# Corporate Strategy, Conformism, and the Stock Market*

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**Abstract**

We show that imitation of other public firms' strategies can increase the value of a firm because it enhances its manager's ability to obtain information from stock prices and thereby the efficiency of its investment decisions. This conformity effect is stronger for private firms because their managers can learn information from stock prices only if they imitate other public firms' strategies (since they cannot learn their own stock price). As predicted, we find that firms differentiate their products more after going public and this pattern is stronger for firms with better informed managers or less informative peers' stock prices.

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# 1 Introduction

An important function of financial markets is to produce information, reflected in asset prices. Decision makers (e.g., firms' managers, capital providers, regulators, central bankers, or consumers) can then use these prices, in addition to their own signals, as a source of information. This "active informant" role of the stock market (Morck, Shleifer, and Vishny (1990)) implies that informational efficiency matters for real efficiency.[1]

Theoretical and empirical research on this topic has focused on whether and how stock prices influence real decisions (see Bond, Edmans, and Goldstein (2012) for a survey). This influence materializes *ex-post*, i.e., once stock prices are observed. In contrast, little attention has been paid to *ex-ante* effects of the informant role of stock markets. Intuitively, it incentivizes managers to take actions to enhance their stock price informativeness. These actions are not directly influenced by stock prices but they can also have real effects. In particular, we show that a manager might optimally imitate other public firms' strategies because this behavior (conformism) enhances his firm's stock price informativeness. We also show that the evolution of firms' differentiation choices after they go public is consistent with this mechanism.

The economic intuition for this result is as follows. When a manager imitates other firms' strategies, he increases the correlation between the cash-flows of his growth options with those of other firms. This effect increases the informativeness of his own stock price about his growth options because it enables market makers in his stock to use trades in other stocks (or their prices) as a source of information (as explained in more detail below).[2] Accordingly, differentiation has an informational cost: It weakens a firm's own stock price informativeness and thereby its manager's ability to efficiently exercise his growth options. This cost increases firms' incentives to imitate the strategy of other firms.

We formalize this intuition in a model where, at date 1, the manager of a firm chooses one of two strategies: A common strategy already followed by several established public firms, or a unique strategy. Subsequently (at date 3), the manager has the option to implement

[1] For instance, Fama and Miller (1972), p.335 writes: "*An efficient market has a very desirable feature. In particular, at any point in time market prices of securities provide accurate signals for resource allocation; that is firms can make production-investment decisions.*"

[2] See Pasquariello and Vega (2015) for evidence of cross stock learning by market makers.

his strategy, at a cost, or to abandon it at zero cost. The payoff of this "growth" option is strategy-specific and uncertain. It depends on whether the strategy chosen by the manager is good or bad (e.g., on whether the demand for the firm's product will be strong or weak). The type of a strategy is unknown at date 1. A good unique strategy yields a larger cash flow than a good common strategy (e.g., because the firm enjoys more market power) and has therefore a larger net present value. However, a bad strategy has a negative net present value. When he decides to exercise or not his growth option, the manager uses information about the type of his strategy collected between dates 1 and 3, namely his own private information and his stock price realized at date 2.

As in Kyle (1985), stock prices in our model are set by risk neutral market makers who absorb the order flow (the net buys and sells orders from informed speculators and liquidity traders) in each stock. The market maker in the stock of a firm following the common strategy learns information about the value of this stock (i.e., the type of the common strategy) from observing order flows in *all* stocks of firms following the same strategy (cross-asset learning). As a result, the informativeness of the stock price of a firm following the common strategy increases with the number of firms following this strategy. In contrast, cross-asset learning is not possible for a market maker in the stock of a firm following the unique strategy: She cannot learn from trades in other stocks because these trades are only informative about a *different* strategy. Thus, even if fewer speculators choose to be informed about the common strategy (precisely because stock prices are more likely to reflect their information), the stock prices of firms following the common strategy is more informative if the number of public firms following this strategy is large enough.

In this case, when the manager relies on information in his own stock price, he accounts for the fact that choosing the common strategy enhances the precision of the information conveyed by his stock price and therefore the efficiency of his decision to exercise or not his growth option. Therefore, in choosing his strategy, the manager trades off this informational benefit of the common strategy with the cash flow gain associated with the unique strategy. If the latter is not too large, the manager is better off following the common strategy. In contrast, when the manager only relies on his own private information, he always chooses the unique strategy because differentiation yields a larger cash-flow, holding the type of strategies equal.

In sum, the common strategy – *conformity* – is a way for the manager to bolster up the informativeness of his stock price, and thereby the value of his growth options, given that he relies on stock price information.[3] This "conformity effect" is stronger when the informational cost of the unique strategy is greater; for instance, when the number of speculators producing information about the unique strategy is smaller. Thus, the conformity effect is stronger for a private firm because there is no secondary market for its shares and therefore no informed trading in a private firm stock. Accordingly, other things equal, a private firm in our model is less likely to choose the unique strategy than a public firm because it can only learn information from stock prices by adopting the same strategy as other publicly listed firms.

The going-public decision of a firm should therefore be associated with an *increase* in the uniqueness of its strategy in the years following its Initial Public Offering (IPO).[4] We test this prediction using a sample of 1,231 U.S. firms that go public between 1996 and 2011. We measure the uniqueness of the strategy chosen by a firm using the level of differentiation of its product offering relative to that of related (peer) firms. We identify the set of peers for each newly public firm at the time of its IPO using Hoberg and Philipps (2015)'s Text-Based Network Industry Classification (TNIC). For every pair of firms, Hoberg and Phillips (2015) define an index of product similarity based on the relative number of words that firm-pairs share in their 10-Ks' product description. We use (one minus) this index as a proxy for the level of product differentiation between each firm-pair.

For each going-public firm, we track (over five years after its IPO) the change in its differentiation vis-à-vis each of its "established" peers at the time of the IPO (i.e., peers listed for more than five years). To better separate effects specific to the ownership status

[3]In general, the literature on real options has not considered how managers could affect information available to them when they consider exercising their real options. One exception is Bernardo and Chowdry (2001). However, they do not consider the possibility for managers to obtain information from stock prices, which is critical for our findings.

[4]Some papers (e.g., Maksimovic and Pichler (2001), Spiegel and Tookes (2009), or Chod and Lyandres (2011)) analyze the effects of IPOs on competitive interactions in product markets. However, this literature has not considered how differentiation choices change after a firm goes public. For instance, Chod and Lyandres (2011) shows that newly-public firms compete more aggressively with their rivals after going public because their owners can better diversify idiosyncratic risks in capital markets. Their analysis and tests assume that industry definition – and the extent of differentiation among firms – is fixed before and after the IPOs.

of the firm (private/public) from those due to a general trend in differentiation or changes in peers' product choices, we construct counterfactual firm-pairs made of the peers of peers of the IPO firm $i$ that *are not* peers of firm $i$. Consistent with our prediction, we observe that going-public firms become significantly *more* differentiated in the years following their initial public listing. In particular, the average degree of product differentiation between a newly-public firm and an established peer increases at a faster rate than that observed for counterfactual pairs.[5]

Our model further suggests that the weakening of the conformity effect – the increased differentiation – following an IPO should be larger for firms whose informational cost of differentiation is smaller, that is, IPO firms with better privately informed managers or IPO firms with less informative peers' stock prices. We also find empirical support for these cross-sectional predictions. First, the increase in product differentiation is larger for IPO firms whose managers are *a priori* better informed, as measured using the intensity and profitability of insider trading. Second, IPO firms whose established peers' stock prices are *less* informative (as proxied by the PIN measure, the forecasting ability of prices, the size of price reactions to earnings surprises, and analysts' coverage) differentiate at a faster pace after their floatation.

We recognize that the observed increase in product differentiation post-IPO could be consistent with alternative explanations. Variables omitted from our specifications could jointly explain the association between the going-public decision, sources of information for managers, and differentiation. In particular, easier access to external funding for newly public firms could enable them to finance more innovative projects and lead to more differentiation post-IPO. Yet, our results persist after controlling for variables capturing innovation and ease of access to financing. Of course, other mechanisms might still explain our findings. They will have however to explain why differentiation post-IPOs is sensitive to managerial information and stock price informativeness as found in our cross-sectional tests and predicted by our theory.

Our paper contributes to the literature on the effect of asset prices on real decisions,

[5] This result is obtained controlling for (i) firm-pair fixed-effects, i.e., any time-invariant differences within pairs (e.g., differences in age or geographical location), and (ii) time-varying control variables that could affect the evolution of firms' differentiation choices over time (e.g., size, growth opportunities, or access to capital).

the so called feedback effect (see Bond, Edmans, and Goldstein (2012) for a survey). This literature has mostly focused on how decisions at a given point in time (e.g., an investment, asset sales, or acquisition decision by a firm) are determined by the information content of lagged asset prices.[6] In contrast, we study how managers can *ex-ante* influence their stock price informativeness in anticipation of future decisions.[7] Very few papers consider this possibility.[8] To our knowledge, our paper is first to propose that managers have an incentive to imitate other firms to strengthen the informativeness of their stock price.[9]

Our paper also adds to the literature on interactions between financial and product market decisions. Models analyzing this interplay (e.g., Titman (1984), Brander and Lewis (1986), Maksimovic (1988), or Bolton and Scharfstein (1990)) do not consider the information produced by secondary financial markets, nor its effect on firms' product market strategies. Similarly, the research on the links between product market characteristics and asset prices typically take the structure and intensity of competition in product markets as given and analyze how competition influences stock returns (e.g., Hou and Robinson (2006), or Bustamante (2015)), or informed investors' trading decisions and stock price informativeness (e.g., Tookes (2008), or Peress (2010)). Our analysis implies that product market structures and stock price informativeness are in fact jointly determined when managers learn from stock prices.

Finally, our analysis contributes to the vast theoretical and empirical literature on con-

[6] See, for instance, empirical and theoretical works by Morck, Shleifer, and Vishny (1990), Dow and Gorton (1997), Luo (2005), Chen, Goldstein, and Jiang (2007), Edmans, Goldstein, and Jiang (2012), Foucault and Frésard (2012), Edmans, Goldstein, and Jiang (2015), or Dow, Goldstein, and Guembel (2015).

[7] There is evidence that managers take actions to shape endogenous characteristics of their stocks. In particular, Balakrishnan et al.(2014) show empirically that firms actively seek to influence the liquidity of their stock by voluntarily disclosing more information than what is required by regulation.

[8] Subrahmanyam and Titman (1998) and Foucault and Gehrig (2008) are exceptions but they consider changes in the firm's financial environment rather than product markets' changes as a way to influence stock price informativeness. In Subrahmanyam and Titman (1998), a firm's manager goes public because, once public, he can learn information from his stock price. In Foucault and Gehrig (2008), a firm's manager cross-lists because the stock price of cross-listed firms is more informative. In either case, the manager's decision (going public or a dual-listing) raises firm value because it allows managers to make better informed investment decisions. This feature is absent from other models in which managers enhance price efficiency through disclosures (e.g., Fishman and Hagerty (1989), security design (e.g., Boot and Thakor (1993)), or overinvestment (Strobl (2014)).

[9] Foucault and Frésard (2014) and Huang and Zeng (2015) consider models in which firms learn information from their own stock price and the stock price of their competitors because firms' cash-flows are correlated. However, they take as given the correlation in firms' cash-flows (i.e., the risk factors to which firms choose to be exposed). In contrast, in our model, this correlation is endogenous.

formism in managerial decisions (see Lieberman and Asaba (2006) for a review). The economic literature on this topic attributes conformism to reputation concerns (e.g., Scharfstein and Stein (1990)), information cascades and herding behaviors (e.g., Bikhchandani, Hirshleifer, and Welch (1992)), or correlated signals among decision makers. In our model, conformism arises for a different reason: Strategic conformity enhances the value of a firm's growth options because it enables managers to extract more informative signals from stock prices.

The rest of the paper is organized as follows. In the next section, we describe the model. In Section 3, we show that imitation of other firms' strategies can enhance the value of a public firm because it makes its stock price more informative for his manager. We also consider the case of a private firm and show that the value of imitation is stronger when a firm is private. We present the data used to test this prediction in Section 4. Section 5 reports the empirical findings and Section 6 concludes. The appendix contains the proofs for the theoretical part of the paper. The online appendix, available on the authors' websites, contains additional theoretical and empirical results.

# 2 Model

The model has four dates $t \in \{1, 2, 3, 4\}$. Figure 1 describes the timing of events.

**[Insert Figure 1 about here]**

At date 1, the manager of firm $A$ ("the entrant") chooses a "strategy" $S_A$. Two strategies are possible: A unique strategy, $S_{\mathrm{u}}$, or a common strategy, $S_c$ – already chosen by $n$ other public firms ("the incumbents"). Each strategy can be Good ($G$) or Bad ($B$) with equal probabilities.[10] We denote the type of strategy $S \in \{S_{\mathrm{u}}, S_{\mathrm{c}}\}$ by $t_S \in \{G, B\}$. The types of these strategies are independent and unknown at date 1. The type of a firm's strategy determines its cash flow at date 4 (see below).

At date 2, investors can buy or sell shares of firms' stocks after receiving information about the type of their strategies (see below). In the baseline model, we assume that all

[10] We assume that no firm has yet chosen the unique strategy. This is not key for the conclusions, however. Our results only require the number of incumbent firms following the unique strategy to be smaller than the number incumbent firms following the common strategy.

firms, including $A$, are publicly listed. In Section 3.3, we consider the case in which firm $A$ is privately owned.

At date 3, after observing stock prices and receiving additional information, the manager of firm $A$ has the option to pursue his strategy or to abandon it.[11] Abandonment has no cost and yields a payoff of zero. If, instead, the manager proceeds with his strategy, firm $A$ must invest an indivisible amount normalized to one. For incumbents, this irreversible investment has already been sunk.

We denote the manager's decision at date 3 by $I \in \{1, 0\}$ where $I = 0$ if he abandons his strategy and $I = 1$ otherwise. Moreover, we denote by $m(S, S_A, I)$ the number of firms following strategy $S$ after firm $A$ has made its decision, $I$, at date 3. For instance, if $S_A = S_c$, we have $m(S_c, S_c, 1) = n + 1$ and $m(S_c, S_c, 0) = n$. In any case, $m(S_u, S_c, I) = 0$. Similarly, if $S_A = S_u$, we have $m(S_u, S_u, 1) = 1$, $m(S_u, S_u, 0) = 0$, and $m(S_c, S_u, I) = n$. To simplify notations, we often use the shorthand $m_{S.I}$ to denote the number of firms following strategy $S$ when the manager's decision at date 3 is $I$ (keeping in mind that this number depends on the strategy chosen by firm $A$).

Firm $A$ faces no financing constraints and there is no agency problem so that, at any date, the manager makes the decision that maximizes firm value. We now describe in more detail our assumptions on the firms' cash flows and the actions taking place at the various dates. For expositional clarity, it is easier to proceed backward, starting from the date at which cash flows are realized.

**Firms' Cash Flows (t=4).** If $I = 0$, the cash flow of firm $A$ at date 4 is zero. If $I = 1$, its cash flow depends on the type of firm $A$'s strategy. Specifically, in this case, this cash flow is $r(S_A, m_{S_A.1}, G) = \overline{r}(S_A, m_{S_A.1}) + \sigma_{S_A}$ if it is good and $r(S_A, m_{S_A.1}, B) = \overline{r}(S_A, m_{S_A.1}) - \sigma_{S_A}$ if it is bad. Similarly, the cash-flow of incumbent firms at date 4 is $r(S_c, m_{S_c.I}, G) = \overline{r}(S_c, m_{S_c.I}) + \sigma_{S_c}$ if the common strategy is good and $r(S_c, m_{S_c.I}, B) = \overline{r}(S_c, m_{S_c.I}) - \sigma_{S_c}$ if it is bad. Thus, if $I = 1$, incumbents and firm $A$ have the same final cash flow if they have the same strategy.

[11] One should interpret firm $A$'s real option at date 3 as an option to scale up or not its initial investment associated with the choice of a strategy. To simplify notations, we have set this initial investment to zero. We assume that the cost of switching from one strategy to the other at date 3 is high enough so that switching is never optimal. This is a reasonable assumption when investments are strategy specific.

We make two assumptions on firms' cash flows. First, the cash flow of the unique strategy is higher than that of the common strategy, holding the types of both strategies equal. That is:

$$\text{A.1: } r(S_u, 1, t_{S_u}) > r(S_c, n+1, t_{S_c}), \text{ when } t_{S_u} = t_{S_c}. \tag{1}$$

This assumption captures the notion that differentiation can increase a firm's profit because it softens competition (see, for instance, Tirole (1990), Chapter 7 or Sutton (1991)). Moreover, we assume that

$$\text{A.2: } r(S_c, n, G) > r(S_c, n+1, G) > \ r(S_c, n, B) > r(S_c, n+1, B),$$

which is equivalent to $0 < \overline{r}(S_c, n) - \overline{r}(S_c, n+1) < 2\sigma_c$. This means that the entry of firm $A$ has a negligible effect on incumbents' average cash-flow relative to the volatility of this cash-flow. This is a reasonable assumption if firm $A$ is small. Assumption A.4 can be relaxed. However, when $r(S_c, n+1, G) < r(S_c, n, B)$, the expression for equilibrium stock prices at date 2 is slightly different. We therefore skip the analysis of this case for brevity. We also assume that the smallest possible cash flow of an incumbent is strictly positive (i.e., $r(S_c, n+1, B) > 0$). This implies that even if the common strategy is bad, there is no incentive for incumbents to abandon their strategy because the cost of implementing this strategy is already sunk.

**The Exercise of the Growth Option (t=3).** At date 3, the manager of firm $A$ has three sources of information. First, he privately observes a signal $s_m \in \{t_S, \varnothing\}$ about the type of his strategy. Specifically, $s_m = t_S$ with probability $\gamma > 0$ or $s_m = \varnothing$ with probability $(1-\gamma)$, where $\varnothing$ is the null signal corresponding to no signal. We refer to $s_m$ as "managerial information." Second, the manager of firm $A$ observes the stock prices of established firms, denoted by $p_{j2}$ for $j \in \{1, ..., n\}$. Finally, the manager of firm $A$ observes his own firm's stock price, $p_{A2}$. Hence, the manager's information set at date 3 is: $\Omega_3 = \{p_{12}, .., p_{n2}, p_{A2}, s_m\}$.

Let $\text{NPV}(S_A, m_{S_A.1}, t_{S_A}) = r(S, m_{S_A.1}, t_{S_A}) - 1$ be the realized net present value of firm $A$ if the manager pursues his strategy at date 3 and the type of this strategy is $t_{S_A}$. At date

3, for a given decision $I$, the expected value of firm $A$ is

$$V_{A3}(I, S_A) = I \times \mathrm{E}(\mathrm{NPV}(S_A, m_{S_A.1})\,|\Omega_3), \tag{2}$$

where $\Omega_3 = \{p_{12}, .., p_{n2}, p_{A2}, s_m\}$ is the manager's information set at date 3. At this date, the manager of firm $A$ chooses $I$ to maximize $V_{A3}(I, S_A)$ and we denote by $I^*(\Omega_3, S_A)$ his optimal choice at date 3. It immediately follows from eq.(2) that $I^*(\Omega_3, S_A) = 1$ if, conditional on the information available at date 3, the expected net present value of the strategy of firm $A$ is positive, and $I^*(\Omega_3, S_A) = 0$ otherwise. Hence, the expected value of firm $A$ at date 3 is:

$$V_{A3}(I^*, S_A) = \mathrm{Max}\{0, \mathrm{E}(\mathrm{NPV}(S_A, m_{S_A.1})\,|\Omega_3)\}. \tag{3}$$

**The Stock Market (t=2).** At date 2, investors can buy or sell shares of all firms in the stock market. There are three types of investors: (i) a continuum of risk-neutral speculators, (ii) liquidity traders with an aggregate demand $z_j$, uniformly and independently distributed over $[-1, 1]$, for firm $j$, and (iii) risk neutral market makers. A mass $\pi_c$ of speculators produces information about strategy $S_c$ and learns its type perfectly. Remaining speculators have no information about strategy $S_c$. Similarly, if firm $A$ chooses the unique strategy, a mass $\pi_u$ of speculators produces information about this strategy and learns its type perfectly. We take $\pi_c$ and $\pi_u$ as given. However, we show in Corollary 2 that the main force behind our findings is unchanged when $\pi_c$ and $\pi_u$ are endogenous.

Let $\widehat{s}_i(S) \in \{G, B, \varnothing\}$ be the signal received by speculator $i$ about strategy $S$, where $\widehat{s}_i(S) = \varnothing$ means that the speculator has no information. After receiving her signal, each speculator can buy or sell at most one share of each stock (e.g., due to wealth constraints).[12] We denote by $x_{ij}(\widehat{s}_i(S_j)) \in [-1, +1]$ the demand of speculator $i$ for shares of firm $j$ following strategy $S_j$ given her signal about this strategy. The order flow, $f_j$ – the sum of speculators and liquidity traders' demand – for stock $j$ is:

$$f_j = z_j + x_j, \tag{4}$$

[12] As there is a continuum of speculators, each speculator behaves competitively in choosing its decision to buy or sell one share, as in Foucault and Fresard (2014) or Dow, Goldstein, and Guembel (2015).

where $x_j = \int_0^1 x_{ij}(\widehat{s}_i(S_j))di$ is speculators' aggregate demand of stock $j$.

As in Kyle (1985), the order flow in each stock is absorbed by risk neutral market makers at a price equal to their valuation for the stock, i.e., its expected payoff given all available public information at date 2. Thus, stock prices at date 2 are:

$$p_{A2} = \mathrm{E}(V_{A3}(I^*(\Omega_3, S_A), S_A) \mid \Omega_2), \tag{5}$$

and,

$$p_{j2} = \mathrm{E}(r(S_c, m_{S_c.I}, t_{S_c}) \mid \Omega_2) \text{ for } j \in \{1, .., n\}. \tag{6}$$

We assume that market makers observe the order flow in each stock before setting their price, i.e., $\Omega_2 = \{f_1, ..., f_n, f_A\}$. Thus, a market maker specialized in a stock can learn information from the order flows of other stocks. We refer to this possibility as "cross asset learning" (see Pasquariello and Vega (2015) for evidence of cross asset learning by market makers). This assumption is natural because managers make their decisions at low frequency. Thus, by the time at which managers make their decisions, stock prices are likely to reflect all order flow information.

Consequently the stock price of firm $A$ is a sufficient statistic for the information contained in the order flows of all stocks about the type of the strategy followed by firm $A$. Thus, at date 3, the manager's decision will only depend on his own stock price in equilibrium. Alternatively, we could assume that market makers can condition their price only on the order flow in their stock (no cross asset learning). In this case, the manager optimally condition his decision at date 3 on *all* stock prices (as in the case in which firm $A$ is private; see Section 3.3). This does not change the implications of the model (as the analysis of Section 3.3 shows). The reason, intuitively, is that cross-asset learning is then performed by the manager rather than market makers.

**Stock Market Equilibrium.** The stock price of firm $A$ directly depends on its manager's decision at date 3, $I^*(\Omega_3, S_A)$. The stock prices of incumbents also depend on this decision when firm $A$ chooses the common strategy because it affects the number of their competitors ($n$ or $n+1$) and thereby their cash flow. In turn, the manager's optimal decision at date 3 itself depends on stock prices. Thus, in equilibrium, the manager's optimal decision, $I^*(\Omega_3, S_A)$, and the stock prices of *all* firms are *jointly* determined, as usual in models with feedback effects of stock prices on decision makers' choices.

Formally, we define a stock market equilibrium as a set of (i) trading strategies, $x^*_{ij}(\cdot)$, for each speculator in each firm, (ii) stock prices $p^*_{j2}(\cdot)$ for $j \in \{1, ..., n, A\}$, and (iii) a decision rule $I^*(\cdot)$ for the manager of firm $A$ such that (i) the trading strategy of speculator $i$, $x^*_{ij}(\cdot)$, maximizes her expected profit given other speculators' trading strategies, stock prices $p^*_{j2}(\cdot)$, and firm $A$'s decision rule, (ii) the decision rule $I^*(\cdot)$ maximizes the expected value of firm $A$, $V_{A3}(I, S)$, at date 3, given the information contained in stock prices, and (iii) stock prices satisfy (5) and (6) given that speculators and the manager behave according to $x^*_{ij}(\cdot)$, and $I^*(\cdot)$. Last, market makers and the manager of firm $A$ update their beliefs about the type of firms' strategies according to Bayes rule.

**The Optimal Strategic Choice (t=1).** At date 1, the manager chooses the strategy, $S^*_A$ that maximizes the value of firm A at this date, $V_{A1}(S_A)$. We deduce from eq.(3) that this value is

$$V_{A1}(S_A) = \mathrm{E}(V_{A3}(I^*, S_A)) = \mathrm{E}(\mathrm{Max}\{0, \mathrm{E}(\mathrm{NPV}(S_A, m_{S_A.1})\,|\Omega_3\,)\}). \tag{7}$$

Importantly, in choosing $S_A$, the manager of firm $A$ accounts for the effect of his strategic choice on the information that he will be able to obtain at date 3 from stock prices because these prices are part of $\Omega_3$.

For the problem to be interesting, we make two additional assumptions on the net present value of pursuing its strategy at date 3 for firm $A$. First, we assume that this net present value is positive if and only if the strategy is good, that is,

$$\text{A.3: } \mathrm{NPV}(S_A, m_{S_A.1}, B) < 0 < \mathrm{NPV}(S_A, m_{S_A.1}, G) \text{ for } S_A \in \{S_u, S_c\}.$$

This assumption has two implications. First, a good common strategy dominates a bad unique strategy. This reflects the fact that product differentiation cannot generate revenues if it does not cater to consumers' taste. Thus, the choice between the unique and the common strategy is not trivial. Second, the manager's flexibility to ramp up or not his strategy at date 3 has value. Indeed, if A.2 is not satisfied, the manager's optimal decision at date 3 is either to always abandon his strategy or to always pursue it, whatever his date 3 belief about the type of this strategy. In either case, his real option at date 3 has no value because the expected value of the firm at date 1 is identical whether the firm has this option or not.[13]

We also assume that in the absence of information at date 3, the *expected* net present value of pursuing its strategy is negative for firm $A$, that is,

$$\text{A.4} : \text{E}(\text{NPV}(S_A, m_{S_A.1}, t_{S_A})) = \overline{r}(S_A, m_{S_A.1}) - 1 < 0 \text{ for } S_A \in \{S_u, S_c\}. \quad (8)$$

Thus, the manager's optimal decision at date 3 is to abandon his strategy ($I^* = 0$) if he obtains no information at date 3 (either because he receives no private signal or because stock prices are uninformative). If instead $\text{E}(\text{NPV}(S_A, m_{S_A}, t_{S_A})) > 0$, the manager would optimally pursues his strategy when he has no information. This affects the expression of stock prices at date 2 without affecting the implications of the model. Thus, we skip the analysis of this case for brevity.

# 3 The stock market and strategic conformity

## 3.1 Benchmark: the manager learns no information from stock prices

As a benchmark, consider the case in which the manager only relies on his private information. In this case, he pursues his strategy at date 3 if his private signal indicates that the strategy is good and does nothing otherwise because, unconditionally, the expected net present value of either strategy is negative (A.4). Hence, the expected value of firm $A$ at date 1 is:

$$V_{A1}^{benchmark}(S_A) = \frac{\gamma}{2}(r(S_A, m(S_A, S_A, 1), G) - 1).$$

[13]Moreover, if A.2 is not satisfied, the manager of firm $A$ either does nothing or chooses the unique strategy for all parameter values. Indeed, if the firm chooses the unique strategy, its expected value at date 1 is then $Max\{\overline{r}(S_u, 1) - 1, 0\}$ (since the firm can anyway abandon the strategy at date 3 if $\overline{r}(S_u, 1) - 1 < 0$). If it chooses the common strategy, its expected value is $Max\{\overline{r}(S_c, n+1) - 1, 0\}$. Thus, if differentiation yields a larger cash flow on average, i.e., $\overline{r}(S_u, 1) > \overline{r}(S_c, n+1)$ (a reasonable assumption since differentiation softens competition), choosing the unique strategy always dominates the common strategy.

We deduce that:

$$\frac{V_{A1}^{benchmark}(S_u)}{V_{A1}^{benchmark}(S_c)} = \lambda(n) \overset{def}{=} \frac{(r(S_u, 1, G)) - 1}{(r(S_c, n+1, G)) - 1} > 1, \tag{9}$$

where the last inequality follows from A.1.

We refer to the ratio $\lambda(n)$ as the "cash flow gain of differentiation" for firm $A$. This ratio plays an important role in the rest of the analysis. As $\lambda(n) > 1$, we deduce the following result from eq.(9).

**Proposition 1** *: (Benchmark) When the manager of firm A only relies on his private information, he optimally chooses the unique strategy.*

We have assumed that the manager has the same probability of obtaining private information about each strategy ($\gamma$) and that each strategy has the same probability ($\frac{1}{2}$) of being good. In the benchmark case, one could obtain that the manager chooses the common strategy if (i) he is more likely to be privately informed about the common strategy, or (ii) this strategy has a higher probability of being good. Our assumptions are made precisely to control for such mechanical effects. If these effects were present, the gist of our results would be unchanged, i.e., the manager is more likely to choose the common strategy when he relies on information from stock prices for his decision than when he does not (the benchmark case).

## 3.2 The conformity effect

We now consider the case in which the manager relies on stock prices as a source of information. To this end, we proceed in two steps. We first derive the equilibrium of the stock market when firm $A$ chooses the common strategy (Lemma 1) and the unique strategy (Lemma 2) and compare the informativeness of firm $A$'s stock price in each case (Corollary 1). Then, in the second step, we use these results to obtain the value of each strategy at date 1 for firm $A$ and deduce the conditions under which imitation (choosing the common strategy) maximizes firm value (Proposition 2).

Let define $p_{A2}^H(S_A) = r(S_A, m_{S_A.1}, G) - 1$, $p_{A2}^L(S_A) = 0$, and $p_{A2}^M(S_A) = V_{A1}^{benchmark}(S_A)$.

Similarly, let define $p_{c2}^{H}(n) = r(S_c, n, G)$ and $p_{c2}^{L}(n) = r(S_c, n, B)$. Moreover, let $f_{\max} = Max\{f_1, ..., f_n, f_A\}$ and $f_{\min} = Min\{f_1, ..., f_n, f_A\}$.

**Lemma 1** *: When firm A chooses the common strategy and $\pi_c \in (0,1)$, the stock market equilibrium is:*

1. *Speculator i buys one share of firm $j \in \{1, .., n, A\}$ if $\widehat{s}_{ij}(S_c) = G$, sells one share of firm j if $\widehat{s}_{ij}(S_c) = B$, and does not trade otherwise.*

2. *The stock price of an incumbent firm is (i) $p_{j2} = p_{c2}^{H}(n+1)$ if $f_{\max} > (1-\pi_c)$, (ii) $p_{j2} = \frac{\gamma}{2} p_{c2}^{H}(n+1) + (1-\frac{\gamma}{2}) p_{c2}^{L}(n)$ if $f_{\max} \leq (1-\pi_c)$ and $f_{\min} \geq -(1-\pi_c)$, and (iii) $p_{j2} = p_{c2}^{L}(n)$ if $f_{\min} < -(1-\pi_c)$.*

3. *The stock price of firm A is (i) $p_{A2}^{H}(S_c)$ if $f_{\max} > (1-\pi_c)$, (ii) $p_{A2}^{M}(S_c)$ if $f_{\max} \leq (1-\pi_c)$ and $f_{\min} \geq -(1-\pi_c)$, and (iii) $p_{A2}^{L}(S_c)$ if $f_{\min} < -(1-\pi_c)$.*

4. *If the manager of firm A receives a private signal then he follows his signal, i.e., he implements his strategy at date 3 if the signal indicates that the strategy is good and abandons it if his signal indicates that the strategy is bad. Else, the manager follows his stock price: he implements his strategy at date $t = 3$ if his stock price is $p_A^H(S_c)$ and abandons it otherwise.*

This is the unique stock market equilibrium when firm $A$ chooses the common strategy (see the online appendix).[14] In equilibrium, if she receives a signal, a speculator optimally trades the maximum possible size because she is risk neutral and too small to affect the equilibrium price. If speculators learn that the common strategy is bad, they optimally sell all stocks. Thus, conditional on the common strategy being bad, the largest possible realization of the order flow in any stock is less than than $(1-\pi_c)$ because the demand from liquidity traders cannot exceed 1. Consequently, if the order flow for one stock is higher than $(1-\pi_c)$, market makers infer that the common strategy is good and the stock price of all firms, including firm $A$, adjusts to its highest possible level (Parts 2 and 3 of Lemma

[14] Models with feedback effects often feature multiple equilibria (e.g., self-fulfilling equilibria in which stock prices do not reveal information and therefore the manager never invests). This is not the case here because $\gamma > 0$ (the manager can receive information) and the simple structure of the model (order flows are either fully revealing or completely uninformative).

1).[15] The high level for its stock price signals to the manager of firm $A$ that the common strategy is good. Accordingly, he optimally implements the common strategy (Part 4 of Lemma 1), even if he receives no private information about this strategy.

Symmetrically, a realization of the order flow less than $-(1-\pi_c)$ in one stock reveals that speculators have discovered that the common strategy is bad. Thus, the stock price of all firms adjusts to its lowest possible level. A low level for his own stock price signals to the manager of firm $A$ that the common strategy should not be pursued further.

Other realizations of the order flow (in $[-(1-\pi_c),(1-\pi_c)]$) are equally likely when the common strategy is good or when it is bad. Thus, for these realizations, market makers obtain no information from investors' trades. Consequently, stock prices, including the stock price of firm $A$, do not contain information about the type of the common strategy. Hence, in the absence of private information, the manager of firm $A$ does not pursue the common strategy because its expected net present value is negative (Assumption A.4).[16]

In sum, the stock prices of firms following the common strategy fully reveal the type of this strategy if either $f_{\max} \geq (1-\pi_c)$ (in which case market makers learn that the common strategy is good) or $f_{\min} \leq -(1-\pi_c)$ (in which case market makers learn the the common strategy is bad). Otherwise, the stock prices of firms following the common strategy do not contain information. Thus, one can measure the *informativeness* of the stock price of any firm following the common strategy (including the stock price of firm $A$ when it follows this strategy) by:

$$\overline{\pi}(n,\pi_c) = \Pr(f_{\max} \geq (1-\pi_c)) + \Pr(f_{\min} \leq -(1-\pi_c)) = 2\Pr(f_{\max} \geq (1-\pi_c)), \qquad (10)$$

where the last equality comes from the symmetry of the distribution for $f_{\max}$ and $f_{\min}$.

[15] Observe that Assumption A.2 implies that $r(S_c, n+1, G) > (1-\gamma/2)\overline{r}(S_c,n) + \gamma\overline{r}(S_c,n+1)/2 > r(S_c,n,B)$. Thus, the stock price of all incumbents is maximal when the largest realization of the order flow across all firms is greater than $(1-\pi_c)$. This is also the case for firm $A$ because $p^H_{A2}(S_c) > p^M_{A2}(S_c) > p^L_{A2}(S_A)$.

[16] If $\pi_c = 1$, order flows always reveal the type of the common strategy while if $\pi_c = 0$, order flows are always uninformative. The condition $\pi_c \in (0,1)$ in Lemma 1 excludes these uninteresting cases.

Calculations yield:[17]

$$\overline{\pi}(n, \pi_c) = 1 - (1 - \pi_c)^{n+1}. \tag{11}$$

Thus, the informativeness of the stock price of any firm following the common strategy (e.g. firm $A$ when it follows this strategy) increases with (i) $\pi_c$, the fraction of investors informed about the type of this strategy and (ii) $n$, the number of firms following the common strategy. Intuitively, cross-asset learning leverages market makers' ability to learn speculators' information about the type of the common strategy. Indeed, they can learn information from multiple ($n$) signals, i.e., the order flows of *all* stocks following this strategy. The precision of this source of information naturally increases with the number of signals, which explains why $\overline{\pi}(n, \pi_c)$ increases in $n$.

We now consider the equilibrium of the stock market when firm $A$ chooses the unique strategy. Let $f_{\max,-A} = Max\{f_1, f_2, ..., f_n\}$ and $f_{\min,-A} = Min\{f_1, f_2, ..., f_n\}$.

**Lemma 2** *: When firm $A$ chooses the unique strategy and $\pi_u \in (0, 1)$, the stock market equilibrium is:*

1. *Speculator $i$ buys one share of firm $j \in \{1, .., n, A\}$ if $\widehat{s}_i(S_j) = G$, sells one share of firm $j$ if $\widehat{s}_i(S_j) = B$, and does not trade otherwise.*

2. *The stock price of an incumbent firm is (i) $p_{j2} = p^H_{c2}(n)$ if $f_{\max,-A} > (1 - \pi_c)$, (ii) $p_{j2} = (p^H_{c2}(n) + p^L_{c2}(n))/2$ if $f_{\max,-A} \leq (1 - \pi_c)$ and $f_{\min,-A} \geq -(1 - \pi_c)$, (iii) $p_{j2} = p^L_{c2}(n)$ if $f_{\min,-A} \leq <-(1 - \pi_c)$.*

3. *The stock price of firm $A$ is (i) $p^H_A(S_u)$ if $f_A \geq (1 - \pi_u)$, (ii) $p^M_A(S_u)$ if $f_A \in (-(1 - \pi_u), (1 - \pi_u))$, and (iii) $p^L_A(S_u)$ if $f_A \leq -(1 - \pi_u)$.*

4. *If the manager of firm $A$ receives a private signal then he follows his signal: he implements his strategy at date 3 if his signal indicates that this strategy is good and abandons it if his signal indicates that the strategy is bad. Else, the manager follows*

[17] Observe that $\Pr(f_{\max} \geq (1 - \pi_c)) = 1 - \Pr(f_{\max} < (1 - \pi_c))$. According to Lemma 1, informed speculators buy stocks of firms following the common strategy when $t_{S_c} = G$. Thus, in this case, we have $f_j = z_j + \pi_c$ for all firms. We deduce that $\Pr(f_{\max} < (1 - \pi_c) | t_{S_c} = G) = (1 - \pi_c)^{n+1}$, where the last equality from the fact that the $z_j s$ are uniformly and independently distributed over $[-1, 1]$. When $t_{S_c} = B$, informed speculators sell stocks, so that $f_j = z_j - \pi_c$. Thus, the event $f_{\max} < (1 - \pi_c)$ has probability one. We deduce that $\Pr(f_{\max} \geq (1 - \pi_c)) = 1 - \Pr(f_{\max} < (1 - \pi_c)) = (1 - (1 - \pi_c)^{n+1})/2$.

*his stock price: he implements his strategy at date $t = 2$ if his stock price is $p_A^H(S_u)$ and abandons it otherwise.*

The equilibrium is qualitatively similar to that obtained when firm $A$ chooses the common strategy and again it is unique. The only important difference is that when firm $A$ chooses the unique strategy, market makers in firm $A$ cannot learn information from trades in incumbents' stocks. Thus, the stock price of firm $A$ only depends on the order flow in its market and its informativeness is measured by $\pi_u$. Comparing $\overline{\pi}(n, \pi_c)$ and $\pi_u$, we obtain the following corollary.

**Corollary 1** *(Imitation enhances stock price informativeness) In equilibrium, the stock price of firm $A$ is more informative about the type of its strategy when it chooses the common strategy instead of the unique strategy (i.e., $\overline{\pi}(n, \pi_c) > \pi_u$) if and only if $n \geq \left(\frac{\ln(1-\pi_u)}{\ln(1-\pi_c)} - 1\right)$.*

Thus, the choice of his strategy by the manager of firm $A$ influences the informativeness of his stock price at date 2. In particular, even if $\pi_c < \pi_u$, there always exists a threshold such that if the number of incumbents, $n$, exceeds this threshold then the stock price of firm $A$ will be more informative about its strategy if it imitates incumbent firms, i.e., if it chooses the common strategy. As explained previously, this result is due to the fact that, as $n$ increases, market makers in stocks of firms following the common strategy obtain an increasingly precise signal about the type of this strategy from order flows (thanks to cross asset learning).

Figure 2 illustrates this point and Corollary 1 for specific parameter values: $\pi_c = 10\%$ and $\pi_u = 30\%$. For these parameters, if $n \geq 3$, the stock price of firm $A$ is more informative for his manager when firm $A$ follows the common strategy, even though the fraction of informed investors about this strategy is smaller ($\pi_c < \pi_u$). Moreover the gap in price informativeness between the two strategies quickly becomes large as $n$ increases (for $n = 10$, we have $\overline{\pi} \approx 68\%$).

**[Insert Figure 2 about here]**

We now derive the value of firm $A$ at date 1 for each possible strategy. We first consider the case in which firm $A$ chooses the common strategy. From the last part of Lemma 1, we deduce that the manager of firm $A$ will pursue its strategy at date 3 if and only if (i) he learns privately that the strategy is good or (ii) he has no private information but his stock price is high (equal to $p_A^H$). The likelihood of the first event is $\gamma/2$ while the likelihood of the second is $(1-\gamma)\overline{\pi}(n, \pi_c)/2$.[18] We deduce that the expected value of firm $A$ at date 1 is:

$$V_{A1}(S_c) = \frac{(\gamma + (1-\gamma)\overline{\pi}(n, \pi_c))}{2}(r(S_c, n+1, G) - 1), \tag{12}$$

when the firm follows the common strategy. Following a similar reasoning, we deduce from the last part of Lemma 2 that the value of firm $A$ at date 1 when it chooses the unique strategy is

$$V_{A1}(S_u) = \frac{(\gamma + (1-\gamma)\pi_u)}{2}(r(S_u, 1, G) - 1). \tag{13}$$

For a given strategy, the value of firm $A$ at date 1 is higher when its manager relies on information in his stock price than when he ignores it: $V_{A1}(S_A) \geq V_{A1}^{benchmark}(S_A)$ for $S_A \in \{S_c, S_u\}$.[19] The reason is that information in firm $A$'s stock price complements the manager's private information and therefore enhances his ability to optimally exercise his real option at date 3. This effect is stronger when the informativeness of the stock price of firm $A$ is higher, which explains why the value of firm $A$ increases with the fraction of informed speculators ($\pi_c$ or $\pi_u$ depending on the case).

Comparing the expected value of both strategies, we obtain the next proposition, which is our main theoretical result.

**Proposition 2** *(Conformity effect): If $\pi_u < \overline{\pi}(n, \pi_c)$ then, at date 1, firm A optimally chooses the common strategy if $\lambda(n) < \widehat{\lambda}(\gamma, \pi_u, \pi_c, n)$ and it chooses the unique strategy if $\lambda(n) > \widehat{\lambda}(\gamma, \pi_u, \pi_c, n)$, where $\widehat{\lambda}(\gamma, \pi_u, \pi_c, n) = \frac{\gamma+(1-\gamma)\overline{\pi}(n,\pi_c)}{\gamma+(1-\gamma)\pi_u} > 1$. If $\pi_u > \overline{\pi}(n, \pi_c)$ then firm A always chooses the unique strategy.*

Thus, there is a set of values for the parameters ($\pi_u < \overline{\pi}(n, \pi_c)$ and $\lambda(n) < \widehat{\lambda}(\gamma, \pi_u, \pi_c, n)$)

[18] Indeed, the probability that the manager has no information is $(1-\gamma)$ and the probability that the stock price of firm $A$ is high is the probability that the largest realization of the order flow in all stocks exceeds $(1-\pi_c)$ (last part of Lemma 1). It follows from Footnote 17 that the probability of this event is $\overline{\pi}(n, \pi_c)/2$.

[19] The inequality is strict if the information conveyed by firm A's stock price is useful for the manager, that is, if (i) $\gamma < 1$ (the manager is not perfectly informed) and (ii) $\pi_u$ or $\pi_c$ (depending on the case) are strictly positive (i.e., stock prices are informative).

such that the common strategy maximizes the value of firm $A$ when the manager relies on information from stock prices while this is never the case when he ignores this information, as in the benchmark case (see Proposition 1). This shows that when the manager relies on the stock market as a source of information, the incentive to differentiate is softened. We call this the *conformity effect*.

The intuition for this result is as follows. If $\pi_u < \overline{\pi}(n, \pi_c)$, the stock price of firm $A$ is more informative for its manager if the latter follows the common strategy. In this case, the manager of firm $A$ faces the following trade-off: Differentiation yields a larger cash flow if the unique strategy is good ($\lambda(n) > 1$) but the manager receives a less accurate signal from his stock price, which lowers his ability to efficiently exercise his growth option. If $\lambda(n) < \widehat{\lambda}(\gamma, \pi_u, \pi_c, n)$, this informational cost of differentiation dominates the cash flow gain. It is then optimal for the manager to imitate incumbent firms.

The threshold $\widehat{\lambda}(\gamma, \pi_u, \pi_c, n)$ decreases with $\gamma$ and goes to one when $\gamma$ goes to one. Indeed, when the manager is better privately informed, he needs to rely less on stock prices as a source of information. Hence, the informational gain of adopting the common strategy – and therefore the conformity effect – is smaller. This informational gain is also smaller (resp., larger) when $\pi_u$ (resp., $\overline{\pi}(n, \pi_c)$) is higher, which explains why $\widehat{\lambda}(\gamma, \pi_u, \pi_c, n)$ decreases with $\pi_u$ (resp., increases with $\overline{\pi}(n, \pi_c)$). When $\gamma$ and $\pi_u$ go to zero then $\widehat{\lambda}(\gamma, \pi_u, \pi_c, n)$ become infinitely large. In this case, in stark contrast with the benchmark case, firm $A$ always chooses the common strategy.

If $\pi_u > \overline{\pi}(n, \pi_c)$, there is no informational cost to choosing the unique strategy because firm $A$'s stock price is more informative about the payoff of this strategy (conditional on firm $A$ choosing it). In this case, there is no conformity effect. However, the case $\pi_u < \overline{\pi}(n, \pi_c)$ is more plausible because $\overline{\pi}(n, \pi_c)$ quickly increases with $n$ (see Figure 2). This effect also implies that the threshold $\widehat{\lambda}(\gamma, \pi_u, \pi_c, n)$ increases with $n$. The effect of the number of incumbents on the incentive to differentiate is ambiguous, however, because the cash flow gain from differentiation might also increase with $n$.

In sum, choosing the common strategy is a way for the manager of firm $A$ to enhance firm value because it makes its stock price more informative when $n$ is large enough, as implied by Corollary 1. One concern is that this finding might not be robust when speculators optimally choose to produce information about the common or the unique strategy. Indeed, speculators earn a smaller expected profit per share in stocks in which prices are more informative. If information is costly, this effect reduces speculators' incentive to produce information about the common strategy. Hence, with endogenous information acquisition, the mass of speculators buying information about the common strategy, $\pi_c$ might decrease in $n$. To address this issue, the next corollary considers the case in which speculators optimally decide whether or not to buy information about a strategy, at cost $C$. It shows that, even in this case, the stock prices of firms following the common strategy remain more informative about the type of this strategy for $n$ large enough.[20]

**Corollary 2** : *Suppose* $0 < C < \frac{n}{2}(2\sigma_c - \gamma(\overline{r}(S_c, n) - \overline{r}(S_c, n+1))$. *In equilibrium, the informativeness of the stock market about the common strategy when firm* $A$ *follows this strategy is higher than the informativeness of the stock market about the unique strategy, i.e.,* $\overline{\pi}(n, \pi_c^*(n)) > \pi_u^*$ *if* $n \geq \overline{n}$, *where* $\pi_c^*(n)$ *and* $\pi_u^*$ *denote the equilibrium fraction of informed speculators about the common and the unique strategies, respectively and* $\overline{n}$ *is a threshold defined in the appendix.*

For brevity, the proof of this corollary is provided in the on-line appendix. Informed speculators' expected profit decreases with the mass of speculators informed about the same strategy (see the proof of Corollary 2). The equilibrium mass of speculators informed about a given strategy is such that their total expected profit is just equal to the cost of acquiring information, $C$. The condition on this cost guarantees that it is not too large so that some speculators are willing to pay it in equilibrium, at least for the common strategy. Corollary 2 only establishes that for $n$ large enough, $\overline{\pi}(n, \pi_c^*(n)) > \pi_u^*$. This does not imply that the fraction of informed speculators about the common strategy is higher than the fraction of speculators informed about the unique strategy (i.e., $\pi_c^*(n) > \pi_u^*$).[21]

[20] Corollary 2 compares the informativeness of the stock market about the common strategy when firm $A$ chooses this strategy with the informativeness of the stock market about the unique strategy when firm $A$ chooses this strategy. If firm $A$ chooses the common strategy, the stock market is uninformative about the unique strategy because no firm chooses this strategy.

[21] In general, the effect of $n$ on $\pi_c^*(n)$ is ambiguous. On the one hand, it increases the likelihood that speculators' signal about the common strategy will be revealed, which decreases their gross expected profit per stock from trading on this strategy. On the other hand, it allows speculators informed about the common strategy to trade in *more* stocks and therefore to better amortize their cost of acquisition. Which effect dominates depends on how one specifies firms' cash flows.

**Remark.** The stock price of firm $A$ at date 1 is $p_{A1} = V_{A1}(S_A)$. Hence, whether the manager of firm $A$ chooses the common or the unique strategy at date 1, we have $p^L_{A2} < p^M_{A2} < p_{A1} < p^H_{A2}$.[22] Thus, Lemmas 1 and 2 imply that the manager of firm $A$ goes on with the strategy announced at date 1 if, in reaction to this announcement, his stock price goes up ($p_{A2} - p_{A1} > 0$) and abandons it if his stock price goes down.[23]

### 3.3 The conformity effect is stronger for private firms

Intuitively, other things equal, the informational cost of differentiation should be higher for a private firm than for a public firm because the manager of a private firm can only learn information from other public firms' stock prices and it can do so only insofar that it follows their strategy (see Yan (2015) for evidence that private firms learn from public firms' stock prices). Thus, the conformity effect should be stronger for a private firm.

To formalize this intuition, suppose that firm $A$ is private. Suppose first that its manager chooses the unique strategy. In this case he cannot obtain information from his stock price and incumbent firms' stock prices (because they follow a different strategy). Thus, the manager of firm $A$ only uses his private information to exercise his growth option at date 3, as in the benchmark case. The value of firm $A$ at date 1 (denoted $V^{private}_{A1}(S_u)$) is then identical to that in the benchmark case:

$$V^{private}_{A1}(S_u) = V^{benchmark}_{A1}(S_u). \tag{14}$$

Now suppose that the manager of firm $A$ chooses the common strategy. In this case, he can learn information about his strategy from incumbent firms' stock price. If their stock price is high, the manager of firm $A$ infers that the common strategy is good and therefore

[22] Note that $p^M_{A2} < p_{A1}$. Thus, the stock price of firm $A$ drops relative to its value at date 1 even if order flows are uninformative about speculators' signal. Indeed, in this case, market makers factor in their price that the firm is less likely to pursue its strategy.

[23] A literal interpretation of the model is that managers decide whether or not to abandon their strategy right after observing the stock price reaction to the announcement of their strategy. One example is when a firm announces its acquisition of another firm and then exercises its option to proceed with this acquisition or cancel it depending on how its stock price reacts to the announcement. Luo (2005) shows empirically that a negative reaction to such an announcement increases the likelihood that a firm cancels its acquisition of a target because managers learn information from the stock price reaction, as in our model.

he goes on with the common strategy, even if he does not receive managerial information.[24] Thus, proceeding as in the case in which firm $A$ is public, we deduce that the value of firm $A$ when it is private and its manager chooses the common strategy is

$$V_{A1}^{private}(S_c) = V_{A1}(S_c) = \frac{(\gamma + (1-\gamma)\overline{\pi}_c(n-1))}{2}(r(S_c, n+1, G) - 1). \tag{15}$$

The only difference with the expression obtained when firm $A$ is public (eq.(5)) is that $\overline{\pi}(n-1, \pi_c)$ replaces $\overline{\pi}(n, \pi_c)$. The reason is that market makers in the stocks of incumbent firms cannot learn information from trades in the market of stock $A$ when it is private. Thus, when firm $A$ is private, the informativeness of the stock market about the common strategy is $\overline{\pi}_c(n-1)$.

**Proposition 3** *: When firm A is private, its manager chooses the common strategy if* $\lambda(n) < \widehat{\lambda}^{private}(\gamma, \pi_c, n)$ *and he chooses the unique strategy if* $\widehat{\lambda}^{private}(\gamma, \pi_c, n) < \lambda(n)$*, where* $\widehat{\lambda}^{private}(\gamma, \pi_c, n) = \frac{\gamma + (1-\gamma)\overline{\pi}_c(n-1)}{\gamma}$.

The manager of firm $A$ faces the same trade-off whether private or public. Thus, his behavior is identical in each case: He chooses to differentiate only if the cash flow gain from differentiation exceeds the informational cost of differentiation, that is, the manager of firm $A$ chooses the unique strategy only if $\lambda(n)$ exceeds a threshold, $\widehat{\lambda}^{private}(\gamma, \pi_c, n)$, strictly larger than one. Calculations show that $\widehat{\lambda}^{private}(\gamma, \pi_c, n) > \widehat{\lambda}(\gamma, \pi_u, \pi_c, n)$ if and only if $\pi_u > \frac{\gamma(\overline{\pi}(n,\pi_c) - \overline{\pi}(n-1,\pi_c))}{\gamma + (1-\gamma)\overline{\pi}(n-1,\pi_c)}$ when $\gamma < 1$.[25] We therefore obtain the following implication.

**Corollary 3** *: (The conformity effect is stronger for private firms). Suppose that* $\pi_u > \frac{\gamma(\overline{\pi}(n,\pi_c) - \overline{\pi}(n-1,\pi_c))}{\gamma + (1-\gamma)\overline{\pi}(n-1,\pi_c)}$ *and* $\gamma < 1$ *so that* $\widehat{\lambda}^{private}(\gamma, \pi_c, n) > \widehat{\lambda}(\gamma, \pi_u, \pi_c, n)$*. If* $\lambda(n) \in [\widehat{\lambda}(\gamma, \pi_u, \pi_c, n), \widehat{\lambda}^{private}(\gamma, \pi_c, n)]$ *then firm A chooses the common strategy if it is private and the unique strategy if it is public. Else, firm A chooses the same strategy whether public or private.*

Thus, other things equal, a public firm is more likely to choose a differentiated strategy than a private firm if $\pi_u > \frac{\gamma(\overline{\pi}(n,\pi_c) - \overline{\pi}(n-1,\pi_c))}{\gamma + (1-\gamma)\overline{\pi}(n-1,\pi_c)}$ and $\gamma < 1$. Figure 3 illustrates Corollary 3 by

[24] The equilibrium of the stock market when firm $A$ is private and chooses the common strategy is almost identical to that obtained in Lemma 1. The are only two minor differences. First, obviously, there is no trading in stock $A$. Second, the manager's decision at date 3 depends on incumbent firms' stock prices, instead of its own stock price.

[25] For $\gamma = 1$, $\widehat{\lambda}^{private}(1, \pi_c, n) = \widehat{\lambda}(1, \pi_u, \pi_c, n) = 1$ and differentiation is therefore always optimal.

showing, for specific parameter values, the optimal strategy for firm $A$ when it is public or private.

**[Insert Figure 3 about Here]**

When $\pi_u < \frac{\gamma(\overline{\pi}(n,\pi_c)-\overline{\pi}_c(n-1))}{\gamma+(1-\gamma)\overline{\pi}_c(n-1)}$ and $\gamma < 1$ then $\widehat{\lambda}^{private}(\gamma, \pi_c, n) < \widehat{\lambda}(\gamma, \pi_u, \pi_c, n)$. In this case, if $\lambda(n) \in [\widehat{\lambda}^{private}(\gamma, \pi_c, n), \widehat{\lambda}(\gamma, \pi_u, \pi_c, n)]$ firm $A$ chooses the unique strategy when private and the common strategy when public. Else, firm $A$ chooses the same strategy whether public or private. Thus, Corollary 3 is reversed: The conformity effect is stronger for public firms. However, this case requires that $\pi_u < \overline{\pi}(n, \pi_c) - \overline{\pi}(n-1, \pi_c) = (1-\pi_c)(\pi_c)^n$. As the right hand side of this condition decreases with $n$, there is a threshold $\widehat{n}(\pi_u, \pi_c)$ such that it cannot be satisfied for $n \geq \widehat{n}(\pi_u, \pi_c)$. This threshold quickly decreases with $\pi_u$ or $\pi_c$ and is equal to 1 if $\pi_u > \text{Min}\{\frac{1}{4}, 1-\pi_c\}$. Hence, Corollary 3 describes the most plausible scenario and we use it to develop a test of the model in the next section.

# 4 Testing the conformity effect

## 4.1 The logic of the test

Our model predicts that the conformity effect should be stronger for private firms (Corollary 3). Hence, we examine empirically whether a given firm is *more* differentiated when it is public than when it is private.[26] In our tests, we measure strategic differentiation with an index of *product* differentiation for each firm relative to a set of publicly listed peers, $J_A$ (the incumbent firms of our model).

Let $B$ be a firm from the set $J_A$ of peers for firm $A$ and let $\Delta_{A,B}(k_A)$ be the level of product differentiation of firm $A$ vis-à-vis $B$ when firm $A$ has ownership status $k_A \in \{private, public\}$. Finally, let $\Gamma_A$ be the *average* difference in the level of product differen-

[26] The model has additional implications. However, they are not specific to the conformity effect. For instance, the covariance between the investment of firm $A$ at date 3 and its stock price increases with $n$ when the firm follows the common strategy and is higher than that obtained when the firm follows the unique strategy for $n$ high enough (the proof of this claim is available upon request). This implies that firms' investment should be more sensitive to their stock price in more competitive industries, as found empirically by Ozoguz and Rebello (2013).

tiation between firm $A$ and its peers when firm $A$ is public and when it is private:

$$\Gamma_A = \frac{1}{n} \sum_{B \in J_A} (\Delta_{A,B}(public) - \Delta_{A,B}(private)). \tag{16}$$

Corollary 3 implies that $\Gamma_A$ is either zero or positive, depending on the cash flow gain of differentiation for $A$.

Empirically we can only measure the level of differentiation between a firm and its peers for public firms (see Section 4.2). Hence, we do not observe $\Delta_{A,B}(private)$. To overcome this problem, we look at the evolution of $\Delta_{A,B}(public)$ over time, starting from the year in which firm $A$ goes public.[27] We define the event time variable $\tau = 0, 1, ..., T$ as the public "age" of firm $A$, with $\tau = 0$ being the year of its IPO. We assume that $\Delta_{A,B}(private)$ can be proxied using the level of product differentiation between $A$ and $B$ measured at the time of firm $A$'s IPO, i.e., $\Delta_{A,B,\tau=0}(public)$. We then estimate the following equation:

$$\Delta_{A,B,\tau}(public) = \alpha_{A,B} + \eta_A \times \tau \; + \; \epsilon_{A,B,\tau} \quad \text{for all } B \in J_A, \tag{17}$$

where the coefficient $\eta_A$ measures the average change of product differentiation between firm $A$ and its set of peer firms $B$ over time. Thus, $\eta_A$ is the empirical counterpart of $\Gamma_A$ and Corollary 3 predicts that $\eta_A \geq 0$.

## 4.2 Sample construction

We estimate eq.(17) for a large number of IPO firms (firm $A$), and public firms $B$ (incumbent firms). We obtain the name, CRSP identifier, and filing date of firms going public from the IPO database assembled by Jay Ritter. We restrict our attention to the IPOs during the 1996-2011 period. The sample includes IPOs with an offer price of at least \$5.00, and excludes American Depositary Receipts (ADRs), unit offers, closed-end funds, Real Estate Investment Trusts (REITs), partnerships, small best efforts offers, and stocks not listed on Amex, NYSE or NASDAQ. We exclude financial firms (SIC codes between 6000 and 6999)

[27] This is similar to the approach in Spiegel and Tookes (2014) or Chod and Lyandres (2011) who use the evolution of market shares following a firm's IPOs to empirically capture the transition between private and public status.

and utilities (SIC codes between 4000 and 4999), firms that are listed for less than one year, and firms with missing information on total assets in COMPUSTAT.

We use the Text-Based Network Industry Classification (TNIC) developed by Hoberg and Phillips (2015) to identify peer firms of each going public firms and to measure the degree of product differentiation between pairs of firms. This classification is based on textual analysis of the product description sections of firms' 10-K (Item 1 or Item 1A) filed every year with the Securities and Exchange Commission (SEC). The classification covers the period 1996-2011.[28] For each year, Hoberg and Phillips (2015) compute a measure of product similarity ($\rho_{i,j}$) for every pair of firms by parsing the product descriptions from their 10-Ks. This measure is based on the relative number of product words that two firms share in their product description, and ranges between 0% and 100%. Firms $i$ and $j$ are deemed to be closer in the product space – less differentiated – if $\rho_{i,j}$ is closer to 100%. In each year, the peers of a given firm $i$ are defined by Hoberg and Phillips (2015) as all firms $j$ such that $\rho_{i,j} \geq 21.32\%$. They obtain in this way the TNIC network of firm pairwise similarity.[29]

Following Hoberg and Phillips (2015), we measure the level of product differentiation between any two firms $i$ and $j$ in year $t$ as $\Delta_{i,j,t} = 1 - \rho_{i,j,t}$. As an alternative, we have also considered a measure of stock return co-movement between stock $i$ and $j$ (stock returns of firms that follow less differentiated strategies should co-move more). Results with this measure are provided in the online appendix and are similar to those obtained using $\Delta_{i,j,t}$ (see Tables IA.1 and IA.2 in the online appendix for details).

## 4.3 Econometric specification

We estimate eq.(17) as follows. For each IPO firm $A$, we refer to the set of its TNIC peers in its IPO year ($\tau = 0$) as the *initial* peers of firm $A$. We define the *established* peers of firm $A$ as the subset of its initial peers that have been publicly listed for at least five years as of

[28] This starting date of the classification is the first year in which 10-K forms are available in electronically readable format. See Hoberg and Phillips (2015) for more details.

[29] The 21.32% threshold is chosen to generate set of product market peers with the same fraction of pairs as 3-digit SIC industries. Unlike standard industry definitions, TNIC does not require relations between firms to be transitive (the peers of firm $j$ are not necessarily peers of firm $i$ if $j$ is a peer of $i$). Thus, each firm has its own distinct set of peers, which can change over time as firms modify their product ranges, innovate, and enter new markets.

date $\tau = 0$.[30] We then track product differentiation, $\Delta_{A,B,\tau}$, between the IPO firm $A$ and each of its established peer, $B$, over the five years that follow the IPO year ($\tau \in \{0, ..., 5\}$). If an established peer $B$ leaves the set of firm $A$'s peers in a given year $\tau$ (where $\tau > 0$), we set $\Delta_{A,B,\tau}$ equals to 100%.

Arguably, the level of differentiation between any two firms $A$ and $B$ reflects their *joint* product market strategies. Hence an increase of $\Delta_{A,B,\tau}$ following firm $A$'s IPO might indicate that (i) $A$ differentiates from $B$, (ii) $B$ differentiates from $A$, or (iii) both firms simultaneously differentiate from each other. In addition, the level of differentiation between a firm and its established peers could change post IPO because differentiation between *any* pairs of firms changes over time.

To address this problem and better attribute a change in $\Delta_{A,B,\tau}$ to a decision of firm $A$, we use control firms. For each initial peer firm $B$ (of the IPO firm $A$), we select its set of peer firms in the year of firm $A$'s IPO ($\tau = 0$) that are not in the set of firm $A$'s initial peers, and that have been publicly listed for at least five years as of $\tau = 0$. These are peers of an initial peer of $A$ that are not themselves peers of $A$ at $\tau = 0$. We refer to these peers of peers as $B'$. Among these firms, we select three firms with levels of product differentiation with $B$ that are similar to that of $B$ with the IPO firm $A$. Thus, on average, $\Delta_{B,B',\tau=0}$ is close to $\Delta_{A,B,\tau=0}$ for any pair $A, B$. We then track the product differentiation between $B$ and each firm $B'$ over the five years following the IPO of firm $A$ ($\Delta_{B,B',\tau}$ with $\tau = 0, ..., 5$).[31]

We combine the pairs of IPO firms and their initial peers ($A$,$B$), with all pairs ($B$,$B'$). We refer to the former as *treated* pairs, and the latter set as *counterfactual* pairs. For every pair and event-time year, we compute differentiation $\Delta_{i,j,\tau,t}$ and estimate the following equation:

$$\Delta_{i,j,\tau,t} = \alpha_{i,j} + \eta_0 \tau + \eta_1(\tau \times Treated_{i,j,\tau,t}) + \delta_t + \boldsymbol{\beta}\mathbf{X}_{i,j,\tau,t} + \varepsilon_{i,j,\tau,t}, \quad (18)$$

where the subscripts $i$ and $j$ refer to the pair of firms $i$ and $j$, $t$ is calendar time, and

[30] All our results are robust if we define established firms as initial peers that have been listed for more than 3 years.

[31] If a peer of peer, $B^{'}$, leaves the set of peers of firm $B$ in a given year $\tau$ (where $\tau > 0$) then we set $\Delta_{B,B',\tau} = 100\%$.

$\tau \in \{0, ..., 5\}$ is event-time (i.e., the time elapsed since the entry of pair $(i, j)$ in the sample). The unit of observation is at the firm-pair-time level. The variable $Treated$ is an indicator variable that equals one if a pair includes an IPO firm, and zero otherwise. The pair fixed effects ($\alpha_{i,j}$) control for any time-invariant pair characteristics (e.g., the cash flow gain from differentiation of $i$ versus $j$) and the calendar time fixed effects ($\delta_t$) control for common time-specific factors affecting the level of differentiation across all firms. The vector $\mathbf{X}$ controls for time-varying differences in the characteristics of firm $i$ and $j$, namely firm size (measured by total assets) and market-to-book ratios. We allow the error term ($\varepsilon_{i,j,\tau,t}$) to be correlated within pairs.

## 4.4 Interpretation

In eq.(18), $\eta_0$ measures the average within-pair change of differentiation for all pairs over time, and $\eta_0+\eta_1$ measures the average within-pair change of differentiation for treated pairs. Therefore, $\eta_1$ measures the relative change in differentiation (per year) between an IPO firm and an established peer, compared to the change in differentiation for counterfactual pairs. We interpret $\eta_1$ as the difference in the extent to which a firm is differentiated when it is public and when it is private. Corollary 3 implies that this difference should be positive on average, that is, $\eta_1 > 0$.

We do not claim that firms go public to differentiate more as this is not an implication of our theory. Rather, we use the IPO of a firm as a way to test whether its switch from private to public status is positively correlated with its differentiation choices as predicted by our theory.

Also, we do not claim that $\eta_1$ measures the causal impact of the going public decision on product differentiation. Firms conducting IPOs are not randomly selected and, arguably, many factors affecting a firm's decision to go public could also be related to its ability (or willingness) to increase its product differentiation. Hence, unobserved variables could drive both the event on which we condition for firm $i$ (its IPO) and the evolution of differentiation between firm $i$ and its peers after the IPO. Yet, we are not aware of other theories directly linking a firm's decision to go public to its differentiation or stylized facts suggesting that such a link exists. In these conditions, observing a positive correlation between a firm's decision to go public and its subsequent differentiation vis à vis its competitors provides suggestive evidence supporting our theory. To further test whether the mechanisms described in our model are at work in the data, we also study whether the correlation between differentiation and a firm's going public decision (i.e., $\eta_1$) varies *across* treated pairs as a function of (i) managerial information, and (ii) stock price informativeness as our theory predicts.

### 4.5 Descriptive statistics

Table 1 presents descriptive statistics. Panel A indicates that for $\tau = 0$ the sample comprises 1,231 distinct IPO firms ($A$), 2,678 distinct established peers ($B$), and 2,961 distinct peers of peers ($B'$). The average (public) age of peers and peers of peers is 13.535 and 14.304, respectively. Unsurprisingly, IPO firms are smaller than their established peers, and have higher market-to-book ratios. Peers and peers of peers are overall similar in term of age, size, and market-to-book ratio. The average degree of product differentiation ($\Delta_{i,j}$) is roughly similar across the three sets of firms at $\tau = 0$ (by construction). Panels B and C report pair level information for $\tau = 0$ and pair-year level information across $\tau = 0, ..., 5$. There are 122,195 pairs (633,745 pair-year observations) in the sample, split into 31,427 treated pairs (139,101 pair-years) and 90,768 counterfactual pairs (494,644 pair-years). On average, we observe a given (treated or counterfactual) pair for 4.55 years post IPO.

[**Insert Table 1 about Here**]

## 5 Empirical Findings

### 5.1 IPOs and product differentiation

Table 2 presents estimates for various specifications of eq.(18). The first column considers a baseline specification that includes only the event time variable $\tau$ as explanatory variable, together with firm-pair and calendar year fixed effects. The coefficient on $\tau$ is positive and significant, indicating that the average degree of product differentiation in a given firm pair ($\Delta_{i,j}$) increases over time for all (treated and counterfactual) pairs. The economic magnitude of the estimate is substantial: The average within-pair level of differentiation increases by 0.147% per year, equivalent to a 0.735% increase over our five years window.[32]

**[Insert Table 2 about Here]**

More important for our purpose, we observe in column (2) that the coefficient on the interaction term $\tau \times Treated$ is also positive and significant (0.027 with a t-statistic of 4.824). IPO firms differentiate significantly more from their initial product market peers over time compared to counterfactual firms. The point estimate indicates that the increase of differentiation for newly public firms is about 20% larger than that observed for counterfactual pairs. This finding is new, and supports the model's prediction.

We check the robustness of our findings to various changes in the baseline specification. In column (3), we control for differences in size and market-to-book ratios in each firm-pair. In column (4) we constrain the sample to include only firm-pairs for which we have non-missing observations for at least three years in the post-IPO period. In columns (5) and (6) we alter the construction of counterfactual pairs by taking five matches instead of three in column (5), and by matching on size differences instead of product differentiation in column (6). Our conclusion remains unchanged.

**[Insert Figure 4 about Here]**

Figure 4 displays the pattern of differentiation for treated and counterfactual firm-pairs in event time. We construct this figure by replacing the event-time variable $\tau$ in eq.(18) by a set of event-time dummy variables ($D_\tau$) and their interaction with $Treated$.[33] Figure 4 confirms the larger increase in product differentiation among treated pairs. For each date $\tau$, we observe that $\eta_{1,\tau} > 0$. Moreover, the differentiation gap between treated and counterfactual pairs ($\eta_{1,\tau}$) is widening over time.

[32] This is likely to be a lower bound on the actual rate at which differentiation increases over time for the average pair because TNIC pairs on which we focus are, by construction, the closest pairs in terms of product offerings.

[33] Specifically, we estimate $\Delta_{i,j,\tau,t} = \alpha_{i,j} + +\delta_t + \sum_{\tau=0}^{5} \eta_{0,\tau} D_{i,j,\tau} + \sum_{\tau=0}^{5} \eta_{1,\tau}(D_{i,j,\tau} \times Treated_{i,j,\tau}) + \varepsilon_{i,j,\tau,t}$, and report $\eta_{0,\tau}$ and $\eta_{1,\tau}$ in Figure 4. This approach allows coefficient $\eta_{0,\tau}$ and $\eta_{1,\tau}$ to be different each year.

## 5.2 The role of information

Our model highlights that differentiation has a cost when managers rely on information from stock prices for their decision: it weakens managers' ability to learn information from stock prices. This informational cost is smaller when a manager is better privately informed ($\gamma$ is high), or when stock prices are less informative about the type of the common strategy (i.e., when $\overline{\pi}(n, \pi_c)$ is low). Thus, firms with these characteristics should differentiate relatively more. Hence, we conjecture that the positive correlation between a firm's going public decision and its level of differentiation should be stronger when (i) the manager is better informed, or (ii) peers' stock prices are less informative.[34]

We test these predictions by examining how the changes in product differentiation post-IPO ($\eta_1$) varies cross-sectionally with proxies for managerial information, and peers' stock price informativeness. We modify eq.(18) as follows:

$$\Delta_{i,j,\tau,t} = \alpha_{i,j} + \omega_0 \tau + \omega_1(\tau \times Treated_{i,j,\tau,t}) + \omega_2(\tau \times Treated_{i,j,\tau,t} \times \phi_{i,j}) + ... \tag{19}$$

where $\phi_{i,j}$ represents a proxy for managerial information or peers' stock price informativeness. Eq.(19) decomposes the change in differentiation for treated pairs into an unconditional component ($\omega_1$) and a component ($\omega_2$) that depends linearly on the interacted variable of interest $\phi_{i,j}$. The trade-off highlighted by our model implies that $\omega_2 > 0$ when $\phi_{i,j}$ measures the amount of private information of the manager of firm $i$, and $\omega_2 < 0$ when $\phi_{i,j}$ measures the informativeness of peers' stock prices (firm $j$).

### 5.2.1 Managers' private information ($\gamma$)

We use the trading activity of firms' executives and the profitability of their trades as proxies for managers private information (as, for instance, in Chen, Goldstein, and Jiang (2007) or Foucault and Frésard (2014). We posit that managers are more likely to trade their own stock, and make profit on these trades, if they possess more private information, that is, if $\gamma$ is larger.

We measure the trading activity of IPO firm $i$'s insiders in a given year $t$ as the number

[34] That is, in our tests, we use peers' stock price informativeness as a proxy for the informativeness of an IPO firm's stock price in the absence of differentiation ($\overline{\pi}(n, \pi_c)$ in the model).

of shares traded (buys and sells) by its insiders during that year divided by the total number of shares traded for stock $i$ in year $t$. We call this ratio $Insider_{i,t}$. We measure the profitability of insiders' trades in firm $i$ in year $t$ ($InsiderAR_{i,t}$) by the average one month market-adjusted returns of holding the same position as insiders for each insider's transaction.[35] We then average the value of these two variables over the five-year period following firm $i$'s IPO and use these averages as proxies for the private information of the manager of firm $i$. We obtain corporate insiders' trades from the Thomson Financial Insider Trading database.[36] As in other studies (e.g., Beneish and Vargus (2002), or Peress (2010)), we restrict our attention to open market stock transactions initiated by the top five executives (CEO, CFO, COO, President, and Chairman of the Board).[37] We use CRSP to compute the total number of shares traded (turnover) in each stock and market-adjusted returns on insiders' positions.

**[Insert Table 3 about Here]**

In columns (1) and (2) of Table 3, we find that the coefficient ($\omega_2$) on the triple interaction between $\tau$, $Treated$, and the proxies for $\gamma$ is positive and significant, while the coefficient on $\tau \times Treated$ remains positive and significant. As predicted by our theory, the increase in differentiation post-IPO increases significantly when managers appear to be better privately informed.

#### 5.2.2 Price informativeness of established firms ($\overline{\pi}(n, \pi_c)$)

Next, we consider four measures for the informativeness of established peers' stock prices, that is, $\overline{\pi}(n, \pi_c)$. First, as is common in the literature (see, e.g., Chen, Goldstein and Jiang (2007)), we use the probability of informed trading, $PIN$, developed by Easley, Kiefer, and

[35] The average value of $InsiderAR$ is 0.75% in our sample of IPOs and is significantly different from zero at the 1%-level. This finding supports the notion that insiders have private information and is in line with existing findings on the profitability of insiders' trades (for recent evidence, see Seyhun (1998), or Ravina and Sapienza (2010)).

[36] This database contains all insider trades reported the the SEC. Corporate insiders include those who have "access to non-public, material, insider information" and required to file SEC forms 3, 4, and 5 when they trade in their firms stock.

[37] Arguably owners typically sells large stakes upon public listing (e.g. Helwege, Pirinsky and Stulz (2007)). This could potentially invalidate the use of insider trades to measure managerial information. To address this issue we separately consider the number shares bought or sold divided by the total number of shares traded instead of all transactions. Interestingly our results only hold for buys, but not for sells.

O'Hara (1996, 1997) and Easley, Hvidkjaer, and O'hara (2002). $PIN$ is estimated from a structural market microstructure model in which trades can come from noise or informed traders. It measures the probability that a given trade is informed and corresponds to $\pi_c$ or $\pi_u$ in our model. Stock price informativeness increases with these probabilities in our model. Thus, we expect $PIN$ to be associated with more informative stock prices. We use annual data on $PIN$ computed using the Venter and De Jongh's (2004) method, and provided by Brown and Hillegeist (2007).[38]

Our second proxy is taken from Bai, Philipon and Savov (2014) and relies on the ability of current stock prices to forecast future earnings. To compute this measure, we estimate for each year and each firm a cross-sectional regression of all its peers' three-year ahead earnings on their current prices and earnings.[39] The stock prices of a firm's peers are more informative if they better forecasts future earnings, i.e., if the coefficient on current prices is more significant (as measured by t-stats). We label these estimated coefficients $BPS$.

Our third proxy is the sensitivity of stock prices to earnings news using the "earnings response coefficients" ($ERC$). Following Ball and Brown (1968), we conjecture that informative stock prices should better and more quickly incorporate relevant information about future earnings. Hence, earnings news of firms with informative prices should trigger a lower price response. Thus, a larger value of $ERC_{i,j}$ indicates that the stock price of peer $j$ of firm $i$ is *less* informative. We compute $ERC$ for each firm-year as the average of the three-day window absolute market-adjusted stock returns over the four quarterly announcement periods.

Our fourth proxy uses coverage from professional financial analysts received by peer firms. More coverage is typically associated with improved informational environment. Indeed, analysts gather information about the value of business strategies, and provide value-adding information (e.g. Healy and Palepu (2001)) that has a significant effect on stock prices (e.g., Womack (1996) and Barber, Lehavy, McNichols, and Trueman (2006)). Also, analysts receive direct information from managers and render this information public. Hence, its peers' stock prices should be more informative when peers are covered by more

[38] See http://scholar.rhsmith.umd.edu/sbrown/pin-data. The data covers the period 1996-2010.

[39] As Bai, Philipon and Savov (2014), we use firms' market-to-book ratio to measure normalized stock prices, and earnings before interest and taxes over assets to measure earnings.

analysts .[40]

In columns (3) to (6) of Table 3 we aggregate each proxy by taking its average value over the 5-year period following the IPO (of firm $i$). Across the four proxies $\phi_{i,j}$, we find that the increase in product differentiation for IPO pairs (relative to counterfactual pairs) is significantly *smaller* when the stock price of peer firms is more informative. These cross-sectional findings lend further support for the trade-off underlined in our model: The loss in option value associated with the choice of the unique strategy is higher for firms whose peers' stock price are more informative. Thus, these firms are less likely to differentiate.

## 5.3 Robustness and additional tests

### 5.3.1 Alternative Explanations

An omitted variable might explain the association between the going public decision, sources of information, and differentiation that we reported in Tables 2 and 3. However, this omitted factor(s) should be firm-specific and time-varying since we control for firm-pair and calendar time fixed effects. Moreover, it should be weakly associated with firms' size and market-to-book ratio since we control for these variables. Finally, to explain our cross-sectional results, it should be systematically and strongly correlated with our proxies for managers private information and peers' price informativeness, and strongly associated with firms' differentiation choices.

One such factor might be the extent to which a firm is financially constrained. Indeed, existing research suggests that going public improves firms' access to capital (e.g., Pagano, Panetta, and Zingales (1998)). Thus, it might be easier for financially constrained firms to fund innovation and marketing expenses required for differentiation (see Sutton (1991)) after going public.

To assess whether this mechanism explains our findings, we include additional con-

[40] The literature often uses firm-specific return variation (or 1-$R^2$) as a proxy for stock price informativeness (e.g., Chen, Goldstein, and Jiang (2007) or Fresard and Foucault (2014)). This measure is problematic in our setting. Indeed, this measure is based on the residuals from a regression of a firm's stock returns on the returns of the market and an *industry* portfolio. By construction, this measure is positively related to firms' level of differentiation with industry peers. That is, we expect a firm-specific return variation to be stronger for firms that are more differentiated. This creates a mechanical link between our measure of differentiation and firm specific return variation that precludes the use of this variable as an explanatory variable in our setting.

trol variables in specification (19). We measure access to finance by the availability of a credit rating, whether firms pay dividends (as in Almeida, Campello and Weisbach (2004)), as well as the new text-based measure of financing constraints developed by Maksimovic and Hoberg (2015) using textual analysis on the Management's Discussion and Analysis (MD&A) section of firms' 10Ks.[41] To measure innovation and marketing activities, we use the ratio of R&D over sales, the ratio of advertising expenses over sales, and the number of new patents over assets (obtained from the NBER patent dataset). For each variable, we use its difference between firm $i$ and $j$ as a control variable, as we do for other controls in our baseline tests.

[**Insert Table 4 about Here**]

Table 4 shows that our baseline results are robust to the inclusion of these additional control variables. Namely, we continue to observe that IPO firms differentiate at a faster rate, after going public, than their established peers (the *total* effect of $\tau \times Treat$ on differentiation is positive across all specifications). More importantly, the increase in product differentiation post-IPO is still significantly larger when managers are better privately informed, and is weaker when peers' stock prices are more informative. The estimates of the coefficients of interest in Table 4 are very similar to those obtained in Table 3, suggesting that our cross-sectional findings cannot be explained by changes in access to finance and innovation patterns following firms' IPOs.

[**Insert Table 5 about Here**]

To further assess the relation between access to finance and product differentiation, we use proxies for aggregate time-varying financing conditions. Specifically, in our baseline regression (18), we interact the variable $\tau \times Treated$ with dummy variables equal to one during crises periods (2000-2001 and 2008-2009) and the TED spread. If the increase in product differentiation for IPO firms only reflects easier access to finance, the coefficient on this additional variable should be negative, i.e., the positive correlation between an IPO and differentiation should be smaller when aggregate funding conditions are tight. Results

[41] We thank Jerry Hoberg and Max Maksimovic for sharing their data with us. The data starts in 1997.

in Table 5 indicate that this is not the case. The coefficient on $\tau \times Treated$ is in fact larger during the two crisis periods of 2001-2002 and 2008-2009 (see Columns (1) and (2)). It is also higher when TED spreads are larger (Column (3)). Finally, in Column (4), we find that the coefficient on $\tau \times Treated$ is unaffected by the aggregate volume of IPO, indicating that the effect we estimate is similar in cold and hot IPO markets. Overall, these results further dispel concerns that our findings could be explained by changes in firms' financing environment after their IPOs.

### 5.3.2 Are Prices More Informative about Common Strategies?

Our model suggests that stock prices of firms following common strategies should be more informative than stock prices of firms following unique strategies. Indeed, Corollaries 1 and 2 show that this is the case if the number of firms following common strategies is large enough, even if fewer investors get information about the common strategy. To check whether this is the case in our data, we measure the uniqueness of a given firm $i$ in a given year $t$ (in the TNIC network) as the average (or median) value of $\Delta_{i,j,t}$ across all peers $j$, which we denote $\overline{\Delta}_{i,t}$. We then regress our proxies for stock price informativeness ($PIN$, $ERC$, and $Coverage$) for firm $i$ on $\overline{\Delta}_{i,t}$. For brevity, we report the findings in the on-line appendix (see Panel A of Table IA.3). As expected, we find that stocks prices of more differentiated firms are less informative. The same conclusion holds when we measure the informativeness of stock price by their predictive power for future earnings as in Bai, Phillipon, and Savov (2015) (see Panel B of Table IA.3 in the online appendix).

### 5.3.3 Firm-level Tests

Our main test focuses on time-variation in *pair-level* measures of product differentiation. We obtain similar results if we focus on time-variation in *firm-level* measures. In particular, the level of uniqueness of IPO firms increases significantly more in the five years post-IPO compared to matched firms (see Table IA.4 in the online appendix for more details). Relatedly, we find that across *all* firms the degree of uniqueness significantly increases with public age, and especially during the years following public listings.

# 6 Conclusion

There is growing evidence that the informational efficiency of secondary stock markets has real effects because managers learn information from stock prices. One direct manifestation of this influence is when managers' real decisions (e.g., investment) co-vary with stock prices. In this paper, we show that this channel can also play out in a less obvious way. Specifically, managers can make real decisions to enhance their ability to learn from stock prices at some future point in time.

We illustrate this idea by considering the case of differentiation decisions by a firm. Differentiation lowers the correlation between the payoffs of a firm's growth options and those of its competitors. As a result, a firm's stock price is less informative about its growth options when the firm differentiates. Thus, if managers rely on stock prices a source of information, differentiation has an informational cost. We show that this cost encourages conformity: it leads firms to differentiate less in order to bolster their ability to learn information from their stock price or the stock prices of their competitors. We also show that this conformity effect is stronger for a private firm because, by definition, its manager can learn information only from other public firms' stock prices.

Hence, the conformity effect implies that a firm's incentive to differentiate should increase after it goes public. We confirm this new prediction using data on IPO firms and pairwise measures of differentiation between newly-public firms and their peers. We also show that the rate at which IPO firms differentiate from their peers after their IPO is higher when economic forces inducing conformity according to our model are weaker, i.e., when firms' managers are better privately informed, or when peers' stock prices are less informative.

One implication of our theory is that firms' cash flows (and therefore stock returns) are more correlated when managers rely on stock prices as a source of information. Thus, the feedback of stock prices on firms' differentiation choices might both reduce investors' ability to diversify their portfolio and the variety of products available to consumers. Yet, it helps managers to make more efficient allocation decisions. A welfare analysis of these effects is an intriguing venue for future research.

# A Appendix

**Proof of Proposition 1.** Directly follows from the argument in the text.

**Proof of Lemma 1.** We show that the strategies described in Lemma 1 form an equilibrium.

**Speculators' strategy.** Let $\Pi_j(x_{ij}, \widehat{s}_i(S_j))$ be the expected profit of a speculator who trades $x_{ij}$ shares of firm $j \in \{1, ..., n, A\}$ when his signal about its strategy is $\widehat{s}_i(S_j)$. First, consider a speculator who observes that the common strategy is good, i.e., $t_{S_c} = G$. If he buys the stock of incumbent firm $j$, his expected profit is:

$$\Pi_j(x_{ij}, G) = x_{ij} \times \mathrm{E}((r(S_c, m_{S_c.I}, G) - \widetilde{p}_{j2}) \,|\widehat{s}_i(S_c) = G)\,, \text{ for } j \in \{1, ..., n\},$$

where $m_{S_c.I} = n$ if firm $A$ abandons the common strategy and $m_{S_c.I} = n + 1$ if firm $A$ pursues it. The speculator expects all other informed speculators to buy one share of all firms in equilibrium. Thus, he expects the total demand for each stock to be $\pi_c$. This implies that the likelihood that the demand for one stock is less than $(-1 + \pi_c)$ is zero conditional on $\widehat{s}_i(S_c) = G$ (i.e., $\Pr(f_{\max} < (-1 + \pi_c)\,|\widehat{s}_i(S_c) = G) = 0$). This also implies that $\Pr(\{-1 + \pi_c < f_{\min}\} \cap \{f_{\max} < 1 - \pi_c\}\,|\widehat{s}_i(S_c) = G) = 1 - \overline{\pi}(n, \pi_c)$.

Thus, given that $\widehat{s}_i(S_c) = G$, the speculator expects the price of stock $j$ to be either (i) $r(S_c, n + 1, G)$ if the demand for one stock (including firm $A$) exceeds $1 - \pi_c$ or (ii) $(1 - \gamma/2)\overline{r}(S_c, n) + \gamma\overline{r}(S_c, n + 1)/2$ if $-1 + \pi_c < f_{\min}$ and $f_{\max} < 1 - \pi_c$. If the first case happens, the manager of firm $A$ will pursue his strategy and the payoff of firm $j$ is $r(S_c, n + 1, G)$. In this case, the speculator earns a zero expected profit since he trades at a price that is just equal to the asset payoff. In the second case, the manager of firm $A$ pursues his strategy iff only if he learns privately that the strategy is good, which happens with probability $\gamma$ since $t_{S_c} = G$. Hence, if $-1+\pi_c < f_{\min}$ and $f_{\max} < 1-\pi_c$, the speculator expects the cash flow of incumbent firm $j$ to be $\gamma r(S_c, n + 1, G) + (1 - \gamma)r(S_c, n, G)$. We deduce that

$$\Pi_j(x_{ij}, G) = x_{ij} \times [\frac{(1 - \overline{\pi}(n, \pi_c)) \times (2\sigma_c - \gamma(\overline{r}(S_c, n) - \overline{r}(S_c, n + 1)))}{2}]. \qquad (20)$$

The expression in bracket is strictly positive due to Assumption A.2. Thus, speculator $i$'s optimal order is to buy the maximum possible number of shares of each incumbent firm (i.e., $x_{ij} = +1$ for $j \in \{1, ..., n\}$) when he receives signal $\widehat{s}_i(S_c) = G$. A similar reasoning shows that

$$\Pi_j(x_{ij}, B) = -\Pi_j(x_{ij}, G) \text{ for } j \in \{1, ..., n\}. \tag{21}$$

Thus, the speculator optimally sells one share of each incumbent firm ($x_{ij} = -1$ for $j \in \{1, ..., n\}$) when he receives signal $\widehat{s}_i(S_c) = B$.

Finally consider the case in which speculator $i$ has no information about the common strategy ($\widehat{s}_i(S_c) = \varnothing$). By the Law of Iterated Expectations, the belief of this speculator about the value of stock $j$ must be $\mathrm{E}(\widetilde{p}_{j2})$, which is the price at which the speculator expects to trade. Thus, speculator $i$ obtains a zero expected profit for all $x_{ij}$. Thus, not trading ($x_{ij} = 0$ ) is optimal when $\widehat{s}_i(S_c) = \varnothing$.

We can proceed in the same way to show that a speculator optimally buys stock $A$ if he knows that the common strategy is good and sells it if he knows that the common strategy is bad.

**The manager's decision at date 3.** Now consider the manager's optimal investment policy, $I^*$, at date 3. If the manager receives private information, he just follows his signal because this signal is perfect. Hence, in this case, he pursues the common strategy if $s_m = G$ and he does not if $s_m = B$. If he receives no managerial information ($s_m = \varnothing$), the manager relies on stock prices. If he observes that $p_{A2} = p_{A2}^H$, the manager deduces that $f_{\max} > 1 - \pi_c$. In this case, as $f_{\max} > 1 - \pi_c$ can occur if and only if speculators buy stock $j$, i.e., if $t_{S_c} = G$, the manager infers that $t_{S_c} = G$ and the manager optimally implements the common strategy. If instead the manager observes that $p_{A2} = p_{A2}^L(S_c)$ then the manager deduces that $f_{\min} < -1 + \pi_c$ and that, consequently, $t_{S_c} = B$. In this case, the manager optimally abandons his strategy.

Finally if he observes $p_{A2} = p_{A2}^M(S_c)$ then the manager deduces that $-1 + \pi_c \leq f_{\min}$ and $f_{\max} \leq 1 - \pi_c$ for all firms (including firm $A$). In this case, trades are uninformative about the type of the common strategy. Hence, if the manager has no private information, he does not invest since he expects the net present value of the common strategy to be negative (Assumption A.4).

In sum, given his information at date 3, the manager expects the net present value of the common strategy to be positive if and only if (i) $s_m = G$ or (ii) $s_m = \varnothing$ and $p_{A2} = p^H_{A2}$. We deduce that:

$$I^*(\Omega_3, S_c) = \begin{cases} 1 \text{ if } s_m = G, \\ 1 \text{ if } s_m = \varnothing \text{ and } p_{A2} = p^H_{A2}, \\ 0 \text{ otherwise,} \end{cases} , \tag{22}$$

as claimed in the last part of Lemma 1.

**Equilibrium prices.** We must check that equilibrium conditions (5) and (6) are satisfied by the equilibrium prices given in the second and third parts of Lemma 1. That is, these prices must satisfy:

$$p_{A2} = \mathrm{E}(V_{A3}(I^*(\Omega_3, S_c), S_c) \mid \Omega_2), \tag{23}$$

and

$$p_{j2} = \mathrm{E}(r(S_c, m_{S_c.I^*}, t_{S_c}) \mid \Omega_2) \text{ for } j \in \{1, .., n\}, \tag{24}$$

where $I^*(\Omega_3, S_c)$ is given by (22) and $m_{S_c.I^*} = n + 1$ if $I^* = 1$ and $m_{S_c.I^*} = n$ if $I^* = 0$.

We now show that this is the case. Suppose first that $f_{\max} \geq (1 - \pi_c)$. In this case, order flows reveal that the common strategy is good, i.e., $t_{S_c} = G$. Moreover, according to the conjectured equilibrium, the stock price of firm $A$ is $p^H_{A2}$. Hence, $I^* = 1$. We deduce that:

$$\mathrm{E}(V_{A3}(I^*(\Omega_3, S_c), S_c) \mid \Omega_2) = r(S_c, n + 1, G) - 1 \text{ if } f_{\max} \geq (1 - \pi_c),$$

which is equal to $p^H_{A2}$. Hence, if $f_{\max} \geq (1 - \pi_c)$, Condition (23) is satisfied. Moreover, we deduce that:

$$\mathrm{E}(r(S_c, m_{S_c.I^*}, t_{S_c}) \mid \Omega_2) = r(S_c, n + 1, G) \text{ if } f_{\max} \geq (1 - \pi_c),$$

which is equal to the stock price of firm $j \neq A$ when $f_{\max} \geq (1 - \pi_c)$. Thus, in this case, Condition (24) is satisfied as well.

Now suppose that $f_{\min} \leq -(1 - \pi_c)$. In this case, order flows reveal that the common strategy is bad, i.e., $S_c = B$. Moreover, according to the conjectured equilibrium, the stock price of firm $A$ is $p_{A2}^L$. Hence, the manager never implements his strategy in this case (if he receives private managerial information, he observes that $S_c = B$ and otherwise he infers it from the stock price of firm $A$). Hence, we deduce that:

$$\mathrm{E}(V_{A3}(I^*(\Omega_3, S_c), S_c) \mid \Omega_2) = 0 \text{ if } f_{\min} \leq -(1-\pi_c),$$

which is equal to $p_A^L$. Hence, if $f_{\min} \leq -(1-\pi_c)$., Condition (23) is satisfied. Moreover, we deduce that:

$$\mathrm{E}(r(S_c, m_{S_c}, t_{S_c}) \mid \Omega_2) = r(S_c, n, B) \text{ if } f_{\min} \leq -(1-\pi_c),$$

which is equal to the stock price of firm $j \neq A$ when $f_{\min} \leq (1-\pi_c)$. Thus, in this case, Condition (24) is satisfied as well.

Last, consider the case in which $-1+\pi_c \leq f_{\min}$ and $f_{\max} \leq 1-\pi_c$ for all firms (including $A$). In this case, investors' demand in each stock is uninformative about the common strategy because $\Pr(S_c = G \,|\{-1+\pi_c \leq f_{\min}\} \cap \{f_{\max} \leq 1-\pi_c\}) = \frac{1}{2}$. Moreover, according to the conjectured equilibrium, the stock price of firm $A$ is $p_{A2}^M$. Hence, the manager of firm $A$ will implement the common strategy ($I^* = 1$) if and only if his private signal indicates the common strategy is good, just as in the benchmark case. We deduce that,

$$\mathrm{E}(V_{A3}(I^*(\Omega_3, S_c), S_c) \mid \Omega_2) = V_{A1}^{Benchmark}, \text{ if } -1+\pi_c \leq f_{\min} \text{ and } f_{\max} \leq 1-\pi_c,$$

which is equal to $p_A^M$. Hence, if $-1+\pi_c \leq f_{\min}$ and $f_{\max} \leq 1-\pi_c$, Condition (23) is satisfied. Moreover, we deduce that:

$$\mathrm{E}(r(S_c, m_{S_c.I^*}, t_{S_c}) \mid \Omega_2) = \frac{\gamma(r(S_c, n+1, G) + r(S_c, n, B))}{2} + (1-\gamma)\overline{r}(S_c, n),$$

if $-1+\pi_c \leq f_{\min}$ and $f_{\max} \leq 1-\pi_c$. Thus, $\mathrm{E}(r(S_c, m_{S_c.I^*}, t_{S_c}) \mid \Omega_2) = (1-\gamma/2)\overline{r}(S_c, n) + \gamma\overline{r}(S_c, n+1)/2$, which is the stock price of firm $j \neq A$ when $-1+\pi_c \leq f_{\min}$ and $f_{\max} \leq 1-\pi_c$. Thus, in this case, Condition (24) is satisfied as well.

**Proof of Lemma 2.** The proof of Lemma 2 follows the same steps as the proof of Lemma 1 and is therefore omitted.

**Proof of Corollary 1.** The stock price of firm $A$ is more informative about the payoff of its strategy when it follows the common strategy iff $\overline{\pi}(\pi_c, n) > \pi_u$. One obtains the corollary by replacing $\overline{\pi}(\pi_c, n)$ in this inequality by its expression in (11).

**Proof of Proposition 2.** Firm $A$ chooses the unique strategy iff $V_{A1}(S_u) > V_{A1}(S_c)$. The proposition follows by replacing $V_{A1}(S_u)$ and $V_{A1}(S_c)$ by their expressions given in (12) and (13).

**Proof of Proposition 3.** When firm $A$ is private, it chooses the unique strategy iff $V_{A1}^{private}(S_u) > V_{A1}^{private}(S_c)$. The proposition follows by replacing $V_{A1}^{private}(S_u)$ and $V_{A1}^{private}(S_c)$ by their expressions given in (14) and (15).

**Proof of Corollary 3.** Using the expressions for $\widehat{\lambda}(\gamma, \pi_u, \pi_c, n)$ and $\widehat{\lambda}^{private}(\gamma, \pi_c, n)$, we obtain that $\widehat{\lambda}(\gamma, \pi_u, \pi_c, n) < \widehat{\lambda}^{private}(\gamma, \pi_c, n)$ iff $\pi_u > \frac{\gamma(\overline{\pi}(n,\pi_c) - \overline{\pi}_c(n-1))}{\gamma + (1-\gamma)\overline{\pi}_c(n-1)}$. Thus under this condition, a firm for which $\widehat{\lambda}(\gamma, \pi_u, \pi_c, n) < \lambda(n) < \widehat{\lambda}^{private}(\gamma, \pi_c, n)$ chooses the common strategy if it is private but the unique strategy if it is public.

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**Table 1: Descriptive Statistics**

This table reports the mean values of the main variables used in the analysis and the number of observations. All variables are defined in the text. In Panel A, we present the statistics for firm-level observations (IPO firms, established peers of IPO firms, and established peers of peers of IPO firms). In Panel B, we present statistics for average firm-pair level observations. Pairs that include an IPO firm are treated pairs (Treat=1) and pairs without an IPO firm are counterfactual pairs (Treat=0). In Panel C, we present statistics for average firm-pair-year level observations. Pairs that include an IPO firm are treated pairs (Treat=1) and pairs without an IPO firm are counterfactual pairs (Treat=0). Peers and Peers of Peers are defined using the TNIC industries developed by Hoberg and Phillips (2014). We define established peers as public firms that have been listed for more than 5 years. We track pairs over five years following each IPO, so that the event time variable τ = 0, 1, 2, 3, 4, or 5. The sample period is from 1996 to 2011.

| | Panel A: Firm-level | | |
|---|---|---|---|
| τ=0 | IPO firms | Established Peers | Peers of Peers |
| N | 1,231 | 2,678 | 2,961 |
| Age | 0.000 | 13.535 | 14.304 |
| $\Delta_{i,j}$ | 0.761 | 0.756 | 0.767 |
| # of Peers | 86.128 | 72.126 | 58.985 |
| log(A) | 4.987 | 5.665 | 5.617 |
| MB | 3.480 | 2.283 | 2.144 |
| | Panel B: Pair-level | | |
| τ=0 | Treat=1 | Treat=0 | all |
| N | 31,427 | 90,768 | 122,195 |
| $\Delta_{i,j}$ | 0.754 | 0.762 | 0.760 |
| $Age_i$-$Age_j$ | -13.164 | -2.129 | -4.967 |
| $log(A)_i$-$log(A)_j$ | -0.969 | -0.079 | -0.308 |
| $MB_i$-$MB_j$ | 1.089 | 0.214 | 0.439 |
| | Panel C: Pair-year-level | | |
| All τ | Treat=1 | Treat=0 | all |
| N | 139,101 | 494,644 | 633,745 |
| $\Delta_{i,j}$ | 0.759 | 0.768 | 0.766 |
| $Age_i$-$Age_j$ | -13.265 | -2.082 | -4.536 |
| $log(A)_i$-$log(A)_j$ | -0.847 | -0.047 | -0.222 |
| $MB_i$-$MB_j$ | 0.426 | 0.109 | 0.178 |
| τ | 4.037 | 4.699 | 4.554 |

**Table 2: Differentiation post-IPO: Main Results**

This table presents estimates for various specifications of equation (17). The dependent variable is the degree of product differentiation between firm i and j. The unit of observation is a firm-pair-year. The sample includes pairs where one firm (firm i) is an IPO firm and the other firm (firm *j*) is an established peer, and pairs where one firm (firm i) is a peer of an IPO firm and the other firm (firm *j*) is a peer of firm *i* than is not a peer of the IPO firm. We identify peers using the TNIC network developed by Hoberg and Phillips (2014) and defined established peers as public firms that have been listed for more than 5 years. We select peers of peers using a matching procedure as defined in Section 3. Pairs that include an IPO firm are treated pairs (Treat=1) and pairs without an IPO firm are counterfactual pairs (Treat=0). We track pairs over five years following each IPO, so that the event time variable τ = 0, 1, 2, 3, 4, or 5. The control variables include the difference in size and market-to-book ratio between firms in each pair. The sample period is from 1996 to 2011. The control variables are divided by their sample standard deviation to facilitate economic interpretation. Columns (1) to (3) present baseline estimations. In column (4) we constrain the sample to include only firm-pairs for which we have non-missing observations for at least three years. In column (5) we consider 5 matches to construct counterfactual pairs instead of 3. In column (6) we consider differences in size matches to construct counterfactual pairs instead of product differentiation. The standard errors used to compute the *t*-statistics (in squared brackets) are adjusted for heteroskedasticity and within-firm-pair clustering. All specifications include firm-pair and calendar year fixed effects. Symbols ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

| Dep. Variable: | Product Differentiation ($\Delta_{i,j}$) | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | | | controls | >3yrs | M-5 | M-size |
| τ | 0.147*** | 0.142*** | 0.142*** | 0.130*** | 0.135*** | 0.146*** |
| | [62.90] | [57.38] | [57.33] | [50.52] | [70.91] | [55.94] |
| τ x Treat | | 0.027*** | 0.026*** | 0.014** | 0.035*** | 0.021*** |
| | | [4.82] | [4.73] | [2.50] | [6.46] | [3.76] |
| $\log(A)_i-\log(A)_j$ | | | -0.024*** | -0.014** | -0.020*** | -0.070*** |
| | | | [-3.71] | [-2.06] | [-3.77] | [-10.10] |
| $MB_i-MB_j$ | | | -0.007*** | -0.004** | -0.007*** | -0.002 |
| | | | [-3.35] | [-2.04] | [-4.35] | [-0.82] |
| Pair Fixed Effects ($\alpha_{i,j}$) | Yes | Yes | Yes | Yes | Yes | Yes |
| Year Fixed Effects ($\delta_t$) | Yes | Yes | Yes | Yes | Yes | Yes |
| Obs. | 633,745 | 633,745 | 633,745 | 558,680 | 943,223 | 638,986 |
| Adj. $R^2$ | 0.729 | 0.729 | 0.729 | 0.712 | 0.714 | 0.770 |

**Table 3: Differentiation post-IPO: The Role of Information**

This table presents estimates of equation (18) with various proxies for managerial information and stock price informativeness. The dependent variable is the degree of product differentiation between firm i and j. The unit of observation is a firm-pair-year. The sample includes pairs where one firm (firm i) is an IPO firm and the other firm (firm j) is an established peer, and pairs where one firm (firm i) is a peer of an IPO firm and the other firm (firm j) is a peer of firm i than is not a peer of the IPO firm. We identify peers using the TNIC network developed by Hoberg and Phillips (2014) and define established peers as public firms that have been listed for more than 5 years. We select peers of peers using the matching procedure defined in Section 3. Pairs that include an IPO firm are called treated pairs (Treat=1) and pairs without an IPO firm are called counterfactual pairs (Treat=0). We track pairs over five years following each IPO, so that the event time variable τ = 0, 1, 2, 3, 4, or 5. The control variables (unreported) include the difference in size and market-to-book ratio between firms in each pair. The sample period is from 1996 to 2011. Variable ϕ is either a proxy for managerial information of the IPO firm i (Insider or InsiderAR) or a measure of peers' stock prices informativeness (PIN, BPS, ERC, and Coverage). Each proxy ϕ is divided by its sample standard deviation to facilitate economic interpretation. The standard errors used to compute the *t*-statistics (in squared brackets) are adjusted for heteroskedasticity and within-firm-pair clustering. All specifications include firm-pair and calendar year fixed effects. Symbols ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

| Dep. Variable: | Product Differentiation ($\Delta i,j$) | | | | | |
|---|---|---|---|---|---|---|
| | Managerial Information | | Peers' Price Informativeness | | | |
| ϕ: | $InsiderAR_i$ | $Insider_i$ | $PIN_j$ | $BPS_j$ | $ERC_j$ | $Coverage_j$ |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| τ | 0.142*** | 0.142*** | 0.146*** | 0.125*** | 0.136*** | 0.139*** |
| | [57.44] | [57.31] | [56.43] | [38.13] | [50.98] | [55.62] |
| τ x Treat | 0.020*** | 0.018*** | 0.093*** | 0.083*** | -0.266*** | 0.143*** |
| | [3.57] | [2.79] | [3.30] | [7.74] | [-8.32] | [6.84] |
| τ x Treat x ϕ | 0.022*** | 0.009** | -0.022** | -0.036*** | 0.073*** | -0.061*** |
| | [5.40] | [2.16] | [-2.30] | [-5.78] | [9.65] | [-5.39] |
| Control Variables | Yes | Yes | Yes | Yes | Yes | Yes |
| Pair Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Year Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Obs. | 633,745 | 633,745 | 577,179 | 608,468 | 569,191 | 633,745 |
| Adj. $R^2$ | 0.729 | 0.729 | 0.736 | 0.666 | 0.735 | 0.729 |

**Table 4: Differentiation post-IPO: Alternative Explanations**

This table presents estimates of equation (18) with various proxies for managerial information and stock price informativeness. The dependent variable is the degree of product differentiation between firm i and j. The unit of observation is a firm-pair-year. The sample includes pairs where one firm (firm i) is an IPO firm and the other firm (firm j) is an established peer, and pairs where one firm (firm i) is a peer of an IPO firm and the other firm (firm j) is a peer of firm i than is not a peer of the IPO firm. We identify peers using the TNIC network developed by Hoberg and Phillips (2014) and define established peers as public firms that have been listed for more than 5 years. We select peers of peers using a matching procedure as defined in Section 3. Pairs that include an IPO firm are called treated pairs (Treat=1) and pairs without an IPO firm are called counterfactual pairs (Treat=0). We track pairs over five years following each IPO, so that the event time variable τ = 0, 1, 2, 3, 4, or 5. The control variables (unreported) include the difference in size and market-to-book ratio between firms in each pair. To these controls, we add financing controls (differences in the availability of a credit rating, whether the firm pays dividend, and the text-based measure of financing constraint of Hoberg and Maksimovic (2015)) and innovation controls (differences in spending on R&D over sales, spending on advertising over sales, and the number of new patents over assets). The sample period is from 1996 to 2011. Variable ϕ is either a proxy for managerial information of the IPO firm i (Insider or InsiderAR) or a measure of peers' stock prices informativeness (PIN, BPS, ERC, and Coverage). Each proxy ϕ is divided by its sample standard deviation to facilitate economic interpretation. The standard errors used to compute the *t*-statistics (in squared brackets) are adjusted for heteroskedasticity and within-firm-pair clustering. All specifications include firm-pair and calendar year fixed effects. Symbols ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

| Dep. Variable: | Product Differentiation (Δi,j) | | | | | |
|---|---|---|---|---|---|---|
| | Managerial Information | | Peers' Price Informativeness | | | |
| ϕ: | $InsiderAR_i$ | $Insider_i$ | $PIN_j$ | $BPS_j$ | $ERC_j$ | $Coverage_j$ |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| τ | 0.142*** | 0.142*** | 0.147*** | 0.125*** | 0.136*** | 0.139*** |
| | [57.44] | [56.57] | [56.08] | [37.78] | [50.67] | [54.88] |
| τ x Treat | 0.014** | 0.011* | 0.082*** | 0.072*** | -0.279*** | 0.138*** |
| | [2.47] | [1.70] | [3.30] | [6.48] | [-8.57] | [6.46] |
| τ x Treat x ϕ | 0.021*** | 0.010** | -0.020** | -0.032*** | 0.074*** | -0.062*** |
| | [5.06] | [2.37] | [-2.10] | [-4.90] | [9.64] | [-5.30] |
| Control Variables | Yes | Yes | Yes | Yes | Yes | Yes |
| Financing Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Innovation Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Pair Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Year Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Obs. | 619,151 | 619,151 | 577,179 | 594,912 | 557,178 | 619,151 |
| Adj. R2 | 0.665 | 0.665 | 0.666 | 0.669 | 0.665 | 0.666 |

**Table 5: Differentiation post-IPO: Time-Varying Financing Conditions**

This table presents estimates of equation (18) with various proxies for managerial information and stock price informativeness. The dependent variable is the degree of product differentiation between firm i and j. The unit of observation is a firm-pair-year. The sample includes pairs where one firm (firm i) is an IPO firm and the other firm (firm j) is an established peer, and pairs where one firm (firm i) is a peer of an IPO firm and the other firm (firm j) is a peer of firm i than is not a peer of the IPO firm. We identify peers using the TNIC network developed by Hoberg and Phillips (2014) and defined established peers as public firms that have been listed for more than 5 years. We select peers of peers using a matching procedure as defined in Section 3. Pairs that include an IPO firm are treated pairs (Treat=1) and pairs without an IPO firm are counterfactual pairs (Treat=0). We track pairs over five years following each IPO, so that the event time variable τ = 0, 1, 2, 3, 4, or 5. The control variables (unreported) include the difference in size and market-to-book ratio between firms in each pair. The sample period is from 1996 to 2011. Variable ϕ is a proxy for aggregate financing conditions. We consider four different proxies: $D_{(2000\text{-}2001)}$ and $D_{(2008\text{-}2009)}$ are dummies identifying financial crisis years, TED spread is difference between the interest rates on interbank loans and on short-term U.S. government debt ("T-bills"), and IPO volume is the number of IPO divided by the lagged number of public firms. The standard errors used to compute the *t*-statistics (in squared brackets) are adjusted for heteroskedasticity and within-firm-pair clustering. All specifications include firm-pair and calendar year fixed effects. Symbols $^{***}$, $^{**}$ and $^{*}$ indicate statistical significance at the 1%, 5% and 10% levels, respectively.

| Dep. Variable: | Product Differentiation (Δi,j) | | | |
|---|---|---|---|---|
| ϕ: | $D_{(2000\text{-}2001)}$ | $D_{(2008\text{-}2009)}$ | TED Spread | IPO Volume |
| | (1) | (2) | (3) | (4) |
| τ | 0.142*** | 0.142*** | 0.141*** | 0.142*** |
| | [57.35] | [57.40] | [57.10] | [57.21] |
| τ x Treat | 0.024*** | 0.023*** | 0.013* | 0.024*** |
| | [4.21] | [4.11] | [1.95] | [3.27] |
| τ x Treat x ϕ | 0.010* | 0.026*** | 0.033*** | 0.058 |
| | [1.71] | [2.94] | [3.65] | [0.043] |
| Control Variables | Yes | Yes | Yes | Yes |
| Pair Fixed Effects | Yes | Yes | Yes | Yes |
| Year Fixed Effects | Yes | Yes | Yes | Yes |
| Obs. | 633,745 | 633,745 | 633,745 | 633,745 |
| Adj. R2 | 0.663 | 0.669 | 0.663 | 0.666 |

## Figure 1 : Timing

**t=1**

The manager of firm A chooses a strategy $S_A \in \{S_u, S_c\}$

- **Unique**: $S_u$
- **Common**: $S_c$: already chosen by n firms

**A strategy can be Good (G) or Bad (B).**

**t=2**

**Stock market opens:**
**order flows**: $\{f_1, \ldots, f_n, f_A\}$) and **stock prices**: $\{p_1, \ldots, p_n, p_A\}$ are realized

**t=3**

- With probability $\gamma$, the manager of firm A receives a signal (**$s_m$**) about the type (**G or B**) of his strategy
- He observes stock prices realized at date 2.
- **Real Option**:
  - o Pay $1 and Go on with strategy $S_A$ (**I=1**)
    or
  - o Abandon strategy $S_A$ (**I=0**) at zero cost.

**t=4**

**Firms' cash flows** $(r(S, m_S, t_S))$ are realized.

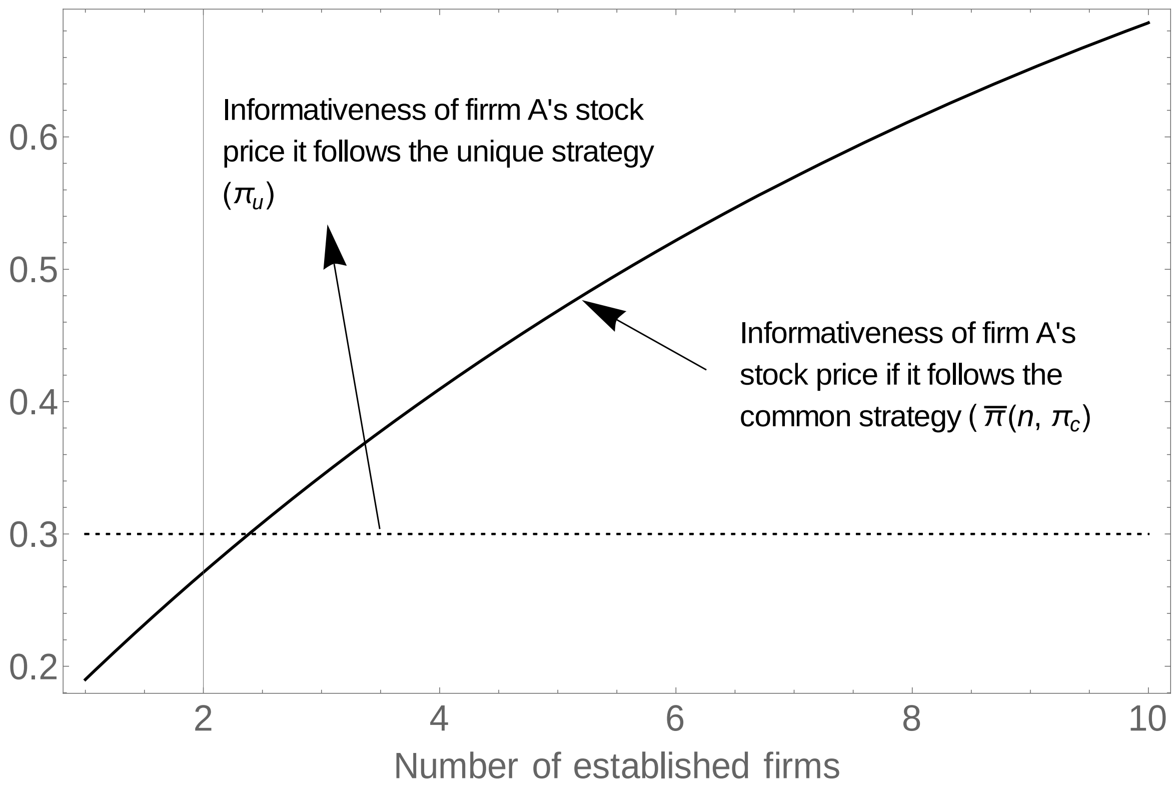


**Figure 2:** This figure shows the informativeness of firm A's stock price about the type of firm A's strategy if it follows the common strategy (plain line) and if it follows the unique strategy (dashed line) as a function of the number of incumbent firms (n).

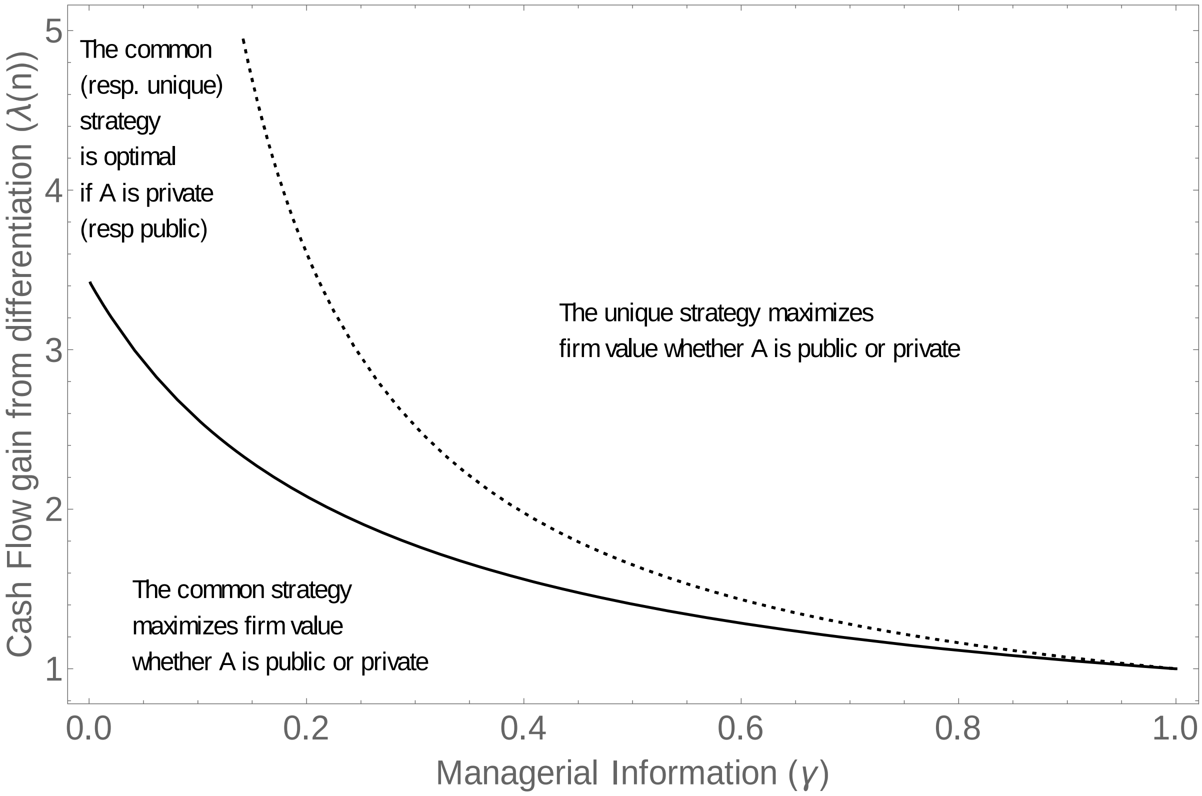


**Figure 3:** This figure shows the optimal choice of the manager of firm A at date 1 when $\pi_u \geq \frac{\gamma(\pi_c(n)-\pi_c(n-1))}{\gamma+(1-\gamma)\pi_c(n-1)}$. The plain line is $\hat{\lambda}(\gamma, \pi_u, \pi_c, n)$ as a function of γ (managerial information) and the dashed line is $\lambda^{private}(\gamma, \pi_c, (n-1))$. Other parameter values are $\pi_u = 0.2, \pi_c = 0.1$ and n=10.