subrahmanyam and Titman, 1999; Polk and Sapienza, 2009).[4] A theory that may explain why rational managers might refrain from unconditionally following the market is provided by Kock (2005) and relates to learning pathologies. Though Kock recognizes that financial markets do send signals for capital allocation, he tempers that these signals are misleading and thus may harm their users. Likewise, macroeconomists rather focus on debt and money markets because macroeconomics assigns a limited role to stock markets in affecting investment decisions. The lack of emphasis on the stock market is probably due to (i) widely held beliefs that stock markets poorly predicts rates of investment; (ii) some macroeconomists argue that business-cycle analysis should be cast in terms of "deep" parameters of tastes and technology, whereby stock markets only passively predict subsequent economic events (Fischer and Merton, 1984); and (iii) doubt about the reliability of stock prices driven by sub-optimally informed (irrational) market participants.

Relatedly, the second normative view posits that investor private information-laden stock prices can enhance managerial investment decisions. This line of thought relies on the notion that stock markets produce, aggregate and disseminate costly and serendipitous information collected from outside investors (*e.g.*, Dow and Gorton, 1997; Subrahmanyam and Titman, 1999; Luo, 2005; Chen, Goldstein and Jiang, 2007; Hasbrouck, 2007). In the course of their day-to-day business, the investing community may, by chance, come across valuable firm-specific information that is not known to managers and controlling shareholders. This information is thus dubbed serendipitous information (Subrahmanyam and Titman, 1999) and enters the public domain through the trading path. Clearly, information cannot be reflected in stock prices unless investors pay attention to it, thus resolving information asymmetries-related uncertainties. The dynamics of serendipitous information entails a reverse flow of information from outside investors to the firm. However, information about the quality of management or information

[4] In a similar vein, Mayer and Sussman (2003) find that most large investments in US firms are financed by new debt and retained earnings.

related to technological factors in use in the firm is more likely to be gained through costly analysis rather than serendipitously. In turn, serendipitous information is expected to be related to the demand side of the firm's products or to the competitive position of the firm in the relevant product market. Because of the diffuse nature of serendipitous information and the low unconditional probability of any individual market participant to unearth such information, one may hardly expect serendipitous information to influence capital allocation. Yet, aggregating even infinitesimally small pieces of valuable serendipitous information over a sufficiently large number of traders can have substantial positive effects on price efficiency through the liquidity channel. In line with this argument, Subrahmanyam and Titman (1999) attribute increased stock price volatility following IPOs to professional information intermediaries missing, *ex ante*, part of price-sensitive firm-specific information but which is in the possession of outside investors. The authors argue further that the amount invested in a focal firm's growth opportunities positively correlates with the information content of equilibrium stock prices.[5] Earlier corroboratory empirical evidence is provided by Jegadeesh, Weinstein and Welch (1993) who report that the *post*-issue stock performance affects the amount of capital invested in the subsequent period.

The ability of investor private information (*i.e.* costly and serendipitous information) to affect corporate investment decisions is demonstrated by Luo (2005) in the context of merger deals. Luo shows that the market reaction to a merger and acquisition upon announcement is considered a useful predictor of whether the "companies later consummate the deal". In this respect, a generalized negative market reaction at announcement would be, *c.p.*, suggestive of the existence of some weaknesses overlooked or simply neglected in the deal.[6] Whether and the extent to which firms experientially and vicariously learn from the market depends on the economic and informational environment they face. It is also shown in the literature that the propensity of management to learn from the market may be an increasing function of the life cycle of their company. In early stages, managers may have information production advantages due to special expertise while they certainly will need to listen more carefully to the market as the company

[5] Equation (17) of their model relates the maximum price that primary markets are willing to pay against claims on the prospects of the firm.

[6] The well-documented negative abnormal returns to bidders are, however, acknowledged.

grows and matures and industry-level and market factors become increasingly important. The empirical evidence that stock price informativeness decreases in firm size (Bakke and Whited, 2010; Jiang *et al*., 2011) reinforces this notion.

The managerial implication of this second normative view (hereafter the serendipitous information hypothesis) is that management should follow market valuations even though these might not coincide with their own assessment of fundamentals (von Furstenberg, 1977; Fischer and Merton, 1984). Firms may, therefore, issue an infinite number of new shares when their shares are overvalued. Prolonging this argument to its logic conclusion, one may yet wonder what the destination of the proceeds from this "infinity" of new shares should be. In fact, to successfully continue to "pump up the tulips" and tap cheap equity finance sources, overvalued firms will have to invest at least part of the capital raised in unproductive capital projects. Because firms with overvalued shares have poor investment prospects, they then would rationally invest (part of) the proceeds in a riskless investment vehicle to maximize current shareholder value, which corresponds to an investment in a constant returns technology (Blanchard *et al*., 1993). By doing so, firms concomitantly send adverse signals to the market, which may ultimately prick a bubble (Myers and Majluf, 1984). Another source of social concern is that issuing an infinitely large number of new shares when the share is overvalued constitutes a pure wealth transfer to incumbent shareholders. The identity of the losers in this transaction is revealed by the source of the perceived mispricing. If information asymmetries between the firm and outsiders cause misvaluation, then new shareholders are the ones who bear the cost of enriching incumbent shareholders. On the other hand, future buyers (not "immediate" new shareholders) are hurt in case of a rational bubble because new shareholders can realize, in turn, capital gains by selling to future buyers at even higher prices. To the extent that the perceived mispricing is driven by fads and the proceeds are invested in (unproductive) capital projects, the marginal product of capital will decrease rapidly, which ultimately hurts both old and new shareholders. This last scenario points clearly to value-destroying actions where managers with career concerns may be the sole short-run winners.

A plausible extension of the argument put forth by Fischer and Merton (1984) is the "mediation role" of the stock market, which casts doubts on the above discussed equity issuance channel. In fact, changes in stock market valuations may affect capital formation at firm level through their direct effects on the availability and cost of alternative sources of finance for the focal firm. As an example, a buoyant stock market acts as a credit multiplier by easing access to debt and money markets while at the same time decreasing the cost of debt to the firm due to increased values of collaterals and thus to enhanced creditworthiness (Morck, Shleifer and Vishny, 1990). As a consequence, firms with unusually high stock prices may respond to investor sentiment by issuing debt and/or money market instruments and channel the funds raised either to cash savings or to fixed capital projects depending on the objective function of the managers.

Summarizing the two normative views above, firms might be reluctant to follow the market (passive informant hypothesis) while they will well do so at times (serendipitous information hypothesis) when making investment decisions. How ought managers to behave in face of this ambiguity? To somewhat relieve managers from the conundrum due to the two above diverging schools of thought about the nature of the relationship between the stock market and real economic activity, Blanchard *et al*. (1993) note that the response of management that has the interest of their shareholders at heart should depend on their assessment of the duration of the perceived misvaluation and the investment horizon of incumbent shareholders. If the latter have short horizons, managers should follow the market à la Fischer and Merton (1984), else they should simply ignore short-term stock market swings. While Blanchard *et al*. (1993) provide an aid to decision-making, whether a firm should respond to market valuations remains both a theoretical and empirical issue. One important issue that has not yet been debated in this paper is the objective function of corporate managers. The developments so far imply perfect alignment of interests, which is unlikely to be the case in many settings. Stock price informativeness thus appears as a necessary (but not sufficient) condition for managers to vicariously learn from the stock market. If the interests are not aligned, managers may ignore even informative stock market signals so as to extract private benefits (Jiang *et al*., 2011). Because we are primarily interested in uncovering whether managers learn from stock markets, we will disregard herein the conflict of interest (which actually relates to why managers respond or ignore stock market valuations).

The empirical literature relating stock prices to fixed capital formation reflects, to some degree, the theoretical disagreement discussed above. Barro (1990) argues that stock prices have substantial power in predicting US aggregate investment after accounting for liquidity constraints albeit the predictive power marginally decreased after the crash of 1987. Furthermore, he finds evidence of Canadian aggregate investment responding more to US stock markets than to the Canadian stock market. Galleotti and Schiantarelli (1994) argue that changes in corporate investment are significantly associated with both the fundamental and fad components of stock prices, with the fundamental component of stock prices having the greater effect. More recently, Baker, Stein and Wurgler (2003) use US firm level data spanning the 1980-1999 period to document that stock prices matter for corporate investment and that this effect is stronger for equity-dependent firms, *i.e.* for firms that exhibit higher needs of external funds to finance marginal investments. Analyzing firm-level data from five emerging economies (India, Jordan, South Korea, Malaysia and Thailand) around the liberalization date, Chari and Henry (2008) report a significant predictive power of stock prices for investment even after controlling for current and expected future sales growth. Moreover, they fail to conclude that costly and serendipitous firm-specific information is entirely irrelevant for the intertemporal capital allocation via the stock market.

The empirical results attained by Blanchard *et al*. (1993) suggest that stock market valuations positively and significantly enter investment equations but less so relative to fundamentals. Yet, they interpret their results to mean that managers ignore market valuations when these diverge from their own assessment of fundamentals. Their conclusion implies that stock market misvaluations have small real effects for investment. In a similar vein, a stream of empirical studies documents that though the stock market is not a pure sideshow, it does not appear to be central either (*e.g.*, Morck *et al*. 1990; Malkiel, 1996; and Samuel, 2001). Relatedly, Porter (1992) finds that stock prices generally have limited predictive power for capital choices in Japanese firms.

In stark contrast with the above, Wang *et al.* (2009) report that the Chinese stock market has no impact on corporate investment through its information channel. They interpret their results to mean that this is probably because stock prices in China contain little information about future operating performance. Li *et al*. (2011) attain similar results using firm-level data of Australian firms over the period 2004-2007. Using a sample of 83 firms listed in five Arab countries (Egypt, Jordan, Morocco, Saudi Arabia and Tunisia), Bolbol and Omran (2005) present evidence consistent with the passive informant hypothesis, suggesting that the stock market plays no role in corporate fixed capital formation decisions. Their results also suggest that while internally generated funds have no effect, sales growth and debt growth appear to significantly color investment. Because their data corroborate the notion that the stock market is a passive informant, Bolbol and Omran conclude that their results justify efforts in their focal region directed at strengthening stock markets. The problem with this interpretation is that whether the passive informant role of the stock market can justify the cost of developing capital markets. Their results merely suggest that one can rule out intertemporal misallocation of capital due to stock market activity. Collectively, the empirical accounts in China, Australia and in the above Arab markets prompt the question as to whether or not the stock market has real effects may depend on the maturity and other microstructure features of the market to hand.

Luo (2005) provides striking evidence that whether or not merging firms will consummate the deal can be robustly predicted by the abnormal stock price reaction at announcement that is orthogonal to both the market's anticipation of the closing decision and its perception of the deal quality at announcement. Interpreting these results, Luo argues that firms extract valuable information from the stock market reaction at announcement and later consider this feedback in closing the deal. What is more, the learning propensity of merging firms seems to increase in the easiness of cancelling the announced deal as well as in the capitalization into the stock price of investor private information that is not known to the managers. Unsurprisingly, there would rationally be no learning effect when investor beliefs about fundamentals embedded in the stock price coincide with managerial assessment of these fundamentals. As a consequence, a necessary condition for managers to learn is stock price informativeness, *i.e.* stock price must convey valuable information that is not known to management.

Durnev, Morck and Yeung (2004) document a robust cross-sectional positive association between a measure of the economic efficiency of corporate investment and the magnitude of firm-specific stock return variation. Similarly, Wurgler (2000) shows that stock price non-synchronicity is suggestive of functionally efficient stock markets in the sense of Tobin (1982). Not only do information-laden stock prices transport signals about the perceived quality of managerial decisions but they also serve as a useful catalyst to corporate governance mechanisms in the sense that they warn the financial markets about the need to intervene when management decisions are poor. Taken together, the results by Durnev *et al.* (2004) and Wurgler (2000) suggest that the information efficiency of the stock market induces economic efficiency of corporate decisions.

Conducive to the predictions in the Subramanyam and Titman (1999) model, Chen *et al*. (2007) show empirically that the sensitivity of corporate investment to stock prices is an increasing function in the amount of private information capitalized in the stock price. The documented effect appears to be robust to the inclusion of managerial information and other information-related variables, suggesting that managers glean investor private information in stock prices about their own firms' fundamentals and incorporate this information when making physical investment decisions. More recently, Jiang, Kim and Pang (2011) use a sample of 2,822 firms listed in 22 countries in East Asia and Western Europe to examine the impact of agency problems (*e.g.*, expropriation of minority shareholders) in the investment sensitivity to stock price. Their results suggest that while firms do learn from stock prices when they make fixed capital formation decisions, managerial learning propensity appears to monotonically decrease in insiders' incentives for private control benefits. One possible limitation of the results attained by Jiang *et al*. (2011) centers on the short sample period which indeed is marked by overly optimistic investor sentiment of the late 1990s. In this setting, it is questionable whether their results are not driven by these overheated market conditions.

On view of the above cryptic survey of the literature, we form the following two testable hypotheses, which center on the managerial learning hypothesis.

Hypothesis 1. Managers follow the signals transmitted by the stock market when they make fixed investment decisions.

Hypothesis 2. Stock price informativeness enhances managerial propensity to listen to stock market signals.

Next, we address the triangular relationship between investor sentiment, stock prices and corporate investment. Does the stock market misprice firms? If the answer is in the affirmative, what causes mispricing? Does it matter for individual firm's fixed investment decisions? Alternatively, how aggressively do firms exploit current investor sentiment? The question as to whether and to what extent the market misprices firms is addressed in Section 2. Searching for the causes of misvaluation touches, *inter alia*, on various areas of finance and psychology such that an extensive elaboration on these issues is beyond the scope of this study. We thus constrain the related discussion to a simple reference to relevant contributions. To begin with, we define mispricing as the deviation of observed stock prices from their fundamental values (see Section 2). The only problem with this definition is that there is no consensus on what an asset's fundamental value is. Notwithstanding, the literature provides a number of factors that are likely to propel investor sentiment-driven misvaluation; these include limits to arbitrage caused by noise traders and short-selling constraints (DeLong *et al*., 1990), selective information disclosure-induced heterogeneous beliefs (Scheinkman and Xiong, 2003; Jiang, Xu and Yao, 2009), psychological biases (Dass, Massa and Patgiri, 2008), money illusion (Brunnermeier and Julliard, 2008) and analysts' forecast errors (Hribar and McInnis, 2012).[7] In fact, investor sentiment may be partly driven by local media slant. Gurun and Butler (2012) document that local media tend to use fewer negative words (sanitization practices) than for non-local firms when reporting on a local firm so as not to deter the firm's local media

[7] Bhattacharya and Yu (2008) and the literature cited therein provide a more elaborate discussion of the determinants of investor sentiment including the 12 factors for the internet bubble of the late 1990s in Shiller (2000). See also Shleifer (2000) for a brilliant exposition of the "life cycle" of bubbles. Seybert and Yang (2012) show in a recent work that a key ingredient in the link between investor sentiment and firm overvaluation is optimistic earnings expectations, and that management earnings guidance helps resolve sentiment-driven overvaluation.

advertising activities, a significant source of revenue for media companies. This media bias induces local firms to be more overpriced relative to their non-local counterparts.

The link between investor sentiment and corporate investment is indirect and runs through the mediation of stock prices. For investor sentiment to affect stock prices, the biased beliefs held by investors about the prospects of a firm need be correlated across a large number of noise traders (Morck, Shleifer and Vishny, 1990). But how does investor sentiment find its way into stock prices? To answer this question we borrow a formal model in which widely held beliefs that stock prices do not only respond to shifts in fundamentals (or that firms use to promote and exploit investor sentiment) could have force.

In their overlapping-generations model of an asset market with irrational noise traders who hold erroneous stochastic beliefs, DeLong *et al*. (1990) show that limits on arbitrage activities would induce share prices to diverge significantly from fundamental values even in the absence of fundamental risks. Recently, Grundy and Li (2010) build on the assumptions of the DeLong *et al*. model and propose a model with risk-averse shareholders and a risk-neutral manager of a firm that has a valuable investment opportunity (*I*) in time 0. Liquidation of the firm takes place in time 1 immediately after realization of the investment payoff and the liquidation mass (including the project's payoff and any remaining cash) is distributed to shareholders. More importantly, the market is populated by two types of investors that hold heterogeneous beliefs about the prospects of the firm: the informed and the uninformed. While the informed and the manager have (rational) unbiased expectations, the uninformed investors only hold biased expectations about the first two moments of the distribution of the firm's cash flows. Imposing unbiasedness (rationality) on the manager serves the purpose of ruling out influences of cognitive biases such as overconfidence. In this setting, Grundy and Li (2010) demonstrate that the equilibrium stock price (P_0) is a function of (i) investor sentiment (α and β), (ii) managerial investment decisions (I), (iii) the fraction of informed investors in the market (λ), and (iv) investors' risk aversion (γ). Formally:

$$\begin{aligned} P_0 &= \frac{\alpha\lambda + \beta(1-\lambda)}{\alpha\lambda + 1 - \lambda} R(I) + C - I - \frac{\gamma\alpha\sigma^2}{N(\alpha\lambda + 1 - \lambda)} \\ \lim_{N\to\infty} P_0 &\approx \frac{\alpha\lambda + \beta(1-\lambda)}{\alpha\lambda + 1 - \lambda} R(I) + C - I \end{aligned} \tag{1}$$

where $R(I)$ is a concave production function, the form of which is known to all shareholders and C is the cash balance at time 0. N is the number of investors in the market while σ^2 captures the variance of the project's payoff which increases in investment spending. Equation (1) shows that investment and investor sentiment (captured by the strictly positive parameters α and β) jointly affect stock prices which, in turn, affect the equity-based payoff of the manager. We shall discuss the issue (simultaneity bias) this raises in estimation in Section 3. The upshot of the model is that the shares can be mispriced because of the influence of the uninformed. Stock prices might respond to shifts in investor sentiment, and arbitrage is not completely effective in eliminating mispricing. This is because funds and patience of arbitragers betting against noise trading are limited. Besides the existence of positive costs of becoming privy to mispricing, arbitragers might not know with certainty the extent to which a security is mispriced (Black, 1986). Without loss of generality, and though the Grundy and Li (2010) model is rich enough to allow for the manager to pursue the maximization of her own wealth (tied to stock prices), we constrain our interpretations herein to accommodate settings in which the manager acts in the best interest of the incumbent shareholders when she makes investment decisions. We only focus instead on the influence of investor sentiment on capital formation at firm level.[8]

After eliciting the path whereby investor sentiment might affect stock prices, we now turn to ascertaining the link between investor sentiment-driven mispricing and corporate investment. Most apparently, misvaluation is likely to affect discount rates and thus investment decisions (Stein, 1996; Chirinko and Schaller, 2011). This is because future cash flows will be discounted at a distorted rate (r_{it} + δ_{it}) rather than at r_{it}, where δ_{it} is negative (positive) for overvalued (undervalued) stocks. It follows that the sign and magnitude of the wedge (ω_{it}) between the present value of future marginal product of capital using the distorted discount rate and the present value calculated under conditions of some correctly specified discount rate (r_{it}) will clearly influence the perceived profitability of alternative capital investment projects.

[8] In this paper, we use the concepts "investor sentiment", "misvaluation", "mispricing" and investor sentiment-driven misvaluation" interchangeably.

Models of market timing provide a number of relevant theoretical contributions linking investor sentiment to investment. While these models in their majority posit the ability of misvaluation to color corporate investment, they condition the relation upon managerial horizons (remember that we assume interest alignment between shareholders and the manager). In this vein, assuming non-binding capital structure policies the equity issuance channel pioneered by Stein (1996) makes two theoretical predictions. In the Stein (1996) model, the manager with long horizon will issue overheated shares to benefit incumbent shareholders without letting this operation affect his investment programs. She simply ignores the noisy signals embedded in stock prices in favor of her own assessment of the firm's fundamentals. While the short-horizon manager will evenly issue overvalued shares, she will let overvaluation distort discount rates (and consequently investment). However, the short-horizon manager will forego any outstanding capital investment if the shares trade below their fundamental value because she perceives higher discount rates. The model predicts that the distortions to investment decisions are yet more pronounced for equity-dependent firms but non-equity-dependent firms can successfully insulate their fixed investment decisions from transient irrational gyrations in their stock prices.

In a similar vein, Gilchrist, Himmelberg and Hubermann (2005) propose a model with rational (unbiased) managerial expectations about the prospects of the firm allowing for heterogeneous investor beliefs and short-selling constraints. They predict that the dispersion of investor beliefs combine with short-selling restrictions to create bubbles. This is because pessimistic market participants would not be able to trade on their beliefs, thereby leaving shares trade at inflated price levels (Miller, 1977). As a corollary, firms facing severe financial constraints will perceive decreased costs of capital, thus stimulating investment. A central prediction of the model is that not the magnitude of the bubble, in its own, is crucial in distorting real investment but its interaction with new equity issue. Their model has clearly implications for our empirical analysis: (i) the inclusion of the interaction term between mispricing and new share issue (*mQ.nsi*) to control for the equity issuance channel and (ii) the choice of the proxy for mispricing (see Section 2).

A second theoretical contribution is the catering theory introduced by Polk and Sapienza (2009). The model exploits the intuition behind the Stein (1996) short-horizon model and relies on the assumptions of managerial rationality, shareholder myopia and absence of agency problems. Polk and Sapienza maintain that if the market misprices firms depending on their level of investment, managers may have an incentive to boost near-term share prices by catering to current investor sentiment. As a corollary, financially healthy firms may engage in value-destroying investment practices when their stock entertains overblown market expectations. By contrast, they may intentionally pass up positive NPV investment opportunities when their shares fall prey to excessive investor pessimism. Examining the demographics of catering, Polk and Sapienza (2009) further conclude that catering should be increasing in R&D intensity (as a proxy for opacity) and share turnover (capturing short shareholder horizons).

Finally, a strand of the literature represented, among others, by Morck, Shleifer and Vishny (1990) predicts that firms operating in a sentiment-infected environment would engage in financial arbitrage in their own shares while setting their investment programs without regard to market valuations. When the stock is overvalued, the firm will issue new shares at unusually high prices and invest the proceeds in a riskless asset or in other fairly priced securities without increasing its real investment levels. By contrast, in low valuation markets the firm may buy back shares and cut dividends without reducing investments (Blanchard *et al*., 1993). The argument is quite convincing. However, there are at least two thorny issues that make it incomplete. First, can firms systematically fool the market? Second, how would the dividend clientele react to announcements of dividend cuts? In sum, the equity issuance (catering) hypothesis predicts an indirect (direct) effect of investor sentiment on investment. In rebuttal, the financial arbitrage hypothesis does posit a response of management to stock market valuation errors but these transactions in their own shares do not affect investment.

On the empirical front, evidence about the nature of the link between stock market valuation errors and business fixed investment is mixed. A number of studies provide evidence in support of the notion that managers make investment decisions that cater to investor sentiment. A strand of research relates merger activity and (non-fundamental) shocks to asset prices. This strand of the literature is represented among others by Shleifer and Vishny (2003), Rhodes-Kropf and Viswanathan (2004), Rhodes-Kropf, Robinson and Viswanathan (2005), Lamont and Stein (2006) and Dong *et al.* (2006). In quintessence, these works collectively document that merger waves as well as the choice of the medium of payment can be rationally driven by misvaluations of the combining firms. Firms with hype-inflated stocks would acquire firms that have real value or that are less overvalued. We only report the empirical evidence at face value and do not question whether targets systematically sell themselves for wampum. A second strand of the empirical work centers on other forms of fixed capital formation. Analyzing US firm-level data over the period 1963-2000, Polk and Sapienza (2009) find evidence consistent with the catering channel which describes how mispricing might distort individual firms' investment decisions and the intensity of the distortion to investment increases in the severity of stock valuation errors.[9]

While Chang *et al*. (2007) document a positive relation between mispricing and subsequent corporate investment levels using a sample of Australian firms spanning the period from 1990 to 2003, the response of investment to mispricing is more pronounced for equity-dependent firms than for their non-equity dependent peers. Interestingly, the results in Li *et al*. (2011) suggest that there is no significant relation between their proxy of mispricing and investment levels using Australian firm-level data from 2004 to 2007. Instead, equity-linked compensation does play an important role in shaping corporate investment decisions. A concern raised by the mixed inferences about the investment-mispricing relation in Australia is related to the robustness of the association to different model specifications and to market conditions. Is then the mispricing-investment relationship a swinging pendulum? Using an econometric errors-in-variables remedy to disentangle variations in Tobin's q which are relevant for investment from those that are not, Bakke and Whited (2010) document that misvaluation affects only investment of small equity-dependent firms that, in their sample, suffer the least from mispricing. In contrast, large firms that are the most prone to mispricing tend to generally ignore mispricing. An earlier study by Blanchard *et al.*

[9] Other studies that have documented a positive relationship between investor sentiment-driven mispricing and investment include Baker, Stein and Wurgler (2003); Gilchrist, Himmelberg and Huberman (2005); Baker and Wurgler (2006); Grundy and Li (2010) and Chirinko and Schaller (2011). A common feature of these works is that they have a US focus.

(1993) examines US aggregate data from 1900-1990 and finds little effect of misvaluation on investment due to limited economic significance.

Based on US aggregate data for the period 1911-1987 and estimating the Q and Euler equations in a simultaneous equations model, Chirinko and Schaller (1996) attest to the existence of bubbles but real investment decisions depend only on fundamentals. Using Japanese firm-level data for the period 1966-1991, Chirinko and Schaller (2001) report evidence of bubbles that have affected business fixed investment. Specifically, the results from their closed-economy specification suggest that the bubble boosted capital formation at firm level by approximately 6-9% in the years 1987-1989. Goyal and Yamada (2004) corroborate the findings by Chirinko and Schaller (2001) that investment responds significantly to stock misvaluation shocks and that fundamentals matter less. Interestingly and in marked contrast to what is predicted by the equity channel (Stein, 1996), Goyal and Yamada (2004) report that mispricing primarily affects Japanese firms that rely more on bank financing and not necessarily those that use equity financing. Finally, Morck, Shleifer and Vishny (1990) attribute a minor role to misvaluation in affecting investment. Basing upon this contrasting empirical evidence, we form the following prediction:

Hypothesis 3. Managers pursue investment strategies that cater to current investor sentiment-driven mispricing shocks.

The next section describes our data and discusses how we constructed measures of fundamental investment opportunities, investor sentiment, stock price informativeness and financial constraints. It closes with some summary statistics.

2. Data and Summary Statistics

Sampling and data sources

The empirical analysis employs data from 2,312 firms (including active and inactive securities) listed in 14 European countries.[10] To sidestep survivorship bias, the first step in the sampling procedure

[10] The sample countries are: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Luxembourg, Portugal, Spain, Switzerland and UK. In ancillary analyses we will distinguish between continental Europe and UK

consists in screening the historical compositions of the focal broad equity indices. This unbalanced panel that spans the period 1991-2011 is well-diversified across 14 industries (ICB level 3).[11] Second, we systematically discard financials and utilities. Subsequently, we require firms to have relevant data for at least three years to avoid earnings management of firms in more recent IPO cohorts and allow for enough time-to-build. Following current practice, we also require that included firms have positive values for sales, total assets, net fixed assets, and market-to-book ratio. Firms for which we are not able to retrieve data for at least 189 trading days (particularly for closing prices, stock returns, and consolidated trading volumes) are deleted for the respective year. Minimum data requirements serve the purpose of getting reliable parameter estimates. All raw data are from Thomson Reuters Datastream. The financial variables are retrieved in euro to mitigate currency risk. We use lagged total book assets as deflator for all financial variables (see Richardson, 2006) and trim all continuous variables by year at the bottom and top 1% levels to mitigate the influence of extreme observations. Next, we discuss the measures of stock price informativeness, long-run fundamental growth opportunities, investor sentiment-driven misevaluation and financial constraints.

Measures of stock price informativeness

We use two measures to proxy for stock price informativeness because price informativeness is unobservable and bears a multitude of features such that it is doubtful that there is a universal measure that captures all its aspects. We primarily rely on firm-specific return variation. Building on the evidence by French and Roll (1986) that a large proportion of stock return variation remains unexplained by systematic risk factors, Roll (1988) concludes that either private information or else occasional frenzy unrelated to information (noise) may cause firm-specific return variation. In a similar vein, Peng and Xiong (2006) argue that in an environment of investors with limited attention, informative stock prices endogenously exhibit higher idiosyncratic variation. Using stock return data from 40 stock markets from 1990-2001, Jin and Myers (2006) show that R^2 increases in several measures of opaqueness. Thus, high stock price co-

because UK markets are reported to show different microstructure features that may affect the sensitivity of investment to either fundamental growth options, private information or to investor sentiment.

[11] The complete list is available upon request. See Appendix A.3 for the list of industries included in this analysis.

movement with systematic (risk) factors is suggestive of lack of transparency, *i.e.*, paucity of private firm-specific information capitalized into stock prices. Opaqueness is a two-edged sword since while insiders may capture more cash flows in good times they need to absorb downside risk when their stock marches downhill.

Reinforcing Roll's (1988) observation that higher relative firm-specific return variation signals more information-laden stock prices, Durnev, Morck, Yeung and Zarowin (2003) document higher association between current returns and future earnings for firms with lower return synchronicity. They interpret this evidence as suggestive of more information about future earnings being capitalized into stock prices. In a similar vein, the results by Morck, Yeung and Yu (2000) suggest a robust link between greater firm-specific variation and better stock market functioning. Our measure of firm-specific return variation (ψ) is based on a regression projection of firm daily stock returns on those of the market index.

A bunch of empirical studies (*e.g.*, Gul *et al.*, 2011a; Panousi and Papanikolaou, 2012) documents that there is no genuine information gain over the single index market model when multifactor models are used. To circumvent the econometric undesirable feature inherent in the measure being bounded within the unit interval, we use its logistic relative version following Durnev *et al.* (2004): $\psi_i \equiv \left(\left(1 - R_i^2\right)/R_i^2\right)$, where R_i^2 is R^2 from the regression of the returns of firm *i* on the returns of a local broad-based equity index. This quantity is computed each year and for each firm. The use of the relative version of firm-specific return volatility helps control for environmental volatility (Lee and Liu, 2011). The inferences are robust to the use of STOXX 600 in lieu of the respective local market indices. In the ensuing discussion we refer to ψ as price non-synchronicity. Because we explicitly account for mispricing in our main specifications, the likelihood of the effect of a measure of private information based on idiosyncratic volatility to be driven by noise is puny. Moreover, Ferreira, Ferreira and Raposo (2011) find that price non-synchronicity and board monitoring are substitutes, which moderates our failure to directly control for agency problems.

However, the widespread use of ψ to proxy for the extent of private information embedded in stock prices is by no means without controversy. In contrast to much of the extant empirical literature examining the effects on firm behavior of stock price informativeness, Lee and Liu (2011) theoretically and empirically document that the relation between firm-specific return variation and ψ may not be monotonic. They specifically find a U-shaped relation between the two, contingent on the firm's information environment. As they put it (p. 11): "Information in the stock price affects firm-specific return variation differently depending on the information environments of the stock." Actually, there is evidence of significant departures from the assumption of perfect substitutability of internal and external finance (resulting from the perfect-market paradigm). It is therefore necessary to partition the sample of firms according to the likelihood that they will face information or incentive problems (Schiantarelli, 1996). To sidestep the ambiguity of the relation between price non-synchronicity and firm-specific return variation, we subsequently re-run the main regressions across ψ –sorted homogenous groups. Other studies casting doubt on the ability of ψ to capture the amount of private information impounded in the stock price include Dasgupta *et al*. (2010) and Xing and Anderson (2011). These studies argue that high idiosyncratic volatility firms have poor information disclosure practices, which is not compatible with transparency. Jiang, Xu and Yao (2009) argue that firms with high idiosyncratic volatility are more likely to be mispriced than firms with low idiosyncratic volatility. Another shortcoming of ψ is that it may reflect both informed and uninformed trading (Ferreira *et al*., 2011). This prompts our use of a trading-based variable to alternatively capture stock price informativeness.[12]

Amihud illiquidity ratio

Because of the controversy surrounding the interpretation of ψ as a valid measure of stock price informativeness, we use an alternative trading-based variable for robustness checks: the Amihud illiquidity ratio (*Air*). This measure is calculated as the annual average of the daily ratio of absolute stock

[12] The empirical literature has deployed a battery of measures of price informativeness. Examples are: price efficiency measures (Saffi and Sigurdsson, 2011); price-response delay (Hou and Moskowitz, 2005); Probability of Informed trading (Easley, Hvidkjaer and O'Hara, 2010); private information trading measure (Llorente, Michaely, Saar and Wang, 2002).

returns to euro volume (multiplied by 10^6). Formally: $Air_{it} = T^{-1} \Big/ \sum^{T} |r_{it}| / VC_{it} * p_{it}$, where r_{it} (p_{it}) is the day t return (closing price) on stock i; T is the number of trading days over which the average is computed and VC captures the consolidated trading volume measured in number of shares. This quantity expresses the percentage price change for one euro of daily trading volume and is a proxy for the price impact of order flow. We thus expect *Air* to increase with the perceived amount of informed trading (Kyle, 1985; Fernandes and Ferreira, 2008). Insofar, we expect a positive association between *Air* and ψ . A pitfall inherent in *Air* is the likelihood of the measure to reflect inventory costs associated with placing an order of a certain size.

Measures of mispricing and long-run growth opportunities

The literature has used a smorgasbord of measures to proxy for investor sentiment, thus making the search for a useful measure of mispricing challenging. A strand of the literature has crudely used Tobin's q (Baker *et al*., 2003; Chang *et al*., 2007). The problem with this measure is that it unambiguously admits alternative explanations since even in inefficient markets q may capture not only investor sentiment but also fundamentals even in inefficient markets. Nonetheless, Gilchrist *et al*. (2005) conclude that while Tobin's q may be convincingly used as an indirect proxy for bubbles, they warn against using q to proxy for investment opportunities. Indeed, their model predicts that proxies of bubbles (such as equity issue) enter negatively the regression conditional on q. Our interpretation of this prediction is that the "wrong" sign emerges from multicollinearity arising potentially from high correlation between the non-fundamental component of q and the included proxies for bubbles. And, new share issue cannot convincingly proxy for bubbles (it is only a possible channel of exploiting bubbles) given the argument that equity is a costly source of financing because of ownership dilution and the existence of cheaper sources of finance. On the other hand, Chirinko and Schaller (2011) use the price-to-sales ratio (*pts*) as a qualitative measure of investor sentiment relying on the ability of this measure to vehicle the popularity of the stock and changes in product demand. One pitfall of the price-to-sales ratio is its failure to capture the whole picture of fundamentals (see criticism to flexible accelerator models of investment). Furthermore, the work by Teoh, Welch and Wong (1988) and Sloan (1996) suggest that firms with high discretionary accruals exhibit lower subsequent returns, implying that these firms were overpriced. As a result, a number of studies use discretionary accruals to proxy for mispricing (*e.g.*, Polk and Sapienza, 2009).[13]

The primary measure of mispricing used in this study is the non-fundamental component of the market-to-book ratio (*mQ*) as introduced by Rhodes-Kropf, Robinson and Viswanathan (2005, hereafter RRV). This measure qualified as “ideal but difficult” (Chang *et al.*, 2007) is assumed to be positively associated with the level of investor sentiment in the stock market. What is more, *mQ* does not suffer from the Bakke and Whited (2010) critique pertaining to endogeneity, lack of variation, or ambiguity.[14] We then use the fundamental component of the market-to-book (*fQ*) as a measure of growth opportunities embedded in stock prices because traces of animal spirits in unadjusted *q* makes this latter an imperfect measure of growth options. A second measure of mispricing used is the composite security issuance (Daniel and Titman, 2006). This quantity captures the amount of equity issued or retired by a firm in exchange of cash or services (in case of stock options). As indicated in Section 2, we explicitly control for overvaluation-induced new equity issues (*mQ.nsi*) in order to tease out the independent role of catering on investment from the influence of investment through the equity financing channel. The steps of the decomposition and the computation of the composite security issue are relegated to appendices A.2-A.3.

Measures of finance constraints

Finance constraints are endogenously determined with investment, which prompts us to search for an instrument. The literature has suggested many possibilities to measure the severity of financial constraints.[15] Fazzari, Hubbard and Petersen (1988) interpret their finding of a positive relation between cash flow and investment (after controlling for *q*) as suggestive of the presence of finance constraints. Indeed, if the cost of capital is a function of the source of funds, the availability of finance will affect the

[13] Other proxies for investor sentiment encountered in the literature include closed-end fund discounts (Morck, Shleifer and Vishny, 1990:161), a proxy for belief heterogeneity such as the standard deviation of analysts’ earnings per share forecasts (Bakke and Whited, 2010). More elaborate techniques have been introduced by Bakke and Whited (2010) and Chirinko and Schaller (2011) to detect mispricing and its affect on investment.

[14] Using the contemporaneous mispricing measure or the lagged one has no overturning effect on the loading of none of the variables of interest. So, endogeneity of our measure of mispricing may not be of concern in our data.

[15] See Hadlock and Pierce (2010) for an excellent evaluation of commonly used proxies for financial constraints.

investment behavior of some firms. Most obviously, if lenders screen borrowers based on observable firm characteristics the availability of internal funds enhances the firm's ability to finance new investment. There are two reasons for the positive association between investment and internally generated funds: agency problems and market imperfections (Richardson, 2006). Chirinko and Schaller (1995) find evidence that liquidity affects the timing of investment spending and it matters because of transaction costs and information asymmetries between the firms and credit suppliers. A recent study by Chen and Chen (2012) documents the decline and disappearance of investment-cash flow sensitivity over time. Because finance constraints have for sure not disappeared, Chen and Chen cast serious doubt on the ability of investment-cash flow sensitivity to measure finance constraints. Earlier work by Kaplan and Zingales (1997, 2000) reports that there is persistence of the positive relation of investment and cash flows even for firms that do not face finance constraints.

We use firm size as measured by book assets as our primary measure of finance constraint. Indeed, theory predicts that financially constrained firms use to be small and young. Moreover, size can be considered exogenous since it is not a choice variable for the manager in the short-run (Bakke and Whited, 2010; Hadlock and Pierce, 2010). Our alternative measure of finance constraints is KZ4 which is similar to the prominent index in Kaplan and Zingales (1997). Only do we exclude q from the computations consistent with current practice (Wurgler, 2003). Using the logit coefficients in Kaplan and Zingales (1997):

$$KZ4 = -1.001909CF + 3.139193LTD - 39.36780DIV - 1.314759C \tag{2}$$

In the equality above, CF denotes cash flow, LTD is total long-term debt, DIV is total dividends, and C is the stock of cash. All of the right hand side variables are deflated by the beginning-of-period book assets. In contrast to size, KZ4 is prone to endogeneity since the index clearly relies on endogenous financial choices. Evaluating commonly used methods of finance constraints, Hadlock and Pierce (2010) document instability of the coefficients underlying the traditional KZ index. This is more so for dividends and cash. For this latter variable, the results obtained by Hadlock and Pierce suggest that firms with higher cash holdings are more likely to be constrained (precautionary cash holdings) which runs counter to the predictions of the KZ index. More important, they argue that the fatal flaw of the KZ index is that it incorporates the same information into both the left hand side and the right hand side of the regression. As a result, they guard against using of the index in favor of measures based on firm size and age. On this reasoning, while we use KZ4 to place our results in the literature, firm size shall be our primary measure of finance constraints. A fuller list of variable definition is in Appendix A.1 (see also the notes Tables 1 and 2).

Sample and summary statistics

Table 1 provides summary statistics. Our primary measure of investment is *capx* which is the ratio of capital expenditures to lagged total book assets. The average *capx* is 6.8% with a standard deviation of 11.4%. The alternative measure of investment *dppe* (which is constructed similarly to *capx* but uses changes in property, plants and equipments in the numerator) is less than half of *capx* but with a higher standard deviation. Both *capx* and *dppe* are similar in magnitude to those reported in Jiang *et al*. (2011). In contrast, the average book-to-market ratio of 5.54 appears to be high relative to those generally reported in the literature. The natural logarithm of the long-run fundamental (non-fundamental) value to book value (see RRV, 2005) is 0.575(0.042). As indicated above, ψ (*Air*) is used as the base (alternative) measure of stock price informativeness and exhibits an average of 3.47(2.55). The higher standard deviation of *Air* suggests substantial cross-sectional variations in the liquidity of the sample firms. In accord with Campbell, Lettau, Malkiel and Xu (2001), we find that stock price non-synchronicity exhibits a positive time trend over the 1991-2006 period. Yet, a regression of price non-synchronicity on a constant and time yield a significant negative coefficient for time over the whole period. This suggests that price synchronicity has increased since the subprime crisis has unfolded. Surprisingly, the sample firms have cash savings (10.2%) that dwarf their investment-to-capital ratio (t = 24.67). However, this difference is only significant for smaller firms (t = 19.62, p <0.001), which is reminiscent of precautionary savings. This is reassuring for our use of size to instrument finance constraints. For our European sample firms, we could not corroborate the secular increase in cash holdings of US firms documented among other by Bates, Kahle and Stulz (2009). A fixed-effects regression of the average cash-to-assets ratio on a constant and time yields a significantly negative coefficient on time over the whole period. The cash ratio climbed from 7.84% in 1992 to a 20.46% in 2000 before dramatically falling to only 2.07% in 2011 (see Panel B of Figure 1). As a result, cash buildup seems to track stock market valuations. The difference between cash flows and cash savings is insignificant. Comparing *nsi* to *capx* (*dppe*), we note that though there are new equity issues, they cannot completely cover the investment needs of the sample firms. More importantly, a median firm does not issue new shares while the median investment measure is non-zero and positive. This means that the sample firms are more likely to tap other finance sources than equity markets when making decisions to finance fixed capital formation. Our measure of leverage (the ratio of debt to assets) shows no particular time trend for the firms in our sample. However, when leverage is measured as net debt ratio (*i.e.* the difference of total debt and cash scaled by book assets) we find a sharp decrease of leverage in the periods 1998-2001; 2004-2007 and 2009-2011. Most of this decrease in net debt ratio parallels the increase in cash holdings except for the period from 2009-2011 when both net debt and cash holdings exhibit a negative time trend. The positivity of the variables *csi* and *mQ* combined with *pts* lying above unity is symptomatic of the likelihood of the presence of bubbles in the data. Eventually, we find that the sector-wide short-run deviations from firms' long-run pricing (*branch*) are significantly higher than the firm-specific pricing deviations from short-run industry pricing (*firm*) at the 1% level. The fact that our measure of investor sentiment-driven misvaluation (*mQ*) is significantly non-zero ($t = 5.56$, $p < 0.0001$), is suggestive of market participants on the one hand and managers on the other hand relying on different sets of information about the genuine prospects of the focal firms. Because the decomposition procedure by RRV (2005) is not interpreted in an asset pricing model sense, a negative (positive) *mQ* indicates undervaluation (overvaluation). Furthermore, mispricing is a rather transient phenomenon (Baker, Foley and Wurgler, 2009). As a result, we examine the adequacy of our extracted measure of mispricing by testing whether high *mQ* firms earn subsequently lower returns. This pattern is present in our data (see Section 4). This is a testament to the notion that mispricing does persist long enough to allow managerial investment decisions to respond. Is this a sign of limitations to arbitrage? While the average annual stock return amounts to -2.6%, the average return on assets (beta) lies by 4.1% and the average sample firm is a defensive title with a beta amounting to 0.26.

Table 1. Full sample summary statistics

Variable	*# Obs.*	*Mean*	*Std. Dev.*	*5th Pctl.*	*25th Pctl.*	*Median*	*75th Pctl.*	*95th Pctl.*
capx	31,106	0.068	0.114	0.004	0.021	0.043	0.079	0.196
dppe	32,017	0.031	0.155	-0.062	-0.010	0.004	0.033	0.178
mtbv	33,834	5.541	198.791	0.370	1.030	1.730	2.980	8.070
fQ	30,490	0.575	1.343	-0.344	0.305	0.609	0.886	1.393
mQ	30,376	0.042	1.307	-1.234	-0.446	0.007	0.475	1.376
firm	30,501	-0.020	1.063	-1.336	-0.478	-0.028	0.438	1.360
branch	30,446	0.040	1.210	-0.840	-0.220	0.044	0.261	0.913
pts	31,491	1.423	2.914	0.120	0.320	0.650	1.360	4.670
ψ	34,039	3.470	2.500	0.180	1.690	3.040	4.790	8.140
Air	29,790	2.551	11.156	0.002	0.007	0.076	0.622	10.605
leverage	34,612	0.165	0.342	0.000	0.020	0.100	0.220	0.470
cash flow	31,899	0.108	0.133	-0.070	0.052	0.098	0.155	0.302
sales	31,364	1.338	1.021	0.341	0.770	1.140	1.612	2.974
cash	27,704	0.102	0.235	0.000	0.020	0.050	0.110	0.342
nsi	27,183	0.028	0.107	0.000	0.000	0.000	0.004	0.161
csi	29,915	0.058	0.874	-1.239	-0.378	0.000	0.445	1.516
return	34,576	-0.026	0.568	-1.021	-0.231	0.018	0.275	0.717
beta	34,056	0.261	0.557	-0.020	0.030	0.120	0.360	1.050
roa	32,370	0.041	0.097	-0.141	0.018	0.050	0.085	0.167

Note. The variables in Tables 1 and 2 can be partitioned in five categories, the first of which pertains to our measures of investment. *capx* (*dppe*) is the ratio of capital expenditures (changes in property, plants and equipments) to lagged book assets. The second category centers on stock valuations. *mtbv* is the raw market-to-book ratio, *fQ* (*mQ*) denotes the natural logarithm of the fundamental (non-fundamental) component of the market-to-book ratio while *firm* and *branch* are the valuation deviations at the firm level and at the industry level, respectively; *pts* is the price-to-sales ratio. The third group of variables is information-based. ψ is the relative logistic idiosyncratic volatility (or price non-synchronicity) and *Air* is the Amihud (2002) illiquidity ratio. Though heterogeneous, the fourth category includes liquidity (or financing) variables and a measure of capital productivity (the sales-capital ratio, *sales*). The liquidity-based measures, which are actually scaled by lagged book asset, regroup leverage (debt to total assets), cash flow, cash holdings and *nsi* is the net proceeds of new security issues. In contrast, *csi* (composite security issuance) measures a "firm's growth in market value that is not attributable to stock returns". (Daniel and Titman, 2006:1614). The last group of variables relates to stock returns (*return*) and to the operating performance (*roa*) and a measure of relative systematic risk (market model *beta*). All variables are trimmed at the 1% tails to remove the effect of influential outliers. In Table 2, which uses the same set of variables as Table 1, the null hypothesis tested in the last two columns is, H0: Quartile 4 – Quartile 1 = 0, correcting for unequal variance across quartiles.

Table 2. Sample statistics using firm size, KZ4, ψ and *mQ* as stratification criteria

Panel A: Stratification by size

	Small	Quartile 2	Quartile 3	Large	*t-stat* Diff.	[*p* -val.]
capx	0.062	0.071	0.070	0.068	3.02	[0.0026]
dppe	0.022	0.034	0.036	0.034	4.78	[0.0000]
mtbv	12.549	3.682	2.880	3.055	-1.84	[0.0661]
fQ	0.689	0.561	0.554	0.516	-10.53	[0.0000]
mQ	-0.051	-0.008	0.029	0.178	13.81	[0.0000]
firm	-0.085	-0.063	-0.010	0.067	8.29	[0.0000]
branch	0.000	0.042	0.027	0.082	5.51	[0.0000]
pts	1.807	1.478	1.204	1.238	-11.44	[0.0000]
ψ	4.502	3.920	3.293	1.962	-72.80	[0.0000]
Air	5.416	1.760	0.767	0.107	-27.73	[0.0000]
leverage	0.152	0.139	0.157	0.205	8.74	[0.0000]
cash flow	0.093	0.114	0.114	0.112	8.06	[0.0000]
sales	1.449	1.409	1.370	1.156	-17.13	[0.0000]
cash	0.140	0.122	0.094	0.071	-16.50	[0.0000]
nsi	0.053	0.034	0.021	0.013	-17.02	[0.0000]
csi	0.171	0.068	0.011	0.009	-10.47	[0.0000]
return	-0.070	-0.025	0.000	0.051	13.58	[0.0000]
beta	0.183	0.213	0.292	0.403	28.92	[0.0000]
roa	0.042	0.041	0.044	0.039	-1.71	[0.0878]

Panel B: Stratification by Kaplan-Zingales Index (KZ4)

	Unconstrained	Quartile 2	Quartile 3	Constrained	*t-stat* Diff.	[*p* -val.]
capx	0.072	0.064	0.064	0.072	-0.15	[0.8807]
dppe	0.038	0.025	0.026	0.033	-1.90	[0.0570]
mtbv	3.912	3.461	6.700	5.987	2.44	[0.0148]
fQ	0.762	0.595	0.525	0.406	-12.40	[0.0000]
mQ	0.117	-0.040	-0.070	0.150	1.22	[0.2244]
firm	0.103	-0.062	-0.117	-0.017	-5.88	[0.0000]
branch	0.006	0.006	0.034	0.113	4.05	[0.0000]
pts	1.944	1.633	1.097	0.950	-23.10	[0.0000]
ψ	3.293	3.508	3.354	3.430	3.55	[0.0004]
Air	0.991	2.768	1.985	2.362	9.47	[0.0000]
leverage	0.110	0.106	0.169	0.268	26.55	[0.0000]
cash flow	0.183	0.092	0.083	0.072	-50.97	[0.0000]
sales	1.574	1.347	1.249	1.179	-22.65	[0.0000]
cash	0.185	0.086	0.069	0.060	-26.19	[0.0000]
nsi	0.028	0.030	0.023	0.026	-0.86	[0.3874]
csi	-0.009	0.076	0.051	0.092	6.90	[0.0000]
return	0.063	-0.035	-0.033	-0.066	-14.88	[0.0000]
beta	0.264	0.253	0.282	0.292	3.89	[0.0001]
roa	0.044	0.042	0.042	0.043	-0.83	[0.4094]

Table 2: (Continued)

Panel C: Stratification by ψ

	Opaque	Quartile 2	Quartile 3	Transparent	*t-stat* Diff.	[*p* -val.]
capx	0.070	0.065	0.064	0.062	-4.39	[0.0000]
dppe	0.032	0.030	0.027	0.024	-3.33	[0.0009]
mtbv	7.610	3.044	5.223	4.959	-0.62	[0.5322]
fQ	0.569	0.595	0.612	0.527	-2.23	[0.0261]
mQ	0.214	0.026	-0.076	-0.042	-14.55	[0.0000]
firm	0.123	-0.028	-0.107	-0.104	-12.63	[0.0000]
branch	0.072	0.031	0.013	0.032	-2.69	[0.0071]
pts	1.580	1.380	1.268	1.389	-3.87	[0.0001]
ψ	1.068	2.510	3.804	6.645	210.22	[0.0000]
Air	0.096	0.710	3.074	7.222	30.31	[0.0000]
leverage	0.172	0.155	0.148	0.170	-0.42	[0.6729]
cash flow	0.122	0.108	0.103	0.089	-15.80	[0.0000]
sales	1.204	1.333	1.378	1.403	12.07	[0.0000]
cash	0.099	0.102	0.100	0.094	-1.36	[0.1742]
nsi	0.025	0.027	0.024	0.024	-0.62	[0.5349]
csi	0.001	0.054	0.078	0.104	6.93	[0.0000]
return	0.000	-0.033	-0.033	-0.045	-5.00	[0.0000]
beta	0.517	0.311	0.181	0.051	-62.61	[0.0000]
roa	0.043	0.043	0.045	0.042	-0.55	[0.5797]

Panel D: Stratification by *mQ*

	Undervalued	Quartile 2	Quartile 3	Overvalued	*t-stat* Diff.	[*p* -val.]
capx	0.067	0.067	0.065	0.061	-2.91	[0.0036]
dppe	0.032	0.031	0.029	0.028	-1.25	[0.2107]
mtbv	3.713	4.547	3.991	3.290	-0.81	[0.4160]
fQ	0.569	0.563	0.567	0.565	-0.21	[0.8311]
mQ	0.040	0.041	0.009	0.054	0.55	[0.5771]
firm	-0.037	-0.024	-0.035	-0.022	0.70	[0.4867]
branch	0.063	0.046	0.021	0.042	-0.95	[0.3431]
pts	1.416	1.403	1.330	1.455	0.68	[0.4953]
ψ	3.498	3.439	3.376	3.358	-2.95	[0.0032]
Air	2.327	2.927	2.571	2.693	1.62	[0.1052]
leverage	0.163	0.162	0.169	0.168	0.62	[0.5350]
cash flow	0.106	0.106	0.108	0.104	-0.81	[0.4196]
sales	1.325	1.310	1.351	1.309	-0.77	[0.4441]
cash	0.106	0.102	0.099	0.098	-1.59	[0.1124]
nsi	0.028	0.027	0.025	0.028	0.13	[0.8918]
csi	0.060	0.054	0.072	0.099	2.21	[0.0271]
return	-0.009	-0.019	-0.033	-0.019	-0.98	[0.3253]
beta	0.269	0.269	0.265	0.271	0.29	[0.7755]
roa	0.040	0.043	0.044	0.045	2.91	[0.0036]

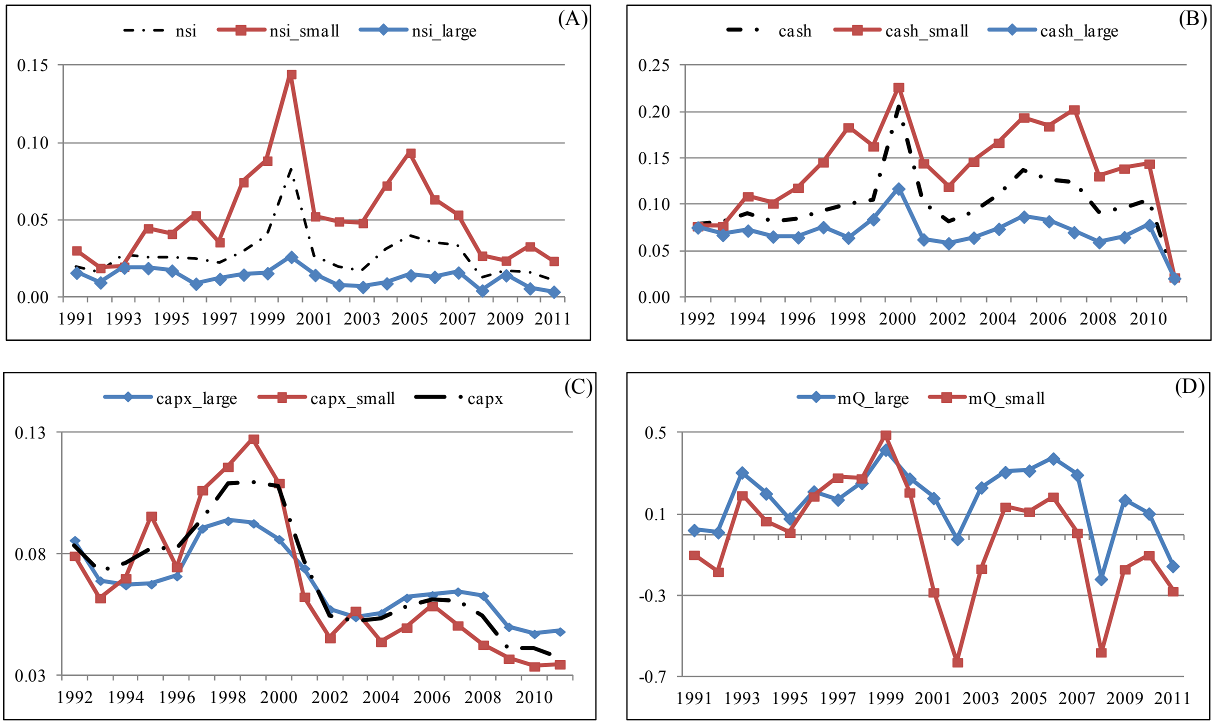

Figure 1. Equity issuance, cash holdings, investment and mispricing: Firms sorted by size

Note. Panel (A) plots the sample means of (trimmed) net equity issues; panels (B) and (C) show the sample means of (trimmed) cash holdings and the investment rate, respectively. The measures of net share issues, cash holdings as well as investment are normalized by one-year lagged book assets. Panel (D), in turn, plots the logs of the (trimmed) means of the non-fundamental component of the market-to-book ratio and captures investor sentiment shifts. We use the top and bottom quartiles of the distribution in book assets to split the sample in large and small firms to instrument financial constraints. We consider firms in quartiles 2 and 3 to capture normal firms. The dotted line in panels (A) to (C) depicts the full sample means of the respective variables.

Small firms invest on average less than large firms across our two measures of investment-to-capital ratios (*capx* and *dppe*). Using the Wilcoxon rank sum test, we find that the probability that capital expenditures of larger firms dwarf those of smaller firms amounts to 0.625. Given that smaller firms exhibit larger values of fundamental investment opportunities (*fQ*), we argue that smaller firms face more severe financing constraints that might hamper fixed capital accumulation for this group of firms. Yet, we temper that the investment levels attained by small firms in the late 1990s are significantly higher than those of large firms. Thereafter, capital accumulation in large firms consistently dwarfs that in small firms (Panel C of Figure 1). Investment ratios in small firms are more volatile than in larger firms. This qualitative evidence brings about at least two issues. First and most obviously, the dynamic relation between the investment behaviors in these two groups of firms is non-monotonic, calling for time indicator variables in estimations. Second, small firms might be more prone to cater to current investor sentiment, thus increasing the probability of over-investment during overheated markets for this group of firms. That small firms suffer more from the insufficiency of financial slack to fund all outstanding profitable investment opportunities is also prominently documented in their lower cash flow-to-capital ratio relative to large firms. By contrast, large firms tend to hoard less cash reserves than their small counterparts.

What is more, overvaluation increases on average monotonically in firm size, *i.e.*, small firms generally tend to be undervalued while their large peers enjoy overblown market expectations about their fundamentals (t = -3.91, p <0.001). Notwithstanding, Panel D of Figure 1 shows that both small and large firms are subject to comparable misvaluation patterns until the year 2000. The recession beginning in 2001 seems to have broken this relation because from this point onwards large firms suffer the most from overvaluation while small firms are confronted with undervaluation (except for the recovery period from 2004 through 2006). A tentative explanation of small firms selling at prices below their fundamental values in the aftermath of 2000 is excessive pessimism and cautionary behaviors of shell-shocked and embittered investors relative to small caps. Ultimately, casual observation (*e.g.*, failure of the Frankfurt Neuer Markt, the Milan Nuovo Mercato, and the Nouveau Marché in Paris)[16] coupled with academic accounts (see Gilchrist *et al*., 2005) suggest that small caps were more affected by the reversal of overblown market environments and the ensuing loss of wealth than large firms. To place our qualitative results in the literature, we follow Chirinko and Schaller (2011) and use the price-to-sales ratio (*pts*) to alternatively capture potential misvaluation. This ratio suggests that small firms are unambiguously more likely to be overvalued than large firms. The difference between the inferences attained using our measure *mQ* and *pts* may trace back to the ability of *pts* to capture the very nature of misvaluation dynamics. As with the market-to-book ratio, we argue that *pts* is likely to simultaneously convey information about fundamentals and non-fundamentals, which renders its interpretation more ambiguous than *mQ*.

[16] Those are only examples. There has also been breakdown of many smaller new markets in Europe in the same period. See New York Times of 28 January 2001.

Specifically, it is likely that *pts* is driven by superior fundamental investment opportunities attached to small firms.

Consistent with Jiang, Xu and Yao (2009), our two alternative measures of investor private information (price non-synchronicity and the Amihud illiquidity ratio) are negatively correlated with firm size. This evidence seems intuitive since large firms that generally trade in prime market segments use to be closely monitored by information intermediaries and financial market regulators. Thus a major portion of price-sensitive information enters the public domain through corporate public information disclosures. And because selective disclosure to a privileged audience of analysts is prohibited[17], any price-sensitive inside information communicated to information professionals must be accessible to the general public without undue delay. We conjecture that the magnitude of information asymmetries might be higher in small firms, thus providing incentives for production of private information for smaller, less-visible firms (Bushee and Miller, 2012). In turn, mispricing decreases as the production of private investor information increases.

Large firms show significantly higher leverage ratios, which reinforces the above conjecture that small firms may be more restricted in their access to external finance than large firms. Bakke and Whited (2010) interpret a similar finding to mean that this is due to the ability of large firms to tap debt markets much more easily. As a consequence, large overpriced firms might successfully ignore current investor sentiment. The equity dependency of small firms is apparent in our measures *nsi/csi* which capture the net equity issue to capital and the composite share issues, respectively (Daniel and Titman, 2006). The corresponding ratios turn out to be substantially larger than those of unconstrained firms (Panel A of Figure 1). Moreover, the stock returns to shareholders in large firms substantially dwarf those in small firms but this superiority goes along with higher relative systematic risk for this group of firms, thus minimizing the likelihood of a size anomaly in our data. This is reassuring in view of our finding that large firms are more likely to co-move with the market. Finally, smaller firms show a slightly higher operating performance (*roa*) relative to large firms.

[17] See EU Directive 2003/6/EC of 28 January 2003 on insider dealing and market manipulation.

However, Panel B of Table 2 shows that the sales-to-capital ratio decreases (increases) monotonically with firm size and KZ4 (stock price informativeness) suggesting substantial differences in capital intensity and cyclical changes in firm-level demand pressure. Since differences in capital intensity might affect profitability (Bhargava, 1994), this effect is likely to feed through to investment decisions (Gilchrist *et al*., 2005). The suggestive evidence of a positive relation between stock price informativeness and capital productivity is reassuring since we seek to document an enhancing role of price informativeness in real investment decisions.

A disconcerting finding is that sorts by firm size and by KZ4 lead to different inferences as to the quality of fundamental investment opportunities of constrained firms. Specifically, sorts by KZ4 reveal that constrained firms have poorer prospects than unconstrained firms. The implication is either unconstrained firms are under-investing or constrained firms are over-investing. This latter implication is clearly absurd. Consistent with our sort by firm size, constrained firms (in Panel B) have stock prices that impound higher amounts of private investor information. The ambiguity of KZ4 is apparent in Panel B of Table 2 in which unconstrained firms hoard much more cash than constrained firms. This is inconsistent with precautionary demand of cash theory. This theory posits that firms facing binding financing constraints would build up cash to shelter from adverse shocks to their cash flows. Letting unconstrained firms hoard excessive cash prompts the potential of resource diversion into non-productive investments. Looking at the net proceeds from new share issues (*nsi*), it is not possible to interpret KZ4 as a useful measure of equity-dependence since both constrained and unconstrained firms show similar patterns in equity issuance. One further illustration of the ambiguity of KZ4 is that it yields similar inferences as firm size relative to *csi*. These pieces of evidence are in stark disaccord with the interpretation by Chang *et al.* (2007) of KZ4 as a "perfect" measure of finance constraints in non-US markets.

Corroborating the findings in Whited and Wu (2006), we find that the investment behavior of high *KZ4* firms is similar to that of low *KZ4* firms (Panel B of Table 2). What is more, high *KZ4* firms exhibit significantly lower fundamental investment opportunities than the unconstrained firms. Combining these two pieces of evidence, there seem to be symptoms of overinvestment by financially constrained firms.

The suspicion of catering propensity or equity issuance channel cannot be unambiguously ruled out. This is an absolutely absurd result. How financially constrained firms finance their investment programs becomes enigmatic, though one may think of private capital. In addition, when we use net debt as a measure of leverage in unreported results, we find that larger firms are systematically more leveraged than smaller firms ($t = 34.49$, $p < 0.001$). On the other hand, high *KZ4* firms make much more use of leverage than their unconstrained peers ($t = 74.06$, $p < 0.001$). This counter-intuitive evidence casts serious doubt on the interpretation of *KZ4* as a valid instrument for the severity of financial constraints. Consequently, while the use of *KZ4* serves the purpose of placing our findings in the literature we will instrument the severity of (binding) financial constraints using firm size in the remaining of the study. This is consistent with Hadlock and Pierce (2010) who cast doubt on the ability of the popular KZ index to measure the severity of financial constraints. They argue that financial constraints diminish as young and small firms grow, suggesting that firm size and age emerge as particularly useful predictors of finance constraint levels. When the firms are sorted by KZ4, we find that the firm-specific component of mispricing is significantly higher than the industry component of mispricing for unconstrained firms.

Firms operating in poor information environments tend to invest more than those that exhibit more informative stock prices (Panel C of Table 2). This is not an anomaly (overinvestment) at first flush since opaque firms in our data show higher fundamental investment opportunities. More importantly, there is a general tendency for opaque firms to be overvalued across all our measures of mispricing (*mQ* and *pts*). Despite their apparent secrecy, firms that have uninformative stock prices do not show particular patterns in their ability to tap debt markets (as measured by their leverage ratio). Consistent with agency theory, opaque firms are more likely to hoard cash flows than those that exhibit high transparency levels. The capital productivity of opaque firms is consequently lower. The sort of the firms by price non-synchronicity suggests that while overvaluation of opaque firms results both from firm-specific and sector-wide valuation errors, the former are substantially lower than the latter. For all other groups of firms, we find evidence similar to those reported for the full sample (Table 1). This attests to the adequacy of the price non-synchronicity to proxy for of investor private information embedded in stock prices.

One common feature of the variables presented in Table 2 is that the time series related to small firms tend to be relatively more volatile than those for large firms. As an example, *nsi* for small firms are about four times as volatile as that of large firms (16.83% vs. 4.81%). Though only suggestive, small firms exhibit higher propensity to follow the market than their large peers. Moreover, small firms turn out to be more overvalued than larger firms (t = 2.19, p = 0.0291) in the 1997-1999 period.

3. Empirical Methodology

The existing literature suggests that liquidity matters in investment equations, but internal funds models have failed to satisfactorily handle the problem of expectations (Chirinko and Schaller, 1995). Collectively, this class of models typically relies either on static expectations (current to current) or on extrapolative expectations (including distributed lags). The econometric source of unease here is that capital accumulation is forward-looking in nature. Hence, the q theory of investment (see Keynes, 1936; Brainard and Tobin, 1968; Tobin, 1969 and Hayashi, 1982) appears as a natural candidate for relating unobservable expectations to observable variables. The problem with q models, however, resides in the possible endogeneity of the liquidity variable and a measurement error problem associated with the use of average rather than marginal q in empirical studies (Schiantarelli, 1996). And, the induced measurement error may be higher for companies with less investor awareness (Chirinko and Schaller, 1995; Fazzari, Hubbard and Petersen, 1988). The good news though is that inasmuch as the regression includes cash flow and a debt-overhang correction, Hennessy (2004) shows that average q (not its marginal counterpart) is the appropriate measure of fundamental investment opportunities.

We prefer the (augmented) q investment equation to its alternatives (internal fund and flexible accelerator models) for the analytical appeal of the model (Baum and Thies, 1999). Although economic theory predicts a contemporaneous association between changes in stock prices and investment growth, empirical evidence in support of this prediction is limited. We thus let subsequent investment be explained by lagged values of long-run growth opportunities, price non-synchronicity and animal spirits, controlling for a number of factors known to otherwise determine investment. Towards this end, we specify the following reduced-form investment equation as our test-bed:

$$Inv_{it} = \eta_i + \beta_1 fQ_{it-1} + \beta_2 \psi_{it-1} + \beta_3 (fQ.\psi)_{it-1} + \beta_4 mQ_{it-1} + \beta_5 (mQ.nsi)_{it-1} + \varphi Control + \varepsilon_{it} \quad (3)$$

Inv_{it} is the ratio of investment (capital expenditures) to lagged assets while η_i is the time-invariant fixed effect which controls for unobserved firm heterogeneity. The subscript *i* and *t* represent the firm and year, respectively. *fQ*(*mQ*) is the natural logarithm of the fundamental (non-fundamental) component of Tobin's *q* and ψ (price non-synchronicity) is our primary measure of investor private information. *nsi* is the ratio of net proceeds from new security issues to book assets. We subsequently include the interacted variable between mispricing and new equity issues (*mQ.nsi*) so as to convincingly disentangle the independent role on investment of the catering channel from that of the equity issuance channel. *Control* is a vector of variables commonly found to otherwise influence business fixed investment spending decisions: cash flow (*e.g.*, Almeida, Campello and Weisbach, 2004), leverage (ratio of total debt to assets), market model beta (Dasgupta, Gan and Gao, 2010), age (to capture firm information environment), firm size, time dummies (tech bubble: 1996-1999; bursting of the tech bubble: 2000-2003 and subprime crisis: 2008-2009);[18] all these three time dummies are interacted with our measure of mispricing (*mQ*). Finally, we include $1/Asset_{it-1}$ (akin to Chen *et al.*, 2007) to isolate the correlation between investment and many of the right-hand-side variables by using a common scaling variable (the beginning-of-the-period book assets). ε_{it} is the error term.

Despite the potential of stock market valuations to importantly influence business fixed investment decisions, identifying the responsiveness of investment spending to stock prices is fastidious. This is because stock market valuations endogenously respond to firm investment decisions. Specifically, general asset valuation models suggest that the value of a firm is a function of its future earnings the realization of which critically hinges upon its investments (*e.g.*, Gordon, 1962; Lutz and Lutz, 1951). The functional form of the stock price model established in Gordon (1962) documents that the stock price is not

[18] Other specifications of these episodes do not overturn the inferences drawn from our base specification.

independent of the firms' dividend behavior. In fact, investors' estimate of a firm's retention rate implies an estimate of its investment rate. Combining this argument with the developments in Section 1 above, it appears that stock prices and firm investment spending are blatantly endogenous variables. Couching the discussion of the relation between stock market valuations and investment in terms of unobservables (long-run growth opportunities, stock price informativeness and mispricing) even exacerbates the endogeneity concern. As a result, Equation (3) is estimated via the instrumental variables estimator, correcting the error structure for heteroskedasticity and within-firm error clustering. Following Blanchard *et al*. (1993), we crudely correct for simultaneity bias and measurement errors-induced problems by using the following instruments: lags 2 through 4 of capital expenditures and net debt-to-asset ratio as well as lags 2 and 3 of the following variables: natural logarithm of the fundamental component of the market-to-book ratio, cash-to-assets ratio, Amihud illiquidity ratio. Moreover, the correlation between *fQ* and *mQ* amounts to -0.764. Apparently, including *mQ* and *fQ* in a regression may induce spurious correlation. Therefore, we orthogonalize the two variables following the Gram-Schmidt theorem before including them into Equation (3).

In the ensuing section, we test our three predictions. We begin with the analysis of the relation between *fQ* and investment (H1) and the change in the relation as stock prices become more informative (H2). The coefficients of interest are β_1 and β_3, respectively. Finally, we test the predictive power of our measure investor sentiment for business fixed capital accumulation and ascertain the transmission path (H3). We thus rely on the sign and magnitude of β_4 and β_5 to ascertain the marginal effect of investor sentiment on investment. Yet, β_4 points to the pertinence of the catering channel while β_5 captures the effect of overvaluation-driven new share issuance. Because the sample firms have shown wide variations in size, informativeness of their stock prices and exposures to financing constraints, we subsequently conduct related tests in homogenous subsamples. To mitigate endogeneity of sample stratification criteria (see Schiantarelli, 1996; Bakke and Whited, 2010) all sample splits are performed using once-lagged variables as telltale signs. Finally, tests are conducted both at the industry and country level.

4. Results

This section is divided into three parts, the first of which reports the main results of the study using the full sample. Part two sorts the sample firms into relatively homogenous subsamples while part three explores investment efficiency implications and provides some robustness checks.

Full sample analysis

Table 3 displays the instrumental variables estimates of the effect on corporate investment of stock market (mis)valuations.[19] The baseline specification is provided in column 2. In column 1, the coefficient on the fundamental component of the book-to-market ratio (*fQ*) is positive and borderline significant. However, when we use our baseline specification (column 2), investment now positively and highly significantly loads on *fQ*, suggesting that managers do vicariously learn about changes in investment opportunities from stock prices when making investment decisions. All else equal, a one-standard deviation increase in investment opportunities as reflected in stock prices boosts investment by 8.25% (1.343 × 0.0614) which represents an increase of 121% relative to the sample average investment ratio. To allay skepticism about potential measurement errors in our primary proxy for investment we re-estimate Equation (3), just replacing *capx* by *dppe* as dependent variable (column 4). In this specification, *dppe* loads, in turn, significantly and positively on managerial knowledge of investment opportunities embedded in stock prices. In fact, the correlation coefficient between *capx* and *dppe* amounts to 0.54 and is statistically significant at the 1% level. The loading on *fQ* even climbs to 8.35% when we use the Amihud illiquidity ratio to proxy for investor private information and *capx* as the dependent variable (column 3). Because the various specifications of Equation (3) lead to similar inferences about the managerial learning hypothesis, we conclude that European stock marketa are by no means is not a sideshow (as opposed to the predictions of the passive informant hypothesis), thus corroborating the predictions of Hypothesis 1.

[19] We do not report R^2 because we estimate the model using instrumental variables (see also Gilchrist, Himmelberg and Huberman, 2005:820). In fact, when the model is not estimated by OLS, R^2 has no unique definition and the use of instrumental variables methods makes it clear that we seek to obtain a consistent estimator and goodness of fit is not what we are actually after (Verbeek, 2008:150). Instead, we report results from our test of overidentifying restrictions. Moreover, the Anderson canonical correlation LM statistics suggest that all the models in Table 3 are identified.

To the extent that we have found that managers generally shade their investment decisions on their perceptions of changing investment opportunities reflected in stock prices, we need to ascertain the conditions under which managers are likely to learn. We therefore test whether the amount of investor private information incorporated in stock prices stimulates managers to either ignore or follow stock market valuations by relying on the sign and magnitude of the coefficient of investment on the interacted variable ($fQ.\psi$). Again, using the baseline estimates in column 2, we notice that the effect on investment of price non-synchronicity is positive and highly significant. The marginal effect of stock price informativeness on investment amounts to 1.30% (0.0002 + 0.0223 × 0.575). In economic terms, a one-standard deviation increase in price non-synchronicity increases the investment ratio by approximately 3.26% (0.01302 × 2.5), which represents an increase of 48% relative to the sample average ratio of capital expenditures. Measuring investment by *dppe* in column 4 does not overturn the conclusion drawn from the estimation using *capx* as dependent variable (column 2). For robustness purposes, we re-run Equation (3) and use the Amihud illiquidity ratio (*Air*), in lieu of price non-synchronicity (column 3) to reduce interpretation ambiguities surrounding price non-synchronicity, to proxy for investor private information. The loading on the interacted variable between *fQ* and *Air* amounts to 1.76% and is significant at the 5% level. However, the marginal effect of *Air* on investment is 0.73% (-0.0028 + 0.0176 × 0.575) and a one-standard deviation increase in *Air* stimulates investment by 8.17% (0.0073 × 11.16). This figure clearly dwarfs the sample average investment ratio, which reinforces the importance of stock price informativeness for corporate investment decisions. Price non-synchronicity and *Air* seem to convey decision-relevant firm-specific information not known to managers that may have been gained either serendipitously or through costly screening endeavors of investors. Consequently, the propensity of managers to vicariously learn from stock prices appears to be an increasing function of the perceived amount of investor private information incorporated in stock prices, thereby attesting to Hypothesis 2. A plausible implication of this result is that less transparent firms would exhibit a general tendency to aggressively follow stock market valuations as their information environment improves.

Table 3. Effect of stock market valuations (*fQ, mQ and ψ*) on investment: Full sample

	(1)	(2)	(3)	(4)	(5)
Variables	*capx*	*capx*	*capx*	*dppe*	*capx*
fQ_{t-1}	0.0309 *	0.0614 ***	0.0835 ***	0.0607 ***	0.0474 **
	(0.0685)	(0.0005)	(0.0020)	(0.0313)	(0.0484)
ψ_{t-1}		0.0002		0.0095	-0.0017
		(0.9800)		(0.4690)	(0.7961)
$fQ.\psi_{t-1}$		0.0223 ***		0.0190 ***	0.0192 ***
		(0.0000)		(0.0147)	(0.0064)
mQ_{t-1}		0.0783 ***	0.0543 ***	0.0659 ***	0.0669 ***
		(0.0000)	(0.0006)	(0.0141)	(0.0035)
$mQ.nsi_{t-1}$		0.0356	-0.0564	0.0587	
		(0.3628)	(0.1112)	(0.3535)	
tech bubble		0.0211 ***	0.0038	0.0321 ***	0.0178 ***
		(0.0056)	(0.3677)	(0.0074)	(0.0053)
tech burst		0.0149 ***	0.0012	0.0061 ***	0.0121 **
		(0.0001)	(0.6710)	(0.3186)	(0.0212)
subprime		0.0074	-0.0109 **	0.0101	0.0051
		(0.3139)	(0.0159)	(0.3848)	(0.4685)
mQ.techbubble		-0.0039	0.0025	-0.0087	-0.0017
		(0.2289)	(0.4713)	(0.0884)	(0.7615)
mQ.techburst		-0.0101 ***	-0.0004	-0.0098 ***	-0.0063 *
		(0.0015)	(0.8898)	(0.0503)	(0.0537)
mQ.subprime		0.0011	0.0013	0.0006	0.0059 *
		(0.1251)	(0.1330)	(0.6133)	(0.0621)
Air_{t-1}			-0.0028		
			(0.6262)		
$fQ.Air_{t-1}$			0.0176 **		
			(0.0401)		
# obs.	20,228	14,756	13,365	14,718	14,670
J-statistic	3.81	8.46	10.89	9.17	7.44
p-value (*J*-test)	0.1488	0.1325	0.0753	0.1025	0.1896

Note. Each cell shows the point estimate from instrumental variables (IV) estimations and the *p*-values (in parenthesis). *capx* (*dppe*) is the ratio of capital expenditures (changes in property, plants and equipments) over beginning-of-period book assets; *fQ* (*mQ*) denotes the natural logarithm of the fundamental (non-fundamental) component of the market-to-book ratio. ψ is the relative logistic idiosyncratic volatility (or price non-synchronicity) whereas *Air* is the Amihud (2002) illiquidity ratio. We interact these two variables with fundamental growth options to assess the moderating or enhancing role of private information on the learning propensity of managers from the stock market (*fQ.ψ* and *fQ.Air*). *mQ.nsi* is an interaction variable between mispricing and net proceeds from new share issues. This interacted variable is used to control for the equity issuance channel. The remaining variables in Table 3 are time dummies capturing the tech bubble period (1996-2000), the crash of the bubble and the ensuing recession (2001-2003) and the subprime crisis (2008-2009). The point estimates of controls are suppressed for brevity but are available upon request to the author. Column 1 includes only *fQ* and controls while Columns 2-3 are fully-fledged and consistent with Equation (3). Column (2) is our baseline model while (3) and (4) offer robustness checks by including *Air* as an alternative measure of private information and using *dppe* to alternatively proxy for the investment ratio, respectively. We report diagnostic statistics for instrument overidentifying restrictions (*J*-statistics and related *p*-values) as well as the panel size at the bottom of the table. All the regressions contain firm fixed effects and the error structure is corrected for within-firm clustering. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Section 2 documents that though under- and overvaluation are both present in our data, the latter appears to be more dominant (see Table 1). Moreover, the correlation between mispricing (*mQ*) and our two measures of investment is positive suggesting the likelihood of sustained investor sentiment-driven investment behavior. We next quantitatively test this claim. In columns 2-3 of Table 3, we explicitly control for the net proceeds from the sale of common and preferred stocks and share repurchases that are driven by perceived misvaluation (*mQ.nsi*). We find that the sample firms robustly cater to investor sentiment, thus lending support to our initial interpretation that investor sentiment-driven mispricing can affect investment decisions and this influence is orthogonal to that of the equity issuance channel. Indeed, the point estimate of mispricing lies between 5.43% and 7.83%. As a corollary, a one-standard deviation change in stock market valuation errors would, *c.p.*, lead managers to raise investment by 7.10-10.23% through the catering channel, which corresponds to a increase of approximately 104% to 151% relative to the sample average investment ratio. At the same time, we find no evidence in support of the equity issuance channel when we use the full sample. Though positive in columns 2 and 4, the interaction variable *mQ.nsi* enters insignificantly the corresponding investment regressions. This is once again a reinforcement of the notion that firms continue to finance a large proportion of their capital projects through other financing sources (*e.g.*, private capital, debt and money market instruments) rather than through the equity channel. To check whether the documented supportive evidence pertaining to the catering channel is robust, we exclude *mQ.nsi* in column 5. The coefficient of investment on *mQ* marginally falls from 7.83% (column 2) to 6.69% and remains highly significant. In a nutshell, consistent with Hypothesis 3, we find that the sample firms cater to investor sentiment to temporarily boost their stock price. While our results concerning the catering channel of mispricing harmonize with those reported by Polk and Sapienza (2009) in their Table 2, the economic magnitude attained in this study is clearly higher. A plausible explanation relates to the higher mean investment ratio in their study (26.25% vs. only 6.8%). The question arises whether temporarily maximizing stock prices should be the overriding goal of managers (for a discussion of this issue, see *e.g.*, Jensen, 2005). At odds with, *inter alia*, Teoh, Welch and Wong (1998), Baker, Stein and Wurgler (2003) and Polk and Sapienza (2009), the sample firms to hand are reluctant to exploit perceived overvaluation through the equity issuance channel.

As an aside, we use a number of indicator variables to capture time-varying effects of the relation between stock market valuations and investment to capture a number of episodes of high uncertainty: the tech bubble (1996-2000); the crash of the tech bubble (2001-2003) and the mainly financial phase of the subprime crisis (2008-2009).[20] We additionally include an interaction between these three indicator variables and our measure of mispricing (*mQ*) to capture time-varying effects of mispricing. The point estimates in column 2 of Table 3 suggest that the tech bubble has unambiguously prompted episodes of vigorous business investment. The coefficient of the tech bubble dummy is positive and significant at the 1% level. However, its interaction with mispricing bears a negative sign but remains insignificant. Aggregating both effects shows that the positive impact on investment of the tech bubble is convincingly robust ($\chi^2 = 6.40$, $p = 0.0114$). Puzzlingly, the coefficient of the indicator variable denoting the 2001-2003 recession period is positive and highly significant. Only does investment loads negatively on the interacted variable between the crash of the tech bubble and mispricing (the point estimate is -1.01%). The sum of these two contrasting effects is positive and only borderline significant ($\chi^2 = 2.84$, $p = 0.0918$). This result suggests that the crash of the bubble had on average no significant welfare-impairing effects on business investment. In a similar vein, and counter to Duchin, Ozbbas and Sensoy (2010) and Campello, Graham and Harvey (2010), we find that the subprime crisis induced no significant cuts in business investment. Our failure to document adverse real effects of the subprime crisis over the 2008-2009 period may be related to the various bailouts for the financial and automotive industries. Though we have excluded financials from the sample, the bailout of the banking industry may still play a role in our ability to document the effect of the crisis on investment since these bailouts may affect the willingness and ability of banks to borrow to the productive sector. Moreover, firms may have used their cash reserves accumulated over the recovery period (2004- mid 2007) to dampen the negative externalities of the crisis in its early phase. On the other hand, one plausible explanation for the difference with prior research is

[20] See Duchin, Ozbas and Sensoy (2010).

that these studies use either US data (impact of market microstructure features) or are based on survey data where the perception of managers and misreporting may distort inferences.

In what follows, we explore the demographics of the various positive relations documented hitherto. Hypotheses 1-3 will be re-examined in subsamples sorted by firm size, price non-synchronicity and KZ4, respectively. The portfolios within a subsample correspond to firms falling in the same quartile in the distribution of a given telltale sign. Furthermore, the regressions are re-run at both the industry and at the country (or region) level.

Subsample analyses

The following analysis relies on the estimates in Table 4. Splitting the sample by size into quartiles (Panel A), we find evidence in support of Hypothesis 1 only for the second and the fourth quartiles. In rebuttal, price informativeness has a learning-enhancing impact across the different quartiles. Hypothesis 2 can thus be rejected for none of these groups of firms. Similarly, catering to investor sentiment is commonplace but the equity issuance channel appears to be the realm of medium-large and large firms. For the large firms, our estimates imply that a one-standard deviation increase in mispricing raises the investment ratio by approximately 10.9%. As a consequence, our results run counter to the findings by Bakke and Whited (2010) who report that smaller firms are more likely to follow the market when making investment decisions while large firms generally do not respond to market valuation errors. We corroborate the claim by Polk and Sapienza (2009) that the impact of mispricing on investment is more pronounced for firms which suffer from the most overvaluation (see also Shleifer and Vishny (2003) for the choice of the medium of payment in a mispricing-driven merger deal). Again, we claim that small firms would be reluctant to issue new shares as a result of overvaluation certainly because of their higher exposure to issue costs relative to large firms. On the other hand, they may tap other sources of financing much more easily even though the cost of these alternative sources of capital may still be higher for small than for large firms. On its way up, the tech bubble has homogenously induced abnormally high investment levels across the sample firms but the effect is more pronounced for large firms. The marginal effect on investment of the tech bubble in large firms amounts to 2.49% (0.0246 + 0.007 × 0.042). In a similar vein, only large firms seem to have borne collateral real damages following the bursting of the tech bubble. What is more, the subprime crisis has had no deleterious effect on the investment behavior of the sample firms. Large firms even have experienced moderate increases in investment during the same period. Indeed, the negative shock to capital supply is more likely to hamper investment in small firms than in large firms.

In Panel B, we find evidence in support of Hypothesis 1 only for firms in the second quartile of price non-synchronicity. While the coefficient on the interaction between *fQ* and price non-synchronicity is borderline significant only for opaque firms, the marginal effect of price non-synchronicity is positive and highly significant for firms in the first and second quartiles. As would be expected, firms with less informative stock prices cater the most. This result is a logic consequence of the dynamics of mispricing if one believes that managers have short horizons. Indeed, mispricing is more likely to persist in poor information environments whereas it gradually vanishes as information uncertainty resolves. What is more, transparent firms (Q4) do not cater but aggressively issue sky-inflated shares and channel the proceeds to outstanding projects which potentially relieve binding financing constraints. Exploring the time-varying effects, we find that the tech bubble has prompted similar increases in investment across the quartiles while collateral real damages during the bursting of the tech bubble and the subprime crisis are limited to opaque firms and firms with medium-high (Q3) informative stock prices.

We now turn to sorts of the firms by KZ4 (Panel C). As in Panel A, evidence in support of Hypothesis 1 is sparse and confined to Q2 and Q4. Likewise, the coefficient on the interaction between growth opportunities and price non-synchronicity is only significant for high KZ4 (constrained) firms. The resulting impact is economically significant. A one-standard deviation change in price non-synchronicity boosts investment by 1.23% [2.5 × (0.0025 + 0.0042 × 0.575)], which represents an increase of 18% relative to the sample mean. Yet, the marginal effect of price informativeness is positive across all quartiles. What is more, the sample firms collectively tend to cater to investor sentiment but the tendency is much less pronounced in constrained firms. This latter group of firms is found to rather opportunistically exploit overvaluation via the equity issuance channel. The aggressiveness of constrained firms in taking advantage of overvaluation is further manifest in the large point estimate on the interaction between mispricing and the tech bubble indicator variable. While only suggestive, this finding points to the "bright side" of investor sentiment consisting in relieving binding financing constraints. Yet, the positive borderline significant loading of investment on the indicator variable denoting the crash of the tech bubble is reminiscent of the interpretation difficulties surrounding KZ4 as a valid instrument for financing constraints (see Section 2).

To the extent that even firms operating in the same industry may face different investment opportunities contingent on firm-level productivity, over time changes in industry prospects and managerial ability (see Maksimovic and Phillips, 2002), we expect heterogeneous investment behaviors in firms operating in different industries.

Industry-level analysis

The industry level results are shown in Panel A of Table 5. Hypotheses 1 and 2 could be rejected only in five out of fourteen cases, respectively, suggesting that in most industries stock prices constitute an important tool for investment decision-making. As in most of the full sample analyses beforehand it comes as no surprise that the catering theory of investment fails to be rejected in eleven of fourteen cases. In rebuttal, the equity issuance channel is much less robust; it is specifically attested to in only six out of fourteen cases. Besides, the tech bubble period was characterized in about 80% of the cases by sustained increases in investment with the retail and technology industries experiencing the highest incremental investments during this period. In contrast, reversals in investment occurred only in the technology, travel, chemicals and to a lesser extent in media companies. Finally, we find that oil and gas and telecom are the two industries that have significantly and adversely been afflicted amid the subprime crisis. While risks of economic slowdown might explain why oil and gas companies would invest less during this period, it is unclear what should have triggered cuts in investment in the telecom sector during the same period due to negative energy demand shocks.

Table 4. Analysis of the effect of stock market valuations on investment in subsamples sorted by size, ψ and *mQ*

	Panel A: Sort by firm size				*Panel B: Sort by price non-synchronicity*				*Panel C: Sort by KZ4*			
Variables	*Q1*	*Q2*	*Q3*	*Q4*	*Q1*	*Q2*	*Q3*	*Q4*	*Q1*	*Q2*	*Q3*	*Q4*
fQ_{t-1}	0.0352	0.0465 **	0.0152	0.0230 **	0.0148	0.0435 ***	0.0312	-0.0287	0.0287	0.0429 **	0.0316	0.0316 ***
	(0.2203)	(0.0374)	(0.2401)	(0.0222)	(0.2360)	(0.0013)	(0.2295)	(0.3169)	(0.1402)	(0.0121)	(0.1149)	(0.0069)
ψ_{t-1}	0.0018	0.0083 **	0.0052 ***	0.0065 **	0.0049	0.0101 ***	-0.0009	0.0016	0.0097 *	0.0122 ***	0.0135 ***	0.0025
	(0.7665)	(0.0409)	(0.0047)	(0.0326)	(0.1817)	(0.0045)	(0.8191)	(0.7081)	(0.0676)	(0.0073	(0.0074)	(0.3575)
$fQ.\psi_{t-1}$	0.0062 **	0.0062 ***	0.0031 **	0.0068 **	0.0054 *	-0.0004	0.0015	0.0027	0.0023	-0.0023	-0.0039	0.0042 ***
	(0.0153)	(0.0004)	(0.0431	(0.0302)	(0.0719)	(0.8913)	(0.5473)	(0.3844)	(0.6052)	(0.5721)	(0.4209)	(0.0099)
mQ_{t-1}	0.0185 ***	0.0197 ***	0.0113 **	0.0240 ***	0.0199 ***	0.0138 ***	-0.0002	0.0040	0.0114 ***	0.0113 **	0.0129 ***	0.0134 *
	(0.0006)	(0.0021)	(0.0383)	(0.0000)	(0.0000)	(0.0003)	(0.9806)	(0.6756)	(0.0049)	(0.0152)	(0.0068)	(0.0927)
$mQ.nsi_{t-1}$	0.0092	0.0063	0.0458 **	0.0834 **	0.0186	0.0078	0.0234	0.0995 ***	0.0120	0.0141	0.0283	0.1982 **
	(0.6541)	(0.7252)	(0.0234)	(0.0185)	(0.2747)	(0.6934)	(0.5572)	(0.0020)	(0.5308)	(0.2987)	(0.3054)	(0.0145)
tech bubble	0.0158 ***	0.0128 ***	0.0137 ***	0.0246 ***	0.0231 ***	0.0124 ***	0.0131 **	0.0181 ***	0.0149 ***	0.0202 ***	0.0226 ***	0.0079
	(0.0055)	(0.0062)	(0.0002)	(0.0000)	(0.0000)	(0.0002)	(0.0158)	(0.0004)	(0.0000)	(0.0000)	(0.0000)	(0.1477)
tech burst	-0.0009	0.0044	-0.0004	0.0071 ***	0.0050 *	0.0015	-0.0010	0.0055	0.0033	0.0025	0.0005	0.0067 *
	(0.8482)	(0.2585)	(0.8705)	(0.0078)	(0.0974)	(0.5728)	(0.8330)	(0.1920)	(0.1447)	(0.4390)	(0.8739)	(0.0883)
subprime	-0.0028	-0.0023	0.0021	0.0062 **	0.0046	-0.0022	-0.0158 ***	-0.0013	0.0008	0.0031	0.0040	-0.0043
	(0.4616)	(0.5892)	(0.5634)	(0.0450)	(0.1436)	(0.4729)	(0.0042)	(0.7583)	(0.7621)	(0.3863)	(0.3770)	(0.3178)
mQ.techbubble	-0.0031	0.0036	0.0010	0.0070 **	0.0070 *	0.0015	0.0125 **	-0.0003	0.0037	0.0078 **	0.0035	0.0084 ***
	(0.4875)	(0.4456)	(0.7714)	(0.0241)	(0.0514)	(0.6390)	(0.0418)	(0.9368)	(0.2030)	(0.0353)	(0.4487)	(0.0099)
mQ.techburst	-0.0006	-0.0017	0.0015	-0.0052 *	-0.0055 *	0.0010	0.0003	0.0014	0.0056 *	-0.0005	-0.0025	0.0001
	(0.8915)	(0.6219)	(0.5052)	(0.0730)	(0.0918)	(0.6781)	(0.9402)	(0.7352)	(0.0635)	(0.8900)	(0.5513)	(0.9808)
mQ.subprime	-0.0021	-0.0035	-0.0002	0.0030	0.0028	-0.0018	0.0003	-0.0039	-0.0034	-0.0014	0.0058	0.0001
	(0.5114)	(0.3415)	(0.6921)	(0.2982)	(0.4221)	(0.5139)	(0.7047)	(0.3110)	(0.2193)	(0.6883)	(0.1581)	(0.8070)

Note. Each cell shows the point estimate from IV estimations and the *p*-values (in parenthesis). The dependent variable used in these estimations is the ratio of capital expenditures over beginning-of-period book assets (*capx*). A definition of the right-hand-side variables is provided at the bottom of Table 3. All the regressions contain firm fixed effect and the error structure is corrected for within-firm clustering. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Country-level analysis

Inasmuch as the response of managers to stock market valuations actually hinges also upon institutional settings "which affect the degree of managerial autonomy" (Mullins and Wadhwani, 1989) and cross-country differences in market microstructure features, we perform cross-country regressions in the next section. Herein, we are only interested in cross-country differences and simply use OLS estimations (we include firm fixed effects and correct errors for within-firm clustering). The point estimates plotted on the first line of Panel B of Table 5 suggest that Hypothesis 1 can only be rejected for Greece, Ireland, Italy and Spain. It is unclear whether this can be considered an artifact of the ongoing debt crisis or due to heterogeneous market size. An argument weakening this claim is that Portuguese managers facing similar negative shocks in the supply of capital seem to adjust their investment behavior to changing investment opportunities perceived in stock prices. And, *e.g.*, the Italian market is about twice as large as the Belgium market in our sample. Thus, market size is no valid argument to explain our results either.

Similar to the evidence about Hypothesis 1, we find that stock price informativeness bolsters the propensity of managers to learn from market valuations when making investment decisions except for five of the fourteen sample countries. In contrast, there seems to be significant evidence in support of the catering theory of investment across the sample countries (except for Ireland, Italy and Portugal). On the other hand, the equity channel hypothesis can be attested to only for three (Finland, Germany and Ireland) out of fourteen countries with Finnish firms exploiting overvaluation the most aggressively through new equity issues. By contrast, Luxembourgish firms appear to prefer catering rather than issuing new shares to finance marginal investments. Specifically, the coefficient of the interaction between *mQ* and *nsi* is significantly negative. As would be expected and consistent with the full sample analyses hitherto, the tech bubble has prompted, on its way up, vigorous waves of investment across the countries except for Austria, Greece, Ireland, Luxembourg and Portugal. Though the German stock market has undoubtedly been subject to the tech bubble that ended with the failure of the New Market, the affect on investment of the rising bubble is moderate relatively to comparable markets. As an example, the real effect of the rising bubble in France is 2.5 times as high as in Germany. On its way down, the tech bubble has led to significant cuts in investment only in German, Swiss and to a lesser extent in Portuguese firms. Finally, the subprime crisis surprisingly shows no significant adverse real effects in none of the analyzed markets.

On the reasoning that the US and the UK have higher standards of investor protection, Shleifer (2000) argues that the cost of investor sentiment will be higher in continental Europe, Asia and Russia than in the US and UK. We partly test this conjecture by segregating our sample in UK and continental Europe. The related OLS results are shown in the first two columns of Table 6. First, counter to widely held beliefs we find that the response of continental European firms to stock market valuations is 2.26 times (1.29% vs. 0.57%) as large as that of UK firms when making investment decisions. However, the enhancing role of stock price informativeness in the stock market valuations-investment relation is similar in continental Europe and in the UK. More important, we corroborate the predictions by Shleifer (2000) that continental European firms are more likely to exploit stock market valuation errors than their UK peers. Indeed, the marginal effect on investment of mispricing in continental Europe is about 2.77 times as high as in the UK. Yet, the coefficient of investment on subsequent excess returns is significantly negative for the UK subsample (t = -2.51, p = 0.0122) while it is insignificant for continental European firms (t = -0.87, p = 0.3757), suggesting that the costs of overvaluation may be relatively higher in the UK than in continental Europe.

A two-sample t-test with unequal variances suggests that, when taken as a bundle, continental European firms are fairly priced (mQ = 0.01, t = 1.17, p = 0.2419) while UK firms are systematically overpriced (mQ = 0.22, t = 14.89, p < 0.001) over the sample period.[21] This pricing differential between the UK and the Continent is statistically significant at the 1% level (t = -12.30, p < 0.001). Actually, this finding is the logic consequence of the stock price of firms in the UK subsample reflecting significantly less investor private information. This conclusion is robust to both measures of price informativeness. Specifically, average price non-synchronicity in continental Europe amounts to 3.59 (and even 4.28 and

[21] The corresponding figures for Germany and France are 0.0087 (t = 0.52, p = 0.6052) and -0.0054 (t = -0.21, p = 0.8307), respectively.

3.66 for Germany and France, respectively) against only 2.73 in the UK. The corresponding figures pertaining to the Amihud illiquidity ratio (*Air*) are 2.97 and 0.25, respectively. These latter figures entail yet that the UK market is much more liquid than continental European markets. If one believes that coverage by financial analysts is traditionally deeper in Anglo-Saxon economies than in the rest of the world, our results turn out to be puzzling. Possibly, one can relate our finding with a strand of literature on information acquisition that posits that the information generated by financial analysts has more market-wide content (see *e.g.*, Piotroski and Roulstone, 2004 for the US and Chan and Hameed, 2006 for 25 emerging economies). While there are admittedly limits to arbitrage, the argument put forward by these authors is that firms with informative stock prices attract arbitrageurs who will focus on firms' fundamentals, thereby reducing the wedge between observed prices and intrinsic values. As a result, UK firms will be quicker in reflecting market-wide information than their continental European counterparts and more likely to be mispriced. Indeed, synchronicity may arise from non-information driven herd behavior of information intermediaries. Our finding hitherto that UK firms earn lower returns than firms in the Continent in the subsequent period is in accord with Wurgler (2000) and Durnev *et al.* (2003) who document a negative relationship between price synchronicity and the efficiency of capital allocation. The question then arises as to whether the UK stock market has over time become less informationally efficient than those in the Continent.

Robustness

Is the result that investor sentiment-driven mispricing matters for real investment an artifact of the late 1990s? We estimate Equation (3) excluding the years 1996 through 2000 in an IV framework. Our inferences are by and large robust to this specification change (see column 3 of Table 6). However, the loading of investment on investment opportunities embedded in stock prices (*fQ*) has decreased by about 43% to level at 3.50% (vs. 6.14% in Table 3), which is statistically and economically significant. The interaction between *fQ* and price non-synchronicity evenly drops by approximately the same magnitude but remains robustly significant at the 1% level. And, while firms generally continue to cater to investor sentiment, they do so in a lesser style during the sample period excluding the 1999-2000 episode. Specifically, a one-standard deviation increase change in overvaluation leads to an increase of 5.83% in investment (vs. 10.23% for the whole sample period). As a result, catering is much more pronounced during rising bubbles, which is not surprising. In addition, when we change the bubble phase to include 1996-1999 period and the subprime to encompass the period between 2008 and 2011, the inferences drawn from Table 3 remain robustly unimpaired (the related results are available upon request).

In further analyses, we examine the investment relevance of the two components of investor sentiment driven valuation errors: *firm* and *branch*.[22] To do so, we replace *mQ* by these two variables in the baseline IV specification Equation (3). The results in column 4 of Table 6 suggest that the inferences pertaining to Hypotheses 1 and 2 mirror those drawn from column (2) of Table 3. Likewise, we obtain similar results about time-varying effects in the stock market valuations-investment relationship. This is not surprising since our measure of mispricing (*mQ*) aggregates the firm specific pricing deviations from short-run industry pricing (*firm*) and the sector-wide short-run deviations from firms' long-run pricing (*branch*). More interestingly, we find that the investment relevance of *firm* (7.34%) is independent of that of *branch* (8.90%).[23] These effects are both statistically and economically significant and associated with the catering theory of investment. As a consequence, the results related to *mQ* presented beforehand are a conservative point estimate of the effect on investment of mispricing through the catering channel. The coefficients of investment related to the equity channel are, though statistically significant, collectively economically insignificant.

Is the documented positive relation between investor sentiment and investment good or bad? The answer is not clear-cut owing to the experiences of welfare-enhancing and welfare-impairing bubbles in the history. We attempt to address this issue in the next subsection.

[22] The characteristics of these variables are provided earlier in Table 1 while their derivation takes place in Appendices A.2. and A.3 following Rhodes-Kropf, Robinson and Viswanathan (2005).

[23] The coefficients on firm and branch in separate specifications are 5.48% and 6.17%, respectively.

Table 5. Subsample Analyses

Panel A: Industry level estimations

Sector	10	11	12	13	14	15	16	17	18	19	20	21	22	23
fQ_{t-1}	0.0041	0.0122	0.0031	0.0160***	-0.0022	0.0092**	0.0117***	0.0077**	0.0342*	0.0153***	0.0254***	0.0089***	0.0138**	0.0019
	(0.3611)	(0.1088)	(0.4522)	(0.0000)	(0.6665)	(0.0264)	(0.0000)	(0.0363)	(0.0838)	(0.0000)	(0.0028)	(0.0004)	(0.0200)	(0.7555)
ψ_{t-1}	0.0002	0.0004	0.0002	-0.0002	-0.0006	0.0001	0.0012**	-0.0003	0.0034	-0.0016**	-0.0009	0.0004	-0.0057*	-0.0007
	(0.8668)	(0.7669)	(0.8622)	(0.7567)	(0.6713)	(0.9554)	(0.031)	(0.8368)	(0.5745)	(0.0329)	(0.7241)	(0.6885)	(0.0807)	(0.7023)
$fQ.\psi_{t-1}$	0.0004	0.0021	0.002*	0.0036***	0.0009	0.0025***	0.0031***	0.0018**	0.0024	0.0053***	0.0072***	0.0025***	0.0048**	0.0031
	(0.788)	(0.2661)	(0.083)	(0.0000)	(0.2647)	(0.0032)	(0.0000)	(0.0309)	(0.644)	(0.0000)	(0.0064)	(0.0001)	(0.0304)	(0.1272)
mQ_{t-1}	0.0176***	-0.0074	0.0147***	0.0125***	0.0066	0.0161***	0.0139***	0.0092***	0.0068	0.0158***	0.0131**	0.0113***	0.0167***	0.0105*
	(0.0000)	(0.1416)	(0.0000)	(0.0000)	(0.101)	(0.0000)	(0.0000)	(0.0003)	(0.5278)	(0.0000)	(0.0313)	(0.0000)	(0.0004)	(0.0781)
$mQ.nsi_{t-1}$	-0.042	0.4234***	0.0422	0.1400**	-0.0501	0.0006	0.0284* *	0.0289*	0.1316*	0.0198	-0.0304	0.0154**	0.0301	0.0449
	(0.5575)	(0.0000)	(0.2773)	(0.0206)	(0.3039)	(0.9585)	(0.0466)	(0.0461)	(0.0759)	(0.1844)	(0.5151)	(0.0406)	(0.4095)	(0.3903)
tech bubble	0.0178***	0.0178***	0.0218***	0.0075**	-0.0047	0.0157**	0.0136***	0.0143***	-0.0041	0.0063**	0.0310***	0.0266***	0.019	0.0186* *
	(0.0010)	-0.0094	(0.0000)	-0.0274	-0.3197	-0.0109	(0.0000)	-0.0012	-0.8108	-0.04	-0.0008	(0.0000)	-0.1181	-0.0406
tech burst	0.0119*	-0.005	0.0027	0.0059*	-0.0019	-0.0014	0.0007	-0.0110***	0.0121	0.0028	0.0106	-0.0116***	-0.0047	-0.0132*
	(0.0514)	(0.4245)	(0.4641)	(0.0703)	(0.6745)	(0.7744)	(0.7701)	(0.0067)	(0.4465)	(0.3269)	(0.1943)	(0.0000)	(0.579)	(0.0905)
subprime	-0.0046	0.0138**	-0.0027	0.004	0.0003	0.002	-0.0039	-0.003	-0.0036	-0.0028	-0.0062	-0.0014	0.0000	0.0049
	(0.5201)	(0.0408)	(0.5193)	(0.267)	(0.9569)	(0.677)	(0.1511)	(0.5781)	(0.8106)	(0.3928)	(0.5138)	(0.6500)	(0.9974)	(0.5598)
mQ.techbubble	0.001	0.007	0.0118*	-0.0061	-0.0009	0.0117*	0.0046	-0.0012	-0.0419*	0.0006	0.0410***	0.0036	0.017	0.0282** *
	(0.8826)	(0.3964)	(0.0619)	(0.1407)	(0.7864)	(0.0631)	(0.1496)	(0.8001)	(0.069)	(0.8139)	(0.0000)	(0.2882)	(0.1638)	(0.0066)
mQ.techburst	0.0083	-0.0076	-0.0099*	0.0007	-0.0015	0.0016	0.0007	0.0111***	0.0088	0.0001	-0.0028	0.0019	-0.0031	0.0069
	(0.2561)	(0.438)	(0.0644)	(0.8354)	(0.7919)	(0.6953)	(0.7833)	(0.0042)	(0.7162)	(0.9724)	(0.7172)	(0.4718)	(0.6974)	(0.5394)
mQ.subprime	-0.001	0.0003	-0.001	0.0083**	0.0003	0.0027	0.0005	-0.0038	-0.0422**	-0.0037	-0.009	-0.002	-0.0158**	0.0021
	(0.8548)	(0.9712)	(0.8401)	(0.0485)	(0.5558)	(0.5947)	(0.8365)	(0.4102)	(0.0434)	(0.3173)	(0.4091)	(0.5366)	(0.039)	(0.8412)
Within R-sq.	0.2011	0.1030	0.1857	0.1548	0.0963	0.0786	0.0777	0.1307	0.0538	0.1022	0.1094	0.2110	0.3948	0.1381
# obs.	586	851	802	1,362	1,330	1,256	5,556	1,063	523	1,864	1,386	2,662	301	959

Note. Each cell shows the point estimate across industries from OLS estimations and the *p*-values (in parenthesis). The dependent variable is the ratio of capital expenditures over beginning-of-period book assets. The industries are as follows: (10): Automobiles & Parts; (11): Basic Resources; (12): Chemicals; (13): Construct. & Material; (14): Food & Beverage; (15): Healthcare; (16): Industrial Goods & services; (17): Media; (18): Oil & gas; (19): Personal and household goods; (20): Retail; (21): Technology; (22): Telecom; and (23): Travel & leisure. The independent variables are the same as those used in full samples analyses (Table 3). We systematically suppressed coefficients on controls for brevity but they are available upon request. All the regressions contain firm fixed effect and the error structure is corrected for within-firm clustering. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Table 5. Subsample Analyses (Continued)

Panel B: Country level estimations

	Austria	Belgium	Finland	France	Germany	Greece	Ireland	Italy	Luxembourg	Netherlands	Portugal	Spain	Switzerland	UK
fQ_{t-1}	0.0203**	0.0392**	0.0232***	0.0100***	0.0101***	0.0038	0.0179	0.0129	0.0394***	0.0145***	0.0215***	0.0055	0.0078**	0.0055***
	(0.0143)	(0.0144)	(0.0009)	(0.0000)	(0.0000)	(0.7273)	(0.1415)	(0.1133)	(0.0071)	(0.0000)	(0.0018)	(0.2937)	(0.01399	(0.00029
ψ_{t-1}	0.0001	-0.0032	0.002	(0.0000)	0.0001	-0.0065	0.0047	0.003	0.0019	-0.0003	-0.0005	-0.001	0.0001	-0.001
	(0.9310)	(0.4061)	(0.2885)	(0.9770)	(0.7871)	(0.2329)	(0.2075)	(0.2812)	(0.7266)	(0.7551)	(0.6918)	(0.5618)	(0.9164)	(0.1387)
$fQ.\,\psi_{t-1}$	0.0067***	0.0138***	0.0070***	0.0026***	0.0027***	0.0068	0.0027	0.0012	0.0077	0.0039***	0.0024	0.0053***	0.0023***	0.0038***
	(0.0018)	(0.0001)	(0.0004)	(0.0000)	(0.0000)	(0.2289)	(0.1729)	(0.6112)	(0.1109)	(0.0000)	(0.2202)	(0.004)	(0.0002)	(0.0000)
mQ_{t-1}	0.0120**	0.0399***	0.0147**	0.0121***	0.0123***	0.0242***	0.0171	0.0041	0.0624***	0.0192***	0.0072	0.0196***	0.0108***	0.0085***
	(0.0483)	(0.0008)	(0.0113)	(0.0000)	(0.0000)	(0.0062)	(0.1324)	(0.4997)	(0.0000)	(0.0000)	(0.2455)	(0.0001)	(0.0000)	(0.0000)
$mQ.nsi_{t-1}$	0.0669	-0.0711	0.2610***	0.008	0.0300***	-0.0816	0.2451***	-0.0237	-0.1801**	0.0128	0.0784*	0.0284	0.0228	0.009
	(0.3365)	(0.5363)	(0.0000)	(0.4217)	(0.0015)	(0.287)	(0.0066)	(0.6774)	(0.0221)	(0.353)	(0.0679)	(0.4745)	(0.1986)	(0.4503)
tech bubble	-0.0008	0.0472***	0.0255***	0.0113***	0.0056*	.	-0.0014	0.0182*	0.012	0.0103***	-0.0034	0.0314***	0.0087***	0.0147***
	(0.9366)	(0.0085)	(0.0088)	(0.0001)	(0.057)	.	(0.9244)	(0.0713)	(0.6538)	(0.0031)	(0.7083)	(0.0000)	(0.0048)	(0.0000)
tech burst	-0.0089	0.0327**	-0.0003	-0.0004	-0.0049**	0.009	-0.0089	-0.0057	0.0177	0.0034	-0.0059	0.0142**	-0.0067**	-0.0011
	(0.3300)	(0.0285)	(0.9698)	(0.8485)	(0.0444)	(0.6574)	(0.5363)	(0.5078)	(0.2921)	(0.3234)	(0.4246)	(0.0462)	(0.0219)	(0.6762)
subprime	-0.0053	-0.0032	0.0016	-0.0022	-0.0015	0.0173	-0.0051	-0.0004	0.0289**	-0.0044	0.0156*	0.0088	0.0009	0.0005
	(0.5515)	(0.8387)	(0.8312)	(0.3625)	(0.5868)	(0.1065)	(0.7601)	(0.9608)	(0.0108)	(0.3636)	(0.0569)	(0.1143)	(0.7659)	(0.8636)
mQ.techbubble	0.0046	0.0604**	0.0068	0.0150***	0.0048*	.	-0.0026	0.0044	-0.0046	-0.0016	0.0093	0.0064	0.0047	0.0067**
	(0.6314)	(0.0115)	(0.4561)	(0.0000)	(0.0523)	.	(0.854)	(0.6803)	(0.9123)	(0.6065)	(0.3044)	(0.4907)	(0.1699)	(0.0147)
mQ.techburst	0.0059	0.0133	-0.0113	-0.0021	0.0023	0.0031	0.0118	0.0028	0.0253	0.003	-0.0115*	0.0047	0.001	0.0012
	(0.5376)	(0.4454)	(0.2734)	(0.3776)	(0.2569)	(0.8846)	(0.4356)	(0.7862)	(0.1793)	(0.4069)	(0.0680)	(0.6537)	(0.6872)	(0.7175)
mQ.subprime	-0.0109	0.0185	-0.0096	0.0003	-0.0027	0.0118	-0.0139	-0.0063	0.0169	-0.0007	0.0108	0.0047	-0.0015	-0.0005
	(0.2315)	(0.3078)	(0.3205)	(0.5386)	(0.3825)	(0.3111)	(0.3737)	(0.5416)	(0.1456)	(0.9126)	(0.1079)	(0.4369)	(0.7182)	(0.8689)
Within R-sq.	0.1106	0.1041	0.1463	0.0848	0.1353	0.1232	0.1759	0.0206	0.1430	0.5946	0.2024	0.1670	0.0983	0.1635
# obs.	377	738	1,053	4,107	4,005	248	345	1,339	62	1,650	363	649	1,725	3,840

Note. Each cell shows the point estimate across countries from OLS estimations and the *p*-values (in parenthesis). The dependent variable is the ratio of capital expenditures over beginning-of-period book assets. The independent variables are the same as those used in full samples analyses (Table 3). We systematically suppressed coefficients on controls for brevity but they are available upon request. All the regressions contain firm fixed effect and the error structure is corrected for within-firm clustering. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Table 6. Further Analyses: Continent vs. UK / Robustness checks

Variables	Continent	UK	ex tech bubble	Disaggregated *mQ*
fQ_{t-1}	0.0129 ***	0.0057 ***	0.0350 **	0.0599 ***
	(0.0000)	(0.0002)	(0.0300)	(0.0003)
ψ_{t-1}	0.0004	-0.0013 *	-0.0047	-0.0059
	(0.2927)	(0.0764)	(0.549)	(0.5168)
$fQ.\psi_{t-1}$	0.0031 ***	0.0041 ***	0.0119 ***	0.0246 ***
	(0.0000)	(0.0000)	(0.0090)	(0.0000)
mQ_{t-1}	0.0131 ***	0.0084 ***	0.0446 ***	
	(0.0000)	(0.0000)	(0.005)	
$mQ.nsi_{t-1}$	0.0323 ***	0.0080	0.0452	
	(0.0000)	(0.5163)	(0.237)	
$firm_{t-1}$				0.0734 ***
				(0.0000)
$branch_{t-1}$				0.0890 ***
				(0.0000)
$firm.nsi_{t-1}$				0.0000 *
				(0.0646)
$branch.nsi_{t-1}$				0.0000 **
				(0.0467)
tech bubble	0.0131 ***	0.0141 ***		0.0200 **
	(0.0000)	(0.0000)		(0.0103)
tech burst	-0.0010	-0.0008	0.0064 **	0.0175 ***
	(0.4865)	(0.7436)	(0.047)	(0.0001)
subprime	-0.0011	0.00017	-0.0019	0.00069
	(0.5271)	(0.5915)	(0.769)	(0.3604)
mQ.techbubble	-0.0000	0.0065 **		
	(0.9760)	(0.0204)		
mQ.techburst	0.0003	-0.0002	-0.0022	
	(0.6083)	(0.9646)	(0.324)	
mQ.subprime	0.0003	-0.0013	0.0010 *	
	(0.6083)	(0.6757)	(0.098)	
$Return_{t+1}$	-0.0011	-0.0055 ***		
	(0.3757)	(0.0000)		
# obs.	15,587	3,588	12,431	14,769
J-statistic			8.24	7.10
p-value (*J*-test)			0.0832	0.2130
within R-sq.	0.0652	0.1622		

Note. The first two columns report on estimates from OLS regressions with firm fixed effects whereas the last two show estimates from IV estimations. Columns (1) and (2) compare OLS estimates for a subsample containing continental European firms and another one containing only UK firms. Column (3) shows the results of Equations (3) when we exclude the tech bubble period (1996-2000) and column (4) plots the results using the two components of investor sentiment driven mispricing (rather than the aggregate *mQ*): *firm* and *branch*. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Investment efficiency implications of the positive relation between investment and mispricing

Mullins and Wadhwani (1989:939) argue that if "[…] the stock market is sometimes swayed by 'irrational' considerations, the absence of an influence of share price on investment […] may then be regarded as an advantage." The question thus arises whether the positive relation between investor sentiment and investment documented hitherto is suggestive of inefficient resource allocation as predicted by the catering hypothesis.

One way to test this prediction is to examine the relationship between investment and future stock returns. To this end, we run OLS regressions of annual stock returns on lagged values of *capx*, *fQ* and *cash flow* and contemporaneous market model *beta*. The regression includes both firm fixed effects as well as time fixed effects while correcting for within-firm clustering. As shown in the first row of Table 7, the coefficient on investment is -0.2381 (t = -7.30, p <0.001). In unreported analyses, we alternatively run a Fama-MacBeth (1973) cross-sectional regression of future returns on *beta*, *capx*, *fQ* and *cash flow*. The coefficient on investment obtained from this specification amounts to -0.1926 and is significant at the 1% level. Consistent with the catering theory of investment, firms that overinvest (under-invest) do earn on average low (high) returns in the subsequent period. These inferences are not overturned if we use market model excess returns in lieu of raw stock returns.

In Table 7, we split the sample firms into subsamples according to firm size, price non-synchronicity and KZ4 to account for the heterogeneity of the sample firms. Overinvesting smaller firms appear to earn significantly lower subsequent returns while large firms to some degree successfully insulate themselves against adverse shocks in future stock returns (Panel A). When the sample is segmented according to price non-synchronicity, the effect of overinvestment on subsequent returns is non-monotonic and probably U-shaped. Firms in the extreme quartiles do not suffer from low subsequent returns but those in the middle quartiles do (Panel B). The sort by KZ4 suggests that the adverse impact of overinvestment on stock returns decreases monotonically in KZ4 (Panel C). This result is reminiscent of the notion that overvaluation of financially constrained firms may relieve binding financing constraints either through the equity channel or via the credit multiplier route (see Section 1). Splitting the sample by

KZ4 additionally allows us to check whether unconstrained firms actually invest in capital projects with negative NPV when they are overvalued. To do so, we enter in the OLS regression estimated above an interaction between investment and an indicator variable denoting firms belonging to the higher quartile in the distribution of KZ4. Consistent with Polk and Sapienza (2009), we notice that subsequent stock returns load positively and significantly so for high KZ4 (constrained) firms. The corresponding point estimate of the interaction is 0.113 ($t = 2.18$, $p = 0.029$) while that of firms in lower quartiles amounts to -0.273 ($t = -8.33$, $p < 0.001$) against -0.238 for the entire sample. Once again, overvaluation of constrained firms turns out to be welfare-enhancing while it has deleterious effects on the performance of overvalued but financially healthy overinvesting firms. The latter scenario is potentially due to empire-building or other value-destroying decisions of managers facing career concerns. They need to invest as their peers do if they not want to fall prey to impatient and skeptic shareholders (see *e.g.*, Scharfstein and Stein, 1990).

Table 7. Investment and subsequent stock returns

	coefficient on investment		*p*-value	within R-sq.	# obs.
Full sample	-0.2381	***	(0.0000)	0.326	26,528
Panel A: Sort by firm size					
Small	-0.4447	***	(0.0000)	0.305	5,352
Q2	-0.4884	***	(0.0000)	0.340	6,447
Q3	-0.079		(0.1922)	0.377	6,794
Large	-0.0018		(0.9741)	0.429	7,493
Panel B: Sort by price non-synchronicity					
Opaque	-0.0204		(0.7387)	0.477	7,173
Q2	-0.4925	***	(0.0000)	0.378	6,856
Q3	-0.3449	***	(0.0000)	0.312	6,546
Transparent	-0.1031		(0.1140)	0.217	5,946
Panel C: Sort by KZ4					
Unconstrained	-0.5198	***	(0.0000)	0.362	6,727
Q2	-0.4503	***	(0.0000)	0.320	6,408
Q3	-0.2215	***	(0.0044)	0.346	6,846
Constrained	-0.1289	**	(0.0129)	0.354	6,518

Note. Table 7 reports the results form an OLS regression of annual stock returns on lagged values of *capx*, *fQ* and *cash flow* and contemporaneous market model *beta*. The regression includes both firm fixed effects as well as time fixed effects while correcting for within-firm clustering. The results are presented in four compartments the first of which pertains to the full sample.

Panel A relates to sorts in quartiles by firm size as measured by book asset at the beginning of the period. Panel B shows the results for the sort by price non-synchronicity and Panel C uses KZ4 as the telltale sign. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

In a second step, we follow Duchin, Ozbas and Sensoy (2010) to further investigate the efficiency of investor sentiment-driven investment. We use lagged values of mispricing and investment to construct four different long-only investment strategies. Because firms in the middle quartiles of our two telltale signs can be considered the "normal" firms, we only consider the two extreme quartiles of the same distributions. The constructed portfolios (P11, P14; P41; P44) are rebalanced annually on 30 June of each year (beginning on 30 June 1993), thus allowing firms to migrate across portfolios over time. This is important as the information environment changes over time, which may alter the dynamics of mispricing for a focal firm. Moreover, investment is shown to be associated with stock market valuations even if timing and magnitude may differ. The first (second) index of a portfolio denotes its quartile affiliation in the distribution of *mQ* (*capx*). As an example, P41 is a portfolio that includes firms that concomitantly fall in the fourth quartile of *mQ* and quartile 1 of *capx*. P41 thus corresponds to the group of overvalued under-investing firms. If the market subsequently correctly processes information and managers act to the best interest of their shareholders, we expect investor-sentiment driven overinvestment (P44) to underperform a portfolio of overvalued firms with lower investment ratio (P41). P41 may include firms that ignore short-term overvaluations or those that float new shares at inflated prices and channel the proceeds into cash or any other fairly priced assets (because managers or shareholders have long horizons). Figure 2 plots the cumulative gross returns on the four different portfolios over the 6/1993-12/2011 period.

Consistent with our prediction, we find that P41 outperforms P44 by 6.87% (on annual basis) and the difference is statistically significant at the 1% level ($t = 4.81$, $p < 0.001$). The inference is not impaired when we consider risk-adjusted returns (*e.g.*, Sharpe-ratios). While not that surprising, this result is interesting for at least three reasons. First, the positive relation between *mQ* and investment documented in the results heretofore is welfare-impairing for overinvesting overvalued firms. This is likely to be the case of managers in financially unconstrained firms that only cater to investor sentiment to either secure their job (sharing-the-blame-effect) or to build empires through, *e.g.*, prestige acquisitions. Second, the funds raised during favorable market conditions (via equity issues or through the credit multiplier route) should have been returned to shareholders. Third, in light of the blatant underperformance of P44 relative to P41 our measure *mQ* seems to correctly capture stock market valuation errors and the presumption that investor sentiment is at work in our data gains strength.

P14 and P41 earn similar gross returns over the investment period with an annual return of 13.73% and 11.81%, respectively. Interestingly, P11 earns 20% *p.a.* which clearly dwarfs the horrendous performance of all other investment strategies. We conclude that undervalued firms, whatever their investment behavior, appear to yield higher subsequent returns than their overvalued counterparts. Actually, our data suggest that both undervalued and overvalued firms have comparable investment opportunities (see Panel D of Table 2).

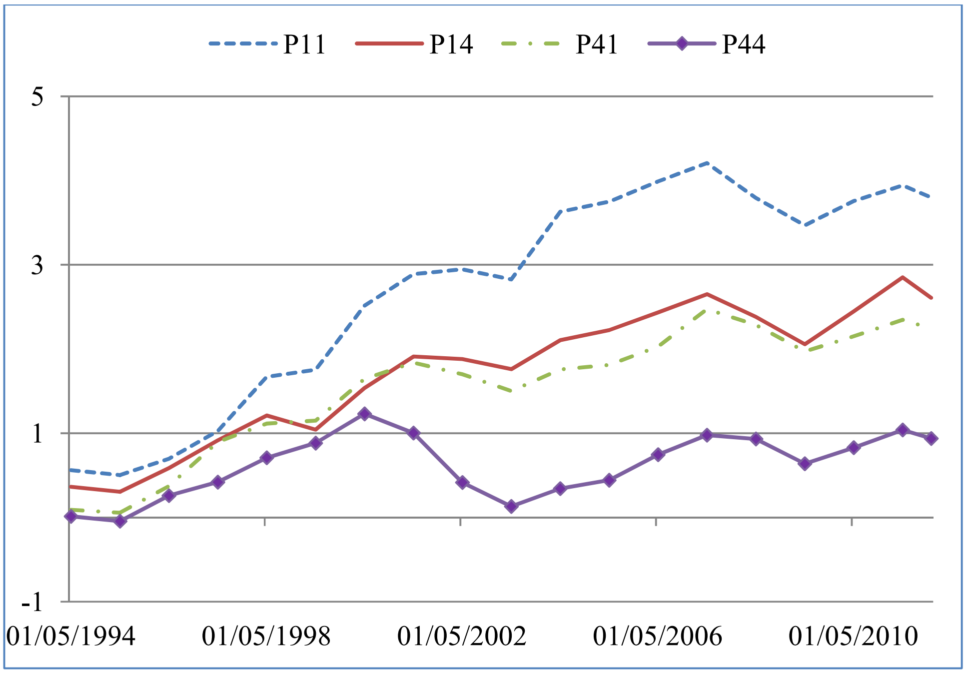

Figure 2: Mispricing-investment sorted portfolio returns

5. Conclusions

The European stock markets analyzed in this study have real economic effects inasmuch as managers appear to vicariously learn from stock prices by adjusting their investment behavior to perceived changing long-run investment opportunities. As would rationally be expected, the propensity of managers to shade their investment decisions on stock market signals is an increasing function of the perceived amount of private investor information impounded in the stock price. Combining these two pieces of evidence, we are led to unambiguously reject the passive informant hypothesis. This finding is yet a two-edged sword. The good news is that managers appear to be rational forecasters by integrating forward-looking signals about developments in the relevant product markets conveyed by stock prices in their decision-making processes. This is tantamount to managers making use of all available decision-relevant information that includes serendipitous information. Because of the enhancing role of stock price informativeness, it is of interest to understand the paths through which stock prices become more informative. These include investor relations activities (Bushee and Miller, 2012). Besides, Gul, Srinidhi and Ng (2011) find that board gender diversity improves the informative content of stock prices via two different channels of transparency. The effect runs through increased public disclosure by managers in large firms and by providing greater incentives for the production of investor private information in small firms. While the "bright side" of stock market-based decision-making is straight forward, elaborating on its "dark side" seems to be tedious. Clearly, shading investment decisions on stock market valuations will be beneficial if the signals transmitted are genuine.

The stock market inherently synthesizes various learning characteristics that hive it off from other types of economic feedback in the firms' selection environment. Indeed, learning from the stock market entails intentional outcome-oriented feedback (either experiential or vicarious) learning. The peculiarity of such a learning process resides in its focus on an outcome (stock prices in the case to hand) that reflects investor beliefs about an "underlying" outcome in the product market (*e.g.*, substantial growth in corporate sales or profits potentially due to favorable expectations about competition). And, because of the heavily reliance on investor beliefs learning from the stock market exhibits features of institutional adaptation processes (Kock, 2005). One more complication is that investor beliefs are neither observable nor are they actions that can be imitated by firms, thereby prompting two thorny issues. Formation processes and complexity of investor expectations result in mutual and simultaneous learning schemes and firms' use of simple heuristics. In practice, firms hardly design elaborate learning processes aimed at capturing the whole picture projected by stock price signals, which makes them prone to causal errors when acting upon stock market signals. Rational and unbiased managers may thus be reluctant to follow the market. As a consequence, the complexity of stock price-based signals about firms' long-run growth options may be bad news since even if the signals are genuine, simplistic heuristics used within firms may lead to suboptimal decisions. Besides, stock markets may at times be subject to "animal spirits". This argument leads us to the third main hypothesis tested in this study.

Parsing out the market-to-book ratio (our proxy for average Tobin's q) into its fundamental and non-fundamental components as described in Rhodes-Kropf, Robinson and Viswanathan (2005), we find evidence suggesting the existence of overvaluation (see Table 1). More importantly, investor sentiment-driven stock price bubbles are found to significantly boost investment on their way up, but bursting bubbles are, if anything, marginally associated with an investment drought (only in subsample analyses). In addition, the route of investor sentiment transmission to investment runs substantially through the catering channel. While opaque firms are more likely to cater, evidence for the equity issuance hypothesis is confined to large, transparent and constrained firms. Unexpectedly, the negative shock to capital supply amid the subprime crisis has had no significant effects on investment. Are public complaints about distorting real effects of stock markets exaggerated? The answer is not clear-cut. Borrowing heavily from Roubini (2006), the documented positive relation between mispricing may be considered a consequence of the moral hazard (from the side of both investors and managers) arising from the asymmetric response of monetary authorities to rising and bursting bubbles. Our failure to document real effects of bursting bubbles during the 2001-2003 recession period can certainly be explained by central banks generally aggressively reacting to crashes of bubbles (than to growing ones). On the other hand, the asymmetric response to bubbles coupled with the different government bailouts should be accounted for when measuring the real effects (costs) of mispricing.

To check whether the positive relationship between mispricing and investment is good or bad, we have designed, *inter alia*, four long-only portfolio investment strategies based on a double sort using mispricing and investment as telltale signs. We find that overvalued overinvesting firms have subsequently horrendous performance while undervalued under-investing firms significantly outperform all other combinations plotted in Figure 2. This result is symptomatic of value-destroying investment decisions driven by investor sentiment since under-investment is, *per se*, suboptimal. Consequently, there is cause for concern if managers either cater to investor sentiment or issue new shares at inflated prices to finance new investments (with negative NPV). Counter to Shleifer (2000), we find no evidence in support of the claim that costs of market inefficiency may be higher in continental Europe than in the UK. In contrast, we find that firms in the UK subsample earn subsequently lower returns than their peers in the Continent.

This study suffers from a number of limitations that open up avenues for future research. First, stock price informativeness constitutes a necessary (but not sufficient) condition for managers to learn. To sidestep suboptimal managerial decisions due to either agency problems or cognitive biases, we have imposed the stark restrictions that managers act in the best interest of shareholders and that they have unbiased expectations. This way of doing is consistent with our interest in ultimately ascertaining whether managers follow signals transmitted by the stock market and not, *per se*, why they (may) do so. However, the latter issue is of interest because managerial incentives to extract private benefits would affect whether and the way managers respond to market valuations. Would our results be robust to the presence of conflicting incentives between shareholders and managers? Second, do cognitive biases or career concerns affect firm investment decisions? A third issue of interest relates to the very meaning of the popularly used relative logistic idiosyncratic return variation (*e.g.*, Jin and Myers, 2006; Dasgupta *et al*., 2010; Lee and Liu, 2011). Does it really denote price informativeness? If not, how can it be altered to play this role?

Appendix A.1. Definition of the main variables used in the analysis

capx: capital expenditures over beginning-of-period book assets

dppe: change in property, plants and equipments over beginning-of-period book assets

fQ: natural logarithm of the fundamental component of the market-to-book ratio

mQ : natural logarithm of the non-fundamental component of the market-to-book ratio

firm: firm-specific mispricing (column 2 of Table A.3.)

branch: sector-wide mispricing (column 3 of Table A.3.)

pts: price-to-sales ratio

ψ: price non-synchronicity based on the single index market model

Air: Amihud (2002) illiquidity ratio which is the average daily ratio of a stock's absolute return by the dollar volume

leverage: total debt-to-assets

cash flow: cash flow over beginning-of-period book assets

sales: net revenues over beginning-of-period book assets

cash: cash over beginning-of-period book assets

csi: composite share issuance (Daniel and Titman, 2006)

return: continuous annual stock returns

beta: market model betas

roa: ratio of operating income before depreciation and amortization expenses to total assets.

age: number of years preceding the observation year that the firm has a non-missing stock price in the Datastream database.

Appendix A.2. Conditional regression multiples – Fama-MacBeth (1973) two-step procedure

	Industry Classification Benchmark (Datastream Level 3 supersector name: INDM3)													
Parameter	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**
$E(\hat{\alpha}_0)$	-0.683	-0.543	-0.840	-0.576	-1.124	-0.847	-0.820	-0.722	-0.122	-0.876	-1.061	-0.680	0.634	-0.602
	0.15	0.12	0.15	0.17	0.12	0.22	0.07	0.19	0.17	0.12	0.11	0.17	0.09	0.18
	-4.62	-4.37	-5.79	-3.37	-9.05	-3.93	-12.27	-3.86	-0.72	-7.41	-9.92	-4.05	6.73	-3.38
$E(\hat{\alpha}_1)$	0.750	0.746	0.744	0.687	0.741	0.640	0.653	0.644	0.734	0.674	0.668	0.618	0.506	0.650
	0.03	0.03	0.03	0.02	0.04	0.04	0.02	0.05	0.02	0.02	0.03	0.03	0.07	0.03
	21.50	25.40	23.73	28.96	20.32	17.02	39.55	14.25	29.66	29.28	25.79	18.40	6.91	22.89
$E(\hat{\alpha}_2)$	0.225	0.227	0.267	0.269	0.300	0.356	0.332	0.350	0.229	0.318	0.355	0.359	0.335	0.309
	0.03	0.02	0.03	0.03	0.03	0.04	0.01	0.04	0.02	0.02	0.02	0.03	0.05	0.03
	6.89	9.91	9.58	10.04	10.12	9.37	26.20	8.66	10.82	14.86	17.68	12.89	6.18	10.70
$E(\hat{\alpha}_3)$	-0.016	-0.042	-0.027	-0.043	0.000	0.001	-0.052	-0.061	-0.047	-0.053	-0.023	-0.060	-0.086	-0.059
	0.01	0.01	0.01	0.01	0.01	0.02	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	-2.41	-7.62	-3.20	-5.53	0.03	0.04	-14.65	-6.09	-4.86	-10.47	-2.69	-7.36	-9.03	-7.82
$E(\hat{\alpha}_4)$	0.413	-0.204	0.171	-0.205	0.204	0.439	-0.255	0.130	0.065	-0.147	-0.208	0.064	-0.173	-0.092
	0.20	0.18	0.13	0.11	0.13	0.18	0.06	0.15	0.14	0.12	0.12	0.16	0.37	0.03
	2.08	-1.10	1.28	-1.88	1.60	2.48	-4.33	0.87	0.45	-1.24	-1.69	0.41	-0.47	-2.66
Average R-squared	**0.93**	**0.90**	**0.92**	**0.87**	**0.89**	**0.89**	**0.85**	**0.87**	**0.95**	**0.82**	**0.89**	**0.83**	**0.91**	**0.86**

Note. The estimated industry-year regression is given in Equation (A.1) at the bottom of Appendix A.3. The industries are as follows: (10): Automobiles & Parts; (11): Basic Resources; (12): Chemicals; (13): Construct. & Material; (14): Food & Beverage; (15): Healthcare; (16): Industrial Goods & services; (17): Media; (18): Oil & gas; (19): Personal and household goods; (20): Retail; (21): Technology; (22): Telecom; and (23): Travel & leisure. How to read the table: The first row returns the average value of each coefficient from Equation (A.1), the second row shows the Fama-MacBeth (1973) standard errors and the third row provides the corresponding *t* statistic.

Appendix A.3. Decomposing market-to-book at the firm-level

Valuation component	$m_{it} - b_{it}$	$m_{it} - v(\theta_{it};\hat{\alpha}_{jt})$	$v(\theta_{it};\hat{\alpha}_{jt}) - v(\theta_{it};\bar{\hat{\alpha}}_{j})$	(2) + (3)	$v(\theta_{it};\hat{\alpha}_{j}) - b_{it}$	Sample size
	(1)	(2)	(3)	(4)	(5)	
Panel A: Full sample						
	0.62	0.00	0.04	0.04	0.58	30446
Panel B: Distribution across industries						
Automobiles & Parts	0.29	-0.26	-0.15	-0.41	0.70	871
Basic Resources	0.26	0.19	-0.02	0.17	0.10	1258
Chemicals	0.47	-0.11	0.00	-0.11	0.58	1132
Construct. & Material	0.42	0.10	0.15	0.25	0.17	1947
Food & Beverage	0.51	-0.15	-0.09	-0.24	0.75	2155
Healthcare	0.92	-0.24	-0.02	-0.25	1.17	1790
Ind. Goods & services	0.61	0.14	0.08	0.22	0.39	7944
Media	0.80	-0.25	0.00	-0.25	1.04	1870
Oil & gas	0.69	-0.02	0.01	-0.01	0.70	728
Pers. & househ. goods	0.51	0.05	0.09	0.15	0.36	2752
Retail	0.73	0.14	0.01	0.16	0.58	1810
Technology	0.78	-0.11	0.04	-0.08	0.86	4387
Telecom	0.90	-0.24	0.35	0.12	0.78	488
Travel & leisure	0.52	0.08	0.04	0.13	0.39	1314
Panel C: Distribution across countries						
Austria	0.25	-0.23	0.08	-0.14	0.39	652
Belgium	0.50	-0.09	0.01	-0.08	0.58	1287
Finland	0.62	0.05	0.02	0.06	0.56	1379
France	0.62	-0.06	0.05	-0.01	0.62	5928
Germany	0.58	-0.04	0.03	-0.01	0.59	7350
Greece	0.59	0.01	0.12	0.12	0.47	577
Ireland	0.58	-0.13	0.03	-0.10	0.68	415
Italy	0.46	0.00	0.04	0.04	0.42	1993
Luxembourg	0.29	-0.47	0.16	-0.31	0.60	121
Netherlands	0.74	0.02	0.08	0.09	0.65	2118
Portugal	0.31	-0.19	0.24	0.06	0.25	582
Spain	0.56	0.04	0.04	0.09	0.48	1129
Switzerland	0.55	-0.04	0.00	-0.04	0.59	2253
UK	0.87	0.20	0.01	0.22	0.65	4662

Note. The decomposition of the market-to-book ratio in its fundamental and non-fundamental component follows Rhodes-Kropf, Robinson and Viswanathan (2005) and is similar to Li, Henry and Chou (2011). The description herein is therefore restricted. We specifically estimate the following industry-year regression and subsequently capture the point estimates:

$$\ln(MV_{it}) = \alpha_{0jt} + \alpha_{1jt}\ln(BV_{it}) + \alpha_{2jt}\ln(NI_{it}^{+}) + \alpha_{3jt}I_{(<0)}\ln(NI_{it}^{+}) + \alpha_{4jt}\ln(LEV_{it}) + \varepsilon_{it} \quad \text{(A.1)}$$

$$mQ = \frac{m_{it} - \hat{m}_{it}}{TA_{it}} \text{ and } mQ = \frac{Debt_{it} + \hat{m}_{it}}{TA_{it}} \quad \text{(A.2)}$$

Lower case letter denote the natural logarithm of a focal variable. Thus, *m* stands for the log of market value. MV = market value; BV = book value; NI^{+} = positive net income while I is an indicator variable suggesting negativity of net income and LEV is leverage as defined in Table 3 (ratio of total debt-to-assets). The non-fundamental component (*mQ*) is the difference between the market value and the fitted value, divided by firm's total assets. In contrast, the fundamental component (*fQ*) which tracks long-run growth options is the sum of book value of debt and fitted market value, divided by firm's total assets.

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