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Abstract

The paper analyzes the *strategic waiting* tendencies of IPO firms. Our game theoretic model shows why some high-quality firms may strategically delay their initial public offering until a favorable signal about the economic conditions is generated by other issuing firms. Survival analysis suggests that IPOs in the highest quality decile have significantly higher median waiting days (since the start of a rising IPO cycle) than the IPOs in the lowest decile. During the early stages of an expanding IPO cycle the average firm quality is lower than in its later stages. We find supporting evidence also from the IPOs of future S&P 500 firms.

Keywords: IPO clustering, IPO cycles, social learning, information aggregation, strategic waiting, survival analysis

JEL Classification: C41, C72, D82, D83, G30, E32

1. Introduction

The recent activity in the initial public offerings (IPOs) market has been anemic, and the overall U.S. economy was in recession (e.g., there were only two IPOs issued in the U.S. during 2008Q4 and three issued during 2009Q1). This study analyzes the strategic considerations that affect the IPO decision under such conditions.[1] It shows how some firms that are about to go public would benefit from strategically delaying their issuance to obtain more information about the current economic conditions. Extra information about economic conditions is valuable, because an IPO during an economic slowdown is riskier and costlier.[2]

In the game theoretical model we develop, the economic activity and the IPO market have a potential to improve, but there is uncertainty about when they might do so. No single economic actor knows the aggregate state of the economy to the fullest extent. Even the most informed economic actors, like the National Bureau of Economic Research (NBER) or the Federal Reserve (Fed), cannot confirm a recession or an expansion until after it starts (for example, the latest U.S. recession that started in the fourth quarter of 2007 was confirmed by NBER one year later, in late 2008.). Each individual economic agent, however, has a reliable private signal about the particular part(s) of the economy it specializes on. For example, car dealers receive *timely* information about the demand for cars, realtors about the demand for housing, investment bankers about the desire for new corporate deals, etc. In short, the information is dispersed in the hands of the public (i.e., investors).

When one of the private firms goes public successfully or unsuccessfully, the other agents in the economy obtain new information about the aggregate economic conditions. That is, the outcome of the IPO event helps these agents aggregate their privately held information. If the first IPO fails, it will incur monetary and labor costs. If successful, however, the pioneering IPO(s) will draw in

[1]The reasons for the IPO decision and the factors affecting its timing are analyzed from different angle by other studies. See for instance, Chemmanur (1993), Zingales (1995), Pagano, et al. (1998), Chemmanur and Fulghieri (1999), Hoffmann-Burchardi (2001), Stoughton, et al. (2001), Alti (2005), Benninga, et al. (2005), Pastor and Veronesi (2005), and Chod and Lyandres (2010), among others.

[2]Lowry (2003), Pastor and Veronesi (2005), and Ivanov and Lewis (2008) document that IPO activity is closely related to the current state of the economy. Our *Figure 1* also shows that the periods with the lowest number of IPOs coincide with economic slowdowns. This lack of IPO activity during economic slowdowns indicates presence of real or perceived risks of IPO failure, and/or extra costs in the form of less proceeds raised in return for higher percentage of the IPO firm's equity. Thus, there is enough evidence to suggest that the private firms believe their IPO's success to be dependent not only on their own quality, but also on the aggregate state of the economy. This makes the information on the economy valuable for them. Likewise, Choe, et al. (1993) and Korajczyk, et al. (1991) show that the seasoned equity issuances depend on the business cycle.

many more IPOs,[3] as a result of social learning among firms.[4] In such a game, the informational advantages of delayed issuance (i.e., information externalities) cause the private firms to engage in strategic waiting.[5] We show that this strategic behavior of private firms leads to some interesting game-theoretic outcomes, which, in turn, yield several valuable contributions to the IPO literature.

First, our model explicitly describes the process of endogenously selecting the order of issuance in an improving IPO market based on the quality of the competing firms' projects. Simultaneously with firms' strategic behavior, we also model the investors' demand for equity in the presence of asymmetric information about the aggregate economic state and the issuing firm's quality. The main contribution of such a model is to show that the first IPOs do not have to be of the highest quality. Various simulations and empirical tests we perform confirm this theoretical prediction.[6] This outcome separates our model from Hoffmann-Burchardi (2001), who exogenously selects which firm will go public first, and Alti (2005), whose model indirectly implies opposite sequencing outcome. Neither paper, however, provides empirical evidence supporting their arguments.

Second, this paper provides a different perspective on the causes of variation in the IPO volume, and the prolonged inactivity in the IPO markets. All the firms in our model have incentives to delay their issuance until the favorable conditions are confirmed by another firm (strategic waiting). When a successful IPO is observed, everyone will realize that enough IPO investors must have received a positive signal, which can happen only if the true economic state is good. This revelation will lead to convergence of all the opinions toward the truth (information aggregation).[7] As a result,

[3]According to Lowry and Schwert (2002) and Benveniste et al. (2003), the number of new IPOs entering the market is significantly affected by the success (and/or underpricing) of recent and contemporaneous offerings. Lowry and Schwert (2002), in particular, suggest that more positive information revealed during the registration period leads to higher initial returns and higher subsequent IPO activity.

[4]Learning from others' actions is called *social learning* in the economics literature. Chamley (2004) and Chamley and Gale (1994) are two well known examples of this literature. Throughout this paper we will use the terms "social learning" and "information spillovers" interchangeably, because we do not see any differences between them in regards to their application to the IPO market.

[5]Hendricks and Kovenock (1989) is one of the first papers in the *strategic waiting* literature. Such actions are considered "strategic," because firms wait for each other to act first and bear the costs of generating new information about the market conditions.

[6]Anecdotal evidence also supports the idea of strategic waiting by the high-quality firms. A Business Week article (May 27, 2009) writes that "If the stock market does not stabilize, many of the most promising companies can afford to sit on the sidelines." We interpret this as evidence of waiting by (high-quality) IPO firms. Another Business Week article (February 22, 2010) writes "5 of the 11 companies scheduled to go public earlier in February postponed their offerings and the remaining 6 all cut their deal sizes." We interpret these delays as indication of firms' preference of not issuing during recessions.

[7]For a more in-depth treatment of *information aggregation*, see Diamond and Verrecchia (1981), Pesendorfer and

the remaining firms will enter the market en mass, and cause IPO clustering and IPO waves. In related studies, Hoffmann-Burchardi (2001), Alti (2005), and Pastor and Veronesi (2005) also analyze IPO clustering. Unlike Pastor and Veronesi's *decision-theoretic* model, our results are driven by the *strategic* competition among the firms. One implication of this strategic competition is the prolonged inactivity in the IPO markets due to the free-riding incentives of firms; each firm wants the other one to go public first and produce the useful (but may be costly) information. This may cause inactivity with a positive probability even after the economy starts recovering. Unlike our model, however, Hoffman-Burchardi (2001) and Alti (2005)'s models do not explain this important aspect of the IPO markets.

Third contribution is related to the strand of the IPO literature that started with Ritter (1984). His paper suggests that the risk composition among IPO firms during "hot issue markets" may be changing. In a related analysis, Yung, et al. (2008) conclude that, due to the opportunistic issuance of some truly bad firms (with negative NPV), the variance of the firm quality composition during hot markets will increase. They make no predictions, however, about the mean of the quality composition, since little is known about the dynamics that affect the number of high-quality and lower-quality firms during such periods. Our study, in contrast, shows that the strategic waiting by better quality firms could affect the mean quality composition across the cycle.[8]

Fourth, this study also relates to the real options literature (e.g., Cukierman, 1980; Bernanke, 1983; Leahy and Whited, 1996; Bulan, 2005; Philippon and Sannikov, 2007). Strategic waiting of an IPO resembles the behavior of a firm that is facing a real option to wait before undertaking an event that is hard to reverse, because of various fixed costs associated with "failed IPO" (difficulties in returning to the market in the future (see Dunbar, 1998), negative publicity, loss of managerial labor, etc.). Thus, by waiting, the IPO does improve its chances of success. Draho (2000) and Pastor and Veronesi (2005) also analyze real options in the IPO markets. However, their papers do not consider strategic interaction among firms, and so the firms cannot learn from each others actions. Similar to us, Welch (1996) also shows that the high-quality IPO firms benefit from waiting before issuance (it allows them to signal their quality to the investors), but the waiting occurs in the seasoned equity offering (SEO) market, and not in the IPO market.

Fifth, our paper emphasizes also the importance of first issuers in revealing information. While there are other papers in the literature that do this, their focus is different than ours. For example,

Swinkels (1997), and Günay (2008b), among others.

[8] In an empirical study on German IPOs, Petersen (2007) looks into the within-wave differences of firm characteristics associated with adverse selection costs. He claims that his findings imply the presence of sequential learning among IPOs within a wave. Our study demonstrates the presence of such learning, both theoretically and empirically.

in Maksimovic and Pichler (2001) and Spiegel and Tookes (2008), firms do not want to reveal their new know-how to potential entrants into the industry by issuing early, but they need the capital. Benveniste, et al. (2002) propose a model explaining how first IPOs reveal information about the growth opportunities in their industry. In their model the firm qualities are ex-ante identical, and the order of moves are exogenously determined. In contrast, in our model, this order is endogenously determined due to strategic competition over who will bear the risks of failure. The quality of the firm determines its order of going public which, in turn, affects when in the cycle its IPO event will take place.

Our model also incorporates the demand side of the IPO markets. Investors learn the aggregate state by receiving informative but imperfect signals. When they are convinced that the aggregate state is bad (i.e., the economy is in a severe recession), they become pessimistic. Then, they do not participate in the IPO market believing that no firm, regardless of its quality, can successfully complete its investment projects in a severe recession. Firms cannot entice such investors no matter how they price the IPOs. While there are optimistic investors in the market, their numbers will be too low in a bad aggregate state, and hence, their demand will not be enough for the firm to raise the necessary capital (a failed IPO). In short, investors demand is high in good states but low in bad states, and this determines whether the IPO will raise the necessary capital successfully or it will fail. In the Appendix of the paper, we write an alternative model in which the firms can entice investors to participate even in a bad state by substantially lowering their equity price. Our main prediction of high-quality firms delaying their issuance holds in both versions of the model.

Our model yields two types of Perfect Bayesian Nash equilibria. The first type is a pure strategy separating equilibrium, where the low-quality firm always issues first and the high-quality firm always issues after the uncertainty about the economic state is cleared. According to our model, the second type of equilibrium is predicted to be more commonly observed, and it is the only equilibrium observed for a wide parameter range. It is a mixed strategy equilibrium, which yields predictions that are in probabilistic terms. For example, our model implies that the probability of lower quality firms issuing first followed by higher quality firms is greater than the probability of a reversed order of issuance. Hence, we are dealing with averages and generalized patterns. The model does not imply, for example, that high-quality firms will never issue first. Furthermore, all the firms in our model have valuable projects (positive NPV), albeit of different quality. The project's success depends on two factors: the individual firm and the aggregate state of the economy. Our model incorporates two forms of uncertainty: asymmetric information between firms and investors, and uncertainty due to aggregate state of the economy.[9]

[9]In such a set-up, since the uncertainty is at the aggregate economic state and not at the industry level, successful

We perform several empirical tests to check the model's predictions. Since we want to compare various firms' times of issuance relative to the starting point of the rising IPO cycle, we use duration (or survival) analysis. In our case "death" or "failure" refers to the IPO event. We estimate and compare the survival functions of various quality groups. We find that lower-quality firms are likely to go public, on median, between 28 and 88 days earlier in the cycle than the higher-quality ones (depending on the technique used to measure quality). We also report that, on average, firm quality is lower in the early stages of a typical rising IPO cycle in comparison to the mid-to-late stages of the cycle, suggesting that most high-quality firms wait for confirmation of the favorable conditions before going public.

The issuance patterns of a special group of IPOs, the ones that are later on included in the S&P 500 index, are also analyzed to determine any strategic waiting tendencies. We find that the IPOs of future S&P 500 firms like to issue in the mid-stages of an expanding cycle. These firms are not first to issue even in their own industry, which means that they prefer to issue during periods of confirmed market heat. As far as we know, this is the first study to report on issues related to the IPOs of the S&P 500 firms.

At the very minimum, these empirical results imply that the pioneering IPOs in a rising cycle are not always of the best quality. Another implication of these results is related to the market timing hypothesis of Baker and Wurgler (2002) and the peaking cash flows hypothesis of Benninga, et al. (2005). IPO firms' apparent ability to time the market by issuing predominantly during periods of overvaluation in the equity markets or when their cash flows peak, may occur (partially or fully) due to strategic waiting.[10] Firms wait for a favorable signal about the aggregate economic conditions. When there is an exogenous shock that improves the economy and one of the IPOs sees solid demand to its shares, then many of them initiate the IPO process, which can last more than few months.[11] Thus, by the time they observe the first successful issuance(s) and finish their own IPO, the stock market is on the rise and their cash flows are higher due to the same underlying economic shock.

While these arguments suggest that strategic waiting[12] is a competing hypothesis to the market

IPOs in one industry are informative to the firms in another industry.

[10]Schultz (2003) calls this phenomena "pseudo market timing." He shows that the apparent market timing ability of IPOs have alternative explanations. Our strategic waiting hypothesis is one of those alternative explanations.

[11]For the IPOs in our sample, the separation between the filing date and the issuing date is, on average, 77 days. If we include the period of searching for a lead underwriter (which is not easily measurable) and the period between "all-hands" meeting and filing with SEC (which typically lasts between 6 to 8 weeks), we can safely assume that the IPO process lasts longer than one quarter.

[12]The word "strategic" implies that the firms time their issuance according to other issuers, rather than according to the stock market level (strategic timing vs. stock market timing).

and the cash flow timing hypotheses, it can be complementary to them, as well. Waiting can be a part of the market timing strategy of the private firms. These hypotheses differ in the reasons for the waiting. Waiting for another firm to generate favorable signal about the economy, or waiting for the stock market to rise, or waiting for the cash flows to peak? In short, the hypothesis that the private firms time the stock market is indistinguishable from our strategic waiting hypothesis.

In the next section of the paper we describe our game theory model and its predictions. Section 3 describes our data sources and our sample selection. Section 4 elaborates on the various empirical procedures we employ to test the implications of our model. Section 5 presents the results from the tests, and Section 6 concludes the paper. The Appendix includes a couple of extensions of our model.

2. The Model

Firms: Two private firms, denoted by $j = g, b$, have an investment project that requires an external financing of K. The project's return is a random variable that may be equal to 0 with probability $(1 - \pi_{ij})$ or X with probability with π_{ij}. The probability π_{ij} depends on the aggregate state of the economy $i = G, B$ and the individual quality of the firm, $j = g, b$. When the economy is in a bad state (a severe recession or depression), the probability that the return will be X is zero (i.e, $\pi_{Bg} = \pi_{Bb} = 0$).[13] When the economy is in a good state ($i = G$), the individual firm's quality affects the project's outcome; a high-quality firm always has a higher probability of returning X than the lower-quality firm. That is, we assume that $\pi_{Gg} > \pi_{Gb} > 0$ holds. The ex-ante probability that the aggregate state is good or bad is equal to $\frac{1}{2}$. Also, the ex-ante probability that a firm is high- or low-quality is $\frac{1}{2}$. If the firms' do not have enough demand for their equity to raise K, then they will have a failed (or withdrawn) IPO[14], and their payoff from a failed IPO will be $-\gamma$.[15]

Investors: There is a continuum of atomistic investors with a positive mass of R. Each one has one dollar to participate in the IPO. At the beginning of the game, investors receive a signal about

[13] This assumption is relaxed in the Appendix.

[14] Note that the success of the IPO and the success of the project are not the same thing. The success probability of the project that is underway is not dependent on the IPO process. The IPO may be successful, but the project may not. The IPO is necessary only to raise the capital K. The availability of the capital K is dependent on the aggregate state. Once the capital K is available, however, the project's success is affected only by the firm-quality.

[15] γ represents the type of costs described in Dunbar (1998). Since his empirical findings indicate that there are many IPOs that do fail (a withdrawn IPO) and they incur substantial costs due to it, we consider the model with presence of exogenous costs (i.e., γ) to be more relevant. However, in Appendix A we present a version of our model where the IPOs do not fail, because the firms are substantially reducing their offer price to raise the necessary capital even during the bad state. Our results still hold.

the aggregate state. When the state is good, each investor independently receives a good signal with probability $p > 0.5$ and a bad signal with probability $(1-p)$. When the state is bad, each one receives a bad signal with probability p, and a good signal with probability $(1-p)$. Note that the signals are correlated with the aggregate state (i.e., the signals are informative since $p > 0.5$), but imperfect since we assume that $p < 1$.[16] The following table summarizes the signal structure.

	Good Signal	Bad Signal
Good State	p	1-p
Bad State	1-p	p

Investors are uninformed about both the aggregate state and the individual firm quality. Their ex-ante prior about both the aggregate state and the firm quality is $\frac{1}{2}$. Firms know each other's quality, but, like the investors, they are uninformed about the aggregate state. Thus, their prior about the state of the economy is also $\frac{1}{2}$. We also make the following assumptions about the investors' demand:

1) $(1-p)R < K$; 2) $pR > 2K$.[17]

Assumption 1) implies that not enough investors receive a good signal in a bad state. Each investor will receive a good signal with probability $(1-p)$ in a bad aggregate state. The investors who have the wrong belief/information about the state have a mass of $(1-p)R$ by the law of large numbers.[18] These optimistic investors' demand for equity will not be sufficient to buy K amount of equity the firm is issuing in a bad state. In such cases, there will be a need for pessimistic investors' participation. However, the pessimistic investors' do not have sufficient incentives to participate in the IPO when the signal about the economic state is negative (hence, they are referred to as pessimistic investors).

Assumption 2) shows that, in a good state, a mass of pR investors will receive a good signal, and their demand will be enough for both IPOs. Hence, the IPO(s) will be successful, and everyone will deduct that the aggregate state is good.

[16]There are numerous signals generated every day about the conditions in the various parts of the overall economy. These signals include the available information in the markets plus the idiosyncratic or individual experiences about the economic conditions. However, they are imperfect for everybody, including the most informed economic agents, such as the Fed or NBER. That is, these signals are unable to definitively reveal the economic state to everybody. Thus, there is a need for an event – which is highly correlated with the economic state – that will help aggregate the dispersed information. Like in our case, Caplin and Leahy (1994) also use similar signal structure that leads to information aggregation.

[17]These two assumptions put additional constraint on p, and imply that $p > \frac{2}{3}$.

[18]A continuum of investors are receiving a good signal with probability $(1-p)$ in a bad state. Hence, an aggregate of $(1-p)R$ will receive a good signal in a bad state.

IPO pricing: A firm $j = g, b$ will go public by offering a certain percentage of its equity α $(0 < \alpha < 1)$ in return for K. In our game α (and the price of the IPO)[19] is endogenously determined. Investors demand different percentage of the firm depending on their beliefs about the firm quality and the state. The IPO firm issues just enough of its equity to raise exactly K. When the investors do not know the quality of the issuing firm(s), then α will be identical for both firms. We will denote the possible values as α_{G1} (α_{G2}) when one (two) firm(s) issue in the good state. Similarly, α_{B1} and α_{B2} will denote the same values, but for the bad state. When investors know (or deduce) the issuing firm's true quality, $j = b, g$, they will demand α_{ij} in state $i = B, G$.

When a firm goes public, it uses a "second price" auction with a uniform price (which is a similar mechanism used in conjunction with bookbuilding). The investors bid on the shares, and reveal the price they will pay (i.e., reveal their α). In a second price auction, investors pay the highest losing bid. This implies that in situations where the firm(s) need the participation of pessimistic investors, the equilibrium α is going to be determined by these pessimistic investors (i.e., percentage of equity needed to raise K will be high). The second price auction is commonly used by the literature (e.g., Alti, 2005).

Also, we need to impose the following assumption, since the firm can not issue more than 100% of its equity: 3) $\frac{K}{(1-p)X\pi_{Gg}} = \alpha_{Bg} > 1$, where $\alpha_{Bg}(1-p)X\pi_{Gg} = K$ determines the equity share (α_{Bg}) the pessimistic investors would demand in the bad state, if they knew for sure the issuing firm is a high-quality one.[20]

This assumption essentially says that, it is not realistic to expect that there would be a feasible equilibrium in which the pessimistic investors participate in an IPO despite of the fact that their reliable signal indicates a bad state (i.e., a severe recession or depression). Even if the investors assume that all the conditions are favorable to participation – such as i) their signal is wrong, which happens with a very small probability of $1 - p$ during the bad state; and ii) the issuing firm is a high-quality one – the equilibrium α would turn out to be above 100%. $(1 - p)$ is too small, which requires α to be very high to achieve the equality in the above expression.

Therefore, when facing bad economic conditions, the pessimistic investors will know the optimal α is unrealistically high, and so they will not participate in the IPO process. If the pessimistic investors demand more than 100% of the firm's shares, the firm can never satisfy their demand no matter how low they price the shares.[21] So, in a bad state, only a measure of $(1 - p)R$ optimistic

[19] Instead of calculating the offer price, which will depend on how many shares the firm issues in the IPO, we model the percentage, α, of the firm's total equity sold during the IPO.

[20] This assumption is not used in the version of our model presented in Appendix A. Yet, we still find similar qualitative results.

[21] Assumption 3) implies that, in a bad state the investors will not participate in neither good nor bad firm's IPO,

investors will participate. Since $1-p$ is too small, their demand will not be enough in a bad state regardless of the pricing of the firm ($(1-p)R < K$). This implies that in a bad state, firms will not be able to raise K no matter how low they price the shares, and so any IPO during the bad state will fail. Note that, the initial public offering is the event that aggregates privately held information of the investors. That is, the investors will learn the aggregate state after observing the outcome of the IPO.

Of course, one has to ensure, also, that firms have enough incentives to play the game when they do not know the state. This can be satisfied through our next assumption. 4) $\frac{1}{2}(1-\alpha_{Gq})\pi_{Gb}+\frac{1}{2}(-\gamma) > 0$, where $q = 1, 2$. As long as γ is not too large, this condition will be satisfied.

Perfect Bayesian Equilibria: If the game continues for two periods, and there is a waiting cost (or a discount factor, δ, such that $0 < \delta < 1$) for issuing in the second period, what are the possible equilibria? There could be two types of pure Perfect Bayesian Nash equilibria, separating and pooling, and one mixed strategy equilibrium. There are two separating equilibria: i) firm g always goes public in the first period and firm b always issues in the second period; and ii) the reverse is true (b is always first and g always follows). There are two pooling equilibria: i) both firms issue together in the first period and ii) they both wait and issue together in the second period. As we explain later on, some of the pure strategy Perfect Bayesian Nash equilibria can be ruled out either due to theoretical arguments (at least one of the firms have incentive to deviate) or due to unrealistic parameter ranges required to maintain this equilibrium (e.g., δ is too small, and so waiting is too costly). Here, we first concentrate on the mixed strategy equilibrium.

2.1. Mixed-Strategy Equilibrium

In this subsection, we theoretically explain the formation of mixed strategy equilibrium in our model's context. We describe separately the investors' and the firms' behavior in this mixed strategy game.

2.1.1. Investors' Behavior in Mixed Strategy Equilibrium

Let's first determine what fraction of issuing firms' equity, α, will be demanded by the (optimistic) investors. The demand α is endogenous in our game, so it will be determined by the equilibrium of the mixed strategies firms play and the nature of the investors' signal.

The investors' prior about aggregate state is 1/2, but their beliefs are updated upon receiving a signal. An optimistic investor who receives a good signal believes that the aggregate state is good with probability p (Bayesian updating) and it is bad with probability $1-p$. The investors' prior

since $\frac{K}{(1-p)X\pi_{Gb}} = \alpha_{Bb} > \alpha_{Bg} = \frac{K}{(1-p)X\pi_{Gg}} > 1$.

about issuing firm's type is 1/2, but Bayesian learning will update this belief, too. In a mixed strategy equilibrium, $m_j \in (0,1)$, $j = g, b$, denotes the probability of going public in the first period. Consistent with this equilibrium strategies, investors believe that a high-quality firm will go public in the first period with probability m_g and a low-quality firm will go public first with probability m_b.

Let's say that the investors observe only one firm going public. Because of the Bayes' Law, the posterior belief that this is firm g would be $\left(\frac{(1-m_b)m_g}{(1-m_b)m_g+(1-m_g)m_b}\right)$,[22] and their posterior belief that this is a low-quality firm would be $\left(\frac{(1-m_g)m_b}{(1-m_b)m_g+(1-m_g)m_b}\right)$. In addition, if this is a good state, enough investors (more specifically, pR investors) will receive a good signal, and the demand for the IPO's shares will be enough to raise K; that is, the IPO(s) will be successful. In the equation below, we show the calculation of equilibrium α_{G1}, the percentage of the firm demanded by the (optimistic) investors when only one firm is going public before the aggregate state is revealed.

$$\alpha_{G1}\Big[p\Big(\frac{(1-m_b)m_g\pi_{Gg} + (1-m_g)m_b\pi_{Gb}}{(1-m_b)m_g + (1-m_g)m_b}\Big)\Big]X = K \tag{1}$$

The expression inside the parenthesis [ ] shows what is the issuing firm's probability of successfully completing the project (i.e., getting a high return X) from an optimistic investor's point of view. An optimistic investor believes that this is a good state with probability p, and it is firm g with probability $\left(\frac{(1-m_b)m_g}{(1-m_b)m_g+(1-m_g)m_b}\right)$. The probability of successfully completing the project in a good state is π_{Gg}. By multiplying these three probabilities, we get the term $\left(p(\frac{(1-m_b)m_g\pi_{Gg}}{(1-m_b)m_g+(1-m_g)m_b})\right)$. Similarly, an optimistic investor believes that it is a good state with probability p, that it is firm b with probability $\left(\frac{(1-m_g)m_b}{(1-m_b)m_g+(1-m_g)m_b}\right)$, and that the probability of successfully completing the project for this firm b is π_{Gb}; thus the term $\left(p(\frac{(1-m_g)m_b\pi_{Gb}}{(1-m_b)m_g+(1-m_g)m_b})\right)$. With probability $(1-p)$, this is a bad state and the return will be zero, because $\pi_{Bj} = 0$ for $j = b, g$. A risk-neutral optimistic investor must get at least α_{G1} percentage of the firm that satisfies Eq. (1).

The pessimistic investors will not participate in the IPO during bad economic conditions, since they believe their return is negative. That is, for a fair return, they will end up asking more than 100 per cent of the shares ($\alpha > 1$), which the firm cannot satisfy. Formally, pessimistic investors will ask for α that satisfies the following equation in a bad aggregate state:

$$\alpha_{B1}\Big[(1-p)\Big(\frac{(1-m_b)m_g\pi_{Gg} + (1-m_g)m_b\pi_{Gb}}{(1-m_b)m_g + (1-m_g)m_b}\Big)\Big]X = K \tag{2}$$

However, this implies that

[22]Since it is observed that there is only one firm going public in the first period, the probability that it is firm g and not firm b is $(1-m_b)m_g$. Similarly, the probability that it is b and not g is $(1-m_g)m_b$. Thus, the total probability of only one firm going public is $(1-m_b)m_g + (1-m_g)m_b$, and that it is firm g is $\left(\frac{(1-m_b)m_g}{(1-m_b)m_g+(1-m_g)m_b}\right)$.

$$\alpha_{B1} = \frac{K[(1-m_b)m_g + (1-m_g)m_b]}{X(1-p)(1-m_b)m_g\pi_{Gg} + (1-m_g)m_b\pi_{Gb}} > \alpha_{Bg} = \frac{K}{(1-p)X\pi_{Gg}} > 1$$

The first inequality is true since $\pi_{Gg} > \pi_{Gb}$, and the second inequality is true by assumption 3).

The main difference between Eq. (1) and Eq. (2) is that in the later one, the pessimistic investors believe that the aggregate state is good with probability $1-p$, and it is bad with probability p.

What if investors observe two firms going public (either in the first or in the second period) when the unrevealed aggregate state is good? Since this is a good state, there are enough optimistic investors to buy all the shares offered. The optimistic investors' prior about individual firm quality will be the same: $\frac{1}{2}$ chance that it is a high-quality firm. Therefore, the optimistic investors who observe two firms going public demand α_{G2} share of the firm such that:

$$\alpha_{G2}\Big[p(\frac{1}{2}\pi_{Gg} + \frac{1}{2}\pi_{Gb})\Big]X = K \tag{3}$$

Similarly, when the aggregate state is bad, the pessimistic investors will not participate in the IPO and the offering will fail.

The equations above summarize the investors' incentives. They will not buy the shares offered unless Eqs. (1)–(3) are satisfied. If the aggregate state turns out to be good, only the optimistic investors (the ones who receive a good signal) will buy the firm shares and $\alpha_{Gq}, q = 1, 2$ shares will be sold. If the aggregate state turns out to be bad, the IPO(s) will fail. This, in turn, means that after the pioneering IPO(s), everybody will discover the aggregate state by observing the success or the failure of the IPO(s).

2.1.2. Firms' Behavior in Mixed Strategy Equilibrium

The two firms' decide whether to go public in the first period (action denoted as IPO1), or wait and then go public in the second period (action denoted as W). Here we concentrate on the mixed-strategy equilibrium, so we have to calculate m_j, $j = b, g$.

The firm j's expected payoff from IPO1 when the economic state is not revealed is:

$$(1-\alpha)(\frac{1}{2}\pi_{Gj})X - \frac{1}{2}(\gamma) \tag{4}$$

The firm j is left with (1-α) shares after the IPO event; the ex-ante probabilities of each state is 1/2, and in a bad state, a failed IPO results in $-\gamma$; thus, the above payoff expression.

As explained above, equilibrium α can take different values (α_{G1}, α_{G2}, and α_{G1W})[23], and the firm may go public in the first or in the second period. So, for each case we have different expected value calculation.

[23] α_{G1W} is a special case of α_{G1}, and it will be explained below.

First, we calculate the expected payoff from IPO1 i.e., firm $j = g, b$ decides to go public in the first period and calculates its payoff depending on whether the other firm plays IPO1 or W. For firm j, the first term in Eq. (5) below shows the expected payoff when it is the sole firm going public in the first period. Going public alone happens with probability $(1 - m_{-j})$, where $-j$ denotes the type other than j. According to firm j this is a good state with probability $\frac{1}{2}$. It has to sell α_{G1} percent of the firm to the investors, and its success probability in a good state is π_{Gj}. Hence, its expected payoff is $(1 - \alpha_{G1})\frac{1}{2}\pi_{Gj}X$. Similarly, for the bad state; the firm's IPO will be unsuccessful and it will incur a cost of γ due to failed IPO costs. The second term shows the expected payoff when both firms go public in the first period; the equilibrium α in the good state that must be sold when both firms play IPO1 is denoted by α_{G2}. Thus, firm j's payoff from playing IPO1 is expressed as:

$$\begin{aligned}(1 - m_{-j})\Big[(1 - \alpha_{G1})\frac{1}{2}\pi_{Gj}X + \frac{1}{2}(-\gamma)\Big]\\ +m_{-j}\Big[(1 - \alpha_{G2})\frac{1}{2}\pi_{Gj}X + \frac{1}{2}(-\gamma)\Big]\end{aligned} \tag{5}$$

Second, we calculate firm j's payoff from waiting in the first period, and going public in the second period. The firm j's payoff will depend on what the other firm does. So, we can write the expected payoff from W for firm $j = g, b$ as follows:

$$\begin{aligned}\delta m_{-j}\Big[\frac{1}{2}(1 - \alpha_{G1W})X\pi_{Gj}\Big] +\\ \delta(1 - m_{-j})\Big[\frac{1}{2}(1 - \alpha_{G2})X\pi_{Gj} + \frac{1}{2}(-\gamma)\Big]\end{aligned} \tag{6}$$

The first term in Eq. (6) above shows firm j's expected payoff when the other firm goes public in the first period, which happens with probability m_{-j}. We adjust for the time value of money by discounting with δ.

When the other firm goes public in the first period, the state is revealed. It can turn out to be bad with probability $\frac{1}{2}$. Then, the firm j will prefer to wait. Hence, its payoff in the first term of Eq. (6) will be zero, rather than $-\gamma$.

Alternatively, the state can turn out to be good with probability $\frac{1}{2}$. Then, the investors will ask for the share of the firm, α_{G1W}, that solves for:[24]

$$\alpha_{G1W}\Big[\frac{(1 - m_g)m_b\pi_{Gg} + (1 - m_b)m_g\pi_{Gb}}{(1 - m_b)m_g + (1 - m_g)m_b}\Big]X = K \tag{7}$$

[24]Eq. (7) that solves for α_{G1W} does not involve p's since the state is revealed. There is no aggregate uncertainty; there is uncertainty only about firm quality. To distinguish this case from the other cases, we used a different notation for α, namely α_{G1W}.

The expression inside parentheses [] in Eq. 7 shows the probability of successfully completing the project by the firm that issued in the second period. As explained earlier, the investors believe that the low-quality firm goes public in the first period and the high-quality firm goes public in the second period with probability $\left(\frac{(1-m_g)m_b}{(1-m_b)m_g+(1-m_g)m_b}\right)$. Similarly, for the high-quality firm issuing first and the low-quality one going second, the probability is $\left(\frac{(1-m_b)m_g}{(1-m_b)m_g+(1-m_g)m_b}\right)$.

The second term of Eq. (6) shows the payoff when the other firm does not go public in the first period, and the state is not revealed. This happens with probability $(1 - m_{-j})$. Then, both firms will have to go public in the second period by assumption 4). There will not be any change in the priors about the economic state, so the firms believe that this is a good (bad) state with probability $\frac{1}{2}$ $(\frac{1}{2})$. The investors will demand α_{G2} percent of the firm in the good state. If the state turns out to be bad, they will have a failed IPO and will pay a failure cost of γ.

Using Eqs. (5) and (6) we can solve for the mixed strategies of each firm, m_b and m_g (the odds of each firm deciding to go public in the first period).

Proposition 1 *There exists a mixed strategy equilibrium if* $m_b, m_g \in (0, 1)$*, and* m_g *and* m_b *simultaneously equates Eqs. (5) and (6) for each* $j = b, g$.

Given the complexity of Eqs. (5) and (6), there are no closed-form solutions for m_b and m_g. Hence, we calculate this mixed strategy equilibrium using numerical methods (i.e., simulations).[25] Our simulation results are presented at the end of this section.

Since each firm uses mixed strategy, the outcomes of the game will be probabilistic. We summarize the outcomes (and their probabilities) in the following corollary.

Corollary 2 *In a mixed strategy equilibrium,*

a) The probability that only firm b goes public in the first period and that firm g goes public in the second period is $m_b(1 - m_g)$.

b) The probability that only firm g goes public in the first period and that firm b goes public in the second period is $m_g(1 - m_b)$.

c) The probability of both, firm g and firm b, going public in the first period is $m_g.m_b$

d) The probability that neither firm goes public in the first period is $(1 - m_g)(1 - m_b)$.

[25] We have tried to find closed form solution using sophisticated equation solvers, such as MAPLE, but the solution were extremely long and cumbersome. Hence, we have to rely on simulations. Simulation methods are widely applied, and are considered a reliable alternative to closed form solutions, by the financial and economics literature (see studies like, Pastor and Veronesi, 2005)

The proof is straightforward by using the equilibrium behavior described in Proposition 1. Note that, since our simulation results for a mixed strategy equilibrium (presented in Section 2.3) always give $m_g \leq m_b$, it is clear that the issuance sequence described in a) is more likely than the one described in b).

The emphasis of the corollary is that the other outcomes are also possible. Namely, the high-quality firm may go public in the first period followed by the low-quality firm in the second period (part b), both type of firms may go public in the first period (part c), or neither of the firms will go public in the first period (part d).

Part d) of the corollary has a testable implication. It shows that there is a nonzero probability of neither firm issuing in the first period. As a result of their mixed strategy, both firms may end up waiting for each other for a long time before going public. This means that there will be periods (mostly during very uncertain times, such as economic slowdowns) when we could observe many days and weeks without having an IPO event. While there may be other explanations for this phenomenon (for example, during slowdowns demand for new equity may be low due to increased risk-averseness or due to investor sentiment (Derrien, 2005) of the investors), our model describes it from the perspective of the rational equity suppliers. We essentially show that the prolonged stretches of low IPO activity can be explained with strategic waiting, as well.

Next, we analyze the various pure strategy equilibria, and explain why most of them are unlikely to occur in this game.

2.2. Pure Strategy Perfect Bayesian Nash Equilibria

Let's, first, consider the separating Perfect Bayesian Nash equilibria.

2.2.1. Separating Equilibria

It is easy to see that a separating equilibrium in which high-quality firm goes public in the first period and the lower-quality one goes public in the second period cannot exist. Firm b has an incentive to deviate from its strategy. If it decides to go public in the first period, it saves the waiting cost and benefits from not being identified as a lower-quality firm. Since investors observe two firms going public, they believe firm b is high-quality with probability $\frac{1}{2}$. That is, if firm b deviates, it will sell a lower percentage of the firm, and receive a higher payoff.

The second separating equilibrium, in which the lower-quality firm always goes public in the first period and the higher-quality firm always goes public in the second period, does exist. The existence of this equilibrium further supports the main claim of this study, that during the periods of high aggregate uncertainty (which typically exists at the beginning of an IPO cycle), higher-quality firms have incentive to delay their IPO. That is, the pioneering IPOs do not always have to be of the highest quality, as is postulated or claimed by many in the literature (see Hoffman-Burchardi, 2001; and Alti, 2005, among others). This is one of our main contributions to the literature.

Due to the separating equilibrium the investors know that the firm conducting an IPO in the second period is a high-quality one issuing in an already-revealed good state. So, they demand α such that: $\alpha_{Gg}\pi_{Gg}X = K$. On the other hand, if the revealed state turns out bad (with probability $\frac{1}{2}$), firm g would choose to not to go public. Thus, its payoff would be zero. Hence, firm g has an equilibrium payoff:

$$Payoff_{Sepg} = \delta\Big[\frac{1}{2}(1-\alpha_{Gg})\pi_{Gg}X\Big] \tag{8}$$

If the high-quality firm deviates, then investors will observe two firms going public in the first period, and they cannot determine the type of the firms. As a result, the investors will ask for α_{G2} share of the firms in the good state. Since the firm issues in the first period, it faces the possibility of failure (i.e., a cost of $-\gamma$). Then, the deviation payoff for the high-quality firm is:

$$Payoff_{Dsepg} = \Big[(1-\alpha_{G2})\frac{1}{2}\pi_{Gg}X + \frac{1}{2}(-\gamma)\Big] \tag{9}$$

For firm b, the equilibrium payoff from going public in the first period is:

$$Payoff_{Sepb} = \Big[\frac{1}{2}(1-\alpha_{Gb})\pi_{Gb}X + \frac{1}{2}(-\gamma)\Big] \tag{10}$$

where $p\alpha_{Gb}\pi_{Gb}X = K$ since the investors can identify b type in a separating equilibrium, but they do not know the aggregate state (hence there is p in the equation).

If firm b deviates, it has to pay a waiting cost, but benefits by hiding its type (which will result in selling a lower percentage, α_{G2}, of the firm). The deviation payoff for firm b is:

$$Payoff_{Dsepb} = \delta\Big[(1-\alpha_{G2})\frac{1}{2}\pi_{Gb}X + \frac{1}{2}(-\gamma)\Big] \tag{11}$$

If the parameters combine in such a fashion that each firm's equilibrium payoff is higher than its deviation payoff, then this separating equilibrium will exist. Analytically solving for such range turned out to be extremely cumbersome. However, we were able to find such equilibria in our simulation results, presented at the end of this section.

2.2.2. Pooling Equilibria

A pooling equilibrium in which both firms go public in the first period may be an equilibrium if the waiting cost is high enough (δ is low).[26] When the waiting costs are low enough (δ is high), firm g

[26]That is, this equilibrium happens in a very high-interest rates environment.

will have an incentive to deviate from this equilibrium to separate itself from firm b. In what follows, we analyze further this pooling equilibrium.

Since both firms are going public in the first period and the state is not yet revealed, upon receiving their reliable signals, the investors' will demand α_{G2} in the good state. The payoff from going public in the first period for a firm $j = g, b$ is:

$$Payoff_{Sj} = \left[(1-\alpha_{G2})\frac{1}{2}\pi_{Gj}X + \frac{1}{2}(-\gamma)\right] \tag{12}$$

Would any firm want to deviate in this case? Firm g may decide to deviate to W strategy, since it benefits from separating itself from firm b. If it does so, the state will be revealed in the first period by the observable demand for the shares of firm b, which is what firm g wants. In that case, however, investors' off-equilibrium-path (or off-path) belief must be specified.[27] According to this off-path belief, only a high-quality firm can benefit from deviating, since it wants to separate itself from b. That is, in this pooling equilibrium the investors believe that, if only one firm is observed going public in the second period, it must be g. Let us emphasize that, if this belief does not make the deviation profitable, then no other beliefs will.[28]

Given that investors believe firm j conducting an IPO in the second period is a high-quality one issuing in an already-revealed good state, they will demand α such that: $\alpha_{Gg}\pi_{Gg}X = K$. If the state turns out to be a bad one in the first period, firm j will again benefit from not going public first. Hence, firm j does have a deviation payoff:

$$Payoff_{Dj} = \delta\left[\frac{1}{2}(1-\alpha_{Gg})X\pi_{Gj}\right] \tag{13}$$

Using this payoff equation, we create the following proposition:

Proposition 3 *If $Payoff_{Dj} \leq Payoff_{Sj}$ for $j = g, b$, then there is a pooling equilibrium in which both firms go public in the first period. In such an equilibrium, the investors' off-path equilibrium belief is that any firm going public in the second period is a high-quality one with probability 1.*

[27]Note that, in a Perfect Bayesian Nash equilibrium, off-equilibrium path beliefs have to be specified only if this equilibrium is a pooling one. Off-equilibrium path beliefs only matter when calculating the deviation payoff; that is, when a firm takes an off-equilibrium action. Technically speaking, in a Perfect Bayesian Nash equilibrium, all beliefs have to be calculated by using Bayes' Law, as long as it can be applied. In a pooling equilibrium, if there is a deviation, Bayes' Law cannot be applied (since the denominator while calculating Bayes Law will be zero); hence, the off-equilibrium beliefs have to be specified directly.

[28]In a Perfect Bayesian Nash equilibrium, any off-path equilibrium can be chosen. With "unreasonable" beliefs, this pooling equilibrium will exist for a wider range of parameters. However, analyzing all of these "unreasonable" beliefs has little practical importance, and thus are beyond the goals and the scope of the current paper.

As we discussed above, this equilibrium does not exist when the waiting cost are not extremely high, because then the condition ($Payoff_{Dj} \leq Payoff_{Sj}$) will not hold. Even if this equilibrium exists, however, it does so for a very specific and a very narrow range of the parameters; the ones for which the above inequality is satisfied.[29] In our simulations we are able to find this equilibrium only for unrealistic values or unrealistic off-path equilibrium beliefs (for example, if investors believe that any firm deviating is a low quality one with probability 1).

Therefore, one would expect that the cases when such an equilibrium occurs in real life are very uncommon. Later on, we show that indeed the empirical tests on real-life patterns of issuance indicate infrequent occurrence of this equilibrium. Even if this pooling equilibrium does occur in real life, however, its outcome is not completely contradictory to the main finding of this paper; that the pioneering firms are not always of the highest quality. This pooling equilibrium implies that the pioneering firms can be of mixed quality (high and low-quality ones issuing together).

Another pooling equilibrium in which both firms wait and go public in the second period is easily ruled out (for reasonable off-equilibrium path beliefs). The high-quality firm benefits from deviating and going public in the first period. It saves the waiting cost; and since it separates itself from the low-quality one (assuming off-path equilibrium beliefs is such that any deviation comes from a g type), it ends up selling a lower percentage of the firm.

In short, our model's equilibria are mostly mixed strategy ones. In fact, it is the only equilibrium for quite a wide range of parameters. A separating equilibrium, where firm g delays issuance for the second period, is also possible. Any other separating equilibria are ruled out. The pooling equilibria are extremely unlikely. In the simulations below, we demonstrate this numerically as well.

2.3. Simulations

The numerical solutions for m_b and m_g are obtained by simultaneously solving the equations obtained through equating the payoffs from IPO1 and W1 for each firm $j = b, g$: Eq. (5) = Eq. (6). The simulation results presented in *Figure 2* show the following outcomes: 1) in a mixed strategy equilibrium, firm b is more likely to go public in the first period than firm g ($m_b > m_g$); 2) for some parameter range the separating equilibrium when firm b goes public in the first and firm g in the second period is observed. In these simulations, we also check for the parameters that yield any pooling equilibria. We find none.

The intuition behind the $m_b > m_g$ result is as follows. The high-quality firm has less to gain

[29] To save space, we do not explicitly specify the range of the parameters when this equilibrium occurs. However, obtaining this range is straightforward using Eqs. (12) and (13), and the condition provided in Proposition 3.

from waiting compared to the low-quality firm. Therefore, to make this firm indifferent between going public first and waiting, more information has to be revealed to the high-quality firm in the equilibrium. This can only happen if the low-quality firm goes public in the first period more often.[30]

As discussed earlier, the separating equilibrium can occur when firm g finds it beneficial to pay the waiting costs to distinguish itself from firm b. If the waiting cost is not too high, on the other hand, firm b will also go public in the second period (W) and this equilibrium will not exist.

In our model we have seven parameters, X, K, p, δ, γ, π_{Gg}, and π_{Gb} (π_{Bb} and π_{Bg} are equal to zero by assumption). We have tried numerous values for these fixed variables. For obvious space limitations, we report here only the outcomes from the following values: $X = 3$, $K = 1$, $p = 0.8$, $\delta = 0.9$, $\gamma = 0.3$, $\pi_{Gg} = 0.75$, $\pi_{Gb} = 0.65$.[31] In the figures below we keep six of these parameters constant, and report the relationship between m_j and the varying seventh variable. *Figure 2* shows these relationships. The variable on the x-axis takes 50 different values. In all the graphs, for all the parameter values, $m_b \geq m_g$. When $m_b = 1$ and $m_g = 0$, we have a separating equilibrium.

Further comments on the graphs are in order. 1) *Figure 2A* shows that as the potential return of the project, X, increases, both m_g and m_b increase, because reward-to-risk ratio of going public in the first period increases. The reward ratio increases more for the g firm. After a certain threshold, it becomes profitable for g firm to differentiate itself from b firm by deciding to play only W; its payoff from W becomes high enough to pay the waiting cost. 2) According to *Figure 2B*, the probability of issuing in the first period for both firms is declining as the capital needed to be raised for the project (K) increases, because the reward-to-investment ($\frac{X}{K}$) ratio is decreasing. As $\frac{X}{K}$ declines relative to costs of failure (γ), the firms find it more valuable to wait. For high enough reward-to-investment ratios (i.e., low Ks), the high-quality firm will find it profitable to pay the waiting costs and separate itself from firm b. Thus, the separating equilibrium for low Ks. 3) If the signal's quality (p) is increasing, the likelihood of IPO1 action by both firms is also increasing (see *Figure 2C*). In such cases the value of waiting for uncertainty resolution is less, because the signal is more accurate. We could not find a separating equilibrium for the parameter range we used. 4) As δ increases, waiting becomes less costlier due to less discounting costs, which causes both m_b and m_g to decrease. As waiting cost becomes less, the low quality firm is willing to pay the waiting cost to pose as a high quality firm; hence, the separating equilibrium disappears (*Figure 2D*). 5) As shown by *Figure 2E*, when the costs of IPO failure (γ) are high, probability of waiting by both firms is higher. While we do not show it in the plot, we found separating equilibrium for low enough γ. 6) As π_{Gb} is approaching the high-quality firm's quality indicator (π_{Gg}), then both firms issuing in the first period increases.

[30] We thank the referee for this intuition.

[31] The MATLAB code used to run the simulations is available through the authors.

For both firms, the percentage of the proceeds they need to pay the investors to compensate for asymmetric information, α, is declining. Since, both firms are high quality, investors demand lower compensation for risk (i.e, they demand lower underpricing). Thus, bigger chunk of the proceeds are left to the firms. Also, firm b does not have much incentive to pose as a good firm, since the α it needs to pay to investors is not that large (its quality is similar to g's); hence, a separating equilibrium emerges. *Figure 2F,* shows this relationship. 7) *Figure 2G* depicts the relationship between m_g and m_b as the discrepancy between the firms' qualities is increasing (π_{Gg} increases and π_{Gb} stays fixed). Early on, the quality discrepancy is small, hence, firm b does not gain much by posing as g. After a threshold point, firm b benefits from being seen as a g type, which breaks the separating equilibrium.

2.4. Testable Predictions

Our model has three testable predictions:

Prediction 1: It is more likely that, as a new rising IPO cycle starts, lower quality firms will issue ahead of the higher quality firms. Thus, these lower quality firms are more likely to go public in the earlier periods of the new expanding cycle (see the numerical solutions related to Proposition 1).

Prediction 1 is a novel one, and our study analyzes it for the first time in the literature. Thus, the testing of this prediction will be the emphasis of our empirical analysis.

Note that this prediction does not suggest that truly bad firms (i.e., firms with negative expected NPV) will issue first. Its emphasis is on the issuance order of the firms with smaller, but positive, expected NPVs relative to the "best" IPOs. As we show in Appendix B, the truly low quality firms can *only* issue during periods when the state is confirmed to be good in the second period, because their expected payoff from issuing during uncertain periods is so low that it does not overcome the risks of the IPO.

Prediction 2: During economic slowdowns (i.e., periods of elevated aggregate uncertainty), there will be fewer IPO events (Corollary 2d).

This last prediction has been tested before (see Lowry, 2003; and Pastor and Veronesi, 2005, for instance). It is based on our model's insight that even if they have viable projects, the private firms will not issue immediately, but they will wait for more favorable signals about the economic conditions. When the economy is in recession, their projects are worth less (π_{Bj} is smaller than π_{Gj}), and the chances that their IPO will be unsuccessful are higher (not enough investors receive a "buy" signal). The private firms will delay their issuance during such periods, because they have been "learning" about these conditions from the recently failed IPOs.

Our model has an implication related to IPO clustering, as well.

Prediction 3: IPO issuances will tend to cluster in certain periods.

The first successful IPO will reveal to all the remaining firms that the aggregate state is good. As a result, all the firms with valuable projects will enter the IPO market en mass, because waiting is no longer optimal for any firm (it has a cost). Furthermore, in the periods that follow, any private firm that discovers a new profitable project will issue immediately (without waiting), because the aggregate state is known to be good. This process will continue until the rising IPO cycle ends.

Prediction 3 has been the focus of several theoretical studies (see Hoffmann-Burchardi, 2001; Benveniste, et al., 2002; and Alti, 2005). From an empirical stand point, our *Figure 1* makes it obvious that there are periods of intense IPO clustering. So we will not focus our attention on analyzing this prediction any further. However, it is important to note that our model provides a previously unexplored explanation to the IPO clustering phenomenon. Namely, strategic competition among private firms for more information about the economic/market conditions can lead to such clustering.

A forecast: In our model the "game" starts when the IPO market is very slow or completely shut down. Therefore, our paper has a specific, and very timely, prognosis of the type of firms that will issue when the current trough of the IPO cycle is replaced by the expanding stage. As the new IPO cycle starts to form from the current, extremely low levels of activity, it is probabilistically more likely that mediocre firms (low quality, but with positive NPV) will dominate the pioneering cohort of issuers. The really high-quality firms (say future S&P 500 firms) will likely issue in the later, confirmed, stages of the rising cycle. The lowest quality ones (with negative NPV) will issue even later, when it is close to the top of the cycle.

3. Data

Next, we provide some details about our data sources and our sample selection process.[32]

[32]Ideally, to test our hypothesis, we would use the universe of all the private firms that could go public at each point in time, but such a sample is unavailable to us. However, using the sample of *observable* IPO events – which is very commonly used in the IPO literature for testing various IPO hypotheses – is not a bad alternative for three reasons. First, since nobody knows the quality distribution of private firms that can go public at any point in time, it can be assumed that it is normally distributed (by Central Limit Theorem). Hence, one should expect to see an evenly split sample of higher quality and lower quality private firms going public at a given point in time; assuming there are no other effects changing this composition. Our tests clearly show that, on average, relatively more high quality firms go public in the mid-to-late stages of the rising cycles than in its starting stage. Therefore, there must be an external factor that changes this composition, and we claim that it is the strategic waiting by the higher quality firms. Second, it is not unrealistic to assume that sooner or later (almost) all the firms that could have gone public (i.e., had a good

3.1. The IPO Sample

To construct our sample of initial public offerings (IPOs) we apply the following sample selection criteria. We extract all the IPOs between 1973 and 2007 included in the Securities Data Company (SDC)'s database (Pre-1973 coverage of IPO events by SDC is not that reliable (Gompers and Lerner, 2003).). After eliminating REITs, closed-end funds, ADRs, unit offers, and MLPs, there are 9,676 common stock IPOs left in the sample. We do not exclude IPOs with offer price less than $5, because such screening will eliminate disproportionately more low quality firms, which can bias our results. Since our analysis relies on market trading data, we drop out any IPO that does not have data in CRSP weekly or monthly files. We are left with 8,593 distinct IPO events in the SDC sample.

For the period between 1975 to 1984, we also use Jay Ritter's hand collected data – obtained from his webpage – to append our SDC sample. Again, we are interested only in CRSP listed, common stock, and firm-commitment IPOs. There are 361 such firms that are not covered by the SDC data. Another data source we rely on is Registered Offering Statistics (ROS)[33] dataset to find common stock, firm-commitment, and CRSP listed IPO firms not reported in any of our previous sources. We find 59 such IPOs. Thus, our combined initial sample is 9,013 IPOs.

In some instances CRSP does not have trading data for the months immediately following the issuance of the new public firm. Also, for various reasons CRSP may stop coverage of some firms. In those cases, the missing return observations are replaced with CRSP value-weighted index's return. As recommended by Barber, et al. (1999), such missing return observations are replaced with CRSP value-weighted index's return.

In a robustness test, instead of replacing the missing returns, we assume that all the firms that match with CRSP, but have too many missing observations, are of lowest quality (decile 1). In most instances these firms are the ones that get delisted from CRSP due to inability to meet the exchange standards. Then, we perform the same tests as below. Our results are qualitatively unchanged, suggesting that such a sample selection problem has a minimal impact on them.

The IPO data items we retrieve from SDC, Ritter, and ROS data files are the CUSIP of the firm, the date of the issue, its total assets at the time of issuance,[34] its industry classification (at 2- and

project with positive NPV) do ultimately go public, because waiting too long is costly. Thus, (almost) all such private firms do eventually show up in our IPO sample. Third, the effect of those private firms that do not show up in our IPO sample will be minimal, and it will be averaged out, since we are averaging across the cycles and within firm quality groups. So, just like in any statistical inference, we rely on the law of large numbers.

[33]This dataset is created by compiling the records of the Securities and Exchange Commission (SEC) from January 1970 through December 1988 in regards to the effective registrations of domestic business and foreign government securities under the Securities Act of 1933.

[34]If it is missing, we use assets from COMPUSTAT for the first quarter after the issuance.

3-digit SIC level), its offer price, its underpricing,[35] total proceeds it raised, and its founding year used to calculate its age[36] at the time of issuance. The monthly trading data of our sampled IPO firms are obtained from CRSP. The accounting data is from COMPUSTAT.

3.2. The S&P 500 Sample

For some of our tests we need to determine which of our sampled IPOs end up being listed in the prestigious S&P 500 index. These are the most successful IPO firms and thus, the ones that are most likely to engage in strategic waiting. For that purpose we identify all the firms that were part of the S&P 500 index for each year between 1973 and 2007. We use the dataset available through Wharton Research Data Services (WRDS) that lists the historic S&P 500 Index constituents. We hand check this data to assure that the name of the firm matches with its correct CUSIP in COMPUSTAT and correct PERMNO in CRSP. According to this dataset, in December of every year between 1973 and 2007 there are exactly 500 firms listed in the S&P 500 index. During 1973-2007 period, total of 771 firms (with distinct CUSIPs) were added to this index. When we match these firms with the above IPO sample, we identify 219 IPO firms that ultimately became part of the S&P 500 index.

4. Testing Procedures

In this section, we set up our testing procedure. These empirical set-ups are designed to test the main prediction of our model, which is that in a rising IPO cycle the best firms can afford to wait until the market's heat is confirmed. Multiple empirical set-ups are created to triangulate the results, and to avoid any criticism that any particular test may be biased.

[35]We calculate this variable in two different ways: 1) using the first-day return data available from SDC and 2) using CRSP daily data. For the calculations in 2), we essentially retrieve the closing price for the first trading date of the firm. When the first trading date in CRSP does not match the issuance date in SDC, we use the earliest date with nonmissing price data that is at most three days separated from the issuance date; otherwise, we leave the observation empty. In the instances when both the underpricing from SDC and the underpricing from CRSP are available, we use the later one, because we consider the CRSP data to be more reliable.

[36]For further information on this variable, we also rely on Field-Ritter dataset of company founding dates, as used in Field and Karpoff (2002) and Loughran and Ritter (2004). When we see inconsistencies between this data and our main data sources, we rely on the former.

4.1. Rising IPO Cycle

The model describes the behavior of private firms around the time when the IPO market starts to heat up i.e., model's predictions are primarily related to the periods when the IPO cycle is rising. Thus, as a first step, we need to identify the periods of rising IPO activity.

We use the number of IPOs in each quarter as our most relevant measure of market heat.[37] The aggregate issuance data is from Jay Ritter's website. It includes the number of IPOs and the equally-weighted underpricing of these offerings in each month going back to 1960. Converting this data into quarterly observations is straightforward.

We first take the moving average MA(4)[38] of the quarterly IPO issuance observations. Then, we identify a rising IPO cycle as the period when this MA(4) has risen for at least three back-to-back quarters. *Figure 1* shows the plot of the quarterly IPO activity and its 4-quarter moving average. According to the above definition, there are twelve rising (or expanding) cycles between 1970 and 2007. A typical rising cycle lasts between 5 to 7 quarters (7 of the 11 rising cycles are such), but we have three expanding cycles that lasted only 3 or 4 quarters, and one that lasted 14 quarters (between 78/2 and 81/3).

Also, we perform the following robustness test on an alternatively defined "rising cycle." We eliminate any cycle that does not have its trough (i.e., its starting point) below the historical average of the quarterly IPO events (again, we use the above described time series on IPO volume that goes back to 1960s.). Rising cycles that have their lower turning point (i.e., their troughs) very high up may not represent the true spirit of a "slow" IPO market, which is when our model predicts that strategic waiting would be most valuable. There are three cycles that fit this description: $85/3-87/1$, $93/3-94/2$, and $95/3-96/4$. See *Figure 1* and *Table 1* for reference. After eliminating the IPOs that were issued in these three rising cycles, we perform our main tests (see below) on the IPOs issued in the remaining eight rising cycles. Our qualitative conclusions still hold. Results available from the authors.

[37]One can also use alternative measures of market heat, such as the growth rate in real private nonresidential investment (see Lowry, 2003; Pastor and Veronesi, 2005; and Yung, et al., 2008). We have done our survival analysis tests using this measure of investment activity, where a rising cycle is defined as at least three back-to-back quarters of positive growth in such nonresidential investment activity. We find that, on average, the low-quality firms lead the high-quality ones by one to three months (the difference is significant at 5% level). These results are available upon request.

[38]There are about 40% fewer IPOs issued in the 1^{st} quarter of the callendar year than in its 4^{th} quarter. MA(4) controls for this seasonality effect.

4.2. Location on the Rising Cycle

Our model's main prediction is related to the issuance order of IPOs with different qualities. One way to test this prediction is by determining whether the firms going public in the early parts of a rising cycle are of different quality from the ones issuing in the later parts of it.

After identifying each rising cycle, we rank the quarters (or in some instances the months) within each cycle as the 1^{st}, 2^{nd}, ..., n^{th} quarter/month since the beginning of the rise. As noted earlier, there is only one incidence when the quarter count reaches 8 or above. So, to avoid any results that are driven only by a single cycle, we do not consider the quarters (months) that are located beyond the 7^{th} quarter (21^{st} month).[39]

4.3. Firm Quality

How do we determine an IPO firm's quality? There are various measures used by the literature, but the one that is most relevant to us is the long-run return performance of the firm after issuance. Long-run returns should reflect most of the quality components (investment opportunities, operating efficiency, profitability, etc.) of a firm. So, we use the 3-year and 5-year post issuance performance of IPO firms, as an *ex post* measure of their quality.[40] As a robustness check, we employ two other indicators of quality: 1) average cash flows the firm generates within 3 (or 5) years after issuance, and 2) Standard&Poor's Index Committee's judgment on which firm is good enough to be a part of the S&P 500 index.

To calculate a firm's long-run return, we use the market adjusted model.[41] Namely, let R_{jt} represent firm j's stock return (with dividends) for month t. The abnormal return is $AR_{jt} = R_{jt} - R_{mt}$, where R_{mt} returns are represented by the contemporaneous return on the CRSP equally-weighted market index (with dividends).

Firm j's cumulative abnormal return (CAR) and buy-and-hold abnormal return (BHAR) across T periods are defined as

$$CAR_{jt} = \sum_{t=1}^{T} AR_{jt} \tag{14}$$

[39]It is interesting to note that, the most intense quarter of the rising cycles (in terms of the number of issues) is the 4^{th} quarter.

[40]According to Helwege and Liang (2004), the *ex-ante* measures of quality are not very reliable, so we refrain from using them.

[41]Using Fama-French three factor or Fama-French-Carhart four factor models make little difference in our qualitative results.

$$BHAR_{jT} = \prod_{t=1}^{T} (1 + R_{jt}) - \prod_{t=1}^{T} (1 + R_{mt}) \,. \tag{15}$$

Using their long-run returns, we sort all the firms issued during rising cycles into quality deciles. Firms with the best post-issuance performance are in decile 10 and the worst ones are in decile 1. Sorting into deciles within each rising cycle separately, makes little difference in our results.

4.4. Survival Analysis

Some of our empirical tests rely on survival or duration analysis, which is commonly used to model time to event data. In our case the event is, of course, the initial public offering. Survival time refers to the timespan between the beginning of an up cycle and the date the firm goes public (measured in days). The beginning of an up cycle is considered to be the first day of the first quarter of a rising cycle.[42]

Many studies in financial economics have used survival functions (or the corresponding hazard rates) in their analysis (see Whited, 2006, for a recent example). While there are many ways to estimate survival functions and the corresponding hazard rates, the most appropriate technique in our case is the Kaplan-Meier (KM)'s nonparametric method. KM produces an estimate of survival function without having to specify the distribution of lifetimes.

KM defines an estimate of survival function as follows. Let there be a total of k IPO events in the sample. The event times are denoted with $t_1 \leq t_2 \leq ... \leq t_k$. Let m_i represent the number of firms that go public at time t_i, where $i = 1, 2, ..., k$. Let n_i be the number of firms that are yet to go public (i.e. all the firms in the analyzed sample that will go public after t_i). The KM estimate of the survival function at t_i is the cumulative product

$$\hat{S}(t_i) = \prod_{j=1}^{i} \left(1 - \frac{m_j}{n_j}\right) \tag{16}$$

$\hat{S}(t_i)$ is a right-continuous step function with jumps in the event times (i.e., the events at t_i are included in the estimate of $S(t_i)$). In our case we have no censored data. All the firms in our sample ultimately end up going public. So, the number of events is equal to the number of firms.

[42] This date may seem a little arbitrarily chosen – empirically it is very difficult to pinpoint a particular day when an expanding IPO cycle starts. For our purposes the most important thing is to pick *a* starting point. We compare all the following issuance dates *relative* to it.

5. Results

This section presents the results from the above described testing setups.

5.1. Descriptive Statistics of the Cycles

Before we proceed with our empirical tests, we first describe the cycles in terms of various IPO features. *Table 1* shows the start and the end of each cycle, its duration, the total number of IPOs that went public in it, and what percentage of these IPOs had positive 5-year returns (BHAR or CAR). Other IPO characteristics of the firms issued in these cycles are also displayed for reference: the mean returns (BHAR and CAR), mean and median underpricing, mean and median proceeds (in year 2000 dollars[43]), mean and median age, and mean and median size (measured by total assets just before or just after the issuance converted to year 2000 dollars).

An immediate observation from the table is the huge difference in the total number of IPOs issued in each cycle. For example, even though the expanding cycle of $95/3 - 96/4$ lasted only for six quarters, it had 1,044 firms go public in it. Other cycles with comparable length had far fewer IPO issuances. The up cycle of $03/3 - 05/1$, for instance, lasted seven quarters, but had one-third of the number of IPOs in it. Similar, but less striking, results can be found across the contracting IPO cycles. These findings suggest that the length of the cycle does not necessarily imply more IPO activity (the Spearman correlation between the length of the cycle in quarters and the number of firms in it is 0.13 for the rising IPO cycles and 0.19 for the declining IPO cycles, and both are insignificant at 10% level.)

As expected, there are more IPO activity taking place in the rising cycles than in the declining cycles. On average, 499 IPOs go public in a rising cycle vs. 321 in a falling cycle. Note that, we had equal number of rising and falling cycles during 1973-2007 period, which is 11.

Across the rising cycles (and to a lesser extent across the falling cycles) we see major variation in both the long-run (5-yr BHARs and CARs) and the first-day returns (underpricing). Similar observations can be made about other IPO characteristics in the table. The main conclusion from this table is that the expanding cycles – which are the focus of this paper – can be very different from each other in terms of the IPO features. For example, the two most notable expanding cycles with strikingly different IPO characteristics are the $75/3 - 76/4$ and the $99/2 - 00/1$ cycles. While the former cycle features IPOs that are older, less-underpriced, and of better quality (as captured by larger percentage of IPOs with positive long-run returns or by the higher mean long-run returns), the latter one has the opposite features.

[43]For this purpose we use monthly CPI data obtained from Bureau of Labor Statistics website.

The sub-sections that follow present our empirical results, which are averaged across the rising cycles. Performing the tests separately for each cycle would be tedious and too overwhelming for this paper. While analyzing each of the eleven cycles separately could lead to interesting insights, our focus is on our model's implications.[44]. The prediction(s) of our model are general and in probabilistic terms, and thus we have to deal with cross-cyclical averages and general patterns. The fact that our hypothesis of IPOs engaging in strategic waiting holds across cycles of such diverse nature should be considered as a testament to its strength.[45]

5.2. Survival Analysis of the IPO Quality Groups

As the first test of our hypothesis, we estimate (using the KM method described above) the survival functions of each IPO quality group. Then, we compare them to find out which quality group "survives" longer (i.e. issues later in the rising cycle). This survival analysis is the most direct test of our hypothesis.

As our "high-quality" ("low-quality") group we take the IPOs that are in the top (bottom) performance decile measured either with BHAR or CAR (3- or 5-year time horizon).[46] *Figure 2A* plots the estimated survival functions of high- and low-quality IPO sub-samples when 3-year BHARs are used to rank the firms.[47] The survival function for high-quality IPOs is consistently above the survival function of low-quality IPOs, which implies that high-quality firms wait longer after the start of the rising cycle before enacting an IPO event. Figures 2B-2D show the same plot for 5-year BHAR, 3-year CAR, and 5-year CAR, correspondingly.

Table 2 presents the mean and the median survival days of each quality sub-sample. The Log Rank and the Wilcoxon nonparametric tests for the null hypothesis of identical survival curves across these quality sub-samples are also presented. As we can see from the table, all of the tests reject (at 5% significance level) this null hypothesis, in favor of lower quality IPOs issuing one-to-three months earlier (on median). The mean/median waiting days of the firms from all quality deciles, not only

[44]We would gladly present the results for each cycle separately to any interested reader

[45]In unreported results, we performed our analyses by removing each cycle one at a time, and run our tests. The main conclusions still hold.

[46]Alternatively, we define as high quality the IPOs with positive long-run returns. The rest of the IPOs are low quality. The qualitative conclusions are unchanged.

[47]We truncated the number of days at 640 (or 7-quarters), because as noted earlier, we have only one incidence of an up cycle lasting beyond 7 quarters. Inclusion of the days beyond 640 would make the analysis dependent on a particular cycle, which is not our goal. We should not that the results when such a truncation is not performed still hold, but they create a discontinuity in the survival functions, which could be confusing for the reader. These results are available upon request.

the highest and the lowest ones, are available from the authors.

5.3. Average IPO Quality Across The Rising Cycle

After sequencing the months of an up cycle the way described earlier, we check the average quality of the firms in each month. Our proxies for quality are 3-year and 5-year return measures (CARs or BHARs).[48] For this test we use months instead of quarters, because for monthly quality averages provide a more refined information on the quality composition along the rising cycle. We will use these refined data points to run a simple OLS regression of quality vs. time trend. *Table 3* shows the mean IPO quality for each month of the rising cycle (averaged across the rising cycles). Again, we stop the count at the 21^{st} month (7^{th} quarter), because, as explained earlier, only one rising cycle lasts longer than that.

Figures 3A and 3B plot the MA(6) of the mean quality of issuing firms in each month. Taking the moving average (MA(6)) helps with graphically observing the secular trend across the cycle. It is noticeable that, the average IPO quality is generally higher in the later stages of the cycle than in its early parts. Of course, we are dealing with averages and generalized patterns, here. We are not claiming that each consecutive month should have higher mean quality. For us, the only important thing is to show that high-quality firms tend to *avoid* issuing in the early stages of the cycle, which seems to be reflected by the graph (Christoffersen, et al., 2009) This is more easily seen using the coefficient estimates from a simple OLS regression of the corresponding quality measure on the time trend (see the bottom part of *Table 3*). All four of them are positive, and with the exception of one, all are significant at 5% level. The coefficient for 5-year BHARs is significant at 10% level. In short, as the cycle is rising, and the certainty on the favorable issuance environment increases, the mean IPO quality improves, as well.

In unreported results, we find that the $4^{th} - 6^{th}$ quarters of the rising cycle are the ones that have the highest percentage of IPOs with *positive* post-issuance returns (3-to-5 year CARs and BHARs).

As we explained in Section 2.4, and proved in Appendix B, it is possible that during the mid-to-late stages of a rising cycle there are some extremely low-quality firms with negative expected NPV going public. The results above show that the quantity of these IPOs is apparently not enough to substantially lower the *mean* quality of all IPOs going public during these periods. However, such truly low-quality firms can, and do, influence the variance in the quality composition during hot IPO

[48] This test is similar in spirit to Banerjee, et al. (2009). They use a similar method to measure the long-run performance of leaders and followers, where they define firms issuing in the first (second) half of an IPO market as leaders (followers). Instead, we perform the more refined versions of these tests, by reporting the performance of the firms issuing in each month of the rising IPO cycle, separately.

markets (see Yung, et al., 2008; and Lowry, et al., 2010).

5.4. Evidence from S&P 500 Firms

Next, we investigate when in the rising IPO cycle, the future S&P 500 firms prefer to go public. The IPOs that are later on included in the S&P 500 index are special group of very successful IPOs. Not only that they provide an alternative testing group for our hypothesis, but also they are an interesting sub-sample of IPOs that no study we know of has focused on before. If our theory is correct, these are the firms that can afford to engage in strategic waiting the most.

As mentioned earlier, there are 219 IPOs issued between 1973 and 2007 that were subsequently listed in the S&P 500 index. Of these IPOs, 130 (or 59%) are issued during a rising IPO cycle. Using this sample of 130 S&P 500 firms, we perform two tests. In the first test we check how many of these firms are issued in each location (or quarter) of a rising cycle. 11 IPOs are issued in quarters (8 through 14), so we exclude them from the sample for this test. They represent the exception: they belong to the only cycle that lasted more than 7 quarters. Thus, we focus our analysis on 119 IPOs that were issued in a quarter located from the 1^{st} in line to the last (7^{th}) in line of a rising cycle.

Table 4 presents some of the results from the tests associated with this IPO subsample. In comparison to the first quarter, the mean number of firms per cycle per location is much higher for quarters 2 through 5. The mean issuance jumps from 2.57 in the first quarter to 3.67 in the fifth quarter: a 43% jump. Similarly, we have a total of 26 IPOs issued in the fourth quarter, which is 44% higher than the corresponding number in the first quarter, 18. This is despite the fact that, by definition, not all of our rising cycles has to last until the fourth quarter. All of them, of course, have at least three quarters. In short, it is not the first quarter that is the most active one with regards to the IPOs of the future S&P 500 firms, but the quarters following it (especially, quarters 4 and 5). So, most S&P 500 IPOs (112 out of 130, or 86%) were not issued in the first quarter, which is what one would expect, if the best firms were engaging in strategic waiting.

In the second test we ask "Were the S&P 500 firms first to issue within their industry?" For each rising cycle (remember that there are 11 of them), within each 2-digit (or alternatively 3-digit) industry, we order all the issuing firms from 1^{st} to n^{th} to go public. The beginning of the cycle is the first day of the first quarter of the corresponding cycle. Then, we find the issuance order of each S&P 500 firm within their industry. *Table 5* shows that for 2-digit SIC sorting, mean issuance order is changing from 3.89 to 32.60 from cycle to cycle. Thus, the evidence indicate that S&P 500 firms are not first to issue in their industry when the IPO market starts to heat up. Usually, there are at least 3 or 4 firms in their industry issuing before them.

As we narrow the sorts to be within 3-digit SIC industries, the chances that the S&P 500 firms will issue first are increasing, of course, but still for majority of the cycles (7 out of 9 cycles with an S&P 500 firm issuance in it) there are at least two other firms in the industry that issued earlier (based on median issuance orders in each industry in each cycle). In unreported results, we look at each S&P 500 firm individually, and find that 77% of them were not the first to issue in their 3-digit SIC industry. For example, Genentech Inc. was 5^{th}, Apple Inc. and Microsoft Corp. were both 18^{th}, and Starbucks Corp. was 15^{th} to issue within their corresponding 3-digit industry.

Note that, these last tests are biased against our model's prediction. Our model does not relate to the industry of the IPOs; the information about the aggregate state of the economy is released regardless of the industry of the first issuing firm. All of our prior tests have shown that, normally, the high-quality firms are not first to issue as the cycle starts to expand. In this test, however, we find a stronger support for our model: the best firms (i.e. S&P 500 firms) are not the first issuers even in their own industry.

For reference, we also report the issuance order of S&P 500 firms within all the firms in the corresponding cycle, not just within their industry. As shown in column (3) of the table, for the majority of the cycles, literally hundreds of firms issued ahead of these S&P 500 firms.

In a robustness test, we perform the same analysis on S&P 500 IPOs as above, but we eliminate any firm that has merged with another firm before it became part of the index. Such cases are not that informative about the quality of the original IPO firm. We obtain Mergers&Acquisitions data from SDC, we match it with our sample of 130 IPOs, and we check whether and when they engaged in any form of M&A activity. If it is before the inclusion in the index, we drop it from the sample. These restrictions leave us with 72 IPOs that were included in the index on their own right (without merger). *Tables 4* and *5* show the results for this subsample, as well (under the columns named "Subsample"). Our main conclusion, that the first quarter is not the most active quarter for these high-quality firms, still holds. Second through the fifth quarters seem to be the most active ones for these firms (see *Table 4*). Similarly, our main conclusion from *Table 5*, of S&P 500 IPOs not being first-to-issue in their industry, is qualitatively unchanged by the use of the above subsample of non-merged IPOs.

In unreported analysis, we also eliminated the firms that did not became part of the index within certain period of time (say 5 years). These two restrictions (no merger and inclusion within 5 years) eliminated most of our sampled IPO firms: there were only 35 of them left. For these remaining firms, the most active quarters were 2^{nd} and 4^{th} quarters, and the 1^{st} quarter was among the least active ones, thus confirming our main findings above. Detailed results available upon request. Therefore, based on the results from this subsection, we conclude that S&P 500 firms 1) are usually not the first movers in their industry as the new expanding cycle starts; and 2) they prefer to go public during periods of confirmed market heat (after the initial, more uncertain, quarter is over).

5.5. An Alternative Definition of Quality

To check whether our results are robust to an alternative definition of quality, we use the average post-issuance cash flows of the firm as an indicator of its quality at the time of issuance. Specifically, using COMPUSTAT data, we calculate the average annual cash flows[49] of each firm during the first 3 years (or alternatively, 5 years) of its public trading. There are total of 3,370 (or 3,390) IPOs issued in a rising cycle, for which there are enough data points to calculate the 3-year (or 5-year) average annual cash flows.

We sort these firms into deciles based on their average post-issuance cash flows, such that the firms with the highest (lowest) cash flows are in decile 10 (decile 1). We, then, perform the same tests as above, but with this new definition of quality. For brevity, we report only the results from the most direct test of our hypothesis, namely survival analysis. As we can see from *Figures 2E* and *2F*, and *Table 2*, Panel C, our results from this robustness test confirm that high quality firms (decile 10) wait, on median, 35 to 43 days longer than the low quality ones (decile 1) before issuing.

5.6. Determinants of Strategic Waiting

Next, we estimate what affects the waiting time of the firms. Specifically, we determine whether after controlling for other factors, our quality measures still have explanatory power over the waiting days. The dependent variable is the number of days passed between the start of the rising cycle and the IPO date of the firm (*WaitingDays*). The explanatory variable capturing the firm's quality is approximated by seven different measures: a dummy indicating the inclusion in the S&P 500 index; the rank of the firm's 3-year CAR within the same returns of all the other IPOs in our sample (in deciles); same rank when 5-year CARs, 3-year BHARs, and 5-year BHARs are used; the decile rank of the firm when its 3-year and 5-year average post-issuance cash flows are used.

The remaining explanatory variables are as follows. *Age*, defined as the logarithm of one plus the firm's age at the time of issuance relative to the founding date. *HiTech* is a dummy variable that is 1 if the IPO firm is in a hi-tech industry and 0 if otherwise.[50] *Leverage* is calculated as the total

[49] We define cash flows as [*Income Before Extraordinary Items* + *Depreciation&Amortization* – *Dividends* (Preferred + Common)] / *Assets*. In an alternative definition, we use *Sales* as a scaling variable in the previous equation; our qualitative results do not change.

[50] Hi-tech industries are those that have a three-digit SIC code in 283, 357, 366, 367, 381, 382, 383, 384, 737, 873, and

debt of the firm divided by its total assets. Both total debt and total assets are for the first fiscal year of public trading. *NI/Sales* denotes the net income of the firm divided by its sales (both net income and sales are for the first fiscal year of public trading). *Reputation* shows the updated Carter and Manaster (1990) underwriter prestige rankings obtained from Jay Ritter's website. This data is not available for the 1970s, so we extrapolate an underwriter's reputation from 1980-1984 period to be its reputation for the earlier periods. *ROA* is the return-on-assets during the first fiscal year of the new public firm retrieved directly from COMPUSTAT. *Size* is measured by the logarithm of the total sales of the firm at the end of the first fiscal year, converted to year 2000 dollars. *VC* is a dummy variable that indicates whether the IPO was backed by one or more venture firms (=1) or not (=0). The information on venture capital presence is obtained from the SDC datafiles and the Ritter's website. Finally, the variables *Offer Price* and *Underpricing* are already defined in section 3.1. *Table 6* displays the results from the OLS estimation of the determinants of the strategic waiting days for all the IPOs issued in a rising cycle. There are total of 5,484 such firms. Because of the missing data problem associated with various variables retrieved from COMPUSTAT, the number of firms used in each regression is much lower than the above number (see the bottom of the table for more information). This trade off between having enough observations with non-missing data and having many more control variables from COMPUSTAT on the right-hand-side of the estimation equations was the determining factor on how many explanatory variables we can afford to put in our regressions.

The main conclusion from the table is that our quality measures are significantly positively related to *WaitingDays*, even after we control for many other factors. Note that, the control variables we use are likely capturing other quality dimensions of the firm. For example, it is likely that IPOs with high NI/Sales for the first year are of high quality, as well. So, inclusion of many such explanatory variables to the right-hand-side convolute the conclusions that we can derive from such regression. However, we are satisfied that our quality measures have positive OLS coefficient estimates in relation to *WaitingDays*, which is what one would expect if high-quality firms are strategically waiting for favorable signals about the issuance conditions.

6. Conclusion

To the best of our knowledge, this is the first study to explain how a high-quality IPO firm may benefit from strategically delaying its issuance to obtain more information about the market conditions. As

874. These SICs belong to sectors such as biotech, computing, computer equipment, electronics, medical equipment, pharmaceuticals, software, etc.

we demonstrate above, our model has novel predictions about the issuance order of IPOs with different qualities and the composition of the firms in each stage of an expanding cycle. Our empirical results show that the pioneering IPOs are not usually the best ones within an expanding IPO cycle. For example, we find that IPOs of S&P 500 caliber quality mostly prefer to issue during the mid-stages of a typical expanding IPO cycle. They are not the pioneering issuers even in their own industry.

Our papers' demonstration of how the best firms are usually not the first to issue in a rising cycle is an important one. We show, both theoretically and empirically, that any assumption (or postulation) that the first issuers are always the best firms and all the followers are of lower quality is a shaky one. Indeed, the reverse order is more likely to happen in a typical rising IPO cycle.

Another implication of our model is related to the timing of the IPO issuance. We show that IPOs engage in timing due to strategic motives, and not necessarily due to reasons related to market overvaluation (Baker and Wurgler, 2002; and Pagano, et al., 1998) or peaking cash flows (Benninga, et al., 2005). Many IPOs delay their issuance for the purposes of discovering the market conditions. By the time the information about the aggregate state of the economy is spread among waiting private firms and they act on it, the stock market is already rising, and the private firms' cash flows are at high levels due to the same underlying economic reasons that also caused an increase in the IPO activity. Thus, most IPO issuances appear to coincide with the market's overvaluation.

Finally, our model yields a new explanation of the IPO clustering. Upon issuance of the first successful IPO(s), the investors' aggregate their private information, uncertainty about the economic and the market conditions is lifted, and all the remaining waiting firms, which were strategically delaying their issuance, are entering the market en mass. Therefore, strategic timing (waiting) can, partially or fully, explain this phenomenon.

Analyzing the strategic waiting competition among firms that are issuing seasoned equity, or among the IPOs within the same industry may also yield fruitful insights. Further empirical work can be done to find whether there is any meaningful issuance order in a declining IPO cycle. Similar analysis can also be performed for each individual cycle separately, and then compare the cycles. More detailed empirical analysis is needed also to decompose the true character of issuing IPO cohorts at various stages of the cycle.

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Appendix A. An Alternative Version Of The Model

In this appendix, we investigate a version of our model where the firms can reduce their offer price (increase α) so that the demand for their shares will always be sufficient to raise K (i.e., the IPO will always be successful), regardless of the aggregate state and the issuing firm's quality.

We assume that $\pi_{Gg} > \pi_{Gb} > \pi_{Bg} > \pi_{Bb} > 0$ holds; namely, we relax the assumption that $\pi_{Bj} = 0$ for $j = b, g$ in the main model. Most of the remaining aspects of the main model remain the same. The description of the firms is the same as in the main model. So is the investors, except that investors learn the aggregate state not from the IPO's success or failure, but from the prices of the previous IPOs. For firms to be successful in all the states of the economy, we revise Assumption 3 as follows: Assumption 3) The $\alpha's$ from Eqs. A.4 and A.8 should satisfy $\alpha_{B2}, \alpha_{B1W} < 1$.

IPO pricing: A firm $j = g, b$ will go public by offering α $(0 < \alpha < 1)$ percent of its equity in return for K. When a firm goes public, it uses a "second price" auction with a uniform price. The investors bid on the shares and reveal their prices (i.e., reveal their α). There are two types of investors, so there are only two bidding prices. Since the uniform price mechanism is used, if the demand from optimistic investors is not enough, the firm may need to sell to both optimistic and pessimistic investors. That is, in a good state, the firm sells only to optimistic investors, who pay a higher price (a lower percentage of the firm, denoted as α_G). In a bad state, however, the issuing firm has to sell to both optimistic and pessimistic investors to be successful. Hence, the firm has to offer a higher percentage of the firm (denoted as α_B). Note that, everyone will learn whether the state is good or bad after observing the percentage of the firm sold.

Equilibria: The game continues for two periods, and as before, there is a discounting factor (δ) when issued in the second period. There are two types of pure Perfect Bayesian Nash equilibria, separating and pooling, and one mixed strategy equilibrium. As we explain later on, all the pure strategy Perfect Bayesian Nash equilibria can be ruled out either due to theoretical arguments (one of the firms have incentive to deviate) or due to unrealistic parameter ranges required to maintain this equilibrium (e.g., δ is too small). Therefore, we concentrate mostly on the mixed strategy equilibrium.

A.1. Perfect Bayesian Mixed-Strategy Equilibrium

First, we explain the firms' strategies and the formation of mixed strategy equilibrium in this context. Then, with the help of simulations, we show it numerically that this is the *only* type of equilibrium that exists for a wide range of parameter space. We describe separately the investors' and the firms' behavior in this mixed strategy game.

A.1.1. Investors' Behavior in Mixed Strategy Equilibrium

Let's first determine what fraction of its equity, α, the firms need to sell to entice enough investors to participate in the IPO. Like in the main model, the α will change depending on the true state of the economy and the number of firms issuing at a given period. However, in this version of the model α_{B1} and α_{B2} will be less than 1 by our assumption of no unsuccessful IPO; so, they will play a role in the calculations below.

In the equation below, we show the calculation of α_{G1}, the percentage of the firm demanded by the (optimistic) investors when only one firm is going public before the aggregate state is revealed.

$$\alpha_{G1}\Big[p(\frac{(1-m_b)m_g\pi_{Gg}+(1-m_g)m_b\pi_{Gb}}{(1-m_b)m_g+(1-m_g)m_b})+(1-p)(\frac{(1-m_b)m_g\pi_{Bg}+(1-m_g)m_b\pi_{Bb}}{(1-m_b)m_g+(1-m_g)m_b})\Big]X=K \qquad \text{(A.1)}$$

The expression inside the parenthesis [ ] shows what is the issuing firm's probability of successfully completing the project from an optimistic investor's point of view. A risk-neutral optimistic investor must get at least α_{G1} percentage of the firm that satisfies Eq. (A.1).

A pessimistic investor (who thinks that this is a bad state with probability p, $p > 0.5$), on the other hand, demands a higher share of the firm when she observes only one firm going public. That is, her α_{B1} is higher than her α_{G1}. Also, since optimistic investors' demand in a bad state is not enough to buy all the shares of the firm, the percentage of the firm that will be sold is equal to α_{B1} (due to "second price" auction with uniform pricing). Specifically, the following equation should be satisfied in a bad aggregate state:

$$\alpha_{B1}\Big[p(\frac{(1-m_b)m_g\pi_{Bg}+(1-m_g)m_b\pi_{Bb}}{(1-m_b)m_g+(1-m_g)m_b})+(1-p)(\frac{(1-m_b)m_g\pi_{Gg}+(1-m_g)m_b\pi_{Gb}}{(1-m_b)m_g+(1-m_g)m_b})\Big]X=K \qquad \text{(A.2)}$$

The main difference between Eq. (A.1) and Eq. (A.2) is that in the later one pessimistic investors believe that the aggregate state is good with probability $1-p$, and it is bad with probability p.

What if investors see two firms going public (either in the first or in the second period) when the unknown aggregate state is good? Since this is a good state, there are enough optimistic investors to buy all the shares offered, so their demand determines α. Optimistic investors' posterior about individual firm quality will be the same as their priors, which is $\frac{1}{2}$ chance that it is a high-quality firm. Therefore, optimistic investors who observe two firms going public demand α_{G2} share of the firm such that:

$$\alpha_{G2}\Big[p(\frac{1}{2}\pi_{Gg}+\frac{1}{2}\pi_{Gb})+(1-p)(\frac{1}{2}\pi_{Bg}+\frac{1}{2}\pi_{Bb})\Big]X=K \tag{A.3}$$

Similarly, when the unknown aggregate state is bad, pessimistic investors will determine price of the IPOs (i.e., firms' α). That is, the investors demand α_{B2} percent of the shares such that:

$$\alpha_{B2}\Big[(1-p)(\frac{1}{2}\pi_{Gg}+\frac{1}{2}\pi_{Gb})+p(\frac{1}{2}\pi_{Bg}+\frac{1}{2}\pi_{Bb})\Big]X=K \tag{A.4}$$

The equations above summarize the investors' incentives. They will not buy the shares offered unless Eqs. (A.1)–(A.4) are satisfied. If the aggregate state turns out to be good, only the optimistic investors will buy the firm shares and $\alpha_{Gq}, q=1,2$ shares will be sold. When the aggregate state turns out to be bad, since the optimistic investors demand is not enough to buy all the shares offered, the second price auction will result in α_{Bq} shares to be sold, where $\alpha_{Bq}>\alpha_{Gq}$. This, in turn, means that after the pioneering IPO(s), everybody will discover the aggregate state by observing how strong the demand is (i.e., is it α_{Bq} or α_{Gq}.)

A.1.2. Firms' Behavior in Mixed Strategy Equilibrium

The two firms' decide whether to go public in the first period (IPO1), or wait and then go public in the second period (W). Here we concentrate on the mixed-strategy equilibrium. The calculations are similar to the model, so we do not give detailed explanations. The exception here is that there is no IPO failure, thus the expected payoffs are different.

First, we calculate the expected payoff from IPO1 i.e., firm $j=g,b$ decides to go public in the first period and calculates its payoff depending on whether the other firm plays IPO1 or W. For firm j, the first term in Eq. (A.5) below shows the expected payoff when it is the sole firm going public in the first period. Going public alone happens with probability $(1-m_{-j})$. According to firm j this is a good state with probability $\frac{1}{2}$. It has to sell α_{G1} percent of the firm to the investors, and its success probability in a good state is π_{Gj}. Hence, its expected payoff is $(1-\alpha_{G1})\frac{1}{2}\pi_{Gj}X$. Similarly, for the bad state; the firm has to sell α_{B1} percent of the firm to the investors, and its expected payoff would be $(1-\alpha_{B1})\frac{1}{2}\pi_{Bj}X$. The second term shows the expected payoff when both firms go public in the first period; hence, the share of the firms that must be sold is given by α_{G2} and α_{B2} in the good and in the bad states, respectively.

$$(1-m_{-j})\Big[(1-\alpha_{G1})\frac{1}{2}\pi_{Gj}X+(1-\alpha_{B1})\frac{1}{2}\pi_{Bj}X\Big]$$
$$+m_{-j}\Big[(1-\alpha_{G2})\frac{1}{2}\pi_{Gj}X+(1-\alpha_{B2})\frac{1}{2}\pi_{Bj}X\Big] \tag{A.5}$$

Second, we calculate firm j's payoff from waiting in the first period, and going public in the second period. The firm j's payoff will depend on what the other firm does. So, we can write the expected payoff from W for firm $j=g,b$ as follows:

$$\delta m_{-j}\Big[\frac{1}{2}(1-\alpha_{G1W})X\pi_{Gj}+\frac{1}{2}(1-\alpha_{B1W})X\pi_{Bj}\Big]+$$
$$\delta(1-m_{-j})\Big[\frac{1}{2}(1-\alpha_{G2})X\pi_{Gj}+\frac{1}{2}(1-\alpha_{B2})X\pi_{Bj}\Big] \tag{A.6}$$

The first term in Eq. (A.6) above shows firm j's expected payoff when the other firm goes public in the first, which happens with probability m_{-j}. When the other firm goes public in the first period, the state will be revealed. It will be a good state with probability $\frac{1}{2}$. Then, uncertainty will be only about each firm's quality. As explained earlier, the investors believe that the low-quality firm will go public in the first period and the high-quality firm will go public in the second period with probability $\left(\frac{(1-m_g)m_b}{(1-m_b)m_g+(1-m_g)m_b}\right)$. Similarly, for the high-quality one issuing first and the low-quality one going second, the probability will be $\left(\frac{(1-m_b)m_g}{(1-m_b)m_g+(1-m_g)m_b}\right)$. Given these beliefs, and if the economic state is good, the investors will ask for the share of the firm, α_{G1W}, that solves for:[51]

$$\alpha_{G1W}\Big[\big(\frac{(1-m_b)m_g\pi_{Gb}+(1-m_g)m_b\pi_{Gg}}{(1-m_b)m_g+(1-m_g)m_b}\big)\Big]X=K \tag{A.7}$$

With probability $\frac{1}{2}$, the state will be bad, and everyone will learn this. Then, the investors will ask for α_{B1W} percent of the firm:

$$\alpha_{B1W}\Big[\big(\frac{(1-m_b)m_g\pi_{Bb}+(1-m_g)m_b\pi_{Bg}}{(1-m_b)m_g+(1-m_g)m_b}\big)\Big]X=K \tag{A.8}$$

The second term of Eq. (A.6) shows the payoff when the other firm does not go public in the first period, and the state is not revealed. This happens with probability $(1-m_{-j})$. Then, both firms will have to go public in the second period. The firm believes that this is a good (bad) state with probability $\frac{1}{2}$ ($\frac{1}{2}$). The investors will demand α_{G2} percent of the firm in the good state, α_{B2} percent of the firm in the bad state.

Using Eqs. (A.5) and (A.6) we can solve for the mixed strategies of each firm, m_b and m_g.

[51] Eq. (A.7) that solves for α_{G1W} does not involve p's since the state is revealed. There is no aggregate uncertainty; there is uncertainty only about firm quality. To distinguish this case from the other cases, we used a different notation for α, namely α_{G1W}.

Proposition 4 *There exists a mixed strategy equilibrium if $m_b, m_g \in [0,1]$ simultaneously equates Eqs. (A.5) and (A.6) for each $j = b, g$. That is, firm $j = b, g$ goes public in the first period with probability m_j.*

Given the complexity of Eqs. (A.5) and (A.6), there are no closed-form solutions for m_b and m_g.[52] So, we use simulations.

A.1.3. Simulations

The numerical solutions for m_b and m_g are obtained by simultaneously solving the expressions obtained through equating the payoffs from IPO1 and W1 for the firm $j = g, b$ (i.e., Eq. (A.5) = Eq. (A.6)). To save space we do not report all the details about the simulations (results available upon request), but we see that for all the parameter values, $m_b \geq m_g$.[53] This result is the central prediction of our model; before issuing, the higher-quality firms are more likely to wait for confirmation of the rising cycle.

Intuitively, firm g has an incentive to pay the waiting cost and separate itself from the firm b by issuing in the second period. However, b also has the incentive to mimic g and issue in the second period. Therefore, a separating equilibrium is not possible; hence, we get a mixed strategy equilibrium. In this mixed strategy equilibrium, given that g has more incentive to issue in the second period by paying the waiting cost, it should be compensated by the investors. This is exactly what happens when investors believe that the firm that issues in the second period is more likely the g type; that is, $1 - m_g \geq 1 - m_b$.

Since firms use mixed strategy, the outcomes will be probabilistic. These outcomes are the same

[52] In the above model, the firms will be able to go public even if it is known that the state is bad. In such a case, the investors will simply ask for higher percentage of the shares in return for providing the necessary capital, K. In the previous version of our model (presented in the earlier versions of our paper, which is available upon request from the authors), we assumed that the firm quality is *known*, and that in a bad state no firm can afford to go public because of the large costs associated with failure (see Dunbar (1998) for details on these costs). In that model we show that there was a similar mixed strategy equilibrium, where firm b is again more likely to go public in the first period compared to firm g. That model is more parsimonious, so we can obtain a closed form solution for the m_g and m_b.

[53] The MATLAB codes we built also check whether there are any equilibrium other than the mixed strategy equilibrium. Our simulations show that the mixed strategy equilibrium is the most widely seen equilibrium, with some exceptions occurring for certain (extreme) values of one or more of the parameters. For example, we can obtain a pooling equilibrium, if δ is too small, say 0.7. When δ is too small, it implies an economic environment with very high interest rates ($\delta = 0.7$ implies period-over-period interest rates of 30%). Similarly, for some of the parameter values, we obtain cases where $\alpha > 1$, which is not a feasable outcome. Finally, unlike the main model, in our current numerical solutions we rarely see a separating equilibria.

as the ones presented in Corollary 2, in Section 2.1.

Next, we analyze the pure strategy Perfect Bayesian Nash equilibria, and explain why they are unlikely to occur in this game.

A.2. Pure Strategy Perfect Bayesian Nash Equilibria

First, we consider the separating Perfect Bayesian Nash equilibria.

A.2.1. Separating Equilibria

A separating equilibrium in which g goes public in the first and b goes public in the second period cannot exist, because b has an incentive to deviate from its strategy. When it goes public in the first period, it saves the waiting costs and it can pool together with g. Since investors observe two firms going public, they believe firm b is high-quality with probability $\frac{1}{2}$. That is, when b deviates, it will sell a lower α.

The second separating equilibrium, in which b always goes public in the first period and g always goes public in the second period, could potentially exist if δ is too high. We are unable to prove theoretically that such an equilibrium does not exist. If it does, however, it is supportive of the main claim of this paper that when there is aggregate uncertainty, the higher-quality firms have incentive to delay their IPO.

Our simulations could not find this equilibrium, either, no matter what parameter range we have checked. One explanation as to why we could not find such an equilibrium is as follows. Firm b could also benefit from deviating to the second period and issue together with Firm g. It will pay a waiting cost (δ), but it would sell a lower percentage of the firm when it pools with firm g, since the investors cannot identify the quality of the firm. Thus, when δ is very high, it is likely that b will deviate to pool together with g. When δ is small, on the other hand, this equilibrium does not exist, since firm g will deviate to going public in the first period. Firm g's savings of waiting costs will exceed the cost of partially being identified as a b type. Below, we give further details on this equilibrium.

Given that investors know that the firm conducting an IPO in the second period is a high-quality one issuing in an already-revealed good state, they will demand α such that: $\alpha_{Gg}\pi_{Gg}X = K$. On the other hand, if the revealed state is bad, investors will demand α such that: $\alpha_{Bg}\pi_{Bg}X = K$. Hence, firm g has an equilibrium payoff:

$$Payoff_{Sepg} = \delta\Big[\frac{1}{2}(1-\alpha_{Gg})\pi_{Gg}X + \frac{1}{2}(1-\alpha_{Bg})\pi_{Bg}X\Big] \tag{A.9}$$

If the high-quality firm deviates, then investors will observe two firms going public in the first period; hence, they cannot determine the type of the firms. As a result, investors will ask α_{G2} or α_{B2} share of the firms in good and bad state, respectively, where α_{i2}, $i = B, G$ is defined in Eqs. (A.3) and (A.4). To further elaborate: investors who received a signal i think that this is state i with probability p and state $-i$ with probability $1-p$, and a firm can be good or bad quality with probability $\frac{1}{2}$. Then, the deviation profit for the high-quality firm is:

$$Payoff_{Dsepg} = \Big[(1-\alpha_{G2})\frac{1}{2}\pi_{Gg}X + (1-\alpha_{B2})\frac{1}{2}\pi_{Bg}X\Big] \tag{A.10}$$

For b firm, the equilibrium payoff from going public in the first period is:

$$Payoff_{Sepb} = \Big[\frac{1}{2}(1-\alpha_{Gb})\pi_{Gb}X + \frac{1}{2}(1-\alpha_{Bb})\pi_{Bb}X\Big] \tag{A.11}$$

where $\alpha_{Gb}(p\pi_{Gb} + (1-p)\pi_{Bb})X = K$, and $\alpha_{Bb}(p\pi_{Bb} + (1-p)\pi_{Gb}X = K$, since the investors can identify b type in a separating equilibrium but do not know the state.

If firm b deviates, it has to pay a waiting cost, but benefits by hiding its type. The deviation payoff for b firm is:

$$Payoff_{Dsepb} = \delta\Big[(1-\alpha_{G2})\frac{1}{2}\pi_{Gb}X + (1-\alpha_{B2})\frac{1}{2}\pi_{Bb}X\Big] \tag{A.12}$$

If the firms' separation equilibrium payoffs are higher than their deviation profits, then there will be a separating equilibrium.

A.2.2. Pooling Equilibria

A pooling equilibrium in which both firms go public in the first period may be an equilibrium if the waiting cost is high enough (δ is low). Firm g has more incentive to deviate, since it may separate itself from b, but the waiting costs outweigh the benefit of this deviation. Hence, we can not easily rule out this pooling equilibrium. Of course, when δ is high, this equilibrium disappears. Below, we further analyze this pooling equilibrium.

Two firms are going public in the first period and the state is not yet known. So, upon receiving their reliable signals, the investors' will demand α_{G2} (defined in Eq. (A.3)) and α_{B2} (defined in Eq. (A.4)) in the good and in the bad state, respectively. The payoff from going public in the first period for a $j = g, b$ firm is:

$$Payoff_{Sj} = \Big[(1-\alpha_{G2})\frac{1}{2}\pi_{Gj}X + (1-\alpha_{B2})\frac{1}{2}\pi_{Bj}X\Big] \tag{A.13}$$

Firm g may decide to deviate to play W strategy, since it benefits from separating itself from firm b. If it does so, the state will be revealed in the first period by the observable demand for the shares of the other firm, firm b, which is what firm g wants. In that case, however, investors' off-equilibrium-path (or off-path) belief must be specified. According to this off-path belief, only a high-quality firm can benefit from deviating, since it wants to separate itself from b. That is, in this pooling equilibrium the investors believe that, if only one firm is observed going public in the second period, it must be g. Note that, if this belief does not make the deviation profitable, then no other beliefs will.

Given that investors believe the firm conducting an IPO in the second period is a high-quality one issuing in an already-revealed good state, they will demand α such that: $\alpha_{Gg}\pi_{Gg}X = K$. On the other hand, if the revealed state is bad, investors will demand α such that: $\alpha_{Bg}\pi_{Bg}X = K$. Hence, firm j does have a deviation payoff:

$$Payoff_{Dj} = \delta\Big[\frac{1}{2}(1-\alpha_{Gg})\pi_{Gj}X + \frac{1}{2}(1-\alpha_{Bg})\pi_{Bj}X\Big] \tag{A.14}$$

Using this payoff equation, we create the following proposition:

Proposition 5 *If $Payoff_{Dj} \leq Payoff_{Sj}$, then there is a pooling equilibrium in which both firms go public in the first period. In such an equilibrium, the investors' off-path equilibrium belief is that any firm going public in the second period is a high-quality one with probability 1.*

This equilibrium does not exist when the waiting cost are not extremely high, because then the condition ($Payoff_{Dj} \leq Payoff_{Sj}$) will not hold. In our simulations we find this equilibrium only for values of δ that are unrealistic: say $\delta < 0.8$. This implies period-over-period interest rates of around 20%. Thus, the occurances of such an equilibrium in real life should be uncommon.

A different pooling equilibrium in which both g and b play W cannot be an equilibrium, unless one uses unreasonable off-path equilibrium beliefs. Firm g benefits from deviating and playing IPO1, because it saves the waiting cost and it separates itself from b.

Appendix B. The Case With A Negative NPV Firm

Our model can also incorporate a situation where among the private firms there are certain type of extremely low quality firms with negative expected NPV. Next, we will derive the outcomes in such a situation. To avoid cumbersome calculations, we assume that investors know the quality of this specific firm, but do not know the quality of the other two firms (high and low quality firms). This assumption is not absolutely essential for the results below; we still obtain the same outcomes without this assumption, just the algebra become quite cumbersome and long. Also, as in the main model, we assume that the probability of return X is zero for all three firms in a bad state.

Proposition 6 *Assume that there is one extremely low-quality firm with success probability π_{Ge} such that $\pi_{Ge} > \frac{K}{X}$ and $X\pi_{Ge}(1-\frac{K}{p\pi_{Ge}X}) < \gamma$. The uncertainty about the economic state prevents this firm from going public before the aggregate state is revealed as good. Specifically, it cannot go public in the first period, (i.e., $m_e = 0$), and will go public only in the second period if and only if the revealed state is good.*

Proof: The payoff from going public in the first period for this firm is $\frac{1}{2}(1-\alpha_{Eu})X\pi_{Ge}+\frac{1}{2}(-\gamma)$ where α_{Eu} is the proportion of firm's equity needed to be sold to raise K when the firm is of extremely low quality and the economic state is unknown. It will be equal to, $\alpha_{Eu} = \frac{K}{pX\pi_{Ge}}$. When the state is bad, this firm's payoff is negative, because of the condition $X\pi_{Ge}(1-\frac{K}{p\pi_{Ge}X}) < \gamma$ (the cost of going public, γ, turns out to be greater than the expected benefit of going public). However, if the state is revealed to be good, then the firm's payoff changes, and it will go public only if $\pi_{Ge}X - K > 0$. Note that investors who learn the good state and know the quality of this firm will ask for different α (namely, $\alpha_E = \frac{K}{X\pi_{Ge}}$), and hence the firm will have a payoff $(1-\alpha_E)X\pi_{Ge}$. If this payoff is positive, this firm will go public (since not going public payoff is zero in the second period). But this payoff will be positive when ($\alpha_E < 1$), and it is positive by the assumption in the proposition. Hence, the extremely low quality firm cannot go public before the state is revealed as good. ∎

From the above explanations, one can see that the extremely low quality firm can never go public before the state is revealed as good, because its expected NPV is negative when the state is unknown. Then, assuming that there are high and low quality firms, the game becomes a strategic waiting game between them, as in *Proposition 1*. As we show in that proposition, $m_b \geq m_g$. So, the low quality firm is more likely to go public in the first period, and the high quality firm will likely follow in the second period. If the extremely low quality firm does go public, it can do so only in the second period and if the state is revealed as good.

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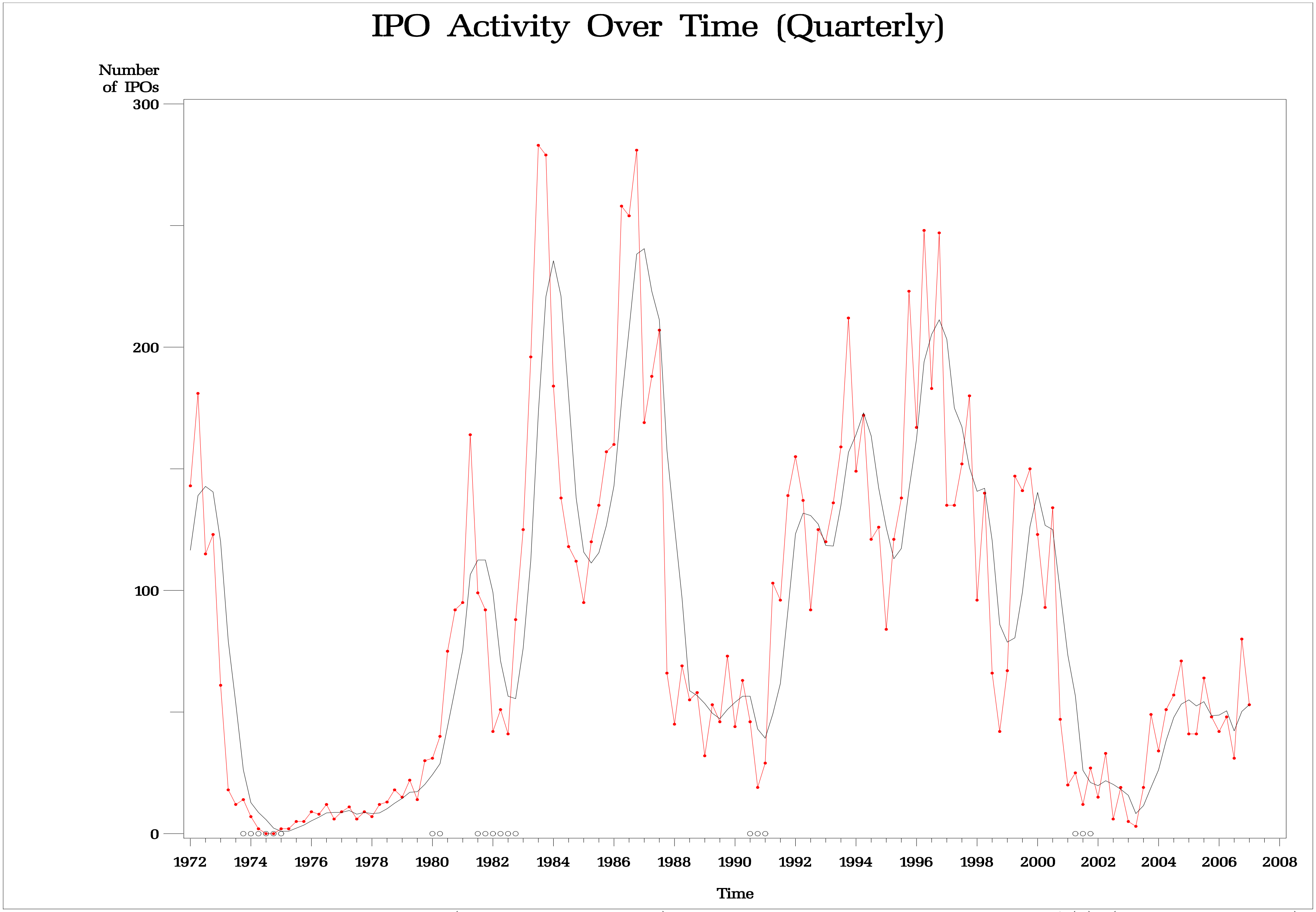
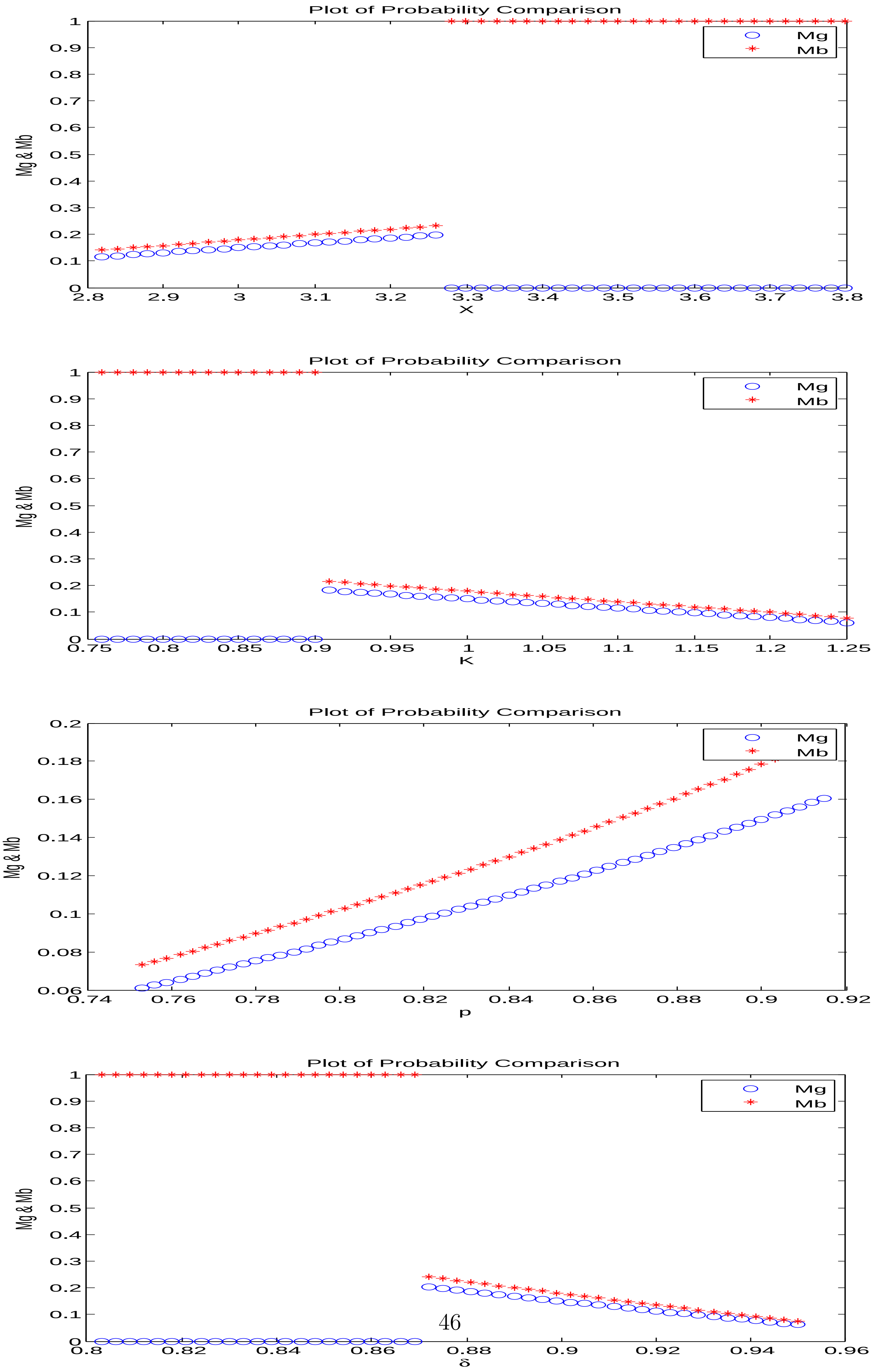
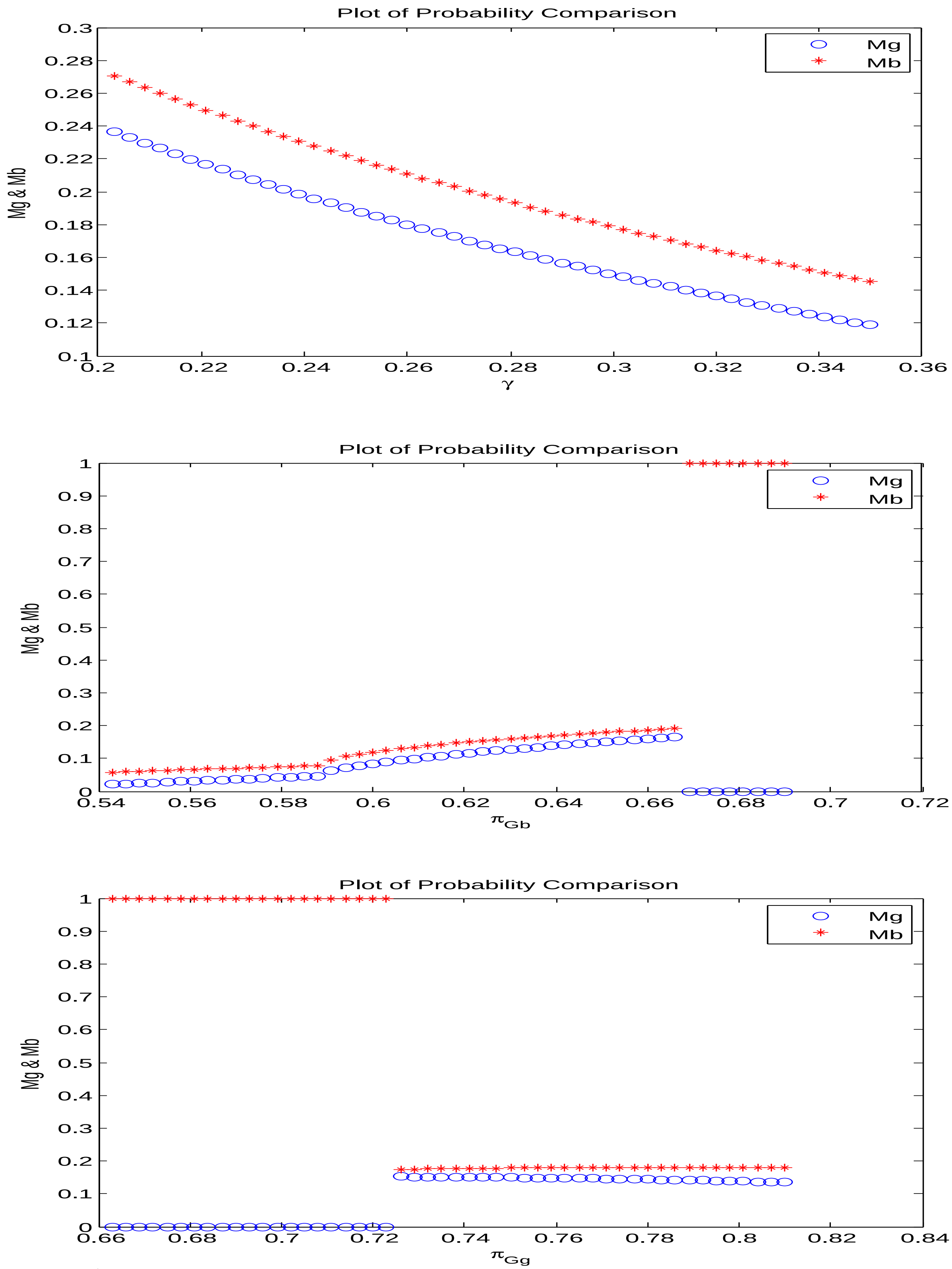
Figure 1: IPO Activity Over Time (Quarterly)



This figure plots the quarterly number of IPOs (the line with the dots), and its four-quarter moving average, MA(4), (the solid black line). Timespan is between 1972 and 2007. For reference, the quarters when the U.S. economy was in a recession, as defined by NBER, are also shown with circles on the horizontal axis.

Figure 2: Simulation Results: Main Model

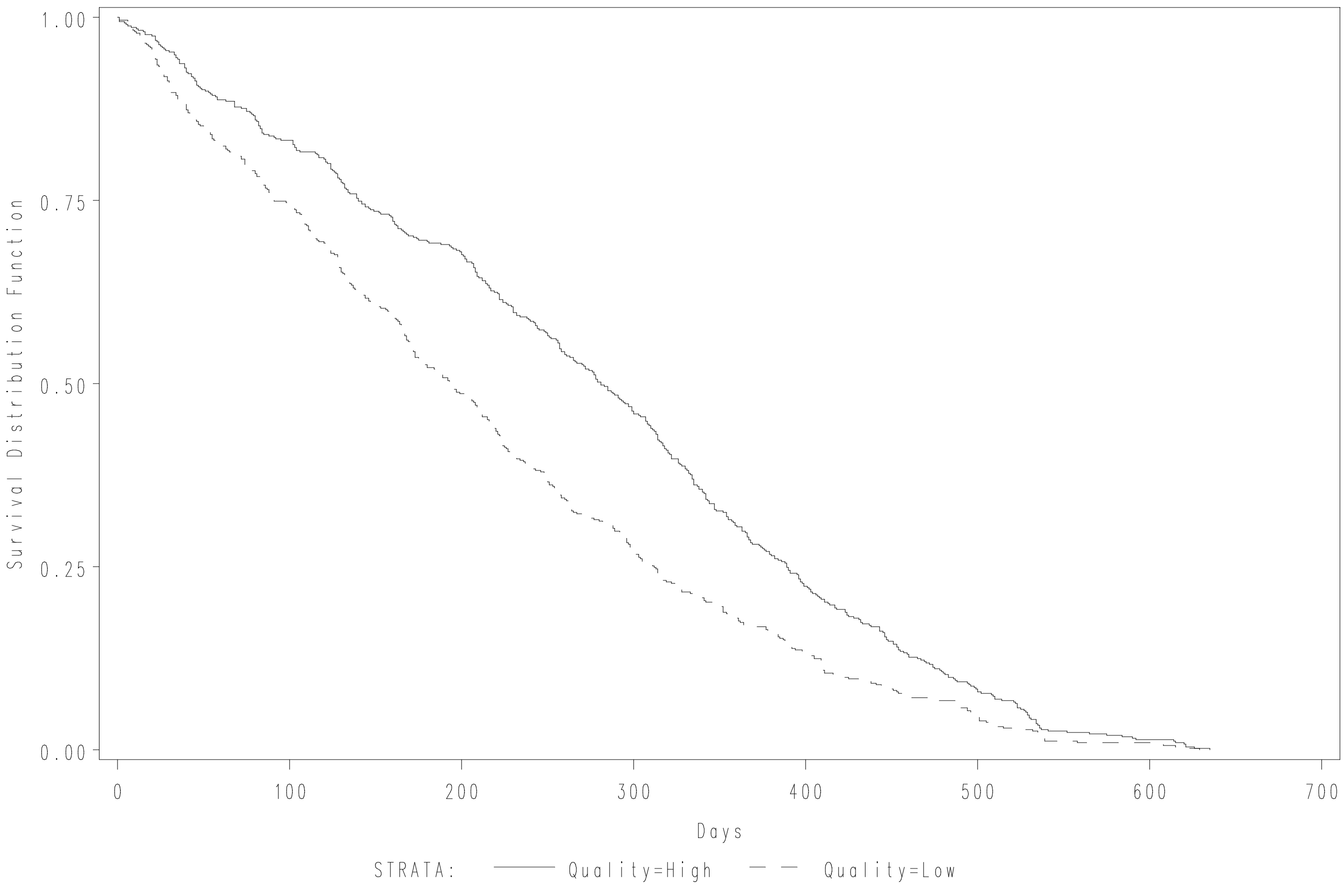




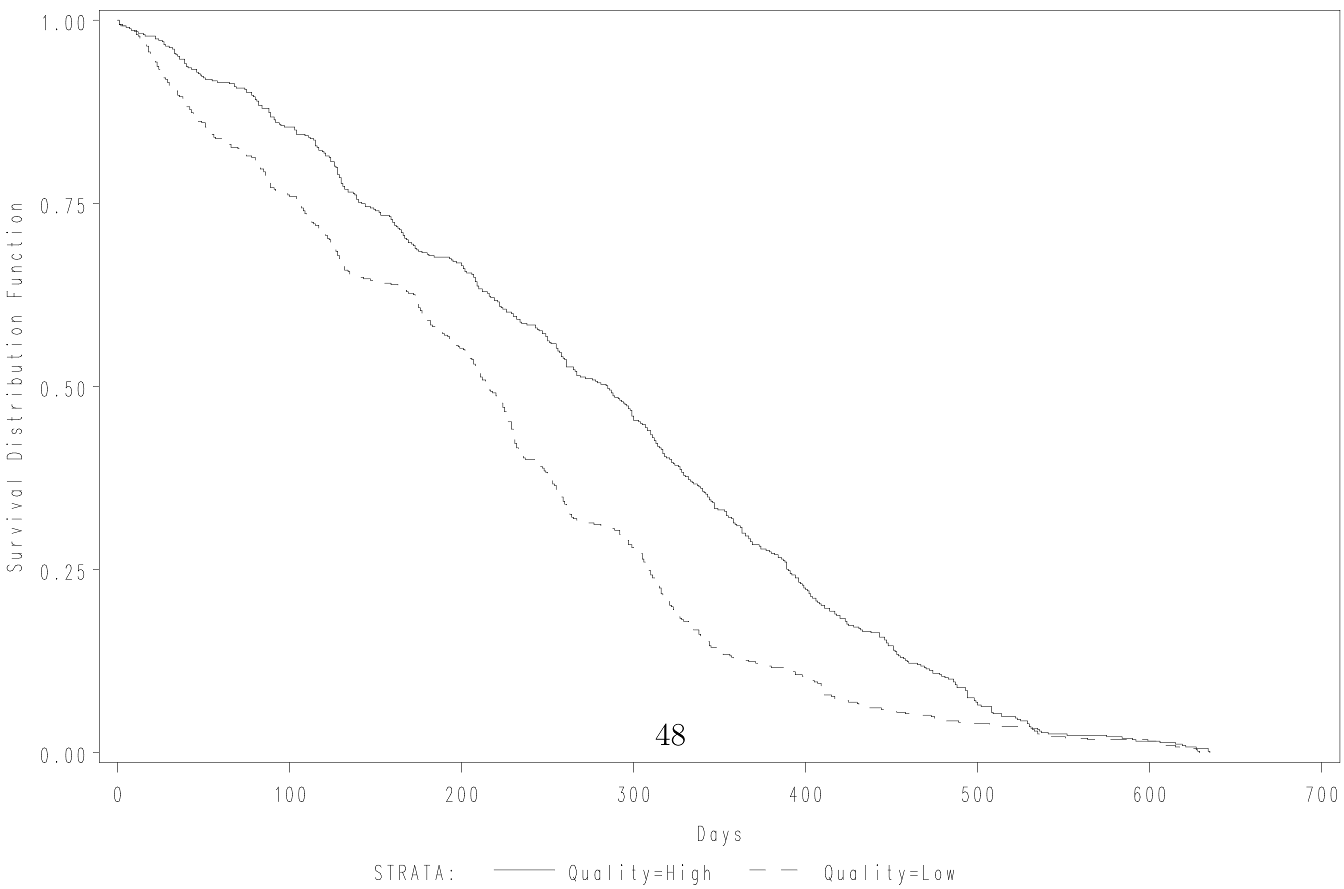
Figures 2A-2F show the results from our simulated outcomes of the main model. The plots display the relationship between a specific parameter from our model (the other parameters are fixed) and the first-period issuance probabilities of the high- and the low-quality firms (m_g and m_b). The parameters from our model take the following values when fixed: $X = 3$, $K = 1$, $p = 0.8$, $\delta = 0.9$, $\gamma = 0.3$, $\pi_{Gg} = 0.75$, and $\pi_{Gb} = 0.65$. The x-axis variable takes 50 different values in the range specified on the graph.

Figure 3: Survival Function by Quality Groups

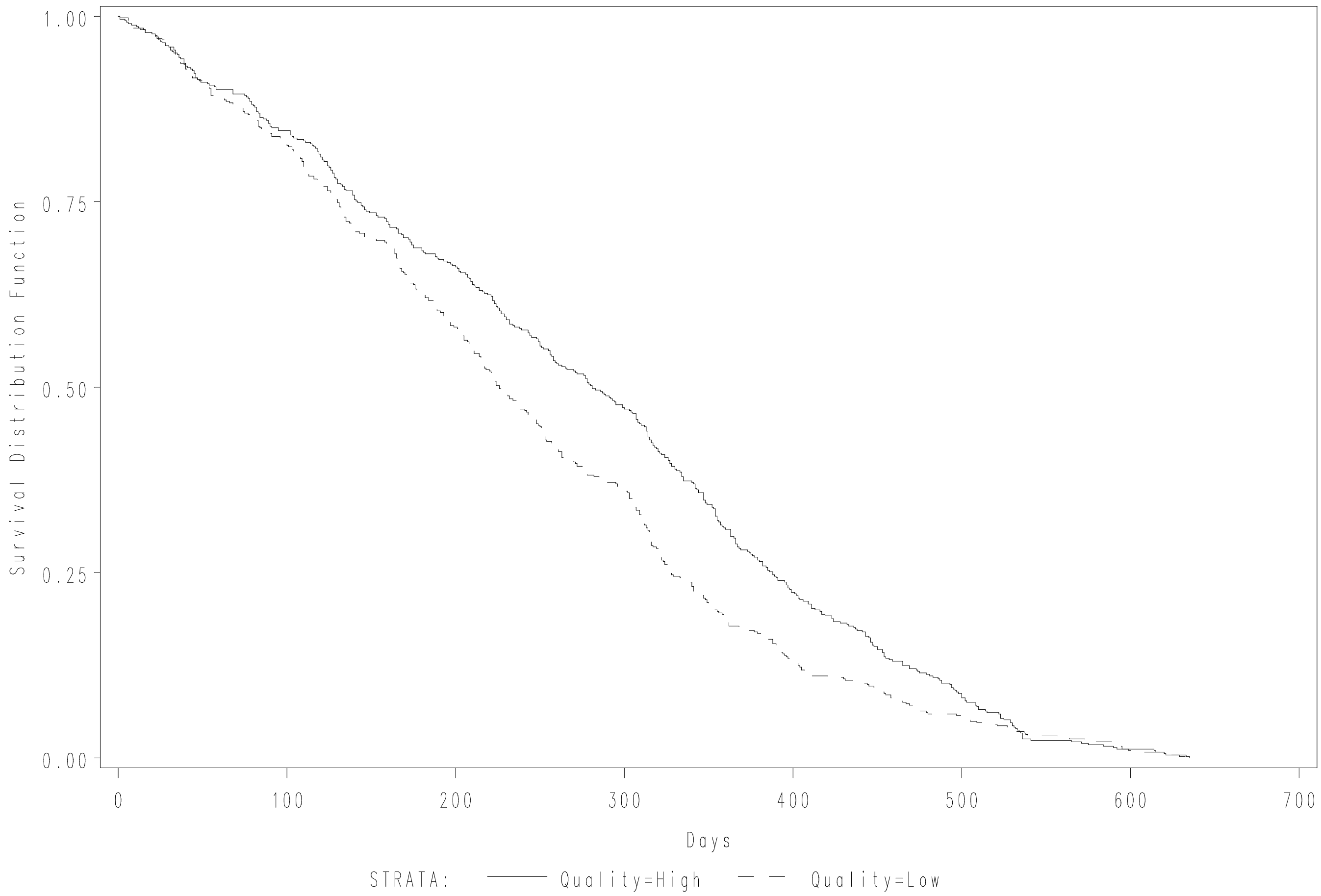
A: Ranking with 3 – year BHAR



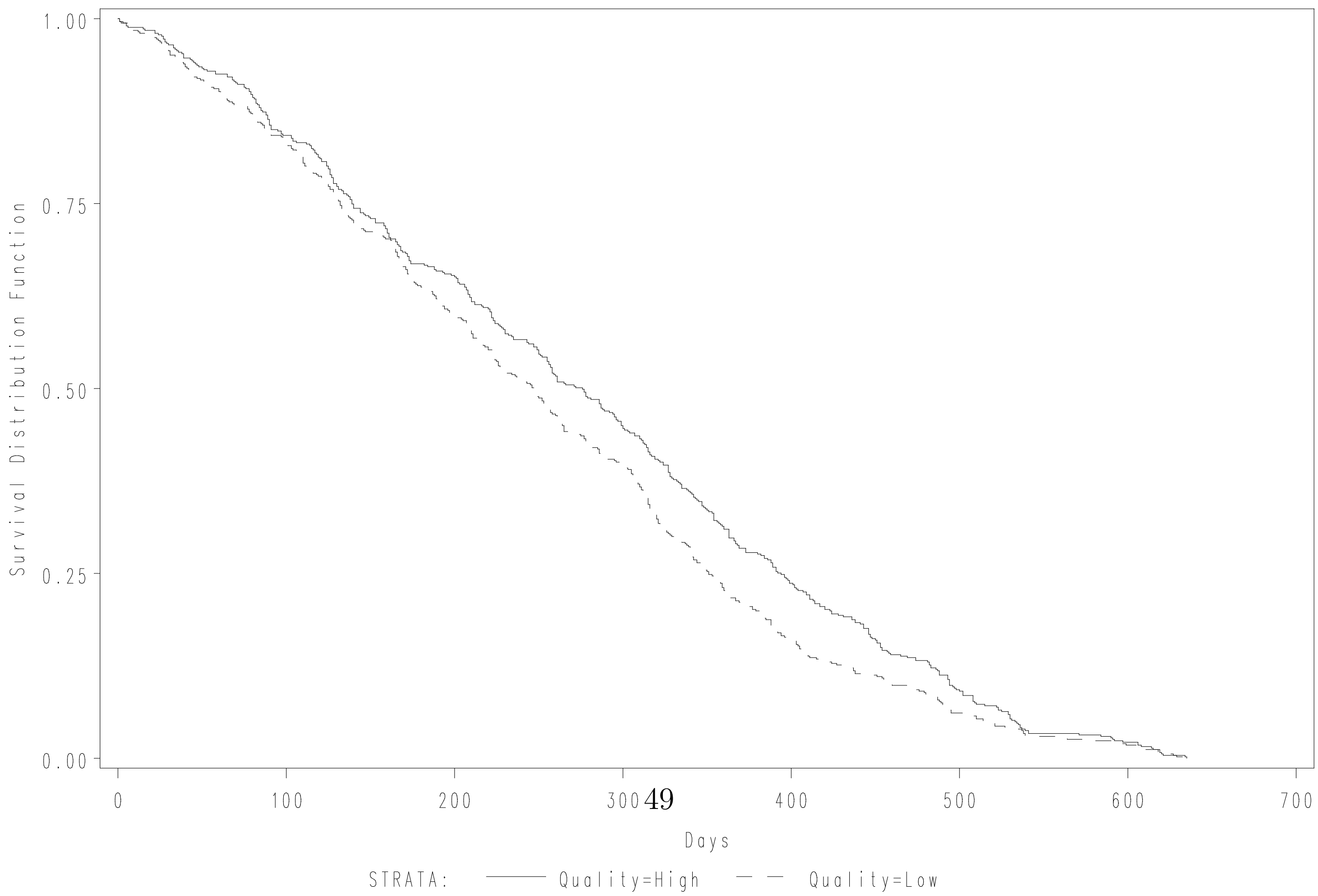
B: Ranking with 5 – year BHAR



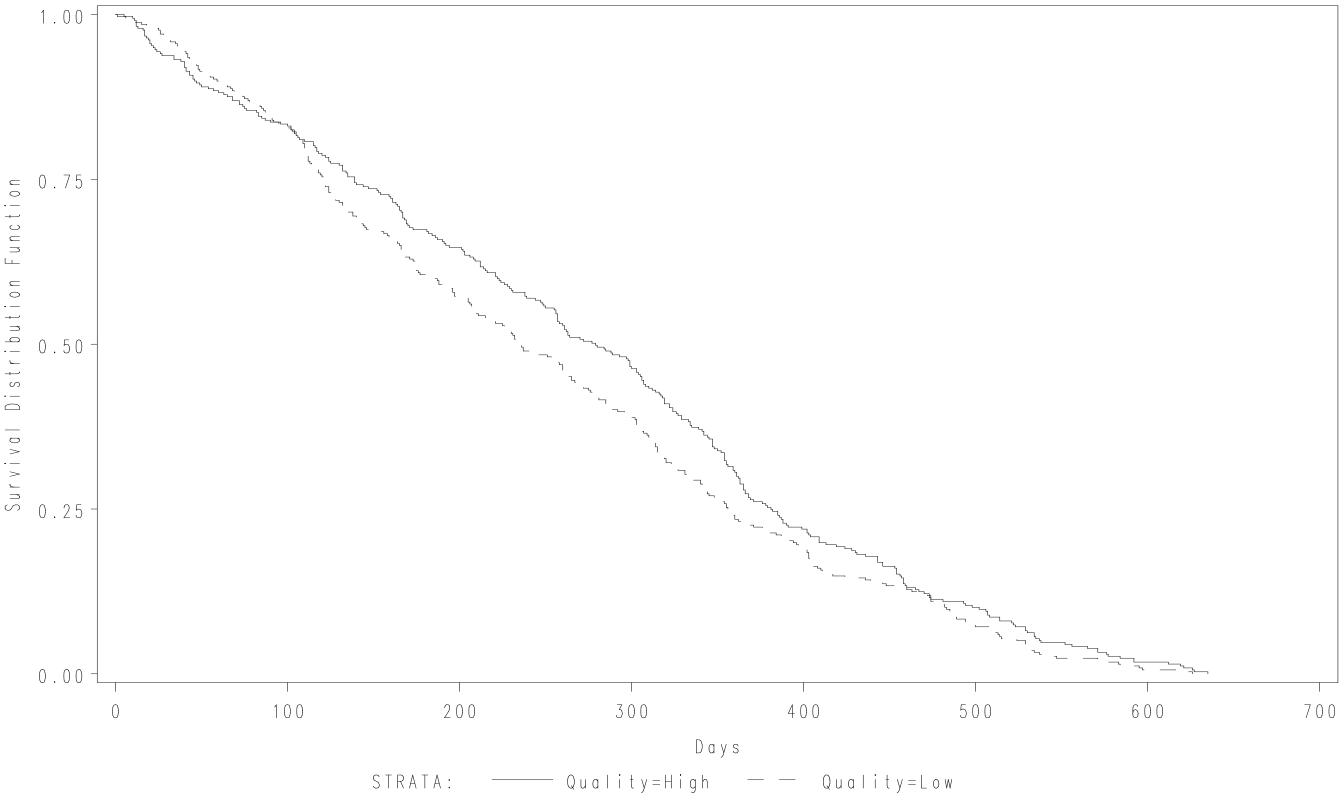
C: Ranking with 3 – year CAR



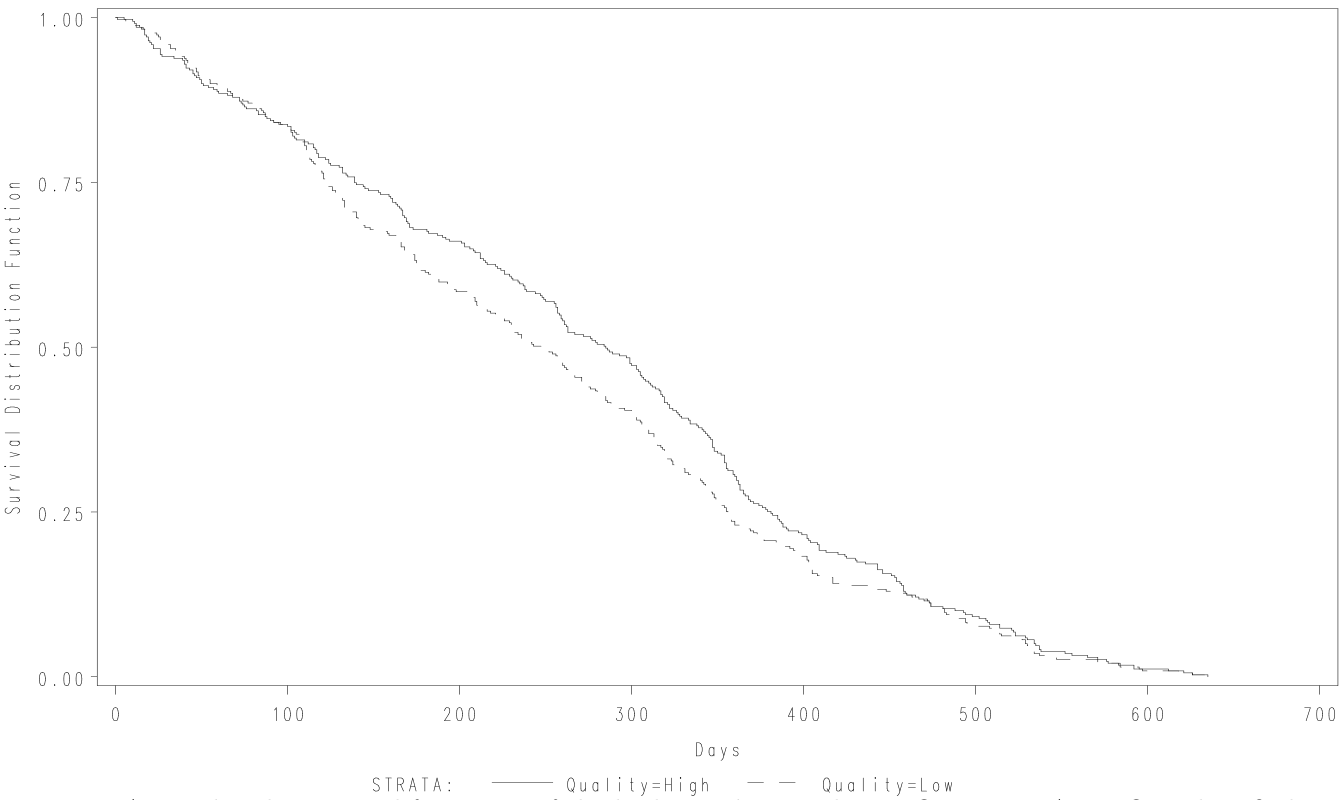
D: Ranking with 5 – year CAR



E: Ranking with Average Cash Flows (3 Years)

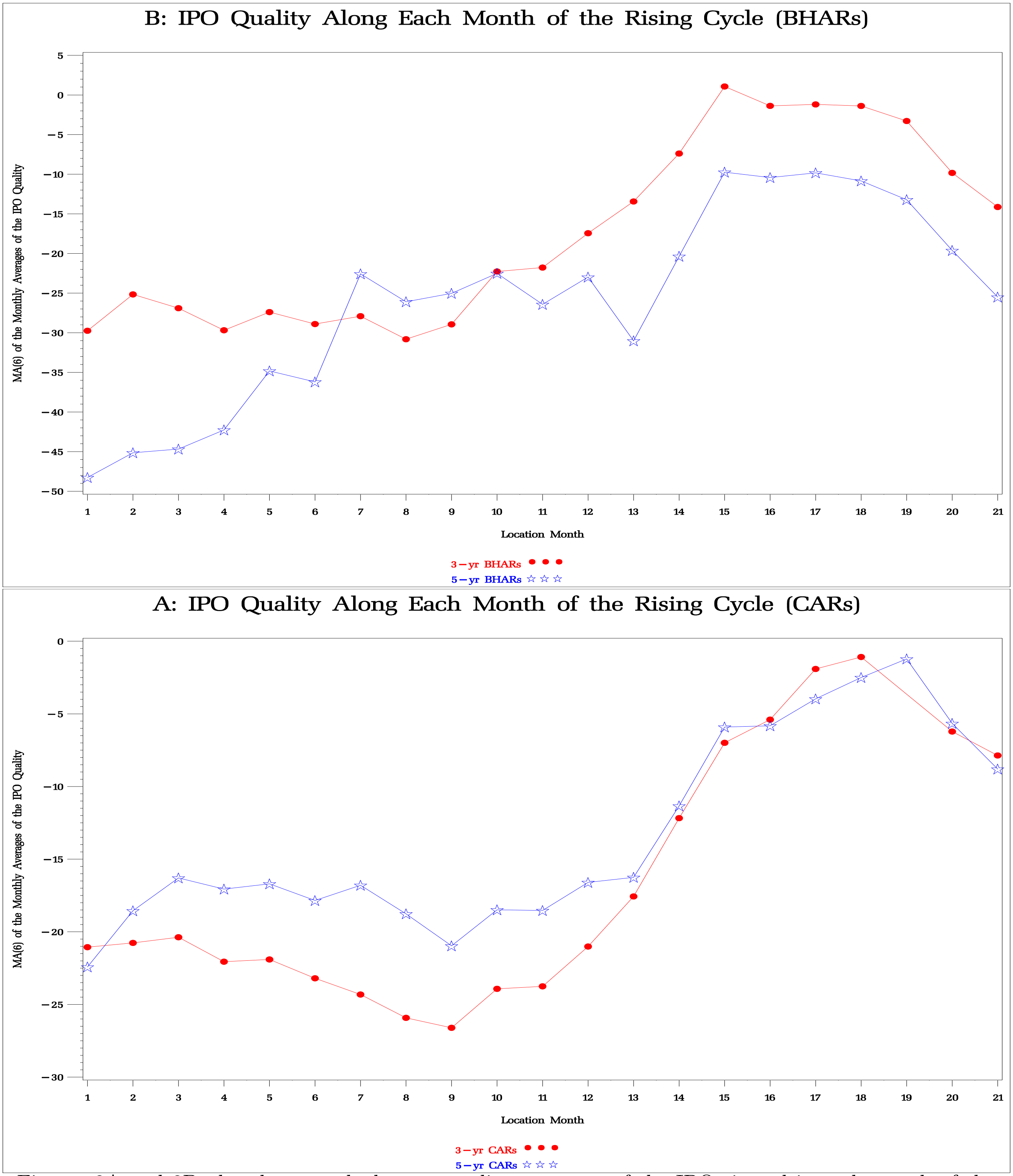


F: Ranking with Average Cash Flows (5 Years)



Figures 2A-2F plot the survival functions of the high- vs. low-quality IPO groups. An IPO is classified as high (low) quality one, if its post-issuance returns or cash flows are in the top (bottom) decile among all the firms issued during the rising cycles. Classification is done using 3-year (and 5-year) BHARs, CARs, and average annual cash flows. The survival function is estimated using Kaplan-Meier nonparametric method.

Figure 4: IPO Quality Across the Rising Cycle



Figures 3A and 3B plot the smoothed mean quality measures of the IPOs issued in each month of the rising cycle. The quality of an IPO is measured by its BHAR or CAR, and the return horizons considered are 3 years and 5 years. A rising cycle is the one for which 4-period moving average (MA(4)) of the quarterly number of IPOs has been rising for at least 3 quarters. After the beginning and the end of the rising cycle is determined, the months in each rising cycle are ordered as 1^{st}, 2^{nd},..., 21^{st} since the beginning of the cycle. To smooth out the monthly fluctuations in the quality means (i.e., to observe clearly the genuine trend along the rising cycle), their MA(6) is taken.

Table 1: Descriptive Statistics of the Cycles

	(1) Duration (qtrs)	(2) # of IPOs	(3) % with +'ve 5yr BHAR(CAR)	(4) Mean 5yr BHAR (CAR)	(5) Mean(Med.) Underp.	(6) Mean(Med.) Proceeds	(7) Mean(Med.) Age	(8) Mean (Med.) Size
Rising Cycles:								
75/3 – 76/4	6	41	31.70(41.46)	–17.28(1.04)	+ 0.38(– 0.75)	$ 27.56($17.52)	25.57(11)	$ 15.37($ 82.13)
78/2 – 81/3	14	453	19.43(37.53)	–74.08(–44.73)	+ 13.80(+ 4.08)	$ 18.33($10.94)	10.71(7)	$ 56.00($ 21.34)
83/1 – 84/1	5	751	32.76(48.60)	– 7.01(–11.02)	+ 9.17(+ 1.56)	$ 31.49($15.37)	16.16(8)	$ 200.38($ 29.79)
85/3 – 87/1	7	832	30.17(46.75)	–12.36(–15.96)	+ 14.23(+ 2.24)	$ 39.59($14.72)	19.61(7)	$ 339.33($ 27.96)
89/4 – 90/2	3	142	22.54(40.85)	–23.69(–24.18)	+ 14.31(+ 5.88)	$ 34.98($20.74)	15.24(8)	$ 271.42($ 50.93)
91/2 – 92/2	5	552	26.45(48.19)	–38.85(–15.52)	+ 10.96(+ 5.67)	$ 54.86($30.24)	18.62(9)	$ 222.48($ 55.75)
93/3 – 94/2	4	658	30.40(47.72)	+16.14(–7.74)	+ 9.68(+ 4.46)	$ 55.27($26.25)	13.05(8)	$ 311.33($ 48.53)
95/3 – 96/4	6	1,044	23.37(49.90)	–31.35(+3.25)	+ 19.89(+ 11.63)	$ 51.41($31.18)	11.86(8)	$ 202.00($ 48.88)
99/2 – 00/1	4	498	08.43(37.75)	–109.51(–55.38)	+ 78.26(+ 44.01)	$101.04($59.85)	9.81(5)	$1745.93($ 93.90)
03/3 – 05/1	7	297	33.33(46.46)	–12.91(–18.84)	+ 10.91(+ 6.00)	$145.19($85.74)	18.55(9)	$ 726.68($213.01)
06/4 – 07/4	5	216	——(——)	——-(——-)	+ 14.40(+ 6.87)	$144.04($80.70)	16.97(10)	$ 756.99($135.29)
Total	66	5,484	26.57(46.15)	–28.20(–16.19)	+ 19.54(+ 5.98)	$ 54.88($25.04)	14.86(8)	$ 435.59($ 53.15)
Falling Cycles:								
73/1 – 75/2	10	53	24.53(47.17)	–39.30(+7.88)	– 2.44(+ 0.31)	$24.56($10.26)	23.46 (6)	$610.22($ 43.91)
77/1 – 78/1	5	29	44.83(58.62)	+12.25(+ 3.68)	+ 5.56(– 0.43)	$15.24($11.48)	9.68 (8.5)	$ 50.29($ 25.36)
81/4 – 82/4	5	174	24.71(40.80)	–40.01(–35.68)	+ 6.99(+ 1.19)	$19.13($ 9.92)	11.36 (7)	$ 55.33($ 21.05)
84/2 – 85/2	5	305	30.16(47.87)	–15.60(–16.64)	– 0.21 (0)	$17.86($ 8.82)	17.33 (10)	$ 72.68($ 20.52)
87/2 – 89/3	10	594	28.11(52.69)	–3.44(+5.06)	+29.47(+ 2.66)	$34.11($12.32)	19.39 (7)	$479.21($ 31.06)
90/3 – 91/1	3	83	19.28(44.58)	–97.87(–21.30)	+10.66(+ 7.29)	$42.11($19.83)	14.71 (8)	$227.94($ 49.06)
92/3 – 93/2	4	443	27.54(45.37)	–27.13(–20.01)	+10.89(+ 6.25)	$59.35($27.33)	17.07 (9.5)	$667.57($ 50.19)
94/3 – 95/2	4	368	23.10(47.55)	–21.61(+0.93)	+16.58(+ 8.33)	$41.66($26.05)	12.82 (8)	$150.85($ 45.65)
97/1 – 99/1	9	861	21.84(49.71)	–40.85(+4.68)	+20.54(+ 9.09)	$68.68($35.71)	14.69 (8)	$579.05($ 75.20)
00/2 – 03/2	13	397	18.89(43.58)	–68.84(–22.88)	+52.07(+11.07)	$155.73($69.05)	14.76 (8)	$2717.36($130.22)
05/2 – 06/3	6	222	41.44(52.70)	+9.00(+1.80)	+ 8.49(+ 3.99)	$127.80($82.01)	22.51 (10)	$677.97($192.12)
Total	75	3,229	25.67(48.26)	–29.53(–6.43)	+20.70(+ 5.19)	$61.16($25.29)	16.13 (8)	$700.84($ 60.27)

The table presents some descriptive statistics of the IPOs in each cycle. The rising and falling cycles are shown with their timespan, duration, IPO sample size, and various other descriptive statistics. A rising cycle is defined as at least three back-to-back quarters of increasing IPO activity. The rest of the quarters are considered as falling. For the IPOs issued in each cycle the following variables are presented under each enumerated column: (1) the duration of the cycle (in quarters), (2) the total number of IPOs, (3) percentage of IPOs with positive 5 year returns (BHAR and CAR), (4) mean returns (BHAR and CAR) in %, (5) mean and median underpricing (in %), (6) mean and median proceeds raised (in year 2000 $s; in million $s), (7) mean and median age of the firms at the time of issuance (in years), and (8) mean size of the firms measured by their assets around the time of issuance (in year 2000 $s; in million $s).

Table 2: Days Since the Start of the Rising Cycle

Panel A: BHAR Returns						
	3 years			*5 years*		
Quality	Mean (Days)	Median (Days)	# of IPOs	Mean (Days)	Median (Days)	# of IPOs
High	274.68	281.00	506	275.68	285.00	507
Low	214.28	193.00	506	216.25	215.50	507
Tests						
Log-Rank	0.0001			0.0001		
Wilcoxon	0.0001			0.0001		

Panel B: CAR Returns						
	3 years			*5 years*		
Quality	Mean (Days)	Median (Days)	# of IPOs	Mean (Days)	Median (Days)	# of IPOs
High	276.10	281.00	506	276.95	276.00	507
Low	241.45	226.00	506	253.20	248.00	507
Tests						
Log-Rank	0.0003			0.0114		
Wilcoxon	0.0001			0.0168		

Panel C: Cash Flows						
	3 years			*5 years*		
Quality	Mean (Days)	Median (Days)	# of IPOs	Mean (Days)	Median (Days)	# of IPOs
High	273.58	279.00	337	274.72	285.00	339
Low	251.66	236.00	337	254.26	250.00	339
Tests						
Log-Rank	0.0489			0.0475		
Wilcoxon	0.0337			0.0443		

The table shows the mean and the median number of days passed since the start of the cycle for "high-" and "low-" quality IPOs. High-quality (Low-quality) IPOs are the firms that are ranked in the top (bottom) decile of the long-run returns or the average annual cash flows. Panels A, B, and C indicate that the quality classification is done using BHAR, CAR, and Cash Flows, correspondingly. The results for two time-horizons – 3-year returns and 5-year returns – are presented under the corresponding columns. The columns under "# of IPOs" present the number of IPOs in each decile. The p-values from two non-parametric tests (*Log-Rank* and *Wilcoxon*) for testing the homogeneity of survival functions across quality groups are also presented. The null is that the survival functions are identical across the two groups.

Table 3: Average IPO Quality Across The Rising Cycle

	BHARs		*CARs*		*Num. of Obs.*	
Period Count	3-year	5-year	3-year	5-year	3-year	5-year
1^{st}	-29.75%	-48.26%	-21.06%	-22.42%	217	217
2^{nd}	-20.57%	-42.02%	-20.47%	-14.69%	252	252
3^{rd}	-30.38%	-43.75%	-19.59%	-11.78%	262	262
4^{th}	-38.04%	-35.00%	-27.10%	-19.36%	291	291
5^{th}	-18.23%	-5.03%	-21.29%	-15.25%	319	319
6^{st}	-36.43%	-43.13%	-29.68%	-23.59%	320	320
7^{th}	-23.80%	+33.53%	-27.76%	-16.12%	251	251
8^{th}	-38.02%	-63.15%	-30.10%	-26.49%	327	327
9^{th}	-19.11%	-37.40%	-23.71%	-25.00%	318	318
10^{th}	+1.97%	-19.87%	-11.01%	-4.48%	265	265
11^{th}	-15.27%	-28.49%	-20.26%	-15.52%	376	376
12^{th}	-10.42%	-22.45%	-13.24%	-12.00%	420	420
13^{th}	+0.23%	-14.75%	-7.07%	-14.03%	236	236
14^{th}	-1.73%	+0.86%	+2.23%	+3.03%	194	194
15^{th}	+31.66%	+26.29%	+7.40%	+7.57%	183	183
16^{th}	-12.71%	-23.95%	-1.43%	-3.96%	190	190
17^{th}	-14.17%	-24.92%	+0.65%	-4.39%	137	137
18^{th}	-11.56%	-28.57%	-8.29%	-3.20%	139	139
19^{th}	-11.16%	-28.97%	+2.37%	-6.34%	41	41
20^{th}	-41.02%	-37.57%	-38.01%	-23.62%	67	67
21^{st}	+5.84%	-8.98%	-2.49%	-11.28%	59	59
OLS Coeff.	+1.3127	+1.0110	+1.1387	+0.7124		
p-value	0.0336	0.0988	0.0101	0.0307		
Adj. R^2	0.1751	0.0913	0.2635	0.1819		

The table presents the average quality of the IPOs issued in each month of a rising cycle. We measure the quality of an IPO by its 3-year (or alternatively, 5-year) BHAR and CAR. A rising cycle is the one for which 4-period moving average (MA(4)) of the quarterly number of IPOs has been rising for at least 3 quarters. After the beginning and the end of the rising cycle is determined, the months in each rising cycle are ordered as 1^{st}, 2^{nd},..., 21^{st} since the beginning of the cycle. The columns under "BHARs" and "CARs" present the results when the quality classification is done using BHAR or CAR, correspondingly. The columns under "Num. of Obs." present the total number of IPOs (summed across rising cycles) issued in each month. At the bottom of the table, we present also some information about the coefficient estimates, significances, and R^2s from a simple OLS regression of the corresponding quality measure on the time trend. The estimated coefficients capture the time trend in the monthly quality averages.

Table 4: Evidence from S&P 500 Firms

Quarter Count	(1) Mean Number of IPOs Per Cycle Per Quarter		(2) Total Number of IPOs		(3) Number of Up Cycles That Have IPOs Issued in The Quarter	
	Main Sample	Subsample	Main Sample	Subsample	Main Sample	Subsample
1^{st}	2.57	1.29	18	9	7	7
2^{nd}	3.29	2.57	23	18	7	7
3^{rd}	3.00	1.50	21	9	7	6
4^{th}	3.71	1.86	26	13	7	7
5^{th}	3.67	2.20	22	11	6	5
6^{st}	4.00	1.50	8	3	2	2
7^{th}	1.00	1.00	1	1	1	1
$(8^{th} - 14^{th})$	1.83	1.00	11	8	1	1

The table displays some information about issuance patterns of IPOs that are ultimately included in the S&P 500 index. After identifying a rising cycle the way described in the text, we rank the quarters within each rising cycle according to where in the cycle they are located: 1^{st} quarter, 2^{nd} quarter, ...,7^{th} quarter since the beginning of the rise. The columns show (1) the mean number of future S&P 500 firms that are issued in each quarter, averaged across different rising cycles; (2) the total number of IPOs in each quarter (summed across the rising cycles); and (3) the number of waves that lasted that many quarters. Under each column we show the results for our main IPO sample of all the future S&P 500 firms, and for a subsample of these IPOs that were not involved in any Mergers and Acquisitions before their inclusion in the index.

Table 5: S&P500 Firms' Order of Issuance Within Their Industries

The Rising Cycle	(1) Total # of IPOs	(2) Total # of S&P 500 Firms		(3) Mean (Med.) Issuance Order All Firms		(4) Mean (Med.) Issuance Order 2-Digit SIC		(5) Mean (Med.) Issuance Order 3-Digit SIC	
		Main Sample	Subsample	Main Sample	Subsample	Main Sample	Subsample	Main Sample	Subsample
75/3 – 76/4	41	5	5	24.50 (24)	24.50 (24)	3.89 (3)	3.89 (3)	2.67 (2)	2.67 (2)
78/2 – 81/3	453	16	12	190.13 (167.75)	169.67 (167.75)	8.55 (4)	7.35 (4)	5.65 (2)	4.86 (2)
83/1 – 84/1	751	17	8	320.59 (299.5)	289.06 (201.75)	15.68 (6.5)	24.17 (26)	9.05 (5)	12.23 (8)
85/3 – 87/1	832	26	10	386.81 (361.25)	347.55 (262.25)	13.91 (12.25)	9.59 (3.75)	7.46 (3.75)	5.47 (3.25)
89/4 – 90/2	142	6	3	58.67 (57.25)	52.17 (73)	5.13 (5)	4.5 (4.5)	3.13 (3)	3.50 (3.5)
91/2 – 92/2	552	26	14	281.04 (285)	325.11 (402.75)	12.83 (8.25)	18.90 (11.25)	7.48 (3)	10.73 (2.5)
93/3 – 94/2	658	13	8	367.04 (300.5)	354.19 (293)	16.05 (12)	11.32 (6)	8.13 (6.5)	4.00 (2.5)
95/3 – 96/4	1,044	15	8	525.67 (496.5)	403.63 (253)	30.36 (16)	42.55 (16)	14.04 (7)	20.14 (8.5)
99/2 – 00/1	498	6	4	227.33 (226.25)	303.63 (366)	32.60 (4)	63.00 (4)	27.10 (3)	52.00 (3)
03/3 – 05/1	297	0	0	–	–	–	–	–	–
06/4 – 07/4	216	0	0	–	–	–	–	–	–

The table presents issuance order of IPOs that are ultimately included in the S&P 500 index. After identifying a rising cycle the way described in the text, we rank each IPOs in the order of their issuance within their 2-digit (or 3-digit) industry since the beginning of the rise of the corresponding cycle (1^{st} firm to issue in their industry, 2^{nd},...,n^{th}) . The beginning of a rising cycle is considered to be the first day of the first quarter of that cycle. Each rising cycle is described by its beginning (exp: 75/3, which shows the third quarter of 1975) and the end of the cycle (exp: 76/4). The columns show (1) the total number of IPOs issued in each cycle; (2) the total number of future S&P 500 firms that are issued in that cycle; (3) among all the firms, what was the mean (median) issuance order of the S&P 500 firms in that cycle; (4) and (5) within their 2-digit or 3-digit SIC industry, what was the mean (median) issuance order of the S&P 500 firms in that cycle. Under each column we show the results for our main IPO sample of all the future S&P 500 firms, and for a subsample of these IPOs that were not involved in any Mergers and Acquisitions before their inclusion in the index.

Table 6: The Determinants of Waiting Days

	Different Quality Measures						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	SP500	3yr CAR	3yr BHAR	3yr CFs	5yr CAR	5yr BHAR	5yr CFs
Intercept	326.3702	324.5179	320.9688	324.4001	322.2476	310.6743	327.0955
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Quality	12.3955	2.0367	5.8066	1.3909	2.1581	6.3208	2.0375
	(0.0419)	(0.0454)	(0.0001)	(0.0955)	(0.0432)	(0.0001)	(0.0381)
Age	2.5461	2.1380	1.3847	1.7747	2.0461	1.8374	1.5748
	(0.6352)	(0.6922)	(0.7959)	(0.7474)	(0.7052)	(0.7331)	(0.7749)
HiTech	-9.3603	-9.9815	-8.8046	-6.2618	-10.7976	-8.0070	-6.2806
	(0.3110)	(0.2830)	(0.3309)	(0.4890)	(0.2520)	(0.3719)	(0.4909)
Leverage	-0.0043	-0.0055	-0.0017	-0.0085	-0.0075	-0.0190	-0.0079
	(0.8171)	(0.7755)	(0.9321)	(0.6071)	(0.6920)	(0.3229)	(0.6350)
NI/Sales	0.1479	0.1563	0.1556	0.1011	0.1567	0.1404	0.1036
	(0.0466)	(0.4400)	(0.4443)	(0.0570)	(0.4351)	(0.4858)	(0.5590)
OfferPrice	-2.3346	-2.2124	-2.3695	-2.9448	-2.2123	-2.4426	-2.9746
	(0.0741)	(0.0860)	(0.0670)	(0.0378)	(0.0856)	(0.0622)	(0.0373)
Reputation	4.1481	4.0357	3.9909	4.2096	3.9007	3.8967	4.2386
	(0.0800)	(0.0861)	(0.0858)	(0.0811)	(0.0980)	(0.0970)	(0.0790)
ROA	5.2039	4.6823	0.9904	0.6731	4.7916	2.5863	-1.0660
	(0.6963)	(0.7193)	(0.9367)	(0.9547)	(0.7131)	(0.8392)	(0.9260)
Size	-3.8214	-4.2109	-4.8771	-3.7536	-4.0288	-4.4464	-4.0537
	(0.2870)	(0.2370)	(0.1730)	(0.3540)	(0.2547)	(0.2088)	(0.3222)
Underpricing	-0.1825	-0.1677	-0.1207	-0.1737	-0.1675	-0.0848	-0.1680
	(0.1082)	(0.1351)	(0.2611)	(0.1319)	(0.1370)	(0.4277)	(0.1418)
VC	-12.2970	-12.6154	-12.6936	-9.4142	-12.8299	-13.2005	-9.3990
	(0.1590)	(0.1493)	(0.1462)	(0.3056)	(0.1409)	(0.1310)	(0.3102)
Obs. Used	2,468	2,468	2,468	2,258	2,468	2,468	2,251
R^2	0.0164	0.0177	0.0270	0.0167	0.0179	0.0293	0.0184

The table presents the results from the OLS regressions estimating the variables affecting the waiting days of the sampled firms. The dependent variable is *WaitingDays*, which measures the timespan (in days) between the start of the rising cycle and the issuance date of the IPO. In the right-hand-side we use seven different *Quality* measures: 1) a dummy variable indicating whether or not the firm was ultimately included in the S&P 500 index; 2) the 3-year CAR ranking of the firm among all the sampled IPOs (in deciles); 3) the 3-year BHAR decile ranking of the firm; 4) the 3-year averaged cash flows (scaled by assets) decile ranking of the firm; 5) the 5-year CAR decile ranking of the firm; 6) the 5-year BHAR decile ranking of the firm; and 7) the 5-year averaged cash flows (scaled by assets) decile ranking of the firm. The remaining regressors are *Age* (which is defined as logarithm of one plus age of the firm at the time of its IPO), *HiTech* (a dummy variable which takes a value of 1 if the IPO firm is in a hi-tech industry; 0 otherwise), *Leverage* (total debt divided by total assets), *NI/Sales* (is the net income of the firm divided by its first-year's sales), *OfferPrice* (the price the issue was offered to public), *Reputation* (underwriter's reputation ranking), *ROA* (is the return-on-assets of the firm, again in the first year of public trading), *Size* (defined as logarithm of one plus Sales), *Underpricing* (first day return), and *VC* (dummy variable indicating whether or not the issue is backed by a venture capitalist). The numbers in the parentheses below the coefficients are the p-values, which are calculated using standard errors that are robust to clustering in time and to heteroskedasticity (Huber-White). At the bottom of the table the number of observations with non-missing data and the adjusted R^2 are also shown.