The Dynamics of Entrepreneurial Firm Exit Choice and the IPO Valuation Premium: Theory and Evidence

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Abstract

We analyze the dynamics of private firms' exit choice between IPOs and acquisitions and the valuation premium of IPOs over acquisitions from pre-2000 to post-2000. We first develop a two-period theoretical model, where in each period, entrepreneurs with private information about the viability of their firm in product market competition choose between IPOs and acquisitions. A key driver of exit choice in each period is the potential help that acquirers can provide to target private firms if they choose to be acquired ("acquisition synergy"), whereas firms that choose to go public do not receive such help. In equilibrium, only higher quality private firms choose to exit through an IPO, while lower quality private firms choose to be acquired. We analyze the dynamics of the above single-period IPO versus acquisition choice by assuming a positive shock to acquisition synergy between the two periods (i.e., pre- versus post-2000). This generates the testable prediction that, while the quality of IPO firms increases after 2000, the average value of acquired firms also increases, leading to a potential shrinkage in the IPO valuation premium. We test the predictions of our model using a sample of private firm exits between 1995 and 2019. First, we find that the fraction of exiting firms that chose an IPO over an acquisition declined significantly in the post-2000 period compared to pre-2000. Second, the IPO valuation premium remains positive in both the pre-2000 and post-2000 periods. Third, the IPO valuation premium shrank significantly from the pre-2000 to the post-2000 period. Fourth, consistent with our theory, the reduction in the IPO valuation premium was significantly larger in the case of private firms in industries where the ability of potential acquirers to help exiting private firms is larger, namely, in more concentrated industries and in industries where the leading public firm had a greater market share.

JEL Classification: G24, G32.

Keywords: Exit mechanisms; Initial public offerings (IPOs); Acquisitions; Valuation premium; Private Firms.

1 Introduction

It is now well known that the volume of private firms going public in U.S. equity markets have declined significantly after the year 2000 (see, e.g., Gao, Ritter, and Zhu (2013)). A related phenomenon is that, of the private firms that do choose to "exit" (i.e., choose to transition from a private status to having some kind of access to the equity market), a much larger proportion choose to be acquired by another firm (public or private) rather than choosing to have an IPO and become a stand-alone public firm (see, e.g., Chemmanur, He, He, and Nandy (2018), who empirically analyze firms' choice between IPOs and acquisitions). A number of hypotheses have been advanced and empirically analyzed to explain the above phenomena, starting with Gao, Ritter, and Zhu (2013), who advanced an "economies of scope" hypothesis, arguing that there has been an ongoing change in the U.S. economy that reduced the profitability of small companies, whether public or private. They argue that many small firms can create greater operating profits by selling out in a trade sale (acquisition) rather than operating as a stand-alone firm. However, while there is now a large literature documenting the reduction in IPOs (and the increase in acquisitions) from before to after the year 2000, less attention has been paid to the dynamics an important variable affecting this choice, namely, the "IPO Valuation Premium" (Bayar and Chemmanur (2011)).

The IPO valuation premium is calculated as the difference in the average valuation of firms going public (exiting through an IPO) versus the average value of comparable firms exiting through an acquisition. The IPO valuation premium is relevant to private firms' choice between IPOs and acquisitions, and the decline in the number of IPOs post-2000, since entrepreneurs whose private firms are able to exit through either mechanism would compare their payoffs arising from their firm exiting through an IPO versus that arising from exiting through an acquisition.[1] The objective

[1] Bayar and Chemmanur (2011) use their theoretical analysis to point out that the IPO valuation premium generates a puzzle since, while a large fraction of private firms choose to be acquired, the valuation of comparable firms in IPOs is much higher on average than the acquisition values of these firms. They propose a resolution of this puzzle based on the argument that entrepreneurs hold on to much of their firm's equity in the long run, and may be aware

of this paper is therefore to analyze the dynamics of the IPO valuation premium (as well as the number of IPOs) from before 2000 to after 2000, thereby generating new insights not only into the IPO valuation premium itself, but also into the reasons underlying the switch to a greater proportion of exits through acquisitions relative to those through IPOs post-2000.

We first develop a simple theoretical model of the dynamics of the exit choices of private firms between IPOs and acquisitions from before to after 2000. Our model generates testable implications for the dynamics of entrepreneurs' exit choice for their firm between IPOs and acquisitions, and equally important, for the dynamics of the IPO valuation premium over the same time period. We then empirically test the main predictions of our model for the dynamics of private firms' IPO versus acquisition choice and for the dynamics of the IPO valuation premium.

Our theoretical model consists of two periods. At the beginning of each period, a set of entrepreneurs (and other current shareholders such as VCs) each managing a private firm wish to exit (at least partially) from the firm, motivated either by a desire to satisfy their personal liquidity needs, or to raise external financing for investment in the firm's growth opportunity (new project), or both. They can accomplish this in one of two ways. They can take the firm public in an IPO, selling some of their equity holdings in the firm (to satisfy their respective liquidity demands) and by issuing new equity (to raise the required investment amount for the firm), with the entrepreneur continuing to manage the firm after the IPO. Alternatively, they can sell their private firm to an acquirer, in which case they divest their entire equity holdings in the firm, with the entrepreneur giving up control of the firm to the acquirer. We analyze the firm's choice between the above two alternatives, namely, an IPO or an acquisition.[2]

A crucial factor driving a private firm's choice between IPOs and acquisitions is competition in the product market: While a stand-alone firm has to fend for itself after going public, an acquirer

of the significant overvaluation of the firm's equity in the IPO market.

[2]For simplicity, we assume that the exit choice is made by the entrepreneur alone.

may be able to provide considerable support to the firm in the product market, thus increasing its chances of succeeding against competitors and establishing itself in the product market. Each entrepreneur has private information about the quality of his own firm, which determines its viability (success probability) in product market competition. Unlike atomistic investors in the IPO market, who can be expected to be at an informational disadvantage with respect to the entrepreneur, potential acquirers will be able to value the firm better by virtue of their industry expertise regarding the viability of alternative business models in the product market. A negative aspect of an acquisition, on the other hand, is that an entrepreneur managing a private firm may derive private benefits from controlling the firm, which he will lose after an acquisition.

In the above scenario, we show that, in the equilibrium of the single-period game, the best firms (whose probability of success in product market competition is above a certain threshold value) chose to exit through an IPO, since they place only a lower value on the help they are likely to receive from acquirers (i.e., we assume that the synergy benefit of an acquisition is lower for higher type firms); below the above threshold of success in product market competition, private firms choose to exit through an acquisition. The IPO valuation premium is positive in each period in the above setting, since the average value of firms above a threshold of quality is higher than the average values of firms that are acquired (even after accounting for the acquisition synergy arising for the help provided to the exiting private firm by the acquirer which increases its probability of success in product market competition).

We next introduce a positive shock to the acquisition synergy (provided by acquirers to exiting private firms) between the first and second periods of the above dynamic model, and study how the nature of the exit choice equilibrium changes between the first and second periods. We develop four predictions. First, the threshold value of the probability of success above which private firms choose to exit through an IPO rather than an acquisition increases in the second period (which we view as 2001 and after in our empirical analysis) compared to the first period (2000 and earlier years). This implies that the average market value of firms going public is higher in the post-2000 period. Second, for reasonable (not too large) values of the acquisition synergy shock, the IPO valuation premium remains positive. Third, the change in the IPO valuation premium between the two periods (from pre-2000 to 2001 and beyond) may be positive or negative (i.e., the IPO valuation premium may increase or decrease between the two periods). This is because the IPO valuation premium is the difference between the average values of firms going public (which is greater in the post-2000 period) and the average values of firms that are acquired (which is also greater in the post-2000 period, by virtue of the positive synergy shock between the two periods). In other words, the change in IPO valuation premium across the two periods will depend upon whether the "IPO quality change effect" is greater or less than the "acquisition synergy shock effect" across the two periods. Fourth, the change in the IPO valuation premium from before 2000 to the post-2000 period will be greater for firms with product markets characterized by a larger acquisition synergy shock.

We test the above predictions of our dynamic model using a sample of private firms that were either acquired or had IPOs between 1995 and 2019. Our sample consists of 2,523 private firms that were acquired during this period (which had at least one year of financial data prior to the acquisition) and 2646 private firms that had IPOs during this period. Our empirical results may be summarized as follows. First, consistent with the existing literature, we find that the fraction of exiting firms that chose an IPO over an acquisition declined significantly in the post-2000 period compared to the pre-2000 period. Second, the IPO valuation premium remains positive in both the pre-2000 and post-2000 periods. Third, the IPO valuation premium shrank significantly from the pre-2000 to the post-2000 period. Fourth, the reduction in the IPO valuation premium was significantly larger in the case of private firms in industries where the ability of potential acquirers to help exiting private firms is larger, namely, in more concentrated industries and in industries where the leading public firm had a greater market share.

When we split our sample between VC-backed and non-VC-backed private firms, the decline in the IPO valuation premium was more significant in the VC-backed subsample, which may reflect, in addition to the product market considerations captured in our theoretical model, the increased availability of VC-financing post-2000 (as documented by Ewens and Farre-Mensa (2020)).[3] Finally, when we split our sample between high R&D intensity firms and low R&D intensity firms, the reduction in IPO valuation premium is significant only for low R&D intensity firms. This may reflect the fact that high R&D intensity firms are likely to be in more innovative and knowledge-intensive firms, so that the product market considerations we capture in our theoretical model (i.e., help from incumbent potential acquirer firms to exiting private firms) may not apply to this subsample of firms.

The rest of the paper is organized as follows. Section 2 presents our dynamic model of exit choice and characterizes its equilibrium. Section 3 develops testable hypotheses for our empirical analysis based on the predictions of our theoretical model. Section 4 describes our data and sample selection procedures. Section 5 presents our empirical tests and results. Section 6 presents an instrumental variable analysis as a robustness test. Section 7 concludes. Appendix A presents the descriptions of variables used in the empirical analysis. The proofs of all the propositions of our theoretical model are confined to Appendix B.

[3] Ewens and Farre-Mensa (2020) argue that the deregulation in securities laws (especially the passage of the NSMIA) in the late 1990s made private equity financing more abundantly available to private firms (especially to later stage private firms) in the post-2000 period. This increased availability of VC-financing may have exogenously reduced the quality of the pool of private firms categorized as VC-backed in the post-2000 period, so that the IPO quality change effect (the first term in the IPO valuation premium calculation) may be lower for such firms post-2000.

2 A Model of the Exit Choice of Entrepreneurial Private Firms and the Dynamics of the IPO Valuation Premium

2.1 The Single Period Exit Choice Game

There are two dates in the model: times 0 and 1. At time 0, the shares of a private firm are held by an entrepreneur (firm insiders). The firm has monopoly access to a single project at time 0 and the entrepreneur has to make a decision regarding whether to take the firm public through an initial public offering (IPO) or sell it to an acquirer.[4] If the firm goes public through an IPO, we assume that the entrepreneur will sell a fraction α of his equity holdings in the firm to IPO market investors and retain the remaining fraction $(1-\alpha)$ until time 1, where $0 < \alpha < 1$. We assume that, in an IPO, the entrepreneur (firm insiders) sells a fraction α of his equity holdings to outside investors to satisfy his personal liquidity demand or to raise new equity to meet the firm's investment demand for its project or both.[5] Subsequently, between time 0 and time 1, product market competition takes place between the firm and other incumbent firms in the product market. If an acquisition takes place at time 0, the acquiring firm buys out all the equity holdings of the private firm from the entrepreneur. After the takeover, the acquirer owns the entire firm and the firm's management is replaced. The acquiring firm can help the target firm in the product market between time 0 and time 1, since it is now a division of the acquiring firm.

At time 1, final cash flows from the firm's project are realized and become common knowledge to all market participants. The final cash flow V at time 1 depends on the exit strategy chosen at time 0, the degree of competition between time 0 and time 1, and firm type (about which insiders

[4] We assume that the entrepreneur's exit decision at time 0 is predicated upon the entrepreneur's portfolio diversification motive or the firm's investment requirement or both.

[5] The total number of shares outstanding in the firm is normalized to 1, so that α can be thought of as either the fraction of shares or the number of shares sold by insiders in an IPO at time 0.

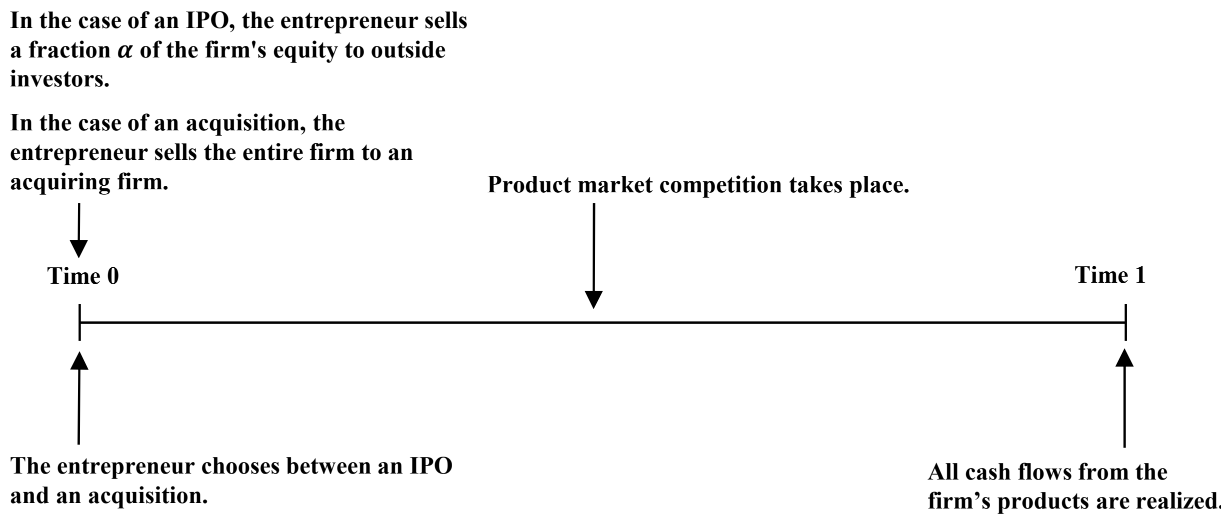

Figure 1: Sequence of Events in the Single Period Exit Choice Game

have private information). The cash flow V can take one of two possible values at time 1:

$$V = \begin{cases} V_S & \text{if the project "succeeds" by time 1,} \\ V_F & \text{if the project "fails" by time 1,} \end{cases} \tag{1}$$

where $0 < V_F < V_S$. There is a risk-free asset in the economy, the net return on which is normalized to 0. All agents are assumed to be risk-neutral. The sequence of events is given in Figure 1.

2.2 The Entrepreneur

The entrepreneur has private information about the firm's type, which is denoted by q. The firm type q can take any value in the closed interval $[0, 1]$. A firm with type $q = 1$ corresponds to a high type (H) firm with a viable, sustainable business model and therefore it is more likely to succeed (probability p_H) as a stand-alone company against the competition in the product market. On the other hand, a firm with type $q = 0$ corresponds to a low type (L) firm which requires more time for product development or further financing (or both) to attain a sustainable business model. Hence its probability of success, p_L, against competition is lower than the probability of success, p_H, of a high type firm with $q = 1$: i.e., $0 < p_L < p_H < 1$. We are thus analyzing a continuum of types model where the type q of any firm is distributed between 0 (L) and 1 (H), with the success probability p_q of a type q firm lying between p_L and p_H; the higher the type q, the greater the firm's success probability. The success probability p_q of any firm with type $q \in [0, 1]$ is then given by:

$$p_q = qp_H + (1 - q)p_L. \tag{2}$$

This implies that the intrinsic stand-alone value V_q of a type q firm after an IPO is given by:

$$V_q = p_q V_S + (1 - p_q)V_F = qV_H + (1 - q)V_L, \tag{3}$$

where $V_H = p_H V_S + (1 - p_H)V_F$ and $V_L = p_L V_S + (1 - p_L)V_F$.

The entrepreneur, who initially holds the entire equity holdings in the firm, derives private benefits of control which we denote by $B > 0$, in addition to his cash flow benefits from holding equity in the firm. If the firm goes public, we assume that the entrepreneur will sell a fraction α of his equity holdings in the firm in the IPO to satisfy his personal liquidity demand or to raise funds for investment or both. If the firm is acquired at time 0, the entrepreneur will be fired from the firm's management and will forfeit his private benefits of control. Since the entrepreneur is risk-neutral, his objective in making the exit decision at time 0 is to maximize the sum of his time 0 cash flow (from selling some or all of his equity in the firm), his time 1 expected cash flow, and the value of the private benefits of control accruing to him.

2.3 The IPO Market

If the entrepreneur decides to take the firm public, he sells a certain fraction α of the firm's equity at the price P_{IPO} in a competitive IPO market that consists of numerous competitive outside investors. The offering price P_{IPO} set by firm insiders for the firm's equity in the IPO will depend on the equilibrium beliefs they conjecture outsiders will form about the type of the firm, since this price has to be such that investors in the competitive IPO market at least break even if they invest in the firm's equity. At the same time, IPO market investors will form their beliefs about firm type after observing the fraction of equity sold by the firm, the price the firm sets for these shares in the IPO, and consistent with the equilibrium strategy of the entrepreneur (firm insiders). As discussed before, outside investors in the IPO market have less information than entrepreneurs about the true quality (type) of the firm. The prior probability assessment of outside investors in the IPO market about firm type q is such that it is continuously and uniformly distributed over the unit interval $[0,1]$: i.e., $q \sim U(0,1)$.

2.4 The Acquiring Firm and the Product Market

Upon an evaluation of the firm's assets and future prospects, we assume that the acquirer will correctly infer the type $q \in [0,1]$ of the firm given the industry expertise of the acquiring firm's management (i.e., there is no information asymmetry between the entrepreneur and the acquirer). After a takeover, the acquirer owns the entire firm and its new project, and the firm's management is replaced. For any target firm with type q, an acquisition adds value in the sense that the acquirer helps the target firm in the product market, so that the probability of success in competition with incumbent firms increases as follows:

$$p_A^q - p_q = \left(q p_A^H + (1-q) p_A^L\right) - p_q, \tag{4}$$

where

$$p_A^H = p_H + \Delta_H,\ p_A^L = p_L + \Delta_L. \tag{5}$$

We assume that $0 < \Delta_H < \Delta_L$ so that the increase in success probability is substantially greater for a type L firm ($q = 0$) than for a type H firm ($q = 1$). Thus, for a type q firm, the increase in the probability of success in product market competition as a result of an acquisition is given by:

$$p_A^q - p_q = q\Delta_H + (1-q)\Delta_L. \tag{6}$$

Clearly, the expected cash flow from the project of a type q target firm is then given by:

$$V_A^q = p_A^q V_S + \left(1 - p_A^q\right) V_F = qV_A^H + (1-q)V_A^L, \tag{7}$$

where $V_A^H = p_A^H V_S + \left(1 - p_A^H\right) V_F$ and $V_A^L = p_A^L V_S + \left(1 - p_A^L\right) V_F$.

Finally, the acquiring firm has some bargaining power against private firms so that the acquisition price P_{ACQ}^q of a type q target firm equals only a positive fraction ρ of the expected cash flow V_A^q:

$$P_{ACQ}^q = \rho V_A^q = \rho\left[qV_A^H + (1-q)V_A^L\right], \tag{8}$$

where we assume that $\frac{V_L}{V_A^L} < \rho < 1$.

2.5 The Equilibrium of the Static Exit Choice Game

The equilibrium concept we use is that of perfect Bayesian equilibrium (PBE) satisfying the Cho-Kreps intuitive criterion. We focus on equilibria where firms with type q above a threshold q^* (i.e., $q^* \le q \le 1$) choose to go public through an IPO at time 0 and those firms with type q below this threshold (i.e., $0 \le q < q^*$) choose to sell their firm to acquirer at time 0.

If the entrepreneur decides to take the firm public ($a = 1$), the IPO valuation of the firm denoted by P^*_{IPO} will be determined according to the updated beliefs of IPO market investors about the firm type based on the equilibrium strategies of IPO firms as described above:

$$P^*_{IPO} = \int_{q^*}^{1} (qV_H + (1-q)V_L)\, f(q\,|\,q \ge q^*) dq, \tag{9}$$

where $f(q\,|\,q \ge q^*)$ is the uniform probability density function of the IPO firm type conditional on the entrepreneur's choice to go public through an IPO ($a = 1$).

If the entrepreneur decides to sell the firm to an acquiring firm ($a = 0$), the acquisition price P^q_{ACQ} for a type q firm will be equal to ρV^q_A as in (8). Given the setting described above, the objective of a type q firm's entrepreneur is to maximize his expected payoff at time 0:

$$\max_{a \in \{0,1\}} a \cdot [\alpha P^*_{IPO} + (1-\alpha)V_q + B] + (1-a) \cdot \rho V^q_A, \tag{10}$$

where a denotes the exit choice; $a \in \{0, 1\}$ according as the firm goes public or accepts the acquisition offer respectively. The next proposition presents the properties of the equilibrium of our model.

Proposition 1. ***(The Entrepreneur's Equilibrium Choice between IPOs and Acquisitions)*** *Let $\alpha < \bar{\alpha}$ and $B_L < B < B_H$ where the thresholds B_L, B_H, and $\bar{\alpha}$ are characterized in (B.5), (B.6), and (B.7), respectively. Then, there exists a Perfect Bayesian Equilibrium (PBE) in which:*

(i) The entrepreneur chooses to take the firm public through an IPO if the firm type q is above the threshold q^*: i.e., if $q^* \le q \le 1$, where the threshold q^* is defined in (B.4).

(ii) The entrepreneur chooses to sell the firm to an acquiring firm in an acquisition if the firm type q is below the threshold q^*: i.e., if $0 \le q < q^*$.

(iii) The equilibrium valuation of IPO firms will be equal to $P^*_{IPO} = V_L + \frac{(1+q^*)}{2}(V_H - V_L)$.

(iv) The average acquisition value of acquired firms will be equal to $\bar{P}_{ACQ} = \rho\left[V^L_A + \frac{q^*}{2}\left(V^H_A - V^L_A\right)\right]$.

Part (i) of the above proposition shows that, in the above equilibrium, it is optimal for the entrepreneur of a type q firm to take his firm public through an IPO if $q \geq q^*$, since the following condition will hold for a firm choosing an IPO if $q \geq q^*$:

$$\alpha P^*_{IPO} + (1-\alpha)\left(qV_H + (1-q)V_L\right) + B \geq \rho\left[qV_A^H + (1-q)V_A^L\right]. \tag{11}$$

Similarly, part (ii) of Proposition 1 shows that it is optimal for the entrepreneur of a type q firm to sell out his firm to an acquiring firm in an acquisition if $q < q^*$, since the following condition will hold for a firm choosing an acquisition if $q < q^*$:

$$\alpha P^*_{IPO} + (1-\alpha)\left(qV_H + (1-q)V_L\right) + B < \rho\left[qV_A^H + (1-q)V_A^L\right]. \tag{12}$$

The information asymmetry in the IPO market implies that, based on the equilibrium strategies given in parts (i) and (ii) of the above proposition, the IPO firm type has a posterior uniform distribution on the interval $[q^*, 1]$. Therefore, the average type (quality) of an IPO firm is equal to $\frac{(1+q^*)}{2}$. While there is no information asymmetry between acquiring firms and target firms, one can also calculate the average acquisition value of acquired firms in our model. This is because the type of acquired firms follows a posterior uniform distribution on the interval $[0, q^*]$. This implies that the average type (quality) of an acquired firm in the above equilibrium is equal to $\frac{q^*}{2}$.

Finally, given the above properties of the entrepreneur's equilibrium choice between IPOs and acquisitions, we define the valuation premium of IPOs over acquisitions in our model as follows:

$$R = \frac{P^*_{IPO}}{\bar{P}_{ACQ}} - 1 = \frac{V_L + \frac{(1+q^*)}{2}\left(V_H - V_L\right)}{\rho\left[V_A^L + \frac{q^*}{2}\left(V_A^H - V_A^L\right)\right]} - 1. \tag{13}$$

2.6 The Equilibrium of the Dynamic Exit Choice Game

In this subsection, we introduce a two-period game where the setting in each period is similar to the one-period game described in subsections 2.1 to 2.5. We assume that, in each period, a new set of private firms make their exit choice, with the difference that, between periods one and two, there is a shock or increase in the synergy benefit parameter Δ_L by an amount $h > 0$, due to a change in the economic landscape in the product market of the private firm: for simplicity, we assume that the synergy parameter Δ_H is unaffected between periods one and two.

Recall that the synergy benefit of an acquisition to a type q firm in the first period is given by:

$$p_A^q - p_q = q\Delta_H + (1-q)\Delta_L. \tag{14}$$

In the second period, this changes to

$$p_A^q - p_q = q\Delta_H + (1-q)(\Delta_L + h). \tag{15}$$

Thus, since the synergy benefit parameter Δ_L increases by an amount $h > 0$ as a result of changes in the economic landscape of the product market of the entrepreneurial firm between periods one and two, this translates to an increase of $(1-q)h$ in the success probability of the project of a target firm with type $q \in [0,1]$. Here, we imagine a scenario in which the entrepreneurial exit choice game described above (in Figure 1) is played repeatedly over time by different sets of private firms with the same quality characteristics except that there is a positive shock to the synergy benefit of an acquisition in the second time period (e.g., in the decade after 2000).

Proposition 2. ***(The Equilibrium of the Dynamic Exit Choice Game)*** *Consider a two-period setting in which the exit choice game described above is played by two different cross sections of firms with the same characteristics. Suppose there is a positive shock h to the acquisition synergy parameter Δ_L between the first and the second period. Then:*

(i) The nature of the equilibrium in each period is similar to that characterized in Proposition 1.

(ii) The equilibrium type threshold q^* for firms going public through an IPO in the second period is increasing in the synergy shock h to an acquisition.

(iii) The IPO valuation premium R in the second period is decreasing in the synergy shock h to an acquisition.

The results of Proposition 2 on the dynamic nature of the entrepreneur's exit choice lead to two important testable hypotheses generated by our model: 1) the fraction of firms choosing an acquisition over an IPO will increase (i.e., the interval $[0, q^*]$ will become larger) as a result of a positive shock to the synergy benefit of an acquisition; 2) the average valuation premium of IPOs over acquisitions will decrease as a result of a positive shock to the synergy benefit of an acquisition.

3 Testable Hypotheses

In this section, we develop testable hypotheses based on the implications of Proposition 2 above for the dynamics of firms' choice between IPOs and acquisitions and the IPO valuation premium. Proposition 2 arises from a dynamic (two-period) model where the single-period exit choice game we discussed in section 2.1 (and shown graphically in Figure 1), is repeated over two periods. For the purposes of our empirical tests, we can think of the first period as occurring during 1995-2000 and the second period as occurring after 2000. Further, we assume that a positive productivity shock in terms of the synergy benefit of an acquisition occurred between the two periods, as empirically documented by Gao, Ritter, and Zhu (2013) and Chemmanur, He, Ren, and Shu (2020). We first discuss our testable hypothesis for the dynamics of firms' choice between IPOs and acquisitions.

Our Proposition 2 predicts that the threshold quality of firms choosing to be acquired will increase in the period after 2000 compared to the decades prior to the end of 2000. This, in turn, implies that a smaller fraction of firms will go public after 2000 compared to the period prior to the end of 2000.

H1: *The propensity of exiting firms to choose an IPO over an acquisition in the period after the year 2000 will be smaller than in the period prior to 2000.*

We now turn to testing the channel through which the propensity of firms to choose an IPO over an acquisition is affected in the post-2000 period compared to the pre-2000 period. Using our theoretical model, we argued that the synergy benefit of an acquisition will be greater in the second (i.e., post-2000) period (the synergy benefit arises through the acquirer helping the exiting private firm to do better in product market competition). It is this positive acquisition synergy shock that motivates a larger fraction of exiting private firms to choose an acquisition over an IPO in the post-2000 period (or conversely, a smaller fraction of private firms choose to exit through an IPO in the post-2000 period). Since the above power of existing public firms (acquirers) to help exiting private firms will be greater in more concentrated product markets and in product markets where the leading firm has a greater market share, this means that, in such product markets, the decline in the propensity of private firms to go public after 2000 will be greater.

H2: *The decline in the propensity of private firms to exit through an IPO rather than an acquisition post-2000 will be greater for private firms in more concentrated product markets or where the leading public firm has a greater market share.*

We now turn to the dynamics of the IPO valuation premium. Our model implies that there are two effects (both emanating from the product market) that affect the valuation premium. First, given a positive shock to the synergy arising from an acquisition in the post-2000 period (arising from the greater help in product market competition provided by potential acquirers to exiting private firms), the threshold type or quality of private firms above which firms choose to go public (rather than be acquired) will be higher in the post-2000 period. This means that the average quality of IPO firms (and correspondingly, their average market value) will be greater in the post-2000 period. We will call this the "IPO quality shock" effect. Second, given the greater synergy benefit of an acquisition in the post-2000 period, the average value of acquired firms will also be greater. We will call this the "acquisition synergy shock" effect. Since the IPO valuation premium depends on which of the above two effects is larger and alternatively this is an empirical question, we will formulate the next hypothesis as a two-sided hypothesis:

H3A: *If the IPO quality shock effect is smaller than the acquisition synergy shock effect, the IPO valuation premium will be smaller in the post-2000 period than in the pre-2000 period.*

H3B: *If the IPO quality shock effect is larger than the acquisition synergy shock effect, the IPO valuation premium will be larger in the post-2000 period than in the pre-2000 period.*

We now turn to testing the channel through which the IPO valuation premium changes from the pre-2000 to the post-2000 period. As we showed using our dynamic model, an increase in the acquisition synergy changes the threshold value of firms going public (this threshold is raised after a positive synergy shock), raising the average value of firms going public. At the same time, the average value of acquired firms goes up in the post-2000 period. While the IPO valuation premium is the net result of the above two effects, both of these effects arise from a larger acquisition synergy shock, which will be greater in more concentrated product markets and those in which the leading firm has a greater market share. This leads to our next testable hypothesis.

H4: *The change in the IPO valuation premium from the pre-2000 to the post-2000 period will be greater for private firms in more concentrated product markets or where the leading public firm has a greater market share.*

We now turn to analyzing the dynamics of the IPO valuation premium in two subsamples of private firms. We will first study venture-capital-backed firms. There are two important factors that may have affected VC-backed firms differently from non-VC-backed firms. First, VC-backed private firms are usually of higher quality than non-VC-backed firms, since VCs screen for (and choose) higher quality private firms to invest in. However, due to the passage of the NSMIA (Ewens and Farre-Mensa (2021)), VC funding became more plentiful after 2000 than before 2000, so that the average quality of VC-backed private firms declined after 2000. Thus, even after a positive acquisition synergy shock after 2000, the sign of the IPO quality shock for VC-backed firms after 2000 is ambiguous (i.e., the average quality of IPO firms backed by VCs may be higher or lower compared to before 2000). Second, the magnitude of the acquisition synergy shock after 2000 may be larger or smaller in VC-backed firms than in non-VC-backed firms. This is because VC-backed firms are likely to be, on average, of higher quality than non-VC-backed firms, so that, *a priori*, they may benefit to a smaller extent from the help of acquirers in product market competition. Thus, we would expect the acquisition synergy shock to be smaller in VC-backed firms post-2000. In summary, even in the VC-backed subsample, it is hard to predict which effect will be larger going from pre-to-post 2000, so that we will state our hypothesis on the dynamics of the IPO valuation premium as a two-sided hypothesis:

H5A*: If the IPO quality shock effect in the VC subsample is smaller than the acquisition synergy shock effect, the IPO valuation premium will be smaller in the post-2000 period than in the pre-2000 period in the VC-backed firm subsample.*

H5B*: If the IPO quality shock effect in the VC subsample is larger than the acquisition synergy shock effect, the IPO valuation premium will be larger in the post-2000 period than in the pre-2000 period in the VC-backed firm subsample.*

We now turn to our second subsample analysis, based on R&D intensity. If we divide our private firm exit sample into two parts, based on R&D intensity, we would expect the higher R&D intensity subsample to consist of more innovative firms and knowledge-intensive firms. On the other hand, the lower R&D intensity firm subsample likely consists of firms in more traditional industries such as manufacturing firms. Given that the higher R&D intensity firms are likely to consist mostly of firms in new (and disruptive) industries born after 2000, the acquisition synergy shock in the post-2000 period is likely to be smaller in such firms than those in low R&D intensity firms. Given this, the shock to IPO firm quality is also likely to be smaller in high R&D intensity firms than in low R&D intensity firms. This means that the change in the IPO valuation premium (which is driven by the IPO firm quality shock and the shock to acquisition synergy from the pre-2000 to the post-2000 period) will also be likely to be larger in the low R&D intensity firms.

H6*: The magnitude of the change in the IPO valuation premium from the pre-2000 period to the post-2000 period will be smaller in high R&D intensive firms than in low R&D intensity firms.*

4 Data and Sample Selection

We use a sample of private target M&As and IPOs between 1995 and 2019 and follow similar restrictions as in Bayar and Chemmanur (2012). The M&A sample is obtained from Thomson Financial SDC Mergers and Acquisitions Database (SDC). We include 100% acquisitions of U.S. private firms acquired by U.S. public firms listed in NYSE, AMEX, or NASDAQ. The transaction value is larger than or equal to $5 million (in 2019 dollars) and the deal status is marked as completed in SDC. We remove firms listed as financials (SIC of 6000-6999) or regulated utilities (SIC of 4900-4999). The initial sample consists of 9,901 private target firms. Since SDC coverage is mainly limited to information on public firms, we also hand-collect financial data for private target firms from the U.S. Securities and Exchange Commission (SEC) EDGAR database. According to S-X rules 3-05 and 1-02(w), firms need to disclose financial statements of an acquired business that is above 20% on any of the three following tests: i) asset size of the private business compared to the acquiring firm, ii) investment size in the private business compared to the acquirer's aggregate worldwide market value, and iii) relative size of net income or revenues of the private business compared to those of the acquiring firm. These statements are usually reported under the S-4 forms, but can also be reported under other forms, such as the S-3, S-1, and 8-K forms. In our sample, financial information is available for 2,523 private firms with at least one fiscal year of financial data prior to the acquisition.

For our IPO sample, we obtain our data from the SDC database on U.S. Global New Issues. We follow the prior literature and exclude deals characterized as spin-offs, ADRs, unit offerings, foreign issues, reverse LBOs, close-end funds, REITs, financial and regulated utilities firms, and offerings less than $5 million in size. Similar to the M&As restrictions, we require the listing to be under the NYSE, AMEX, or NASDAQ exchange, and the issuing firm to have data available in CRSP and Compustat the fiscal year prior to the exit. We also follow Jay Ritter's "Corrections to Security Data Company's IPO database" to adjust for several mistakes and typos in the SDC database. Our final sample of IPO firms consists of 2,646 deals announced between 1995 and 2019.

We also use several other databases to obtain information about our M&A and IPO samples. One of our main variables of interest is to identify the exiting firms backed by venture capitalists. Therefore, we use the SDC Platinum VentureXpert to distinguish between the VC backed and non-VC backed transactions (for both M&As and IPOs). We also obtain information on stock prices and firm-level financial variables using CRSP and Compustat, respectively. Finally, we use the I/B/E/S database to extract information on analyst earnings forecasts which is used in our multivariate setting.

Panel A of Table 2 presents the sample summary statistics for our valuation measures. Our two valuation measures consist of the price-to-sales and the price-to-book equity ratios, which have been previously used in the literature to capture the exit valuation of private firms in the case of an IPO or an acquisition (see, Brau, Francis, and Kohers (2003), Brau, Sutton, and Hatch (2010), and Qi, Sutton, and Zheng (2015)). The price for an IPO is defined as the IPO offering price multiplied by the number of shares outstanding and the price for an acquisition is defined as the deal value paid for the private target by the acquiring firm, collected from the SDC database. Sales is the private firm's sales in the year prior to the exit, collected from Compustat. Book equity is the book value of equity of the private firm in the year prior to the event.

In columns (1) and (2), we observe that both valuation ratios are higher for IPOs compared to M&As. This is consistent with the literature on the IPO premium which suggests that there is a valuation premium for IPOs over M&As (see for example, Poulsen and Stegemoller (2008), Bayar and Chemmanur (2011), and Bayar and Chemmanur (2012)). We next move to columns (3) to (6) which display the valuation statistics based on the pre-2000 and post-2000 periods. Average valuation ratios are higher during the first period of our sample compared to the second one. For example, the price-to-sales ratio for M&As is higher for period one (1.12) compared to period two (0.97), but also higher for the IPOs (2.12 vs. 1.73, respectively). Interestingly, we see that valuations ratios have declined more sharply in IPOs compared to M&As (0.15 in M&As vs. 0.39 in IPOs). This is also the case for the price-to-book equity ratio, but it is also evident when we compared the difference in medians for both valuation ratios. These univariate comparisons are consistent with the claim that IPO valuation premiums relative to M&A's decreased in the post-2000 period.

Panel B of Table 2 shows the summary statistics for the product market competition measures. We employ two proxies to measure the concentration of the industry in which private firms operate. We follow Brau et al. (2003) and Chemmanur, He, He, and Nandy (2018) and use the Herfindahl index (Herfindahl) to measure the degree of competition within an industry in which higher values indicate higher industry concentration. Similar to Bayar and Chemmanur (2012), we also use the largest firm's market share (Leader) at the time of the exit in the same industry as the private firm. Both product market competition variables are calculated using data from Compustat. In all cases, private target firms are in more concentrated industries at the time of exit compared to IPO firms. In our multivariate tests below, we also examine the effect of product market competition measures on the dynamics of the IPO valuation premium in two different periods.

Finally, Panel C shows summary statistics about characteristics of IPO and M&A firms that affect the choice and valuation of these firms at the time of exit. Consistent with prior studies (see Bayar and Chemmanur (2012)), IPO firms are larger compare to acquired firms (size), have higher sales (sales), higher sales growth (sales growth), lower median net income (ROA), lower tangible assets (tangibles), higher capital expenditures (CAPEX), lower leverage (leverage), higher industry forecast errors of analysts (mean error), operate in more profitable industries (CRSP), and are more likely to be backed by venture capital (VC-backed). Thus, these univariate comparison of firm characteristics suggests that IPO firms are more likely to be successful in product market competition as stand-alone firms, whereas private firms choosing acquisitions as an exit route benefit from product market synergies with acquirers. In addition, we find that R&D intensity prior to the exit is higher for IPO firms compared to acquired private targets, which is consistent with the idea that more innovative private firms are more likely to choose an IPO over an acquisition. Some final remarks can be made for leverage and analyst forecast errors where the former is larger for IPO firms in the post-2000 period, whereas the latter is smaller for IPO firms in the pre-2000 period.

5 Empirical Tests and Results

In this section, we proceed with testing our hypotheses by using a multivariate setting to account for variables that affect both the choice and the valuation premiums between IPOs and M&As.

5.1 The Dynamics of the Choice between IPOs and Acquisitions

In this section, we examine the dynamics of private firms' exit choices between IPOs and acquisitions. More specifically, the focus of our tests is to assess whether the propensity of exiting firms to choose an IPO over an acquisition in the period after the year 2000 is smaller than in the decades prior to 2000. Based on the hypotheses developed in Section 3, we use the following probit regression model for our cross-sectional sample of M&As and IPOs:

$$Pr(IPO_i = 1) = \alpha_0 + \beta_1 \, Post2000_i + \beta_2 \, PMC_i + \sum_{j=1}^{J} \gamma_j \, X_{ij} + \eta_k + \epsilon_{i,t-1} \qquad (16)$$

Firms are indexed by i, while t represents the year of exit. Further, j is an index for control variables, and k denotes the industry of firm i. IPO is an indicator variable that equals one if the exit event is an IPO and otherwise equals zero if it is an acquisition. $Post2000$ is an indicator variable that equals 1 if the exit event is announced in 2001 or later. PMC is either of our two measures of product market competition: the Herfindahl index or the leader market share. Control variables (X_{ij}) include the following variables: *Size*, *ROA*, *CAPEX*, *R&D*, *Leverage*, *Tangibility*, *CRSP*, *MeanError*, *SalesGrowth*, and *VCbacked*. All independent variables are measured as of year $(t-1)$. We also include industry (η_k) fixed effects to control for unobserved time-invariant country differences. Table A.1 in the Appendix provides a detailed description of the variables used in the regression model.

Column (1) of Table 3 reports the results of the univariate regression where we regress the IPO indicator variable on the $Post2000$ indicator variable. The coefficient estimate of $Post2000$ is -0.268 and significant at the 1% level. When we include the control variables from (16) in the multivariate regression in column (2), the coefficient estimate of $Post2000$ is still negative (-0.149) and significant. Consistent with hypothesis **H1**, these results suggest that the propensity of exiting firms to choose an IPO over an acquisition in the period post 2000 is smaller than that in the period prior to the end of 2000.

Next, we conduct some subsample analyses. The regression results reported in columns (3) and (4) of Table 3 show that the decrease in private firms' likelihood to choose an IPO over an acquisition in the post-2000 period is statistically significant only in the subsample of VC-backed firm exits. Further, the results reported in columns (5) and (6) of Table 3 show that the decrease in private firms' likelihood to choose an IPO over an acquisition in the post-2000 period is statistically significant only in the subsample of low R&D intensity firms whereas the change in this likelihood is negative but insignificant in the subsample of high R&D intensity firms.

To assess the difference of the impact of product market competition on the dynamics of firms' exit choices across the two subperiods and test hypothesis **H2**, we further augment equation (16) by including an interaction term for the post-2000 period indicator variable and our product market competition measures as below:

$$Pr(IPO_i = 1) = \alpha_0 + \beta_1\, PMC_i + \beta_2\, Post2000_i + \beta_3\, PMC_i \times Post2000_i + \sum_{j=1}^{J} \gamma_j\, X_{ij} + \eta_k + \epsilon_{i,t-1}. \tag{17}$$

Table 4 shows the results of the probit regressions on the choice between IPOs and acquisitions. Our focus is to examine the effect of product market competition on the dynamics of private firms' exit choice between the two periods. In column (1), we find that the coefficient estimate of the Herfindahl index is negative and statistically insignificant with a magnitude of -1.612 for the period before the end of 2000. However, in column (2), we find that the coefficient estimate of the Herfindahl index is negative (-1.941) and statistically significant at the 1% level in the subsample of exits in the post-2000 period. This means that private firms that operate in more concentrated industries are more likely to choose an acquisition over an IPO. Consistent with hypothesis **H2**, this effect is more pronounced during the post-2000 period, which means that potential synergies with acquirers play a more important role in private firms' exit choices in the post-2000 period. Column (3) shows the results of estimating the regression model in equation (17), which includes the interaction variable of the product market competition with the post-2000 period. Even though the coefficient estimate of the interaction variable ($Post2000 \times Herfindahl$) is negative, implying that the negative effect of the industry concentration (Herfindahl index) on the probability of an IPO over an acquisition is stronger in magnitude in the post-2000 period, we do not find any statistical significance.

The coefficient estimates of control variables are similar in sign and significance to prior literature. For example, firms with higher total assets, more sales growth, more capital expenditures, and firms that operate in more profitable industries are more likely to go public via an IPO compared to been acquired, while firms with high leverage are more likely to be acquired rather than going public (see for example, Bayar and Chemmanur (2012) and Chemmanur et al. (2018)).

To further assess the robustness of our results, we examine an alternative measure of product market competition: the leader's market share. Consistent with hypothesis **H2**, the results of the probit regressions reported in columns (4) to (6) of Table 4 also show that in industries where the leader's market share is greater (i.e., in industries dominated by existing market leaders to a greater extent), the propensity of private firms to choose an IPO over an acquisition is smaller in the post-2000 period.

5.2 The Dynamics of the Valuation Premium of IPOs over Acquisitions

In this section, we examine the dynamics of the IPO valuation premium and the effect of the product market concentration on the dynamics of the IPO valuation premium using propensity score matching analysis.

The empirical challenge in comparing the valuations between IPOs and M&As lies in the fact that entrepreneurs and VCs of exiting private firms may make these decisions on certain characteristics they observe in their firm or in the market. To take into account the possibility of self-selection bias by private firms when choosing their exit option, we use a propensity score firm approach.

Using probit regressions that estimate the likelihood of an IPO over an acquisition, we match each acquired firm with similar IPO firms in terms of various firm- and industry-specific characteristics. Thus, for each private firm, we obtain the propensity to go public through an IPO, which we then match to an acquired firm with a similar score. More importantly, we ensure that each firm is matched from the same industry, the same year of exit, and has the same VC backing status. This process mitigates any industry and time differences between IPO and acquisitions, while matching also using the VC backing status eliminates the differences in characteristics observed between VC- and non-VC-backed firms (see for example, Megginson and Weiss (1991), Lindsey (2008), Chemmanur, Krishnan, and Nandy (2011), and Puri and Zarutskie (2012)). To reduce the variance of the estimators and increase the quality of the matching, for each acquisition we use the five nearest neighbouring IPOs with replacement (Smith and Todd (2005)). To assess the validity of our results, we also conduct the matching process using one-to-one, one-to-three, and one-to-ten neighbours. Our main results remain similar in sign and significance in unreported empirical tests.

To test hypotheses **H3A** and **H3B**, we estimate the following regression model in the subsamples of pre-2000 exits and post-2000 exits, respectively:

$$Y_i = \alpha_0 + \beta_1\, IPO_i + \beta_2\, PMC_i + \sum_{j=1}^{J} \gamma_j\, X_{ij} + \eta_k + \epsilon_{i,t-1}, \tag{18}$$

where i represents each firm in the sample and t is the year of exit. The dependent variable in the regression model is one of the two proxies for valuation premium: price-to-sales or price-to-book equity. The key independent variable of interest is the IPO exit choice indicator variable. PMC represents a measure of product market concentration, either the Herfindahl index or the leader market share. Control variables (X_{ij}) are defined as above. All independent variables are measured in the year prior to the exit event and regressions include industry fixed effects (η_k). Table A.1 in the Appendix provides a detailed description of the variables used in the regression model.

We augment the regression model in (18) to include the double interaction term between the IPO exit choice indicator variable and the post-2000 period indicator variable. This enables us to examine whether the IPO valuation premium has changed across the two subperiods using the full sample of exits. The regression model takes the following form:

$$Y_i = \alpha_0 + \beta_1\, IPO_i + \beta_2\, Post2000_i + \beta_3\, IPO_i \times Post2000_i + \beta_4\, PMC_i + \sum_{j=1}^{J} \gamma_j\, X_{ij} + \eta_k + \epsilon_{i,t-1}. \quad (19)$$

In this equation, the key independent variable of interest is the interaction term between the IPO exit choice indicator and the post-2000 period indicator.

Table 5 reports the results of multivariate regressions where we test the hypotheses **H3A** and **H3B** as to whether the IPO valuation premium is larger or smaller in the post-2000 period than in the pre-2000 period. Using both price-to-sales and price-to-book ratios as relevant deal valuation multiples for IPOs and acquisitions, we find that the coefficient estimate of the IPO indicator variable is positive and significant but has a smaller magnitude in the post-2000 period than in the pre-2000 period (see columns (1) versus (2) and columns (4) versus (5)). Using the entire sample of exits in both periods in the regressions reported in columns (3) and (6), we find that the coefficient estimate of the interaction term $IPO \times Post2000$ is negative and significant. These results are consistent with hypothesis **H3A**, which predicts that the IPO valuation premium over acquisitions is smaller in the post-2000 period than in the pre-2000 period.

Next, we analyze whether the dynamics of the IPO valuation premium in the post-2000 period versus the pre-2000 period is affected by the product market competition in the exiting firm's industry. To test hypothesis **H4** developed in Section 3, we use and estimate the following regression model:

$$Y_i = \alpha_0 + \beta_1\ PMC_i \times IPO_i + \beta_2\ PMC_i + \beta_3\ IPO_i + \sum_{j=1}^{J} \gamma_j\, X_{ij} + \eta_k + \epsilon_{i,t-1}, \tag{20}$$

where i represents each firm in the sample and t is the year of exit. The dependent variable in the regression model is one of the two proxies for valuation premium: price-to-sales or price-to-book equity. IPO is the IPO exit choice indicator variable. PMC represents a measure of product market concentration, either the Herfindahl index or the leader market share. The key independent variable of interest in the above equation is the interaction term between the IPO exit choice indicator and the product market concentration variable. Control variables (X_{ij}) are defined as above. All independent variables are measured in the year prior to the exit event and regressions also include industry fixed effects (η_k). Table A.1 in the Appendix provides a detailed description of the variables used in the regression model.

We also augment the regression model in (20) to include the triple interaction term between the IPO exit choice indicator variable, product market concentration variable, and the post-2000 period indicator variable. This enables us to examine whether the effect of product market concentration on the IPO valuation premium has changed across the two subperiods. The regression model takes the following form:

$$\begin{aligned} Y_i = \alpha_0 &+ \beta_1 IPO_i \times Post2000_i \times PMC_i + \beta_2 IPO_i \times PMC_i + \beta_3 Post2000_i \times PMC_i \\ &+ \beta_4 IPO_i \times Post2000_i + \beta_5 PMC_i + \beta_6 Post2000_i + \beta_7 IPO_i + \sum_{j=1}^{J} \gamma_j\, X_{ij} + \eta_k + \epsilon_{i,t-1}, \end{aligned} \tag{21}$$

In this equation, the key independent variable of interest is the triple interaction term between the IPO exit choice indicator, the post-2000 period indicator, and the product market competition variable.

Panel A of Table 6 presents the results of regressions based on the specifications given in equations (20) and (21) and using the price-to-sales ratio as the dependent variable. The results in column (1) show that the effect of product market concentration on IPO valuation premium is statistically insignificant in the pre-2000 period. However, the results in column (2) show that the effect of product market concentration on IPO valuation premium is negative and statistically significant in the post-2000 period. This means that when industry concentration is higher (i.e., in industries in which the potential synergy with an acquirer is larger), the IPO valuation premium is lower in the post-2000 period. In other words, when the product market is more concentrated such that it is dominated by a few existing public firm players, acquired private firms obtain higher exit valuations compared to matched IPO firms in the post-2000 period.

The regression in column (3) in Panel A of Table 6 allows us to assess the statistical significance of the impact of product market concentration on the dynamics of the IPO valuation premiums across the two subperiods. The coefficient of the triple interaction term is negative (-7.056) and statistically significant at the 1% level, which suggests that the effect of product market concentration on the IPO valuation premium is more pronounced in the post-2000 period compared to the pre-2000 period. Columns (4) to (6) present the results for our alternative measure of product market concentration, i.e., the leader market share. More specifically, in the regression results reported in column (6), the triple interaction coefficient is negative (-4.256) and statistically significant at the 1% level. Overall, these results are qualitatively and quantitatively similar to the results outlined in columns (1) to (3) and, thus, provide further support to the prediction of hypothesis **H4**.

As a robustness test, we use an additional valuation multiple measure, the price-to-book equity ratio (P/B), as the dependent variable in our regressions. This measure has been used to proxy for the value paid by public acquirers to buy out private target firms (see for example, Brau et al. (2003)) and is defined as the as the offering price multiplied by the number of shares outstanding (for IPOs) or deal value paid for private targets by the acquiring firm (for M&As) divided by the book value of equity of the private firm in the year prior to the exit event. Panel B of Table 6 shows the regression results using the price-to-book ratio as the dependent variable. The regression results reported in columns (3) and (6) show that the coefficient estimates of the triple interaction terms are negative (-7.740 and -3.101, respectively) and statistically significant for the Herfindahl index and the leader market share measures, respectively. These results further indicate that in more concentrated industries (higher Herfindahl index), the IPO valuation premium (relative to acquisitions) is lower in the post-2000 period than in the pre-2000 period.

5.3 A Direct Channel Test: The Effect of Acquisition Synergy

In this section, we examine the impact of the synergy benefit of an acquisition on the dynamics of the IPO valuation premium and its relationship with product market competition. Our theoretical model in section 2 implies that the change in the valuation premium of IPOs over acquisitions (in the post-2000 period compared the pre-2000 period) is essentially driven by an acquisition synergy shock effect. Therefore, in this section, our objective is to empirically test this implication of our model directly. We proxy for acquisition synergy shocks using the acquisition synergy of public acquisitions in the same industry as the exiting private firms. More specifically, we calculate our measure of acquisition synergy as the value-weighted acquirer and target cumulative abnormal returns (CARs) around acquisition announcement (see Bradley, Desai, and Kim (1988) and John, Kadyrzhanova, and Lee (2022)) at the industry-year level.

Table 7 presents the results for this analysis. Panel A of Table 7 shows the effect of acquisition synergy on the IPO valuation premium. Column (1) and (2) show that the impact of acquisition synergy is negatively related to IPO valuation premiums. That is, when the acquisition synergy is high the IPO valuation premium becomes smaller as the valuation of acquisitions increases.

The triple interaction term ($IPO \times Post2000 \times Synergy$) in column (3) suggests that the effect of acquisition synergy on the IPO valuation premium (using price-to-sale ratio) is more pronounced in the post-2000 period compared to the earlier period. Results are similar when using price-to-book equity ratio (see models (4) to (6)). Overall, these results are consistent with hypothesis **H3A**.

In Panel B of Table 7, we show the impact of product market competition on IPO valuation premium between the two subperiods for the high (columns (1) to (4)) and low (columns (5) to (8)) acquisition synergy subsamples. For brevity we report the effect of the triple interaction terms ($IPO \times Post2000 \times PMC$). Similar as before, we use both measures of product market competition and valuation multiple measures. For the high synergy subsample (columns (1) to (4)) the interaction terms are negative and statistically significant. These results show that when industry concentration is higher in the post-2000 period and acquisition synergies are high, private firms obtain lower IPO valuation premiums. However, this effect is insignificant in the subsample of low acquisition synergies (see columns (5) to (8)). Overall, these results are consistent with hypothesis **H4**.

5.4 The Effect of Venture Capital Backing on the Dynamics of the IPO Valuation Premium

In this section, we examine the impact of VC backing on the dynamics of the IPO valuation premium and how this interacts with product market competition. We perform a similar analysis to our baseline models, but we run our empirical tests separately for VC- and non-VC-backed firms. Table 8 reports regression results for these subsamples and for the two product market competition proxies.

In Panel A of Table 8, the dependent variable is the price-to-sales ratio in the regressions reported in columns (1) to (6), whereas it is the price-to-book ratio in the regressions reported in columns (7) to (12). The results reported in columns (1) to (6) show that the change in the valuation premium of IPOs over acquisitions (over the two subperiods) is not statistically significant in the VC-backed and non-VC-backed subsamples, respectively: the coefficient estimate of the double interaction term $IPO \times Post2000$ in column (3) is positive (0.160) but insignificant in the subsample of VC-backed firms, whereas it is negative (-0.086) but insignificant (in column (6)) in the subsample of non-VC-backed firms. However, when the dependent variable is the price-to-book ratio, the regression results reported in columns (7) to (12) show that the change in the IPO valuation premium in the post-2000 period is negative and significant only in the subsample of non-VC-backed firms: the coefficient estimate of the double interaction term $IPO \times Post2000$ in column (12) is negative (-0.414) and significant at the 1 percent level.

In Panel B of Table 8, the dependent variable is the price-to-sales ratio in the regressions reported in columns (1) to (12). The regression results reported in columns (3) and (6) show the impact of product market concentration (using the Herfindahl index) on the dynamics of the IPO valuation premium for the subsamples of VC-backed and non-VC-backed firms, respectively. The coefficient estimate of the triple interaction term ($IPO \times Post2000 \times Herfindahl$) is negative (-13.366) and statistically significant in the VC-backed subsample (column (3)), while in the non-VC-backed firm subsample, the triple interaction term (column (6)) is insignificant. Consistent with hypothesis **H5A**, these results show that when industry concentration is higher in the post-2000 period, private firms backed by venture capital obtain lower IPO valuation premiums over acquisitions. However, this effect is insignificant in the subsample of non-VC-backed private firms. Our results are qualitatively and quantitatively similar when we use the leader market share as a proxy for product market concentration. For example, the coefficient estimate of the triple interaction term ($IPO \times Post2000 \times Leader$) is negative (-5.689) and statistically significant in the VC-backed subsample (column (9)), while it is weaker and less significant (-2.484) in the non-VC-backed subsample (column (12)).

5.5 The Effect of R&D Intensity on the Dynamics of the IPO Valuation Premium

In this section, we examine the effect of R&D intensity on the dynamics of the IPO valuation premiums and how this interacts with product market competition. Panel A of Table 9 presents the results of regressions where we test whether there is a significant change in the valuation premium of IPOs over acquisitions in the post-2000 period compared to the pre-2000 period in the subsamples of high R&D intensity firms and low R&D intensity firms, respectively. Further, Panel B of Table 9 presents the results of regressions where we test whether changes in IPO valuation premia are sensitive to product market competition in these subsamples.

In Panel A of Table 9, the dependent variable is the price-to-sales ratio in the regressions reported in columns (1) to (6), whereas it is the price-to-book ratio in the regressions reported in columns (7) to (12). The results reported in columns (1) to (6) show that the change in the valuation premium of IPOs over acquisitions (over the two subperiods) is statistically significant only in the subsample of low R&D intensity firms: the coefficient estimate of the double interaction term $IPO \times Post2000$ in column (3) is negative (-0.122) and insignificant in the subsample of high R&D intensity firms, whereas it is negative (-0.429) and significant at the 1 percent level (in column (6)) in the subsample of low R&D intensity firms. Similarly, when the dependent variable is the price-to-book ratio, the regression results reported in columns (7) to (12) show that the change in the IPO valuation premium (over the two subperiods) is significantly negative only in the subsample of low R&D intensity firms: the coefficient estimate of the double interaction term $IPO \times Post2000$ in column (12) is negative (-0.422) and significant at the 1 percent level. Overall, these results are consistent with hypothesis **H6**.

In Panel B of Table 9, the dependent variable is the price-to-sales ratio in the regressions reported in columns (1) to (12). The regression results reported in columns (3) and (6) of Table 9 show that coefficient estimate of the triple interaction variable $IPO \times Post2000 \times Herfindahl$ is negative and significant in the subsample of low R&D intensity firms, whereas this triple interaction term is insignificant in the subsample of high R&D intensity firms. Consistent with the prediction of hypothesis **H6**, we find that the magnitude of the change in the IPO valuation premium from the pre-2000 period to the post-2000 period is smaller in high R&D intensive firms than in low R&D intensity firms. In the regressions reported in columns (7) to (12), we use the leader market share as a measure of industry concentration. Consistent with hypothesis **H6**, the results from this analysis are quantitatively and qualitatively similar to those reported in columns (1) to (6).

6 Robustness Tests: Instrumental Variable Analysis

In this section, we address a potential bias that may arise from potentially non-randomly selected samples. IPO valuation premiums are only available for private firms for which entrepreneurs decide to exit through an IPO or acquisition. In our context, non-random sampling will possibly bias the OLS estimates when an omitted variable simultaneously affects both insiders' decision to exit and valuation premiums (see also Certo, Busenbark, Woo, and Semadeni (2016)). As hypothesized in Bayar and Chemmanur (2011), the entrepreneurs' inside information about the fundamental value of their firms can determine both the exit choice and the market valuation.

An instrumental variable approach is widely accepted to address endogeneity concerns and provide consistent causal estimates. This approach requires the identification of an instrumental variable that is related to the endogenous variable (i.e., the IPO versus acquisition exit choice of a private firm in our context), but unrelated to the dependent variable in the outcome regression (i.e., the IPO valuation premium in equations (18) and (19)). Bhagwat, Dam, and Harford (2016) show that high interim market volatility is negatively associated with acquisition activity in public equity markets, since both acquiring firms and target firms will be more reluctant to engage in deal-making during more uncertain market conditions. Following Bhagwat et al. (2016), Li and Peng (2021) use the interim industry-level uncertainty as an instrumental variable correlated with merger activity. Similarly, we use the interim market risk to serve as such an instrumental variable. We construct a pre-exit industry-level interim market risk using the three-year mean annual beta of the firm's industry peers. We expect that this variable satisfies the relevance and exclusion conditions of an instrumental variable analysis in our setting.

Since our endogenous explanatory variable, IPO_i, is binary, we proceed with a dummy endogenous variable model (Heckman (1978)). In this respect, we follow procedure 21.1 in Chapter 21 of Wooldridge (2010) to conduct an instrumental variable analysis by using the method of probit and two-stage least squares (Probit-2SLS) regressions. This estimation procedure has the advantage that the model generating the predicted probability of an IPO exit is not required to be correctly specified and the 2SLS standard errors are asymptotically valid.[6] The first step in this method uses the probit regression method to estimate the predicted probability of an IPO exit using the following equation:

$$Pr(IPO_i = 1) = \alpha_0 + \sum_{j=1}^{J} \beta_j X_{ij} + \gamma_1 Z_{k,t-1} + \eta_k + \epsilon_{i,t-1}, \tag{22}$$

where i represents the firm i in the sample, k is the industry of the firm, and t is the year of exit. X_{ij} is an independent variable indexed by j as in equation (16), measured at time $(t-1)$. $Z_{k,t-1}$ represents the instrumental variable, the interim market risk, measured in the year prior to the exit. This equation is estimated separately for the pre-2000 period, the post-2000 period, and for

[6] For other studies that have used the Probit-2SLS method, see Adams, Almeida, and Ferreira (2009), Hu and Lee (2020), Kamalahmadi, Yu, and Zhou (2021), Kovak, Oldenski, and Sly (2021), and Xu (2021).

the entire sample period.

From equation (22), we obtain the fitted probability of an IPO exit, $\widehat{IPO}_i$, which we then use as an instrument in the 2SLS IV regression. Namely, we estimate the following first stage 2SLS equation:

$$IPO_i = \alpha_0 + \sum_{j=1}^{J} \beta_j X_{ij} + \gamma_2 \widehat{IPO}_i + \eta_k + \epsilon_{i,t-1}. \tag{23}$$

Finally, we obtain the predicted values (i.e., $Inst\widehat{IPO}_i$) from equation (23) and use these in equations (20) and (21) in place of the IPO indicator variable to estimate the second stage of the 2SLS analysis. Note that since the endogenous indicator variable IPO_i is also interacted with some other exogenous variables (namely, product market competition variables, $Herfindahl$ or $Leader$, and the post-2000 indicator variable, $post2000$) in some of the outcome regressions given in (18) and (19), the interactions of the fitted probability of an IPO exit ($\widehat{IPO}_i$) with these other exogenous variables are also used as additional instrumental variables in the first stage of the 2SLS method (see Wooldridge (2010)) in these regression specifications.

We present the results of our IV regression analysis for the dynamics of the IPO valuation premium in Table 10. Panel A of Table 10 reports the results of the first-stage probit regressions. The positive and significant coefficient estimates of interim market risk (as proxied by the mean annual industry beta of the firm's industry peers) show that our instrument is strongly associated with the IPO exit choice indicator variable, confirming the relevance of our instrument. In Panel B of Table 10, we report the results of the second stage of 2SLS regressions. The format of this table is the same as that of Table 5 except that we replace the potentially endogenous IPO indicator variable with its instrumented variable. The results in all columns confirm those of Table 5, indicating that the valuation premium of IPOs over acquisitions significantly declined in the post-2000 period compared to the pre-2000 period.

In Panel C of Table 10, we provide various test statistics to assess whether the instrumental variable satisfies some identification restrictions. Specifically, we examine whether our instrument satisfies the relevance and exclusion conditions. The Kleibergen-Paap rk LM and Sanderson-Windmeijer F statistics in all specifications are large and statistically significant, which confirms that our selected instrument is correlated with the endogenous variable. Even though our tests imply that our excluded instruments are relevant, their weak correlation with the endogenous variables could lead to weak-instruments problem. As a result, we report two weak identification tests (Kleibergen-Paap Wald F and Cragg-Donald F statistics) and show that both of these exceed the conventional Stock-Yogo weak ID critical values (< 10%), rejecting the null that the instruments are weak. Our tests also reject the null hypothesis of weak instruments (Anderson-Rubin Wald test), suggesting that the coefficients of the endogenous regressors in the structural equation are jointly different from zero.

Further, Panel C of Table 10 reports an overidentification test (Hansen J statistic), which suggests that we cannot reject the null hypothesis that the instruments are validly identified. In addition, we also report the C (GMM distance) statistic to test whether 2SLS IV is preferred over the OLS. The endogenous variables used to calculate this statistic are the IPO indicator variable and its interaction with the post-2000 indicator. The null hypothesis is whether the variables are exogenous. All specifications suggest that the potentially endogenous variables are actually exogenous, so we can rely on the OLS estimates of Table 5. In fact, the OLS coefficients of our main variables of concern are around a third as large compared to the 2SLS estimates, providing a more conservative estimation of the effect we report. For example, the interaction term between the IPO indicator and post-2000 period indicator is -0.143 using the OLS estimates and -0.410 using the 2SLS estimates.

We present the results of our IV regression analysis for the interaction between the dynamics of the IPO valuation premium and product market competition in Table 11. In Table 11, we instrument for the endogenous IPO indicator variable using the interim market risk measure as a plausibly exogenous instrument as described in equations (22) and (23). As noted previously, we also instrument for all the interactions of the endogenous IPO indicator variable with other exogenous variables, using the interactions of the fitted probability of an IPO exit (obtained from the probit regression) with these exogenous variables as additional instrumental variables. Since the probit regressions of the probit-2SLS method are already presented in Panel A of Table 10, we only present the results from the second stage of the 2SLS regressions (Panel A) along with the results of identification and endogeneity tests (Panel B). In Panel A of Table 11, the coefficient estimates in all second-stage regression specifications are qualitatively and quantitatively similar to our key results in OLS regressions reported in Table 6, indicating that the decline in the valuation premium of IPOs over acquisitions in the post-2000 period is larger in industries with higher product market concentration. The results of the identification and endogeneity tests in Panel B of Table 11, confirm the validity of our instrument and suggest that our endogenous variable is actually exogenous (except specification (6)). Therefore, we can rely on the more conservative OLS estimates reported in Table 6.

7 Conclusion

We analyzed the dynamics of private firms' exit choice between IPOs and acquisitions and the valuation premium of IPOs over acquisitions from pre-2000 to post-2000. We first developed a two-period theoretical model, where in each period, entrepreneurs with private information about the viability of their firm in product market competition choose between IPOs and acquisitions. A key driver of exit choice in each period is the potential help that acquirers can provide to target private firms if they choose to be acquired ("acquisition synergy"), whereas firms that choose to go public do not receive such help. In equilibrium, only higher quality private firms choose to exit through an IPO, while lower quality private firms choose to be acquired. We analyzed the dynamics of the above single-period IPO versus acquisition choice by assuming a positive shock to acquisition synergy between the two periods (i.e., pre- versus post-2000). This generates the testable prediction that, while the quality of IPO firms increases after 2000, the average value of acquired firms also increases, leading to a potential shrinkage in the IPO valuation premium. We tested the predictions of our model using a sample of private firms exits between 1995 and 2019. First, we found that the fraction of exiting firms that chose an IPO over an acquisition declined significantly in the post-2000 period compared to pre-2000. Second, the IPO valuation premium remains positive in both the pre-2000 and post-2000 periods. Third, the IPO valuation premium shrank significantly from the pre-2000 to the post-2000 period. Fourth, consistent with our theory, the reduction in the IPO valuation premium was significantly larger in the case of private firms in industries where the ability of potential acquirers to help exiting private firms is larger, namely, in more concentrated industries and in industries where the leading public firm had a greater market share.

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Table 1. Deal Values and Industry Decomposition for IPOs and M&As

This table presents the deal values and industry decomposition for IPOs and M&As for our sample. We use a sample of U.S. private target firms acquired by U.S. public firms and initial public offerings announced over the period between January 1, 1995 and December 31, 2019. The IPO sample is obtained from the SDC database on U.S. Global New issues. The sample excludes deals characterized as spin-offs, ADRs, unit offerings, foreign issues, reverse LBOs, close-end funds, REITs, financial and regulated utilities firms and offerings less than $5 million in size. IPO firms must be listed in the NYSE, AMEX, or NASDAQ exchange, and the issuing firm to have data available in CRSP and Compustat in the fiscal year prior to the exit. The M&As sample is obtained from Thomson Financial SDC Mergers and Acquisitions Database (SDC). The sample includes 100% acquisitions of U.S. private firms acquired by U.S. public firms listed in NYSE, AMEX, or NASDAQ. The transaction value is larger than or equal to $5 million (in 2019 dollars) and the deal status is marked as completed in SDC. Firms listed as financials (SIC of 6000-6999) or regulated utilities (SIC of 4900-4999) are excluded. Private firms must have financial information in the U.S. Securities and Exchange Commission (SEC) EDGAR database. Panel A reports deal value statistics (in 2019 dollars) for both the IPO and M&A samples. Panel B reports the top 10 industries (two-digit SIC code) for both the IPO and M&A samples.

Panel A: Deal Value Statistics for IPOs and M&As

	IPOs				M&As			
Year	N	Mean	Median	Sum	N	Mean	Median	Sum
1995	309	$424	$196	$131,132	87	$124	$70	$10,793
1996	270	$420	$195	$113,305	150	$156	$61	$23,407
1997	241	$356	$173	$85,673	243	$144	$35	$34,968
1998	152	$462	$224	$70,226	241	$124	$40	$29,845
1999	311	$993	$429	$308,902	250	$202	$58	$50,548
2000	240	$818	$520	$196,196	213	$244	$90	$51,890
2001	44	$721	$457	$31,731	88	$145	$54	$12,791
2002	42	$1054	$551	$44,273	69	$128	$52	$8,813
2003	37	$755	$467	$27,946	87	$140	$71	$12,184
2004	115	$1025	$406	$117,890	130	$151	$49	$19,607
2005	99	$638	$409	$63,159	103	$154	$61	$15,865
2006	97	$697	$396	$67,561	100	$143	$63	$14,282
2007	102	$699	$475	$71,278	101	$148	$67	$14,909
2008	15	$699	$476	$10,487	72	$149	$56	$10,708
2009	32	$1339	$670	$42,861	42	$151	$58	$6,329
2010	51	$1874	$507	$95,596	49	$186	$70	$9,123
2011	48	$1566	$714	$75,152	64	$300	$167	$19,200
2012	51	$2681	$515	$136,738	66	$341	$108	$22,474
2013	73	$1188	$451	$86,755	45	$254	$106	$11,448
2014	80	$728	$354	$58,203	81	$417	$60	$33,766
2015	48	$1005	$547	$48,234	65	$411	$96	$26,697
2016	46	$772	$529	$35,494	34	$219	$193	$7,459
2017	57	$1095	$657	$62,386	43	$302	$83	$13,003
2018	58	$1243	$523	$72,064	58	$341	$189	$19,776
2019	28	$5389	$973	$150,889	42	$362	$234	$15,197
Total	2646	$833	$353	$2,204,130	2523	$196	$63	$495,082

Panel B: Top 10 Industries with IPOs and M&As

Industry - IPOs	SIC	N	Industry - M&As	SIC	N
Business Services	73	860	Business Services	73	880
Chemical and Allied Products	28	247	Electronic & other electric equipment	36	192
Electronic & other electric equipment	36	230	Instruments and Related Products	38	154
Instruments and Related Products	38	192	Engineering & Management Services	87	152
Communication	48	120	Chemical and Allied Products	28	114
Industrial Machinery and Equipment	35	107	Communication	48	95
Engineering & Management Services	87	99	Health Services	80	86
Health Services	80	73	Industrial Machinery and Equipment	35	79
Miscellaneous Retail	59	69	Oil and Gas Extraction	13	70
Oil and Gas Extraction	13	60	Wholesale Trade – Durable Goods	50	69

Table 2. Summary Statistics

This table present the summary statistics for our sample. We use a sample of U.S. private target firms acquired by U.S. public firms and initial public offerings announced over the period between January 1, 1995 and December 31, 2019. Refer to Appendix Table A.1 for detailed variable descriptions. Columns (1), (3), and (5) report statistics for the M&A sample, while columns (2), (4), and (6) for the IPO sample. Columns (1) and (2) show the statistics for the entire sample, columns (3) and (4) for the period including or before 2000, and columns (5) and (6) for the period after 2000.

		All		Before 2000		After 2000	
		(1) M&As	(2) IPOs	(3) M&As	(4) IPOs	(5) M&As	(6) IPOs
Panel A: Valuation measures							
Price-to-sales	*mean*	1.04	1.96	1.12	2.12	0.97	1.73
	median	0.78	1.74	0.74	1.88	0.80	1.58
	n	2523	2646	1184	1523	1339	1123
Price-to-book equity	*mean*	2.30	2.74	2.42	2.96	2.19	2.42
	median	2.12	2.6	2.25	2.84	1.99	2.28
	n	1965	2169	946	1277	1019	892
Panel B: Product market competition measures							
Herfindahl	*mean*	0.06	0.05	0.06	0.05	0.06	0.06
	median	0.04	0.04	0.05	0.05	0.04	0.04
Leader	*mean*	0.15	0.14	0.16	0.14	0.15	0.14
	median	0.13	0.12	0.12	0.12	0.14	0.12
	n	2523	2646	1184	1523	1339	1123
Panel C: Control variables							
Size	*mean*	78.24	284.24	61.05	147.17	93.43	470.12
	median	16.55	53.38	12.93	33.28	20.66	104.53
	n	2523	2646	1184	1523	1339	1123
Sales	*mean*	103.29	261.45	78.26	158.47	125.41	401.11
	median	25.81	54.56	21.61	34.84	29.37	104.99
ROA	*mean*	-0.21	-0.25	-0.21	-0.27	-0.22	-0.23
	median	0.04	-0.02	0.04	-0.01	0.04	-0.03
Tangibility	*mean*	0.23	0.22	0.25	0.23	0.21	0.21
	median	0.15	0.14	0.18	0.16	0.12	0.12
CAPEX	*mean*	0.08	0.09	0.09	0.10	0.06	0.07
	median	0.04	0.06	0.06	0.07	0.03	0.04
R&D	*mean*	0.17	0.18	0.16	0.17	0.19	0.19
	median	0.00	0.06	0.00	0.05	0.00	0.08
Leverage	*mean*	0.36	0.35	0.40	0.34	0.33	0.35
	median	0.21	0.24	0.26	0.23	0.18	0.26
CRSP	*mean*	0.08	0.10	0.09	0.12	0.06	0.08
	median	0.08	0.10	0.09	0.11	0.07	0.08
Mean error	*mean*	328.67	364.20	514.03	428.49	164.78	277.02
	median	10.27	19.95	31.72	25.68	3.01	3.00
VC-backed	*mean*	0.31	0.49	0.23	0.48	0.38	0.50
	median	0.00	0.00	0.00	0.00	0.00	1.00
Sales growth	*mean*	0.85	0.92	0.95	1.33	0.75	0.62
	median	0.30	0.42	0.34	0.63	0.26	0.31
	n	1497	1758	712	737	785	1021

Table 3. The Dynamics of the Choice between IPO and Acquisitions

This table presents the results of probit regression analysis. The dependent variable equals to 1 if the observation is an IPO and equals to 0 if it is an acquisition. We use a sample of U.S. private target firms acquired by U.S. public firms and initial public offerings announced over the period between January 1, 1995 and December 31, 2019. ***Post-2000*** is a dummy variable that equals 1 if the event is announced in 2001 or later. Columns (1) and (2) include the entire sample. Columns (3) and (4) report the results based on non-VC-backed and VC-backed transactions, respectively. Columns (5) and (6) report the results based on low and high R&D intensity firms. Refer to Appendix Table A.1 for detailed variable descriptions. The p-values are reported in parentheses and are based on robust standard errors adjusted for heteroskedasticity. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	(1) All	(2) All	(3) Non-VC	(4) VC	(5) Low R&D	(6) High R&D
Post-2000	-0.268***	-0.149*	-0.049	-0.254*	-0.261***	-0.127
	(0.000)	(0.068)	(0.609)	(0.052)	(0.006)	(0.288)
Herfindahl		-1.709***	-1.759**	-1.767	0.012	-3.229*
		(0.005)	(0.013)	(0.190)	(0.986)	(0.057)
Size		0.506***	0.523***	0.422***	0.456***	0.646***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ROA		-0.142**	-0.259***	0.017	-0.415***	-0.176**
		(0.025)	(0.001)	(0.852)	(0.000)	(0.024)
CAPEX		2.429***	2.533***	1.953***	2.259***	2.118***
		(0.000)	(0.000)	(0.005)	(0.000)	(0.002)
R&D		0.500***	0.483***	0.597***		
		(0.000)	(0.000)	(0.000)		
Leverage		-0.049	0.186**	-0.403***	-0.079	0.091
		(0.466)	(0.031)	(0.000)	(0.461)	(0.339)
CRSP		0.955***	1.333***	0.576	1.391***	0.466
		(0.000)	(0.000)	(0.111)	(0.000)	(0.159)
Mean error		0.000	0.000	0.000	-0.000**	0.000
		(0.541)	(0.762)	(0.544)	(0.020)	(0.473)
Sales growth		0.097***	0.077***	0.137***	0.112***	0.120***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tangibility		-0.979***	-1.042***	-0.746**	-0.490**	-0.448
		(0.000)	(0.000)	(0.015)	(0.015)	(0.187)
VCbacked		0.345***			-0.075	0.305***
		(0.000)			(0.419)	(0.001)
Constant	0.158***	-2.048***	-2.263***	-1.184***	-2.179***	-2.136***
	(0.006)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	5169	3255	1825	1430	1486	1769
Pseudo R-squared	0.008	0.228	0.295	0.135	0.248	0.255

Table 4. Product Market Competition and the Dynamics of the Choice between IPOs and Acquisitions

This table presents the results of probit regression analysis. The dependent variable equals to 1 if the observation is an IPO and equals to 0 if it is an acquisition. We use a sample of U.S. private target firms acquired by U.S. public firms and initial public offerings announced over the period between January 1, 1995 and December 31, 2019. ***Herfindahl*** is the lagged value of Herfindahl Index at the two-digit SIC level. ***Leader*** is the market share of the leading public firm in the same industry (two-digit SIC level) as the private firm, with the largest market share at the time of exit. ***Post-2000*** is a dummy variable that equals 1 if the event is announced in 2001 or later. Columns (1) and (4) include only events announced before 2001. Columns (2) and (5) include observations announced in 2001 or later. Columns (3) and (6) include the entire sample. Refer to Appendix Table A.1 for detailed variable descriptions. The p-values are reported in parentheses and are based on robust standard errors adjusted for heteroskedasticity. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	(1) Before	(2) After	(3) All	(4) Before	(5) After	(6) All
Herfindahl	-1.612	-1.941***	-1.671			
	(0.112)	(0.006)	(0.117)			
Post-2000 × Herfindahl			-0.069			
			(0.956)			
Leader				-0.883*	-1.579***	-0.831
				(0.099)	(0.001)	(0.165)
Post-2000 × Leader						-0.723
						(0.339)
Post-2000			-0.146			-0.057
			(0.211)			(0.689)
Size	0.452***	0.545***	0.506***	0.450***	0.543***	0.504***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ROA	-0.141*	-0.116	-0.143**	-0.149*	-0.119	-0.149**
	(0.081)	(0.190)	(0.026)	(0.060)	(0.170)	(0.017)
CAPEX	2.312***	2.691***	2.430***	2.347***	2.730***	2.472***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R&D	0.182	0.760***	0.499***	0.172	0.736***	0.479***
	(0.282)	(0.000)	(0.000)	(0.292)	(0.000)	(0.000)
Leverage	-0.146	0.029	-0.049	-0.145	0.032	-0.048
	(0.134)	(0.765)	(0.466)	(0.136)	(0.743)	(0.476)
CRSP	1.469***	0.653**	0.955***	1.495***	0.658**	0.971***
	(0.000)	(0.046)	(0.000)	(0.000)	(0.041)	(0.000)
Mean error	-0.000	0.000*	0.000	-0.000	0.000	0.000
	(0.335)	(0.088)	(0.541)	(0.341)	(0.133)	(0.616)
Sales growth	0.096***	0.087***	0.097***	0.098***	0.090***	0.099***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tangibility	-1.056***	-0.946***	-0.979***	-1.083***	-0.968***	-1.003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
VCbacked	0.525***	0.214**	0.345***	0.534***	0.211**	0.346***
	(0.000)	(0.011)	(0.000)	(0.000)	(0.011)	(0.000)
Constant	-1.830***	-2.368***	-2.050***	-1.787***	-2.239***	-2.010***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	1449	1806	3255	1449	1806	3255
Pseudo R-squared	0.209	0.254	0.228	0.209	0.257	0.230

Table 5. The Dynamics of the IPO Valuation Premium

This table presents the results of a regression analysis, where the dependent variable is our measure of valuation. In columns (1) - (3), the valuation measure is the natural logarithm of the price-to-sales ratio, while in columns (4) - (6) the natural logarithm of the price-to-book equity ratio. Price for an IPO is defined as the offering price multiplied by the number of shares outstanding, and price for an acquisition is defined as the deal value paid for the private target by the acquiring firm. Sales is the private firm's sales in the year prior to the event. Book equity is the book value of equity of the private firm in the year prior to the event. We use a sample of U.S. private target firms acquired by U.S. public firms and initial public offerings announced over the period between January 1, 1995 and December 31, 2019. ***Post-2000*** is a dummy variable that equals 1 if the event is announced in 2001 or later. ***IPO*** is a dummy variable that equals 1 if the observation is an IPO and equals 0 if it is an acquisition. Columns (1) and (4) include only events announced before 2001. Columns (2) and (5) include observations announced in 2001 or later. Columns (3) and (6) include the entire sample. Refer to Appendix Table A.1 for detailed variable descriptions. The p-values are reported in parentheses and are based on robust standard errors adjusted for heteroskedasticity. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Y: Price-to-sales			Y: Price-to-book equity		
	(1) Before	(2) After	(3) All	(4) Before	(5) After	(6) All
IPO	1.101***	0.920***	1.092***	1.125***	0.766***	1.072***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Post-2000			-0.301***			0.179***
			(0.000)			(0.006)
IPO × Post-2000			-0.143**			-0.234***
			(0.036)			(0.001)
Herfindahl	7.852***	-12.177***	3.992***	3.946***	-27.803***	0.291
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.669)
Size	-0.304***	-0.182***	-0.239***	-0.546***	-0.364***	-0.455***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ROA	-0.706***	-0.583***	-0.710***	-0.073	0.158***	-0.013
	(0.000)	(0.000)	(0.000)	(0.159)	(0.007)	(0.729)
Tangibility	-0.606***	-0.711***	-0.625***	-0.680***	-0.227	-0.676***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.281)	(0.000)
CAPEX	2.861***	1.850***	2.755***	2.457***	1.463***	2.499***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
R&D	0.151	0.101	0.127*	1.291***	1.584***	1.368***
	(0.121)	(0.325)	(0.073)	(0.000)	(0.000)	(0.000)
Leverage	-0.286***	-0.302***	-0.286***	1.824***	1.521***	1.714***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
CRSP	0.004	0.138	0.125	0.624***	0.430***	0.553***
	(0.985)	(0.317)	(0.285)	(0.001)	(0.009)	(0.000)
Mean error	0.000***	-0.000	0.000*	0.000***	-0.000**	0.000
	(0.003)	(0.407)	(0.080)	(0.000)	(0.033)	(0.205)
VCbacked	0.636***	0.313***	0.437***	-0.015	0.209***	0.078**
	(0.000)	(0.000)	(0.000)	(0.733)	(0.000)	(0.012)
Constant	1.415***	4.704***	-0.078	2.111***	13.283***	4.330***
	(0.000)	(0.000)	(0.767)	(0.000)	(0.000)	(0.000)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5207	3854	9061	4108	2948	7056
Adj. R-squared	0.533	0.439	0.483	0.516	0.351	0.449

Table 6. Product Market Competition and the Dynamics of the IPO Valuation Premium

Panel A of this table presents the results of regressions, where the dependent variable is the natural logarithm of the price-to-sales ratio. In Panel B, the dependent variable is the natural logarithm of the price-to-book equity ratio. Price for an IPO is defined as the offering price multiplied by the number of shares outstanding, and price for an acquisition is defined as the deal value paid for the private target by the acquiring firm. Sales is the private firm's sales in the year prior to the event. Book equity is the book value of equity of the private firm in the year prior to the event. We use a sample of U.S. private target firms acquired by U.S. public firms and initial public offerings announced over the period between January 1, 1995 and December 31, 2019. ***Herfindahl*** is the lagged value of Herfindahl Index at the two-digit SIC level. ***Leader*** is the market share of the leading public firm in the same industry (two-digit SIC level) as the private firm, with the largest market share at the time of exit. ***Post-2000*** is a dummy variable that equals 1 if the event is announced in 2001 or later. ***IPO*** is a dummy variable that equals 1 if the observation is an IPO and equals 0 if it is an acquisition. Columns (1) and (4) include only events announced before 2001. Columns (2) and (5) include observations announced in 2001 or later. Columns (3) and (6) include the entire sample. Refer to Appendix Table A.1 for detailed variable descriptions. In Panel B, *Controls* are the same control variables used in Panel A. The p-values are reported in parentheses and are based on robust standard errors adjusted for heteroskedasticity. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Price-to-Sales Ratio

	(1) Before	(2) After	(3) All	(4) Before	(5) After	(6) All
IPO × Herfindahl	0.482	-5.870***	0.674			
	(0.642)	(0.001)	(0.494)			
IPO × Post-2000 × Herfindahl			-7.056***			
			(0.002)			
IPO × Leader				-0.009	-3.018***	0.237
				(0.987)	(0.001)	(0.649)
IPO × Post-2000 × Leader						-4.256***
						(0.000)
IPO	1.077***	1.152***	1.057***	1.108***	1.310***	1.064***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Herfindahl	7.453***	-7.985***	3.341***			
	(0.000)	(0.009)	(0.005)			
Post-2000 × Herfindahl			5.325***			
			(0.008)			
Leader				4.649***	-2.013**	3.458***
				(0.000)	(0.046)	(0.000)
Post-2000 × Leader						-2.308**
						(0.023)
Post-2000			-0.529***			0.007
			(0.000)			(0.963)
IPO × Post-2000			0.150			0.378**
			(0.207)			(0.017)
Size	-0.304***	-0.181***	-0.239***	-0.300***	-0.188***	-0.235***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ROA	-0.705***	-0.583***	-0.709***	-0.676***	-0.576***	-0.686***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tangibility	-0.600***	-0.708***	-0.621***	-0.542***	-0.687***	-0.561***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
CAPEX	2.854***	1.822***	2.742***	2.765***	1.734***	2.646***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R&D	0.151	0.109	0.130*	0.166*	0.101	0.137**
	(0.123)	(0.289)	(0.066)	(0.080)	(0.323)	(0.048)
Leverage	-0.286***	-0.299***	-0.285***	-0.293***	-0.307***	-0.295***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
CRSP	0.004	0.130	0.123	-0.191	0.151	0.001
	(0.983)	(0.343)	(0.292)	(0.341)	(0.269)	(0.992)

Mean error	0.000***	-0.000	0.000*	0.000	-0.000	0.000
	(0.003)	(0.412)	(0.082)	(0.137)	(0.543)	(0.343)
VCbacked	0.636***	0.311***	0.438***	0.626***	0.306***	0.419***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	1.437***	3.344***	-1.366***	0.894***	1.914***	0.248
	(0.000)	(0.001)	(0.009)	(0.000)	(0.001)	(0.525)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5207	3854	9061	5207	3854	9061
Adj. R-squared	0.533	0.440	0.483	0.540	0.443	0.491

Panel B: Price-to-Book Ratio

	(1) Before	(2) After	(3) All	(4) Before	(5) After	(6) All
IPO × Herfindahl	0.341	-3.486	1.008			
	(0.717)	(0.114)	(0.259)			
IPO × Post-2000 × Herfindahl			-7.740***			
			(0.007)			
IPO × Leader				0.385	-0.431	0.805*
				(0.425)	(0.672)	(0.084)
IPO × Post-2000 × Leader						-3.101**
						(0.013)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4108	2948	7056	4108	2948	7056
Adj. R-squared	0.516	0.351	0.450	0.521	0.358	0.457

Table 7. Acquisition Synergy, Product Market Competition, and the Dynamics of the IPO Valuation Premium

This table presents the results of a regression analysis, where the dependent variable is our measure of valuation. In Panel A, in columns (1) - (3), the valuation measure is the natural logarithm of the price-to-sales ratio, while in columns (4) - (6) the natural logarithm of the price-to-book equity ratio. ***Synergy*** is the average acquisition synergy of public acquisitions by year and industry. We calculate acquisition synergy as the value-weighted acquirer and target cumulative abnormal returns (CARs) around acquisition announcement (as in Kose, Kadyrzhanova, and Lee (2022)). Panel B shows the effect of the product market competition on the dynamics of IPO valuation premium for high and low acquisition synergy subsamples, based on industry medians. The dependent variable is the natural logarithm of the price-to-sales ratio (columns (1), (3), (5), and (7)) and the natural logarithm of the price-to-book equity ratio (columns (2), (4), (6), and (8)). We use a sample of U.S. private target firms acquired by U.S. public firms and initial public offerings announced over the period between January 1, 1995 and December 31, 2019. ***Herfindahl*** is the lagged value of Herfindahl Index at the two-digit SIC level. ***Leader*** is the market share of the leading public firm in the same industry (two-digit SIC level) as the private firm, with the largest market share at the time of exit. ***Post-2000*** is a dummy variable that equals 1 if the event is announced in 2001 or later. ***IPO*** is a dummy variable that equals 1 if the observation is an IPO and equals 0 if it is an acquisition. Refer to Appendix Table A.1 for detailed variable descriptions. *Controls* are the same controls variables used in Table 6. The *p*-values are reported in parentheses and are based on robust standard errors adjusted for heteroskedasticity. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Acquisition Synergy and the Dynamics of the IPO Valuation Premium

	Y: Price-to-sales (P/S)			Y: Price-to-book equity (P/E)		
	(1) Before	(2) After	(3) All	(4) Before	(5) After	(6) All
IPO × Synergy	-0.236	-3.117***	-0.600	-0.083	-2.400**	-0.242
	(0.766)	(0.008)	(0.451)	(0.907)	(0.046)	(0.722)
IPO × Post-2000 × Synergy			-3.100**			-2.500*
			(0.022)			(0.065)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4977	2992	7969	3918	2307	6225
Adj. R-squared	0.520	0.454	0.488	0.522	0.360	0.482

Panel B: Product Market Competition and the Dynamics of the IPO Valuation Premium based on High- and Low-synergy subsamples

	High Synergy				Low Synergy			
	(1) P/S	(2) P/E	(3) P/S	(4) P/E	(5) (P/S)	(6) (P/E)	(7) (P/S)	(8) (P/E)
IPO × Herfindahl	2.355*	1.526			-5.604***	-4.266***		
	(0.099)	(0.177)			(0.000)	(0.001)		
IPO×Post-2000×Herfindahl	-5.323**	-6.743**			-1.691	-3.234		
	(0.030)	(0.025)			(0.800)	(0.626)		
IPO × Leader			1.298	1.441**			-2.303***	-1.242**
			(0.108)	(0.027)			(0.001)	(0.042)
IPO×Post-2000×Leader			-3.605***	-3.320**			-0.233	-0.003
			(0.006)	(0.022)			(0.910)	(0.999)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Observations	5999	4611	5999	4611	4387	3452	4387	3452
Adj. R-squared	0.497	0.453	0.493	0.464	0.521	0.480	0.529	0.486

Table 8. The Dynamics of the IPO Valuation Premium in VC-backed Firms

This table presents the results of a regression analysis based on VC-backed and non-VC-backed transactions, where the dependent variable is our measure of valuation. Panel A shows the dynamics of IPO valuation premium. In columns (1)-(6), the valuation measure is the natural logarithm of the price-to-sales ratio, while in columns (7)-(12) the natural logarithm of the price-to-book equity ratio. Panel B shows the effect of the product market competition on the dynamics of IPO valuation premium. The dependent variable is the natural logarithm of the price-to-sales ratio. Price for an IPO is defined as the offering price multiplied by the number of shares outstanding, and price for an acquisition is defined as the deal value paid for the private target by the acquiring firm. Sales is the private firm's sales in the year prior to the event. We use a sample of U.S. private target firms acquired by U.S. public firms and initial public offerings announced over the period between January 1, 1995 and December 31, 2019. ***Herfindahl*** is the lagged value of Herfindahl Index at the two-digit SIC level. ***Leader*** is the market share of the leading public firm in the same industry (two-digit SIC level) as the private firm, with the largest market share at the time of exit. ***Post-2000*** is a dummy variable that equals 1 if the event is announced in 2001 or later. ***IPO*** is a dummy variable that equals 1 if the observation is an IPO and equals 0 if it is an acquisition. Columns (1), (4), (7), and (10) include only events announced before 2001. Columns (2), (5), (8), and (11) include observations announced in 2001 or later. Columns (3), (6), (9), and (12) include the entire sample. Refer to Appendix Table A.1 for detailed variable descriptions. *Controls* are the same controls variables used in Table 6. The *p*-values are reported in parentheses and are based on robust standard errors adjusted for heteroskedasticity. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	VC Backed			Non-VC Backed			VC Backed			Non-VC Backed		
	(1) Before	(2) After	(3) All	(4) Before	(5) After	(6) All	(7) Before	(8) After	(9) All	(10) Before	(11) After	(12) All
Panel A: IPO Valuation Dynamics												
	Y: Price-to-sales						Y: Price-to-book equity					
IPO	0.553***	0.703***	0.638***	1.207***	1.101***	1.200***	0.966***	0.852***	0.851***	1.179***	0.731***	1.179***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Post-2000			-0.867***			-0.082			-0.203			0.351***
			(0.000)			(0.264)			(0.110)			(0.000)
IPO × Post-2000			0.160			-0.086			0.116			-0.414***
			(0.261)			(0.293)			(0.375)			(0.000)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1347	1931	3278	3869	1915	5784	1018	1470	2488	3142	1470	4612
Adj. R-squared	0.360	0.381	0.388	0.549	0.452	0.513	0.538	0.342	0.383	0.520	0.433	0.511
Panel B: Product Market Competition and IPO Valuation Dynamics												
IPO × Herfindahl	0.389	-6.376	2.135	0.692	-4.281**	0.830						
	(0.902)	(0.249)	(0.491)	(0.533)	(0.021)	(0.428)						
IPO×Post-2000×Herfindahl			-13.366**			-3.862						
			(0.030)			(0.101)						
IPO × Leader							-0.551	-4.001**	-0.018	0.346	-1.958*	0.535
							(0.730)	(0.030)	(0.991)	(0.540)	(0.080)	(0.327)
IPO×Post-2000×Leader									-5.689**			-2.484*
									(0.018)			(0.056)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1347	1931	3278	3869	1915	5784	1347	1931	3278	3869	1915	5784
Adj. R-squared	0.360	0.382	0.389	0.549	0.453	0.513	0.370	0.383	0.402	0.557	0.459	0.517

Table 9. The Dynamics of the IPO Valuation Premium and R&D Intensity

This table presents the results of a regression analysis based on high and low R&D intensity firms, where the dependent variable is our measure of valuation. Panel A shows the dynamics of IPO valuation premium. In columns (1)-(6), the valuation measure is the natural logarithm of the price-to-sales ratio, while in columns (7)-(12) the natural logarithm of the price-to-book equity ratio. Panel B shows the effect of the product market competition on the dynamics of IPO valuation premium. The dependent variable is the natural logarithm of the price-to-sales ratio. Price for an IPO is defined as the offering price multiplied by the number of shares outstanding, and price for an acquisition is defined as the deal value paid for the private target by the acquiring firm. Sales is the private firm's sales in the year prior to the event. Book equity is the book value of equity of the private firm in the year prior to the event. We use a sample of U.S. private target firms acquired by U.S. public firms and initial public offerings announced over the period between January 1, 1995 and December 31, 2019. ***Herfindahl*** is the lagged value of Herfindahl Index at the two-digit SIC level. ***Leader*** is the market share of the leading public firm in the same industry (two-digit SIC level) as the private firm, with the largest market share at the time of exit. ***Post-2000*** is a dummy variable that equals 1 if the event is announced in 2001 or later. ***IPO*** is a dummy variable that equals 1 if the observation is an IPO and equals 0 if it is an acquisition. Columns (1) and (4) include only events announced before 2001. Columns (2) and (5) include observations announced in 2001 or later. Columns (3) and (6) include the entire sample. Refer to Appendix Table A.1 for detailed variable descriptions. *Controls* are the same controls variables used in Table 6 except of the R&D. The p-values are reported in parentheses and are based on robust standard errors adjusted for heteroskedasticity. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	High R&D			Low R&D			High R&D			Low R&D		
	(1) Before	(2) After	(3) All	(4) Before	(5) After	(6) All	(7) Before	(8) After	(9) All	(10) Before	(11) After	(12) All
Panel A: IPO Valuation Dynamics												
	Y: Price-to-sales						Y: Price-to-book equity					
IPO	0.974***	0.820***	0.986***	1.029***	0.566***	1.062***	1.250***	1.010***	1.193***	1.099***	0.335***	1.040***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
Post-2000			-0.674***			0.129			0.166			0.243***
			(0.000)			(0.119)			(0.126)			(0.005)
IPO×Post-2000			-0.122			-0.429***			-0.147			-0.422***
			(0.268)			(0.000)			(0.190)			(0.000)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2298	2405	4703	2839	1255	4094	1810	1782	3592	2354	1117	3471
Adj. R-squared	0.438	0.375	0.435	0.512	0.396	0.480	0.524	0.311	0.414	0.532	0.267	0.463
Panel B: Product Market Competition and IPO Valuation Dynamics												
IPO×Herfindahl	1.640	4.899	5.134**	-0.024	-5.886***	-0.400						
	(0.486)	(0.466)	(0.031)	(0.984)	(0.001)	(0.726)						
IPO×Post-2000×Herfindahl			-5.125			-4.962**						
			(0.488)			(0.012)						
IPO×Leader							0.769	-0.975	1.602	-0.361	-2.339**	-0.540
							(0.538)	(0.585)	(0.190)	(0.559)	(0.046)	(0.361)
IPO×Post-2000×Leader									-2.889			-2.003
									(0.183)			(0.125)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2298	2405	4703	2839	1255	4094	2298	2405	4703	2839	1255	4094
Adj. R-squared	0.441	0.376	0.439	0.513	0.400	0.482	0.452	0.375	0.455	0.514	0.403	0.480

Table 10. The Dynamics of the IPO Valuation Premium – Probit-2SLS regressions – Instrument: Interim Market Risk

This table presents the results of the second-stage regressions for the Probit-2SLS estimation as described in section 6. In Panel A, we run a probit regression where the dependent variable equals to 1 if the observation is an IPO and equals to zero if it is an acquisition. The key variable in this regression is industry's interim market risk as proxied by the three-year mean annual beta of the firm's industry peers. In Panel B, we present the second-stage regression where the dependent variable is the natural logarithm of the price-to-sales ratio. ***Instr. IPO-hat*** are the predicted values from equation (23) which is the instrumented variable for the possibly endogenous IPO dummy. Other exogenous variables interacted with the instrumented variable comprise of additional IVs. ***Herfindahl*** is the lagged value of Herfindahl Index at the two-digit SIC level. ***Leader*** is the market share of the leading public firm in the same industry (two-digit SIC level) as the private firm, with the largest market share at the time of exit. ***Post-2000*** is a dummy variable that equals 1 if the event is announced in 2001 or later. Controls are the same control variables used in Table 5. Panel C provides various identification and endogeneity tests from the 2SLS. Columns (1) and (4) include only events announced before 2001. Columns (2) and (5) include observations announced in 2001 or later. Columns (3) and (6) include the entire sample. Refer to Appendix Table A.1 for detailed variable descriptions. All regressions include industry fixed effects whose coefficients are suppressed. The p-values are reported in parentheses and are based on robust standard errors adjusted for heteroskedasticity. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A: First-stage probit regressions

Y: IPO	(1) Before	(2) After	(3) All	(4) Before	(5) After	(6) All
Interim market risk	0.842***	0.224**	0.210**	0.879***	0.246**	0.256***
	(0.005)	(0.031)	(0.015)	(0.000)	(0.029)	(0.004)
Post-2000			-0.290***			-0.303***
			(0.000)			(0.000)
Herfindahl	-9.325***	-7.631	-5.264***			
	(0.000)	(0.162)	(0.001)			
Leader				-3.510***	-2.054	-2.223***
				(0.000)	(0.182)	(0.000)
Size	0.462***	0.555***	0.511***	0.467***	0.554***	0.513***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ROA	-0.000	-0.021	0.014	-0.010	-0.021	0.010
	(0.996)	(0.726)	(0.733)	(0.866)	(0.727)	(0.802)
CAPEX	0.833	2.267***	1.429***	0.908*	2.254***	1.465***
	(0.116)	(0.004)	(0.000)	(0.089)	(0.004)	(0.001)
R&D	-0.163	0.309**	0.140	-0.152	0.309**	0.144
	(0.249)	(0.020)	(0.130)	(0.286)	(0.020)	(0.118)
Leverage	0.356***	0.158*	0.254***	0.359***	0.156*	0.255***
	(0.000)	(0.077)	(0.000)	(0.000)	(0.080)	(0.000)
CRSP	1.351***	0.364	0.846***	1.417***	0.368	0.879***
	(0.000)	(0.181)	(0.000)	(0.000)	(0.176)	(0.000)
Mean error	-0.000	0.000	-0.000	0.000	0.000	0.000
	(0.760)	(0.960)	(0.651)	(0.968)	(0.928)	(0.811)
Sales growth	0.100***	0.101***	0.106***	0.103***	0.100***	0.107***
	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)
Tangibility	-0.557**	-1.309***	-0.781***	-0.585**	-1.303***	-0.789***
	(0.033)	(0.001)	(0.000)	(0.024)	(0.001)	(0.000)
VCbacked	-0.300***	0.079	-0.121**	-0.295***	0.077	-0.116**
	(0.000)	(0.272)	(0.021)	(0.000)	(0.283)	(0.028)
Constant	-1.097**	-1.471***	-1.098***	-1.054**	-1.601***	-1.099***
	(0.017)	(0.000)	(0.000)	(0.020)	(0.000)	(0.000)
Observations	2962	3185	6266	2962	3185	6266
Pseudo R-squared	0.193	0.235	0.196	0.194	0.235	0.197

Y: Price-to-sales	(1) Before	(2) After	(3) All	(4) Before	(5) After	(6) All
Panel B: Second-stage regressions						
Instr. IPO-hat	**1.287*****	**0.635*****	1.079***	**1.202*****	**0.778*****	0.979***
	(0.000)	**(0.006)**	(0.000)	**(0.000)**	**(0.001)**	(0.000)
Instr. IPO-hat × Post-2000			**-0.410****			**-0.368***
			(0.031)			**(0.053)**
Herfindahl	10.825***	-13.992***	5.213***			
	(0.000)	(0.000)	(0.000)			
Leader				4.334***	-4.893***	-0.261*
				(0.000)	(0.000)	(0.093)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
F-statistic	66.40	303.86	97.32	67.56	65.11	94.40
Observations	2962	3185	6266	2962	3185	6266
Panel C: Identification and endogeneity tests						
Underidentification test						
Kleibergen-Paap rk LM statistic	181.19	143.21	327.40	180.58	142.46	145.14
χ^2 p-value	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Sanderson-Windmeijer F stat	128.53	90.77	640.96	127.67	91.28	348.28
χ^2 p-value	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Weak identification test						
Kleibergen-Paap rk Wald F statistic	128.53	90.77	143.29	127.67	91.28	145.14
Cragg-Donald Wald F statistic	142.33	107.22	168.34	143.14	105.98	171.74
Weak instrument robust inference						
Anderson-Rubin Wald test	32.58	6.56	42.61	28.70	10.37	36.41
χ^2 p-value	(0.000)	(0.038)	(0.000)	(0.000)	(0.006)	(0.000)
Endogeneity test of endogenous regressors						
C statistic (GMM distance)	2.376	2.507	4.180	1.240	1.100	3.454
χ^2 *p*-value	(0.123)	(0.113)	(0.124)	(0.266)	(0.294)	(0.178)
Overidentification test						
Hansen J statistic	2.133	0.066	0.748	2.505	0.077	0.689
χ^2 p-value	(0.144)	(0.797)	(0.387)	(0.114)	(0.781)	(0.406)

Table 11. Product Market Competition and the Dynamics of the IPO Valuation Premium – Probit-2SLS Regressions – Instrument: Interim Market Risk

This table presents the results of the second-stage regressions for the Probit-2SLS estimation as described in section 6. In Panel A, we present the second-stage regression where the dependent variable is the natural logarithm of the price-to-sales ratio. ***Instr. IPO-hat*** are the predicted values from equation (23) which is the instrumented variable (using interim market risk) for the possibly endogenous IPO dummy. Other exogenous variables interacted with the instrumented variable comprise of additional IVs. ***Herfindahl*** is the lagged value of Herfindahl Index at the two-digit SIC level. ***Leader*** is the market share of the leading public firm in the same industry (two-digit SIC level) as the private firm, with the largest market share at the time of exit. ***Post-2000*** is a dummy variable that equals 1 if the event is announced in 2001 or later. Controls are the same control variables used in Table 6. Panel B provides various identification and endogeneity tests from the 2SLS. Columns (1) and (4) include only events announced before 2001. Columns (2) and (5) include observations announced in 2001 or later. Columns (3) and (6) include the entire sample. Refer to Appendix Table A.1 for detailed variable descriptions. All regressions include industry fixed effects whose coefficients are suppressed. The p-values are reported in parentheses and are based on robust standard errors adjusted for heteroskedasticity. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Y: Price-to-sales	(1) Before	(2) After	(3) All	(4) Before	(5) After	(6) All
Panel A: Second-stage regressions						
Instr.IPO-hat × Herfindahl	**1.352**	**-9.447***	1.955			
	(0.573)	**(0.099)**	(0.416)			
Instr.IPO-hat×Post-2000×Herfindahl			**-16.636****			
			(0.008)			
Instr.IPO-hat × Leader				**-0.721**	**-4.843***	1.294
				(0.606)	**(0.092)**	(0.337)
Instr.IPO-hat×Post-2000×Leader						**-10.736*****
						(0.001)
Instr.IPO-hat	1.196***	1.049***	1.011***	1.325***	1.405***	0.964***
	(0.000)	(0.005)	(0.000)	(0.000)	(0.003)	(0.000)
Herfindahl	10.099***	-6.458	4.966**			
	(0.000)	(0.275)	(0.011)			
Post-2000 × Herfindahl			10.078**			
			(0.041)			
Leader				4.870***	-0.811	2.810**
				(0.000)	(0.758)	(0.012)
Post-2000 × Leader						2.695
						(0.325)
Post-2000			-0.657**			-0.562
			(0.031)			(0.193)
Instr.IPO-hat × Post-2000			0.276			0.944*
			(0.445)			(0.061)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
F-statistic	66.30	117.00	59.82	65.43	402.76	52.83
Observations	2962	3185	6266	2962	3185	6266

	(1) Before	(2) After	(3) All	(4) Before	(5) After	(6) All
Panel B: Identification and endogeneity tests						
Underidentification test						
Kleibergen-Paap rk LM statistic	161.58	136.33	330.96	152.53	134.12	310.44
χ^2 *p-value*	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Sanderson-Windmeijer F stat	275.78	162.26	655.61	299.92	144.99	628.42
χ^2 *p-value*	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Weak identification test						
Kleibergen-Paap rk Wald F statistic	75.98	57.28	87.18	72.27	56.63	81.44
Cragg-Donald Wald F statistic	86.76	69.93	97.03	84.92	69.19	95.32
Weak instrument robust inference						
Anderson-Rubin Wald test	32.77	7.41	51.73	28.77	10.68	63.57
χ^2 *p-value*	(0.000)	(0.060)	(0.000)	(0.000)	(0.014)	(0.000)
Endogeneity test of endogenous regressors						
C statistic (GMM distance)	2.183	3.317	8.071	1.447	2.382	15.569
χ^2 *p*-value	(0.336)	(0.190)	(0.089)	(0.485)	(0.304)	(0.004)
Overidentification test						
Hansen J statistic	2.052	0.066	0.793	2.575	0.107	0.855
χ^2 *p-value*	(0.152)	(0.797)	(0.373)	(0.109)	(0.744)	(0.355)

APPENDIX A

Table A.1. Variable Descriptions.

Variable	Description
Panel A: Dependent Variables	
Price-to-sales ratio	Price for an IPO is defined as the offering price multiplied by the number of shares outstanding, and price for an acquisition is defined as the deal value paid for the private target by the acquiring firm. Sales is the private firm's sales in the year prior to the event.
Price-to-book equity ratio	Price for an IPO is defined as the offering price multiplied by the number of shares outstanding, and price for an acquisition is defined as the deal value paid for the private target by the acquiring firm. Book equity is the book value of equity of the private firm in the year prior to the event.
Long-run adjusted price-to-sales ratio	The long-run adjusted price for an IPO is calculated using the stock market valuation of the IPO in year 0 and year 3, adjusted for the fraction of shares sold in the IPO by the firm's insiders (for details, see section 5.5). Sales is the private firm's sales in the year prior to the event.
Long-run adjusted price to-book equity ratio	The long-run adjusted price for an IPO is calculated using the stock market valuation of the IPO in year 0 and year 3, adjusted for the fraction of shares sold in the IPO by the firm's insiders (for details, see section 5.5). Book equity is the book value of equity of the private firm in the year prior to the event.
Panel B: Product Market Competition Measures	
Herfindahl	Herfindahl Index at the two-digit SIC level in year *t*-1. The Index is constructed as the sum of squares of the market shares of all firms sharing the same two-digit SIC industry, where market share is defined as sales of the firm to the aggregated sales of the industry. This variable is created using data from Compustat.
Leader	Market share of the leading public firm in the same two-digit SIC industry as the private firm, with the largest market share at the time of exit. This variable is created using data from Compustat.
Panel C: Other Variables	
IPO	Dummy variable that equals 1 if the observation is an IPO and equals 0 if it is an acquisition.
Size	Natural logarithm of the firm's book value of total assets at $t-1$.
ROA	Net income at $t-1$ scaled by the firm's total assets.
Tangibility	Net property and equipment at $t-1$ scaled by the firm's total assets.
CAPEX	Capital expenditures at $t-1$ scaled by the firm's total assets.
R&D	Research and development (R&D) expenses at $t-1$ scaled by the firm's total assets.
Leverage	Sum of long-term and short-term debt at $t-1$ scaled by the firm's total assets.
CRSP	Lagged six-month returns of the equally-weighted CRSP market index prior to the exit.
Mean error	Industry mean of average analysts forecast errors in the year prior to the exit.
Sales growth	Firm's average annual change in sales (from year −3 to −1 or from year −2 to −1 depending on data availability).
Post-2000	Dummy variable that equals 1 if the event is announced in 2001 or later.
VCbacked	Dummy variable that equals 1 if the firm was financed by venture capital, and zero otherwise.

Appendix B: Proofs of Propositions

Proof of Proposition 1. Given the entrepreneur's objective function in (10), the proofs of parts (i) and (ii) follow from the following indifference equation:

$$\alpha P^*_{IPO} + (1-\alpha)\left(q^* V_H + (1-q^*)V_L\right) + B = \rho\left(q^* V_A^H + (1-q^*)V_A^L\right). \tag{B.1}$$

Conditional on the threshold q^* and the entrepreneur's equilibrium strategies in parts (i) and (ii), the type of firms going public through an IPO has a uniform posterior distribution on the interval $[q^*, 1]$. Therefore, it follows from (9) that

$$P^*_{IPO} = \int_{q^*}^{1} \left(qV_H + (1-q)V_L\right) f(q\,|\,q \geq q^*)dq = \frac{(1+q^*)}{2} V_H + \left(1 - \frac{(1+q^*)}{2}\right) V_L. \tag{B.2}$$

Substituting P^*_{IPO} from (B.2) in (B.1), we obtain the equilibrium threshold q^* as

$$q^* = \frac{\rho V_A^L - V_L - \frac{\alpha}{2}(V_H - V_L) - B}{\rho V_A^L - V_L - \frac{\alpha}{2}(V_H - V_L) - \left(\rho V_A^H - V_H\right)}. \tag{B.3}$$

After some simplifications, we obtain:

$$q^* = \frac{\left(\rho \Delta_L - \frac{\alpha}{2}(p_H - p_L)\right)(V_S - V_F) - (1-\rho)V_L - B}{\left(\rho \Delta_L - \frac{\alpha}{2}(p_H - p_L)\right)(V_S - V_F) - (1-\rho)V_L - \left(\rho \Delta_H (V_S - V_F) - (1-\rho)V_H\right)}. \tag{B.4}$$

After some algebraic rearrangement, it follows that the condition (11) for choosing an IPO over an acquisition can be equivalently characterized as $q \geq q^*$ given that q^* satisfies the indifference condition given in (B.1). Similarly, rearranging the condition (12) for choosing an acquisition over an IPO, we find that it is equivalent to the condition that $q < q^*$.

We define

$$B_L = \rho \Delta_H (V_S - V_F) - (1-\rho)V_H, \tag{B.5}$$

and

$$B_H = \left(\rho \Delta_L - \frac{\alpha}{2}(p_H - p_L)\right)(V_S - V_F) - (1-\rho)V_L. \tag{B.6}$$

Note from (B.4) that $q^* > 0$ if and only if $B < B_H$ and $q^* < 1$ if and only if $B > B_L$.

Furthermore, the restriction $B_H > 0$ implies that $0 < \alpha < \bar{\alpha}$ where

$$\bar{\alpha} = \frac{2\left(\rho \Delta_L - (1-\rho)\frac{V_L}{(V_S - V_F)}\right)}{(p_H - p_L)}. \tag{B.7}$$

Given the entrepreneur's equilibrium strategies in parts (i) and (ii), it follows that the average acquisition value of acquired firms is given by:

$$\bar{P}_{ACQ} = \int_0^{q^*} \rho\left(qV_A^H + (1-q)V_A^L\right) f(q\,|\,q < q^*)dq = \rho\left[\frac{q^*}{2} V_A^H + \left(1 - \frac{q^*}{2}\right) V_A^L\right]. \tag{B.8}$$

■

Proof of Proposition 2. Note that in the second period, the new equilibrium threshold q^* as a function of the shock h will be given by:

$$q^* = \frac{\left(\rho(\Delta_L + h) - \frac{\alpha}{2}(p_H - p_L)\right)(V_S - V_F) - (1-\rho)V_L - B}{\left(\rho(\Delta_L + h) - \frac{\alpha}{2}(p_H - p_L)\right)(V_S - V_F) - (1-\rho)V_L - \left(\rho \Delta_H (V_S - V_F) - (1-\rho)V_H\right)}. \tag{B.9}$$

Differentiating q^* given in (B.9) with respect to h, we obtain:

$$\frac{dq^*}{dh} = \frac{\left(B - \left(\rho\Delta_H\left(V_S - V_F\right) - (1-\rho)V_H\right)\right)\rho\left(V_S - V_F\right)}{\left(\left(\rho(\Delta_L + h) - \frac{\alpha}{2}\left(p_H - p_L\right)\right)\left(V_S - V_F\right) - (1-\rho)V_L - \left(\rho\Delta_H\left(V_S - V_F\right) - (1-\rho)V_H\right)\right)^2} > 0, \tag{B.10}$$

since $B > B_L$.

Similarly, the IPO valuation premium in the second period is given by:

$$R = \frac{P^*_{IPO}(h)}{\bar{P}_{ACQ}(h)} - 1 = \frac{V_L + \frac{(1+q^*)}{2}\left(V_H - V_L\right)}{\rho\left[V_A^L(h) + \frac{q^*}{2}\left(V_A^H - V_A^L(h)\right)\right]} - 1, \tag{B.11}$$

where the threshold q^* as a function of the shock h is given in (B.9). The premium R can be equivalently simplified as a function of the shock h as follows:

$$R = \frac{V_F + p_L\left(V_S - V_F\right) + \frac{(1+q^*)}{2}\left(p_H - p_L\right)\left(V_S - V_F\right)}{\rho\left[V_F + \left(p_L + \Delta_L + h\right)\left(V_S - V_F\right) + \frac{q^*}{2}\left(p_H + \Delta_H - p_L - \Delta_L - h\right)\left(V_S - V_F\right)\right]} - 1, \tag{B.12}$$

Differentiating R given in (B.12) with respect to h, we obtain:

$$\frac{dR}{dh} = \frac{\left(V_S - V_F\right)}{\bar{P}^2_{ACQ}}\left[\frac{dq^*}{dh}\frac{\left(p_H - p_L\right)}{2}\bar{P}_{ACQ} - \left(1 + \frac{dq^*}{dh}\frac{\left(p_H - p_L + \Delta_H - \Delta_L\right)}{2} - \frac{q^*}{2}\right)P^*_{IPO}\right] < 0. \tag{B.13}$$

■