

U. PORTO



Optimal Timing for an IPO with Market Sentiment

Author:

José Diogo Oliveira de Castro Ferreira

Master in Finance Dissertation

Supervisor:

Prof. Paulo Jorge Marques de Oliveira Ribeiro Pereira

September 2014

Biographical Note

José Diogo Oliveira Castro Ferreira was born in Coimbra in 1987. Raised in São João da Madeira, moved to Porto in 2005 to start his Bachelor Degree in Economics, which was finished in 2009 at Faculdade de Economia da Universidade do Porto. After some professional experiences that ranged between auditing, consulting and sales promoter, decided to return to his school to pursue his dream and study Financial Markets more closely. The reading of some books, such as *Technical Analysis of Stock Trends* from Edwards, Magee and Bassetti (2007) or *Futuros e Outros Derivados* from Domingos Ferreira (2010), inspired him to give this step forward in order to define a clear path for his career. Since July of 2014 he is working in Lisbon at BNP Paribas Securities Services, dealing with the settlement of trades.

Acknowledgments

First of all, I would like to thank Professor Paulo Pereira for his excellent work, dedication and motivation during this last year. It was an honour for me to work with you and to spend some hours in front of a board thinking how would managers react, what they would do and what are the payoffs for each situation. The way that this work evolved was a challenge for both of us and, fortunately, you were there to help guiding me during this path.

Secondly, I would like to thank my parents. They helped me in the last few years and for me is an honour to show them this work. It wasn't always a simple path, but patience paid off.

I have to acknowledge the help of all of my friends, specially Alexandra Almeida who supported and listened to me when this Dissertation was in a less solid ground.

Finally, to Faculdade de Economia da Universidade do Porto, an honourable school, filled with history and knowledge. The staff from library deserves a special word for being always so kind and gentile. For my Professors during both degrees, I have to say that you helped and inspired me establishing a path in my life. There is only one more name I will quote because of the important role he had during this Master. To Professor Oliveira Marques, who transmitted us his huge knowledge in a relaxed, but always demanding way. I will always remember his quote in my first Master class, in Theoretical Foundations of Finance: "If any of you ends the semester without doubts, I've failed in my mission". It was an honour to meet you Professor.

Contents

Biographical Note	i
Acknowledgments	ii
Abstract	vii
Sumário	viii
1 Introduction	1
2 Literature Review	4
3 The Market Sentiment and the Optimal Timing for an IPO	12
3.1 Benchmark Model	12
3.2 The Model	14
3.3 Solution of the Model	16
3.4 Comparative Statics and Numerical Example	18
3.4.1 Comparative Statics	18
3.4.2 Numerical Example	19
3.5 Studying the Market Sentiment	20
3.6 Conclusion of the chapter	21
4 IPOs, Market Sentiment and Investment Opportunity	22
4.1 The Setting	22
4.2 The Model	23
4.3 Solution of the Model	28

4.4	Numerical Example and Sensitivity Analysis	29
4.5	Studying the market sentiment	37
4.6	Conclusion of the chapter	39
5	Conclusion	40
5.1	Contribution to Financial Literature	40
5.2	Further Work and Limitations of our Model	41
	Bibliography	43

List of Figures

1.1	Variation in the number monthly of IPOs since January 2005 .	2
4.1	Representation of equation (4.5) from Adkins and Paxson (2011). Source: Adkins and Paxson (2011)	26
4.2	Boundary between non-IPO and IPO regions	31
4.3	Boundary between non-IPO and IPO regions for different θ_{V_1} 's. The remaining inputs are according to Table 4.1	32
4.4	Boundary between non-IPO and IPO regions for different θ_{V_2} 's. The remaining inputs are according to Table 4.1	33
4.5	Boundary between non-IPO and IPO regions for different ρ 's. The remaining inputs are according to Table 4.1	33
4.6	Boundary between non-IPO and IPO regions for different σ_{V_1} 's. The remaining inputs are according to Table 4.1	34
4.7	Boundary between non-IPO and IPO regions for different σ_{V_2} 's. The remaining inputs are according to Table 4.1	35
4.8	Boundary between non-IPO and IPO regions for different ϕ 's. The remaining inputs are according to Table 4.1	36
4.9	Boundary between non-IPO and IPO regions for different θ_{V_2} 's	38

List of Tables

3.1	Data for the application of the Model	19
4.1	Data for the application of the Model	29
4.2	Results from variations in V_1	30
4.3	Results from variations in θ_{V_1} . The remaining inputs are according to Table 4.1	32
4.4	Results from variations in ρ . The remaining inputs are according to Table 4.1	34
4.5	Results from variations in σ_{V_1} . The remaining inputs are according to Table 4.1	35
4.6	Results from variations in σ_{V_2} . The remaining inputs are according to Table 4.1	36
4.7	Results from variations in ϕ . The remaining inputs are according to Table 4.1	37

Abstract

Performing an IPO can be one of the most enthusiastic moments in the life of a company. However, during the last decades a lot of criticism has arisen due to some irrationality that is associated with this sector of Financial Markets. In this work we propose two models that are based on the work of Bustamante (2012). The first is a simpler version of reality in which the owner tries to sell part of his company. In this case it is assumed that the company is well-established and without any growth opportunity. The second one includes the idea of an IPO to expand the companies activities and, therefore, its cash flows. As a result, we conclude that the market sentiment plays a very interesting role in the definition of the moment of the IPO. This role is diminished when we are considering the second case.

Sumário

Realizar uma OPV pode ser um dos momentos mais entusiasmantes na vida de uma empresa. No entanto, nas últimas décadas têm existido muitas críticas relacionadas com a irracionalidade associada a este setor dos Mercados Financeiros. Neste trabalho propomos dois modelos que têm por base o trabalho de Bustamante (2012). O primeiro é uma versão simplista da realidade em que o dono da empresa tenta vender parte da mesma, estando esta bem estabelecida e não tendo oportunidades de crescimento. O segundo modelo inclui a ideia de a OPV ser feita para expandir as atividades da empresa e, assim, os seus cash flows. Como resultado, concluímos que o sentimento do mercado tem um papel bastante interessante na definição do momento da OPV. Este papel é diminuído quando consideramos o segundo caso.

Chapter 1

Introduction

When in 1602 the Vereenigde Oost-Indische Compagnie (VOC) or, as is more commonly known, the Dutch East India Company, performed its Initial Public Offering (IPO), this was a historical moment. A new kind of corporate strategy was created in order to gather money to the company to finance its activities. This company was considered by the Global Financial Data website ¹ as one of the biggest companies in history.

It took precisely 180 years to take place the first IPO in American soil. The pioneer company was Bank of North America and was a private business that aimed to control the governmental accounts in a period of Civil War.²

Being these the precursors of the history of IPO activity, these type of corporate strategy became more and more usual. The markets have witnessed several periods where companies have resorted to this strategy in order to allow for the exit of initial shareholders, to fund further investments or, simply, to take advantage of the market.

Below there is a graphic that highlights this evolution since January 2005. This graphic was built according to the data available in the IPO Center

¹See: <https://www.globalfinancialdata.com/gfdblog/?p=1518>

²For more information visit: <http://blogs.wellsfargo.com/guidedbyhistory/2010/04/bank-of-north-america/>

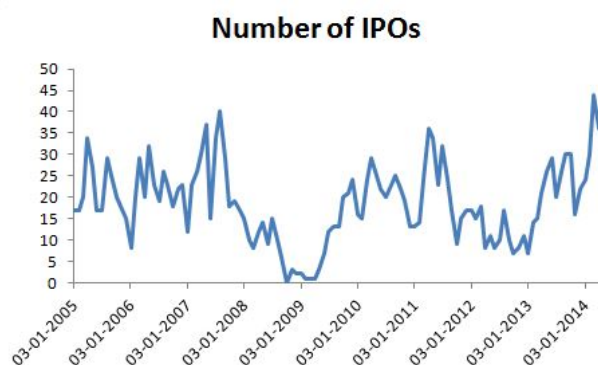


Figure 1.1: Variation in the number monthly of IPOs since January 2005

from the Renaissance Capital³.

From figure 1.1 we can see that the IPO market is extremely volatile and has faced some periods of almost no activity (in October of 2008 there were no IPOs in the US market). This raises some questions. First, what drives the owners to turn their firms publicly listed? Second, why is this activity so volatile? Third, what are the value drivers for this decision?

In this work we intend to provide a Real Options Model which helps to time the IPO decision of the owners of the companies that are considering this process. Regarding the first question raised above, it is not our objective to answer to it. However, a brief presentation of the main reasons for IPOs can be found in the next chapter. The other two question are one of the main interests of this work. We have built two models to time the IPOs. The first model considers the IPO process for companies that have no growth opportunities and intend to take advantage of market overvaluations. In the second model we consider the existence of growth opportunities. However, unlike other authors, we consider that this opportunity is to invest in a new segment rather than to expand the current line of business.

This work is organized as follows: first, we present some relevant literature;

³See: <http://www.renaissancecapital.com/ipohome/press/ipofilings.aspx>

after that we develop the two models. Finally we conclude, summarizing the main findings of each model and providing some paths for future work.

Chapter 2

Literature Review

Performing an Initial Public Offering (IPO) is a huge decision in the life of a company, having great impact on the day-to-day of the business. Its preparation consumes time of the management team and of the Board, requires the presentation of the company to investors, auditing processes, filing of regulatory documents, besides other costly activities. Besides this, the company must choose the optimal moment to initiate the process, gathering information from the market in order to ensure a successful offering. The main motivations referred in the literature for the company are the creation of liquidity for its stocks, being possible for initial shareholders to exit, the raise of funds for future investment, the creation of another way of payment for mergers and acquisitions (through the exchange of stocks of the company) and the enhancement of the image of the company.

Several authors have studied the reasons to perform an IPO, using different methods. Brau and Fawcett (2006) surveyed CFOs of companies that have performed an IPO, CFOs of companies that withdrew the process and others of companies that have never tried it. Röell (1996) compiled the conclusions of several articles, identifying the main motivations for IPOs. Using another method, Rydqvist and Högholm (1995), Pagano et al. (1998) and Alborno and Pope (2004) complement this kind of analysis with econometric studies.

One of the reasons usually addressed in literature is the opportunity to exit that initial shareholders obtain, allowing them to cash in. Röell (1996) points this as one of the reasons for the performance of an IPO, also concluding that the founders are less willing to sell a major stake because they want to retain control over the company. Pagano et al. (1998) reveal that after the IPO there is a period of high turnover in the control of the company, despite the fact that the controlling group keeps a majority position in the company, consistent with the work of Röell. In another study, Alborno and Pope (2004) concluded that divestment from original shareholders was the reason for a group of IPO firms that were acquired afterwards. In a study of the Swedish IPO market, Rydqvist and Högholm (1995) concluded that “*owners reduced the net investment in their own firm to nearly 50% of the previous level*”. Comparing the conclusions of Pagano et al. (1998) and Rydqvist and Högholm (1995) we can state that there is no unique strategy in an IPO. For example, Mello and Parsons (1998) assumed that the optimal strategy was a staged-one, in which in a first stage the IPO was performed to small investors, selling the controlling block in a second stage. This approach is similar to the one of Zingales (1995) which studies the transfer of control through an IPO. These two studies assume the perspective of an IPO as a way to transfer control.

When initial owners intend to exit, they may look for moments of overvaluation of the industry or the market. This would allow compensating the costs of the IPO and taking advantage of the optimism of the market. Ritter (1991) uses this *window of opportunity* theory to help explaining the long-term underperformance of IPOs. To this author, even when the issuer sets a correct price for its shares, the market can produce extremely large returns in the first day, due to an overoptimistic view about the earnings potential of the issuing company. Firms take advantage of this sentiment in the market and issue, generating a poor performance in the future. Lee et al. (1991) observe that the investor sentiment (measured by Value-Weighted Discount on a portfolio of closed-end funds at the beginning of the period)

is an important determinant of the IPO activity. This excessive optimism of investors is reported also by Ibbotson and Ritter (1995) and Lerner (1994). There is the possibility that managers, venture capital funds or owners can effectively time the market, in order to take advantage of some window of opportunity. There are some studies that try to measure this capacity of timing the market. For example, Brau and Fawcett (2006) conclude that “*CFOs define the window of opportunity in terms of overall stock market and industry conditions rather than IPO market conditions*”. In Rajan and Servaes (2002) the market sentiment for an industry drives the number of IPOs in that industry, concluding that the IPOs are made when the industry is overvalued relative to the market. Pastor and Veronesi (2003) conclude that the probability of an IPO is a function of a variation in terms of valuation (return) and not in terms of the valuation itself. Another study, by Blum (2011) reinforces this window of opportunity theory concluding that “*to maximize proceeds firms must time an IPO in accordance to the business cycle as well as overvaluation and low volatility in the stock market*”. Finally, Baker and Wurgler (2007) consider that there is a positive correlation between the market sentiment and the number of IPOs, supporting the idea of *window of opportunity* used by so many authors to explain the activity in this segment.

Other motivation usually reported is the cost of monitoring that private companies require. Pagano and Röell (1998) state that the IPO allows to reduce these costs leading to an increase in the value of the company, existing a lower risk of entrenchment of the management team. Other authors have denoted the importance of the stock market as a management monitoring tool because the price of the stock allows to compare companies within an industry making it more probable the occurrence of a takeover and the monitoring by large shareholders (Holmstrom and Tirole (1993) and Bolton and Von Thadden (1998)). The type of costs referred above are the typical agency costs presented by Jensen and Meckling (1976), more specifically principal-agent costs. However, Dalziel et al. (2010) shed some light over costs sometimes omitted in literature, such as the board monitoring and the

distraction of directors from their main activities to concentrate in the process. According to these authors, this may lead to an increase in operational costs or to the loss of some investment opportunities. In another article, Dalziel et al. (2011) explore the heterogeneity among principals. This heterogeneity leads to a suboptimal performance of the firm, where one of the shareholders may redirect governance devices according to its own interests.

Usually it is also referred that companies perform IPOs in order to finance new investments or to deleverage the company after the execution of any expansion project. Pagano et al. (1998) observe that the investment of companies after the IPO actually decrease, suggesting that companies use this process to rebalance their balance sheet, decreasing the weight of debt and, consequently, the costs of debt financing. A contrasting finding was made by Albornoz and Pope (2004) and Kim and Weisbach (2008), concluding that IPOs are actually motivated by large investments that occur after the process. In the survey of Brau and Fawcett (2006), the answers of the CFOs allowed to conclude that the timing of the IPO is strongly influenced by the “*need for capital to support growth*”. In a study of privately-held companies, Boehmer and Ljunqvist (2004) and Bharath and Dittmar (2006) supported the idea that investment opportunities increase the probability of an IPO.

The last motive massively studied is the acquisition motive. The IPO allows the company to issue stock and later in their lifetime, they may aim to buy other companies. Instead of offering money to the shareholders of the target company, they may offer shares. Thus, the IPO gives the chance to create a new coin of exchange for further acquisitions. Theoretically, in periods of high valuation of the stocks, the company could use them to finance these acquisitions, reducing the need for capital in these operations. Albornoz and Pope (2004) concluded that companies that were acquired after the IPO had as their basic incentive the promotion of that takeover. On the contrary, Brau and Fawcett (2006) rejected the idea that companies go public to be acquired in the future, showing that in the majority of the cases, IPO companies were acquirers in the future, concluding that “*IPOs facilitate*

acquisition activity". Also, they found no statistical significant difference between IPO firms and private firms regarding their positioning to become targets of takeovers. Finally, they concluded that IPOs were used to allow the creation of a new way of payment (using stocks as currency), reinforcing the answers given by the CFOs. The idea of IPO as a way to facilitate acquisition activity and to create "currency" for those acquisitions is also supported by Celikyurt et al. (2010) which study the US IPOs from January 1994 until December 2004, with proceeds higher than \$100 million.

As stated in the beginning of this chapter, an IPO involves certain economic costs. A firm has to comply with several standards, causing it to spend money and time to prove its compliance. According to the PwC Roadmap for an IPO, before the IPO the company incurs in expenses related to legal and accounting advisors, the filing fee, the exchange listing fee and underwriting fees. These are around 7% of the total proceeds from the IPO in US, according to a study by Abrahamson et al. (2011). Although, for European IPOs, underwriting fees are consistently lower than those paid in US. Draho (2000) simply divides these costs as direct costs, including filing fees, legal expenses and administrative costs and indirect costs, which are the underwriting fees. Dalziel et al. (2010) shed some light over costs sometimes omitted in literature, such as the board monitoring and the distraction of directors from their main activities to concentrate in the process. This may lead to an increase in operational costs or to the loss of some investment opportunities.

From the literature referred above, we can understand that an IPO is an option that the owner of the company has, allowing us to model the optimal timing of an IPO as a Real Option. This field of study in finance allows to model several business and management decisions the same way financial options are treated. The first to contribute to this field of study was Myers (1977) that, building on the work of Black and Scholes (1973), identified the importance of distinguishing between assets in place and opportunities to grow, which value is computed by the use of Real Options. Soon, this

new field was adapted to many applications, most of them concentrated in the valuation of investment opportunities. This kind of approach allows to overcome the main limitations of the Net Present Value (NPV) approach. One of the main works in this field is the one Dixit and Pindyck (1994).¹

Despite the huge amount of work regarding Real Options, such as McDonald and Siegel (1986), Luerhman (1998) and Bowman and Moskowitz (2001), there are not many authors that aimed to study IPOs with Real Options. One of the first models that times IPOs was created by Zingales (1995). The author looks at the IPO as a way of transferring control in the company. Starting with a separation between cash flow and control rights, Zingales suggests that the owner must sell the former first, retaining the control of the company. After that, the owner must sell the rest of the company in a direct negotiation. As the author assumes, this model is suitable for subsidiaries. In a different approach, Draho (2000) considers the dynamics of going public using relative valuation techniques. This way, the author values the waiting option and considers its exercise as a cost of the IPO. In this model, private companies are valued in accordance to market indexes. The author conclusions help to explain the hot markets subject, being these a consequence of the optimal exercise of waiting options. Using a binomial model, Benninga et al. (2005) model the decision to go public considering that at the beginning of each period, the owner of the company can take the company public or keep it private (or turn it into a privately held company or not, in the case of being public in the previous period). If the company is private, the owner will receive the value of its cash flows and the private benefits of control. If it is public, its shareholders will receive the cash flows, besides the gains of diversification. When the cash flows are sufficiently high, the gains from diversification outweigh the private benefits of control and the company goes public. Casassus and Villalon (2010) propose a framework where the IPO company (or group of companies) may have an impact in the market condi-

¹If you're interested in this field of study and want to know more, see also Trigeorgis, Lenos (1996), *Real Options – Managerial Flexibility and Strategy in Resource Allocation*, The MIT Press or Copeland, Tom and Antikarov, Vladimir (2003), *Real Options: A Practitioner's Guide*, New York, Cengage Learning

tion, being this impact known by the entrepreneur before the decision. With a general-equilibrium model and studying only the diversification motive to perform an IPO, the author concludes that bigger companies will perform the IPO first, because of greater gains from diversification.

Bustamante (2012) uses signaling game theory to model the time of IPOs. It is assumed that companies time their decision in order to provide private information to outsiders. This way, Bustamante demonstrates that in cold markets, the best companies start the IPO process earlier, in order to signal their quality. On the contrary, in hot markets, all companies go public at the same time.

We will build our model on top of the basic model of Bustamante. We change it in several ways, in an effort to make it more realistic. Bustamante's model is a signaling one, in which asymmetry appears in the difference between good and bad companies. However, her basic model considers perfect information. Also, it is considered that the company performs the IPO to fund the expansion of its current business. We relax the inexistence of asymmetric information, considering that there is a variable reflecting the market sentiment. This variable reflects the premium investors are willing to pay to acquire the company, reflecting the lower amount of liquidity that the owner of the company obtains, when compared to a sale of the totality of the company. We consider likewise that the company performs the IPO to allow the owner to exit from its initial investment. This assumption is only considered in our first model which aims to construct a basic model for the next analysis. Later on in our work we will introduce another approach, differentiated from the one of Bustamante. We consider that an investment will be taken after the IPO but, unlike Bustamante, in our case the investment will allow the company to enter a new segment in the market. Another aspect that is lacking in the basic model of Bustamante is the costs of the IPO. As we have seen before, these can be divided between direct and indirect costs. We consider both of them in our analysis.

Notice that we have constructed over the basic model of Bustamante. In fact, the author corrects some of the aspects referred above, such as the absence of costs in the operations and the inexistence of asymmetries of information. However, the author conducts her work to construct a signaling model, having a very different objective, when compared to our analysis that ignores differences in companies and focuses on the market sentiment and its impact in their valuation.

In the next section we will design our first and basic model, considering that the company has no opportunities to grow and only seeks the listing to allow its owners to exit. We will show that the company will only undertake the IPO if the market is overvalued. Further in our work, we will improve the basic model, with the objective of incorporating the investment motive to perform the IPO.

Chapter 3

The Market Sentiment and the Optimal Timing for an IPO

3.1 Benchmark Model

The starting point of our work was the basic model developed by Bustamante (2012). In the first section of this article, the author considers the optimal timing for an IPO with perfect information. This is the model that we use as the basis of our work. The company makes the IPO to finance a project which allows to expand the current cash flows, which is implemented simultaneously with the IPO.

Despite the fact that the author develops in further sections of her article a model that considers asymmetric information, mainly considering the difference between good and bad companies, we believe that there are some critics that must be referred to this model. The first one is the concept of information asymmetry in the model. This model is a signaling model aiming to time the IPO decision of different companies. This difference between companies is present a factor that measures the growth capacity of a firm, with that factor being bigger for good companies than for bad companies. We introduce a different idea, consistent with Pastor and Veronesi (2003) where companies go public due to changes in the variations observed in the

market. Our factor of market sentiment, θ , can be seen as a premium that investors are willing to pay to have part of that company. This implies that all companies, independently of their type, may have incentives to go public when the market is overvalued. The other aspect that we believe to be important is the inclusion of the costs of the IPO. In the simplest model, Bustamante (2012) does not consider these costs. These costs can either be fixed or variable.

We have first designed a model in which a well established company, without any growth opportunity, aims to perform an IPO. Thus, the owner (or perfectly aligned owners) performs this IPO in order to exit from the initial investment, consistent with the literature presented above (Röell (1996), Rydqvist and Högholm (1995), Pagano et al. (1998) and Albornoz and Pope (2004)). This way, we do not condition our model to the case of companies that have an investment opportunity. In a first model, we consider companies aiming to explore the market overvaluation, considering that the owners will behave in a opportunistic way (Ritter (1991), Lee et al. (1991), Lerner (1994) and Ibbotson and Ritter (1995)). This rationality of the owner is based on the idea that the owner does not have any financial restriction. This way, he won't have any urge to turn the company publicly traded because he has no need to exchange part of his stake for money. If there were any restrictions, the owner could have the temptation to sell, even if it wasn't for an amount that compensated the loss of that stake plus the IPO costs. The inclusion of the investment opportunity will be conceived in the next chapter.

Finally, it is important to notice that we have included a variable for the market sentiment. The reasoning behind this variable is that the owner knows the true value of the company and knows when the market is overvaluing it or not. However, this valuation bias on the market side is not necessarily a sign of market inefficiency. The market can overvalue the company because it sees a possibility of expanding it if the company turns to be publicly listed.

3.2 The Model

We will use the Contingent Claims Approach, as defined by Dixit and Pindyck (1994). The present value of future cash flows, V_t , follows a Geometric Brownian Motion (gBm) process, represented by:

$$dV_t = \mu V_t dt + \sigma V_t dz \quad (3.1)$$

where dz is the increment of a Wiener process, μ is the risk-neutral instantaneous conditional expected relative change in V (or drift) and σ is the instantaneous conditional standard deviation. Note that $\mu = r - \delta$, being r the risk-free rate and δ the opportunity cost from deferring the process. Also, it is important to state that $V_0 > 0$.

Virtually, every private company has the option to go public. This option, as any financial option, has a cost associated with it. According to financial literature, according to the literature presented above, can be divided in two types. First, a fixed amount, that we denote by $C > 0$, that covers all the expenses such as auditing, monitoring and legal fees, between others. Second, a variable amount, hereafter $\lambda > 0$, which is the amount paid to the underwriters.

Also, the owner will sell a fraction $\phi \in (0, 1]$ of its stake in the company. We consider that this value is exogenously chosen (similar to the basic model of Bustamante (2012)). To sell this stake, the owner will consider market conditions, trying to exploit any mispricing. This is coherent with the assumption that there are no financial constraints. Consequently, the owner will only sell if the market is overvalued, paying a higher premium, captured by θ . We assume that this factor already includes the IPO premium reported by Brau et al. (2003) due to the inexistence of a liquidity discount for the company insiders.

Finally, we have considered an all equity company, meaning that the company has not incurred in any kind of debt to leverage its activity. Thus, the owner is the only one entitled to receive the cash flows of the company.

The IPO option value for the owner, $F(V)$, must satisfy the following ordinary differential equation (ODE):

$$\frac{\sigma^2}{2}V^2\frac{\partial^2 F(V)}{\partial V^2} + \mu V\frac{\partial F(V)}{\partial V} - rF = 0 \quad (3.2)$$

The general solution for this ODE is given by $F(V) = A_1V^{\beta_1} + A_2V^{\beta_2}$.

Where:

$$\beta_1 = \frac{1}{2} - \frac{\mu}{\sigma^2} + \sqrt{\left(\frac{\mu}{\sigma^2} - \frac{1}{2}\right)^2 + \frac{2r}{\sigma^2}} \quad (3.3)$$

and

$$\beta_2 = \frac{1}{2} - \frac{\mu}{\sigma^2} - \sqrt{\left(\frac{\mu}{\sigma^2} - \frac{1}{2}\right)^2 + \frac{2r}{\sigma^2}} \quad (3.4)$$

With $\beta_1 > 1$ and $\beta_2 < 0$.

To compute the optimal moment to perform the IPO we have to impose some boundary conditions. The first one is the absorbing barrier and is stated as:

$$F(0) = 0 \quad (3.5)$$

This condition means that if the company does not generate cash flows, the value of the option must be zero. The second condition is the value matching condition and is as follows:

$$F(V^*) = P^*(\phi, \theta, \lambda, V^*, C) - \phi V^* \quad (3.6)$$

where $P^*(\phi, \theta, \lambda, V^*, C) = \phi(1 - \theta)V^*(1 - \lambda) - C$ represents the proceeds from the IPO. The value matching condition states that at the moment of the exercise of the option, the value of that option is given by the difference between what he receives, $P^*(\phi, \theta, \lambda, V^*, C)$ and what he loses, $-\phi V^*$. Notice that the costs are incurred by the owner because those are taken prior to the IPO, *per se*. Also, have in mind that the owner bears the costs of underwriting.

Finally, we have the smooth-pasting condition that ensures that the option value is equal in V^* for both branches and that the transition between branches is smooth. It is given by:

$$\frac{\partial F(V^*)}{\partial V^*} = \frac{\partial P^*(\phi, \theta, \lambda, V^*, C)}{\partial V^*} - \phi \quad (3.7)$$

These three conditions allow us to discover the values for A_1 , A_2 and the optimal moment V^* .

3.3 Solution of the Model

The boundary conditions consist on the restrictions that allow us to define the model. Hereafter, we will develop them in order to obtain the value of the option to perform an IPO.

From the absorbing barrier, we have:

$$\lim_{V \rightarrow 0} F(V) = \infty \quad (3.8)$$

Given that $\beta_1 > 1$ and $\beta_2 < 0$, we must set $A_2 = 0$, otherwise the absorbing barrier condition would not be satisfied. Using the smooth-pasting condition

we determine V^* as being:

$$V^* = \frac{\beta}{\beta - 1} \frac{1}{\phi} \frac{C}{\theta(1 - \lambda) - \lambda} \quad (3.9)$$

Replacing this in the value matching condition and solving for A_1 , we determine that:

$$A_1 = [P^*(\phi, \theta, \lambda, V^*, C) - \phi V^*] \left(\frac{1}{V^*} \right)^{\beta_1} \quad (3.10)$$

In order to maintain economic meaning we say that the owner will only undertake an IPO if:

$$\theta(1 - \lambda) - \lambda > 0 \Leftrightarrow \theta > \frac{\lambda}{1 - \lambda} \quad (3.11)$$

From the expression above we know that the IPO will only be undertaken if the market is sufficiently overvalued in order to compensate for the variable costs, consistent with what we have stated above.

Replacing A_1 , A_2 and V^* in $F(V)$, we have the following expression for the value of the option to perform an IPO:

$$F(V) = \begin{cases} [P^*(\phi, \theta, \lambda, V^*, C) - \phi V^*] \left(\frac{V}{V^*} \right)^{\beta} & \text{if } V < V^* \\ P^*(\phi, \theta, \lambda, V, C) - \phi V & \text{if } V \geq V^* \end{cases} \quad (3.12)$$

Notice that the value of the company for the owner corresponds to the sum of the assets in place and the option to perform the IPO, $V + F(V)$, being in accordance with the theory of Myers (1977).

3.4 Comparative Statics and Numerical Example

3.4.1 Comparative Statics

After obtaining the expressions for the computation of the trigger and the option value, we will study the impact of variations of different variables in the value of each of them.

Starting with the trigger (V^*), we have seen that it is a function of θ , σ , ϕ , C and λ . Taking the derivatives:

$$\frac{\partial V^*}{\partial \theta} < 0 \quad (3.13)$$

$$\frac{\partial V^*}{\partial \sigma} > 0 \quad (3.14)$$

$$\frac{\partial V^*}{\partial \phi} < 0 \quad (3.15)$$

$$\frac{\partial V^*}{\partial C} > 0 \quad (3.16)$$

$$\frac{\partial V^*}{\partial \lambda} > 0 \quad (3.17)$$

The market sentiment has a "negative relation" with the trigger value to perform the IPO. This is an intuitive result given that the owners will take advantage of market overvaluations to sell their company. This allows the owner to cash in some money which they can invest in other businesses and reduce their exposure to risk.

The optimal moment to IPO a company (defined by its optimal value) is a positive function of the volatility and the costs of the IPO, both fixed and the underwriting fees. The volatility signals is consistent with the theory of financial options pricing, when referring to call options. The impact of costs is rather intuitive. As they become larger, so does the trigger value

of the company, meaning that large costs can only be supported by larger companies.

On the contrary, the optimal level of cash flows is negatively affected by the stake of the company to be sold and by the market sentiment.

These results are consistent with the ones of Draho (2000) that finds a positive relation between the optimal level and the costs (both direct and indirect) of the IPO and with the volatility. A negative relation was found regarding the size of the issue.

3.4.2 Numerical Example

To illustrate this first model we take into consideration the case of Houghton Mifflin Harcourt Company (NASDAQ:HMHC), a well established company, formally created in 1880 (it existed since 1832). This company dedicates to the publishing of educational material for the primary and secondary education. In 2013, the company decided to turn itself publicly-traded. This 130+ year old company started listing in the NASDAQ on November 14, 2013. According to Quartz, the objective of this IPO was to allow for the exit of existing shareholders¹.

The data used for this illustration is presented in the table below:

Variable	Value	Description
μ	0.01	Risk-neutral drift
σ	0.25	Volatility
θ	0.133	Market sentiment
ϕ	0.15	Stake to be sold
λ	0.06	Underwriting fees
C	\$4.5M	Cost of the IPO

Table 3.1: Data for the application of the Model

¹See: <http://qz.com/144968/181-years-after-its-founding-this-company-is-finally-going-public/>

We have assumed the value for the risk-free rate, the opportunity costs, the volatility and the market sentiment. To the first three parameters was attributed an usual value in this kind of examples. Any change in those values can be studied according to the analysis in the previous section. The value of the underwriting fees was taken from the 2013 Annual Report of the company, in which is referred that the company has paid \$0.72 per share to underwriters. Dividing this value by \$12, the initial price of the shares, we obtain the 6% fee. The cost of the IPO was also taken from the Annual Report. This operation had a total cost of \$19.6 million, being \$15.1 from underwriting fees and the rest from other costs related to the issuing. The stake to be sold in the IPO is given by the ratio between the amount of shares sold (20.9 million) and the total number of shares (139.9). Finally, we have used the value premium estimated by Brau et al. (2003) that concludes that IPOs are on average overpaid by a factor of 13.3%.

Applying expression (3.9), we obtain an optimal value of the cash flows to perform the IPO of \$1,685 million. Using the financial statements of HMHC for the fiscal year of 2012, we can compute an actual value of discounted future cash flows as being of \$1,615 million. This way, we can see that the company has performed the IPO near the optimal moment according to the model's prescription.

As it can be seen above, the optimal moment to perform the IPO is directly related to the market sentiment. Thus, it is important to perform a more detailed analysis of this factor, given the importance that it assumes in our model.

3.5 Studying the Market Sentiment

According to our model, any company without a growth option needing to be financed only considers an IPO if, and when, the market sentiment is sufficient to pay for the costs of the process. This is a logic result given that the owner of the company is not interested in exchanging a valuable asset for

a less valuable one, if we assume he has no financial constraints.

However, we can work in the other way around and try to understand what has to be the market sentiment in order to be optimal an IPO in the present moment? This implies that $V^* = V_1$.

Taking equation (3.9) and equalizing to V_1 , we obtain the following expression for the estimation of the θ factor.

$$\theta^* = \frac{\beta}{\beta - 1} \frac{C}{\phi V_1} \frac{1}{1 - \lambda} + \frac{\lambda}{1 - \lambda} \quad (3.18)$$

Other way to interpret this result is, assuming that companies are making their decisions in an optimal way, what is the current market sentiment. This way, the estimation above allows us to measure the premium investors are willing to pay to invest in that company.

3.6 Conclusion of the chapter

In this chapter we have considered an all equity company that looks to the IPO market as an opportunity to change its ownership, providing the owners an opportunity to exit, benefiting from a positive market sentiment. Consequently, the option will be exercised when there is a higher optimism in the market, being this one of the possible causes to the *hot markets issue*.

However, there is the possibility that a company performs an IPO in order to obtain funds to finance a project. This has several consequences in terms of timing, being one of them the possibility that the owner considers the process not only in periods of higher optimism, but also in periods of lower optimism, receiving a lower amount during the process. It is this situation that we are going to explore in the next chapter.

Chapter 4

IPOs, Market Sentiment and Investment Opportunity

4.1 The Setting

The model developed in the previous chapter considered only a small range of situations in which the companies performed an IPO. In this chapter we intend to get closer to the model of Bustamante (2012), considering that the company has the opportunity to invest but, at the same time, we distance from her model considering that the company intends to use the proceeds from the IPO in order to enter a new segment of the market. Thus, the company is not expanding the current business but financing the entry in a new one. An example of this kind of managerial behavior is the case of Facebook, for instance. After the IPO on May of 2012, the social network company entered several businesses through the acquisition of other companies. These range from social media related companies to sound studio or virtual reality companies.

Assuming a similar approach compared with the previous model, investors will be willing to pay a premium when buying the company. However, this premium can be divided into two components, θ_1 and θ_2 . The first one is the premium investors are willing to pay for the current business of the com-

pany. The second corresponds to the premium related with the new segment.

This model is based on the investment opportunity idea that can be found in Boehmer and Ljungqvist (2004), Kim and Weisbach (2008) and Brau and Fawcett (2006), among others. This means that immediately after the IPO the company will invest in order to expand its cash flows. While these authors do not differentiate between an investment in the existing segment and a new segment of business, we consider that it concentrates in a new line of business. This implies that companies have a business that is well developed, trying to find a new source to increase their growth rate and, consequently, their value. Thus, we consider that the company is investing in a segment that is strategically important for its future, leading to a higher premium. As we will see below, we won't use a factor of growth as Bustamante (2012) did. We will consider that this factor is already reflected in the premium that investors are willing to pay when investing in the company.

To develop this model we need to distinguish between the old cash flows of the company and the ones that arise from the new investment. This implies the utilization of two stochastic processes. The basis for this work is the one of Adkins and Paxson (2011). In this article, the authors solved a model with two stochastic variables without homogeneity of degree one. The methodology followed here is similar to the one presented in that article.

This section is divided as follows: first we will present the pillars of our model; second, we will present its solution, followed by the comparative statics and the numerical example. Finally, we conclude and synthesize the main ideas.

4.2 The Model

Using the Contingent Claim Approach, as defined by Dixit and Pindyck (1994), we will have two stochastic processes that follow distinct Geometric

Brownian Motions (gBm) that are represented as follows:

$$dX = \mu_X X dt + \sigma_X X dz, \quad (4.1)$$

where $X = \{V_1, V_2\}$, μ_X is the instantaneous conditional expected relative change in X , σ_X is the instantaneous conditional standard deviation and dz is the increment of a Wiener process. Notice that $\mu_{V_1} = r - \delta_1$ and $\mu_{V_2} = r - \delta_2$. The covariance between the two variables is given by:

$$Cov[dV_1, dV_2] = \rho \sigma_{V_1} \sigma_{V_2} V_1 V_2 dt \quad (4.2)$$

In this model we aim to build a boundary as a function of V_1 and V_2 in order to define, for each level of each of the variables, when it is optimal to perform an IPO. This implies that both variables must attain their threshold levels in order to the company turn itself publicly-traded.

As before, we assume that the company has to pay a fixed amount to perform the IPO. This amount, represented by $C > 0$, is supported by the owner of the company pre-IPO. The underwriting fees, $\lambda \in (0, 1]$, are also supported by the owner of the company. As stated above, the company will perform an investment in a new segment. Similarly to Bustamante (2012), this investment occurs at the same time (or right after) of the IPO. This investment cost is represented by I and is included in the same way as in Bustamante's model. Furthermore, this investment has associated a cash flow stream that will be presented by V_2 (being V_1 the cash flow stream of the old business). Both these segments will have associated a premium investors are willing to pay. Thus, θ_1 represents the premium for the old business and θ_2 the premium for the new business. As stated before, the new segment where the company is investing is expected to have a higher growth rate than the old one ($\theta_2 > \theta_1$).

The value of the option to perform an IPO, $F(V_1, V_2)$, must satisfy the fol-

lowing partial differential equation (PDE):

$$\begin{aligned} \frac{1}{2}\sigma_{V_1}^2 V_1^2 \frac{\partial^2 F(V_1, V_2)}{\partial V_1^2} + \frac{1}{2}\sigma_{V_2}^2 V_2^2 \frac{\partial^2 F(V_1, V_2)}{\partial V_2^2} + \rho\sigma_{V_1}\sigma_{V_2} V_1 V_2 \frac{\partial^2 F(V_1, V_2)}{\partial V_1 \partial V_2} + \\ + (r - \delta_1)V_1 \frac{\partial F(V_1, V_2)}{\partial V_1} + (r - \delta_2)V_2 \frac{\partial F(V_1, V_2)}{\partial V_2} - rF(V_1, V_2) = 0 \end{aligned} \quad (4.3)$$

The general solution for this PDE has the form:

$$F(V_1, V_2) = AV_1^\beta V_2^\eta \quad (4.4)$$

Replacing $F(V_1, V_2)$ in equation (4.3) we obtain the following elliptical equation:

$$\begin{aligned} Q(\beta, \eta) = \frac{1}{2}\sigma_{V_1}^2 (\beta - 1)\beta + \frac{1}{2}\sigma_{V_2}^2 (\eta - 1)\eta + \rho\sigma_{V_1}\sigma_{V_2}\beta\eta + \\ + (r - \delta_1)\beta + (r - \delta_2)\eta - r = 0 \end{aligned} \quad (4.5)$$

The equation above describes an ellipse. For $\beta = 0$, the equation becomes:

$$Q(0, \eta) = \frac{1}{2}\sigma_{V_2}^2 (\eta - 1)\eta + (r - \delta_2)\eta - r = 0 \quad (4.6)$$

Solving equation (4.6) in order to η we find two roots, a positive and a negative. The same applies for the case of $\eta = 0$. In that case, the equation becomes:

$$Q(\beta, 0) = \frac{1}{2}\sigma_{V_1}^2 (\beta - 1)\beta + (r - \delta_1)\beta - r = 0 \quad (4.7)$$

As Adkins and Paxson (2011) argue:

"(...) the ellipse passes through all 4 axes and has a presence in each of the 4 quadrants. When we impose the line $\beta + \eta = 1$ on the graph $Q = 0$, represented by the line LL' in Figure 1, it clearly intersects the function at 2 distinct points, A and B. If homogeneity degree 1 holds, the values of β and η are uniquely specified by points A and B. When homogeneity degree 1 does not hold, the values of β and η will lie somewhere along the arc ADB or ACB, depending on whether $\beta + \eta$ is greater than or less than 1. Thus,

we require additional information from the boundary conditions in order to solve β and η when $\beta + \eta \neq 1$.”

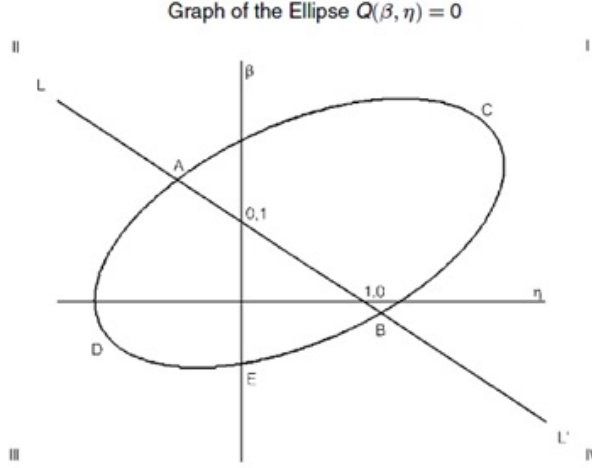


Figure 4.1: Representation of equation (4.5) from Adkins and Paxson (2011). Source: Adkins and Paxson (2011)

The figure above illustrates the statement from Adkins and Paxson referred above.

Following Adkins and Paxson (2011) methodology, we will develop a function that arises from the value matching and from the smooth-pasting condition. This function will intersect the function $Q(\beta, \eta) = 0$, generating the values for β and η . From figure 4.1 we can infer the possible values for these variables.

$$S_1 : \{\beta_1, \eta_1\} \rightarrow \beta_1 \geq 0, \eta_1 \geq 0; \quad (4.8)$$

$$S_2 : \{\beta_2, \eta_2\} \rightarrow \beta_2 \geq 0, \eta_2 \leq 0; \quad (4.9)$$

$$S_3 : \{\beta_3, \eta_3\} \rightarrow \beta_3 \leq 0, \eta_3 \leq 0; \quad (4.10)$$

$$S_4 : \{\beta_4, \eta_4\} \rightarrow \beta_4 \leq 0, \eta_4 \geq 0; \quad (4.11)$$

Thus, we can rewrite the solution of equation (4.3) as being:

$$F(V_1, V_2)_H = A_1 V_1^{\beta_1} V_2^{\eta_1} + A_2 V_1^{\beta_2} V_2^{\eta_2} + A_3 V_1^{\beta_3} V_2^{\eta_3} + A_4 V_1^{\beta_4} V_2^{\eta_4} \quad (4.12)$$

As in the previous model, we need to establish the boundary conditions that will allow us to find the solution.

The first boundary condition is the absorbing barrier. It is expressed below. It is similar to the one in the previous chapter. However, in this case we are stating that if the cash flows of both investments tend to zero, the value of the company to the owner is zero and so does the option.

$$F(0, 0) = 0 \quad (4.13)$$

The second boundary condition is the value matching condition. This one says that the value of the option for the owner in the moment of exercise equals the stake of the new segment that he retains, plus the proceeds from the IPO, deducted by the stake that he has lost and the investment cost. The proceeds from the IPO can be expressed as follows:

$$P^*(\phi, \theta_1, \theta_2, V_1^*, V_2^*, \lambda, C) = \phi[(1 + \theta_1)V_1^* + (1 + \theta_2)V_2^*](1 - \lambda) - C \quad (4.14)$$

The value matching condition is given by:

$$F(V_1^*, V_2^*) = (1 - \phi)V_2^* + P^*(\phi, \theta_1, \theta_2, V_1^*, V_2^*, \lambda, C) - \phi V_1^* - I \quad (4.15)$$

Contrary to the previous model, in which we had a smooth-pasting condition, we now have two. This happens because there are two stochastic variables. Thus, the following two equations define the smooth-pasting conditions.

$$\frac{\partial F(V_1^*, V_2^*)}{\partial V_1^*} = \phi(1 + \theta_1)(1 - \lambda) - \phi \quad (4.16)$$

$$\frac{\partial F(V_1^*, V_2^*)}{\partial V_2^*} = (1 - \phi) + \phi(1 + \theta_2)(1 - \lambda) \quad (4.17)$$

With these boundary conditions we can determine the IPO boundary. Contrary to the previous model, we cannot provide a closed-form solution, as we will explain in the following section.

4.3 Solution of the Model

From the absorbing barrier we can easily conclude that A_2 , A_3 and A_4 are equal to zero. Thus, the solution for $F(V_1, V_2)$ can be reduced to:

$$F(V_1, V_2) = A_1 V_1^{\beta_1} V_2^{\eta_1} \equiv A V_1^{\beta} V_2^{\eta} \quad (4.18)$$

Consequently our function regarding the value for the shareholder is given by:

$$F(V_1, V_2) = A V_1^{\beta} V_2^{\eta} \quad (4.19)$$

We now have three equations (equation (4.15)-(4.17)) for four variables to be determined. Since the number of unknowns is bigger than the number of equations, we cannot provide a unique solution for our model, meaning that there is no closed-form solution. Thus, we are going to determine a boundary of countless pairs of $\{V_1, V_2\}$.

While in the previous model there was a threshold after which the IPO should be undertaken, now we have a region where the IPO should occur and other where it should not. Thus, every company after having computed the value of the new segment can simply calculate the value of the current business after which it should turn publicly-traded.

In the next section we will explore a practical example. The procedure adopted was to consider a fixed value for the company that is considering the IPO. This allows us eliminate a variable that needs to be determined and remain with four variables (A_1, β, η, V_2) for four equations, the ellipse (equation (4.5)) and equations (4.15) to (4.17).

4.4 Numerical Example and Sensitivity Analysis

Numerical Example As explained at the end of the previous section, there is no close-form solution for our model. However, Adkins & Paxson (2011) developed a method that allowed to define a discriminatory boundary between the IPO decision and the non-IPO decision, being indifferent to do it or not in that boundary.

We have used *Mathematica* software to compute several values of the boundary. Using those values, we have created a graphic representing these points and, finally, we have regressed those values in order to obtain that boundary. This is a very simple analysis with a very powerful output.

We will construct over the case of the previous model. However, it is necessary to consider some new variables. Let us imagine that Houghton Mifflin Harcourt Company has the possibility to enter in a new and fast-growing business, such as the Apps market. The table below represents a summary of the variables used.

Variable	Value	Description
r	0.03	Risk-free interest rate
δ_{V_1}	0.02	Discount rate of the old segment
δ_{V_2}	0.025	Discount rate of the new segment
σ_{V_1}	0.25	Volatility associated to the old segment
σ_{V_2}	0.35	Volatility associated to the new segment
ρ	0.2	Correlation between the two segments
ϕ	0.15	Stake to be sold
λ	0.06	Underwriting fees
C	\$4.5M	Cost of the IPO
θ_{V_1}	0.133	Market sentiment for the old segment
θ_{V_2}	0.25	Market sentiment for the new segment
I	\$40M	Investment needed to enter the new segment

Table 4.1: Data for the application of the Model

We are considering here that an investment of \$40 million is necessary to

construct an infrastructure to develop this business. As it is a relatively new business, the volatility associated with it is higher than the volatility of the old segment of the company. Also, the premium is considered to be higher because of the appetite of the investors for companies in this new segment (similarly to what happened in the dotcom bubble). We assume that the owner(s) is(are) trying to sell 15% of the company and that the underwriting fees and the fixed costs of the process are the same.

We will start by computing the value of V_2 for which is optimal to perform the IPO, considering the actual value of the company ($V_1 = \$1,614.19$ million). We could also perform this exercise on the opposite direction, i.e. having the actual value of the new segment, we could compute the optimal value of the company after which we should perform the IPO.

Using the *FindRoot* function in Mathematica, we determine that the value of V_2^* is \$125.71 million, with a $\beta = 0.1571$ and $\eta = 1.2867$.

After this, we must induce some changes in V_1 and execute the *FindRoot* function again. The following table illustrates some of the results obtained:

V_1	0.00	695.29	1,177.47	1,615.19	2,149.82	2,861.41	3,462.3
β	0.00	0.05	0.10	0.16	0.25	0.41	0.59
η	1.30	1.29	1.29	1.29	1.28	1.24	1.19
V_2	189.74	161.49	142.45	125.71	106.28	82.97	66.48

Table 4.2: Results from variations in V_1

With these results we are now in a position of creating the boundary that will help in the decision making. The figure below demonstrates this relation between V_1 and V_2 .

As we can see from figure 4.2, there is a "negative relation" between the value of the current business and the value of the new business, meaning that an increase in the value of the new business demands a lower value of the current business, leading to an earlier IPO. On the contrary, if the value of the new

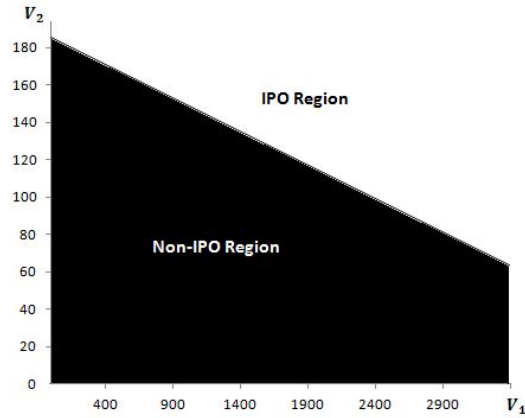


Figure 4.2: Boundary between non-IPO and IPO regions

business is relatively small, the IPO must be made later, demanding a bigger initial business.

Below we will study the impact of variations in several variables, aiming to understand its impact on the trigger values.

Sensitivity Analysis In this section we will impose some changes in the variables of the model. The objective is to study the impact of those variations mainly in the trigger of the second segment.

Variations in θ_{V_1} In the previous chapter, when analyzing the impacts of variations in the market sentiment we have concluded that higher levels of market sentiment lead to lower trigger values. Now, there is a new segment in which the company is going to enter after the IPO. We tested for three levels of market sentiment: the original one, of 0.133, a lower one of 0.09975 and a larger one of 0.16625. The graphic below depicts the differences between the three levels.

As it can be seen, the level triggers for the new sector tend to diminish with increases in the market sentiment of the old sector. This happens because, as before, the owner tends to take advantage of this market premium to take the company public. This way, a higher market sentiment anticipates the

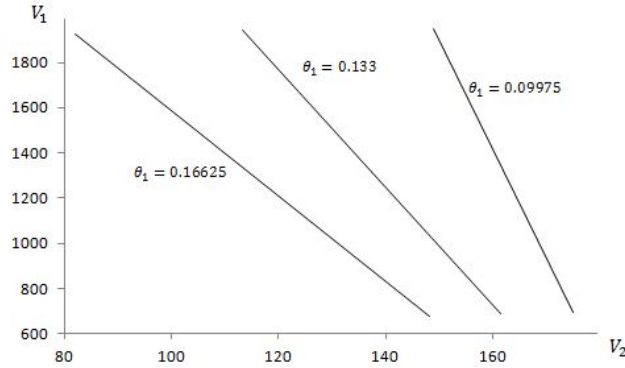


Figure 4.3: Boundary between non-IPO and IPO regions for different θ_{V_1} 's. The remaining inputs are according to Table 4.1

IPO process. Table (4.3) shows the variations in the trigger value of the new segment to our current value of the business:

θ_{V_1}	0.09975	0.133	0.16625
V_2	155.77	125.71	97.98

Table 4.3: Results from variations in θ_{V_1} . The remaining inputs are according to Table 4.1

As in the previous model, there is a tendency to anticipate the IPO given market conditions.

Variations in θ_{V_2} Regarding θ_{V_2} , this factor has less impact in the determination of the trigger of the new segment. This is so because in our setting the new segment is much smaller than old segment, being not so relevant as the old segment. Just to illustrate, the graphic below shows the conclusions for three different values of θ_{V_2} : 0.1875, 0.25 and 0.3125.

As we can see, there are small moves of the boundary for the right or left, depending on a decrease or increase in the market sentiment for the new segment, respectively.

The below figure could have been different if the new segment was more relevant.

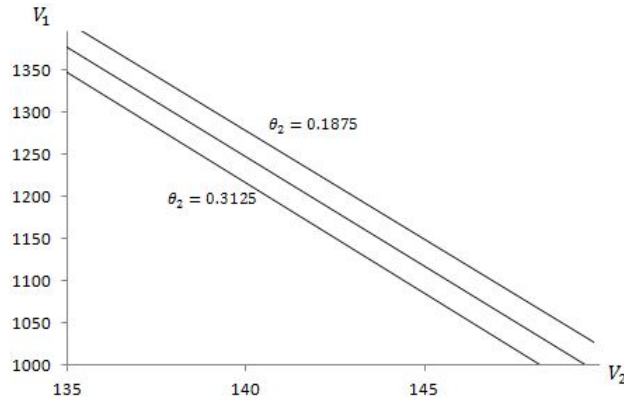


Figure 4.4: Boundary between non-IPO and IPO regions for different θ_{V_2} 's. The remaining inputs are according to Table 4.1

Variations in ρ This parameter highlights the correlation between the old segment and the new one. If we recall the diversification theory of Markowitz (1952), the correlation between two assets must be negative in order to reduce risk. Applying these insights to our model, companies will tend to diversify their business in order to reduce it. Thus, we expect that the trigger for the new investment (considering the actual value of the company) decreases with decreases in the correlation. To study the impact of different levels of correlation, we have computed the different values of the trigger for the second segment with different levels of correlation.

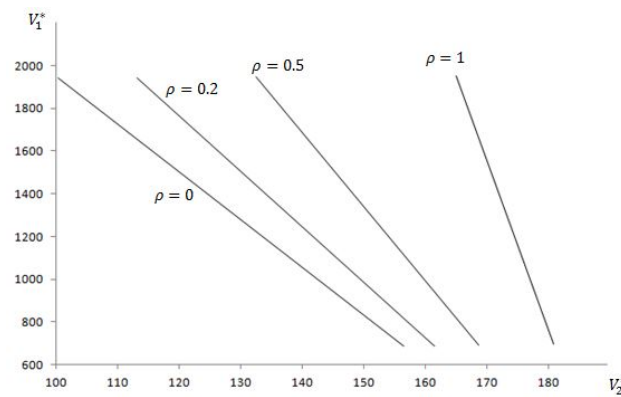


Figure 4.5: Boundary between non-IPO and IPO regions for different ρ 's. The remaining inputs are according to Table 4.1

From the graphic above we can prove that a decrease in the correlation between the two segments leads to a decrease of the trigger values. This reinforces the idea from Markowitz Portfolio Theory. Just as an example, the trigger value for our actual value of the company would be, for each scenario considered:

ρ	0	0.2	0.5	1
V_2	114.75	125.71	142.09	169.27

Table 4.4: Results from variations in ρ . The remaining inputs are according to Table 4.1

This relationship between the correlation and the optimal value of the new segment to perform an IPO is a logic result given the fact that similar segments are more exposed to the same risks. Thus, the diversification effect is not so strong. Consequently, a higher value for the new segment is required to perform the IPO and invest in it.

Variations in σ_{V_1} Theoretically, an increase in the volatility of the old segment means that the value of the option to perform an IPO is bigger. The graphic below highlights this idea:

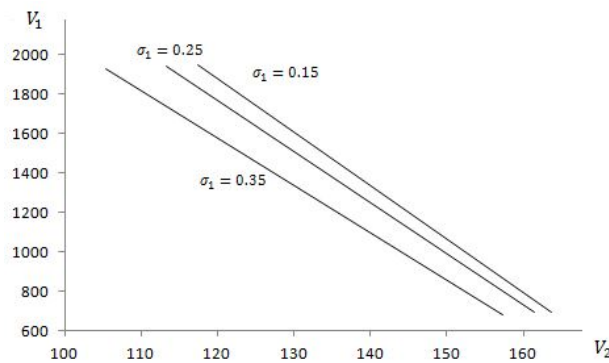


Figure 4.6: Boundary between non-IPO and IPO regions for different σ_{V_1} 's. The remaining inputs are according to Table 4.1

Figure (4.6) expresses very clearly this idea. The following table reinforces it, by showing an increase in the trigger for the new sector with a decrease

of the volatility in the old sector.

σ_{V_1}	0.15	0.25	0.35
V_2	129.66	125.71	118.21

Table 4.5: Results from variations in σ_{V_1} . The remaining inputs are according to Table 4.1

From this analysis we can conclude that an increase in the volatility of the old segment implies a lower trigger value for the new segment. This happens due to the idea that risk is represented by volatility. Thus, a more volatile segment, given the correlation between segments, will induce an earlier IPO to reduce the overall risk of the company.

Variations in σ_{V_2} It is expected that a higher uncertainty regarding the new segment is associated with higher triggers. It is a natural result given the fact that if the owner has to take more risks, he will be more keen to invest in something that has a more certain value. That justifies a delay of the IPO decision. Figure (4.7) demonstrates this.

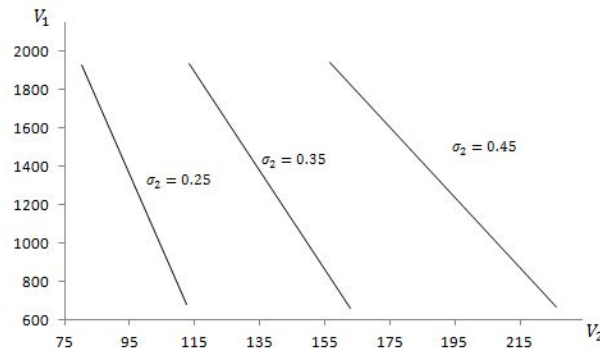


Figure 4.7: Boundary between non-IPO and IPO regions for different σ_{V_2} 's. The remaining inputs are according to Table 4.1

As it can be seen, the boundary of the IPO decision moves to the right while we increment the volatility associated to the new segment. It can also be seen in table (4.6), which presents the value of the trigger for the actual value of the current business under different levels of volatility.

σ_{V_2}	0.25	0.35	0.45
V_2	88.07	125.71	174.23

Table 4.6: Results from variations in σ_{V_2} . The remaining inputs are according to Table 4.1

Contrary to σ_{V_1} , higher volatilities in the new segment represent higher risk for the company. This leads to a delay of the IPO when compared to lower σ_{V_2} 's.

Variations in ϕ The percentage of the company to be sold has a significant impact in the determination of the trigger value of the new segment and, consequently, of the IPO decision. Figure (4.8) shows us the boundary curves for three different scenarios of ϕ : 0.1, 0.15 and 0.2.

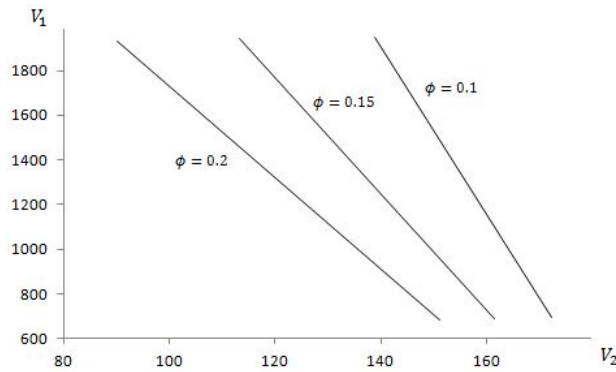


Figure 4.8: Boundary between non-IPO and IPO regions for different ϕ 's. The remaining inputs are according to Table 4.1

For lower values of ϕ , the owner of the company tends to defer the IPO, with the trigger of the new sector being larger. This can be explained by thinking that if the owner is going to retain a higher share of the company, he will be less willing to invest in a new business unless it proves to be the right business.

Table (4.7) shows us the the trigger level for these three possible values of ϕ for the current value of the old business: This conclusion from the model

ϕ	0.1	0.15	0.2
V_2	147.64	125.71	105.25

Table 4.7: Results from variations in ϕ . The remaining inputs are according to Table 4.1

is in line with the Behavioral Finance idea of mental accounting that states that people tend to take more risk with money earned by other means than work. As the owner has already sold part of its stake, he is less exposed to the new segment and therefore is more keen to invest in it.

Other factors: λ , C and I The impact of these variables was not very relevant or already studied in the previous chapter, not justifying a deep study.

Relatively to λ , an increase in the fees paid during the IPO process tends to delay this decision, increasing the trigger for the new sector.

This analysis is similar to the one for the costs of the IPO (C) and for the investment cost to enter in the new segment (I). An increase in any of these costs leads to an increase in the trigger of the new segment for any current value of the old segment, deferring the IPO process.

4.5 Studying the market sentiment

As in the previous chapter, it is important to understand the dynamics of the market sentiment in the decision to perform the IPO. As before, the premium that investors are willing to pay for the old sector continues to anticipate the IPO and subsequent investment. The logic underlying this conclusion was already presented. More importantly is to understand what was the minimum market sentiment for the owner to sell the company.

To study this we continuously replaced this parameter for lower values, until the moment where we get a value for the new segment lower than the in-

vestment cost. Logically, in that case, it would have no economic meaning to perform the IPO and, therefore, to invest in the new segment. We have obtained a value of 3.3216% (or $\theta_{v_1} = 0.033216$). It is interesting to notice that the value of the option would be negative or zero in economic terms. In the case of the first model, the IPO would have to allow the owner to receive at least the fair value for the company, plus the costs of the IPO. In the second model, even for lower values of market sentiment than the one computed on chapter three, it would be optimal to perform the IPO.

Regarding θ_{V_2} , as explained before, the sensitivity analysis didn't allow us to demonstrate the real impact of this variable. This was so due to the parameters defined by us. However, we will illustrate here a different case. Let us imagine that the investment cost was \$400 million. The impact of variations in θ_{V_2} is represented in the graphic below. The remaining of the variables is given in table 4.1, except $I = 400$.

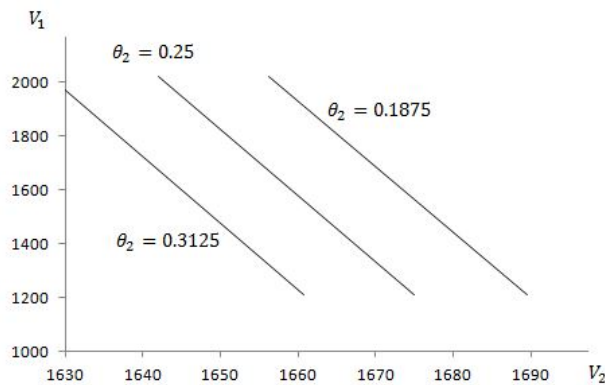


Figure 4.9: Boundary between non-IPO and IPO regions for different θ_{V_2} 's

In this graphic two ideas become clearer. First, the greater the market sentiment, the greater the forces that drive for the decision to perform the IPO. Second, the new segment becomes much more important for the company. The slope of the curve denotes this difference. While in the first analysis of θ_{V_2} , a decrease of \$1 million in V_2 had to be compensated by an increase of V_1 of \$26 million, now the necessary increase is of \$24 million, highlighting

the decrease of importance of the old segment.

4.6 Conclusion of the chapter

During this chapter we tried to give a step further in order to provide a framework for real life IPO's. This is a very demanding process for the owner/management team and we aimed to focus on the main decisions. We considered a case where the company performs the IPO to allow not only the exiting of the owner but also the entering in a new segment. This implied the inclusion of some factors, such as the volatility and the market sentiment of the new segment, the investment cost to ensure the new line of business and the correlation between the two segments. It is important to notice that this entry in a new segment can be done in very different ways. We considered here an entry with an investment from the ground, however this can be made by acquiring an existing company, for example.

It is important to notice the impact of both the volatility of the new segment and the correlation between segments in the decision making process. Both these factors play a very important role in the determination of the trigger for the investment. Also, the percentage of the company to be sold has a very interesting role considering the behavioral hindsights.

Finally, in the study of the market sentiment we concluded that the sentiment in the old segment played a similar rolen when compared to the previous chapter. The sentiment in the new segment also presented a negative relation to the market timing, meaning that a higher sentiment represented a lower trigger to perform the IPO.

Chapter 5

Conclusion

5.1 Contribution to Financial Literature

During this work we have developed two models that aim to support the decision for an IPO in different settings.

Our main goal was to create a model that did not concentrate in the market sentiment but, at the same time, allowed to study it. We have focused on the managerial decision, bearing in mind that this decision is taken considering a given framework for the owner. This is the logic underlying the inclusion of a variable for the market sentiment. And it is this way that we have given a step forward on IPO literature. As presented in Chapter 2, the main works regarding the IPO process with a Real Options perspective are the ones from Draho (2000), Benninga (2005) and Bustamante (2012). These works build over different perspectives but with a similar objective, to time the IPO. Our distinctive approach allowed us to differentiate from these works. While the basic model clearly lies on the market sentiment parameter, showing us that the manager/owner would only perform the IPO if the market was paying more for the company than the value he attributes to her, the second model does not depend exclusively on this parameter.

This capacity to focus in the management decision allows to determine, in

the second model, the timing of the investment and of the IPO. Also, the inclusion of some behavioral insights allows to approximate our model to reality, trying to overcome the typical critics that appear to financial models. As defined before, there is plenty of space to develop from now on, being important to build models that help the decision making process of the owners of these companies. Thus, we think our model provide a solid ground to build on in the future. Being this such an important aspect of the strength of an economy, any model that helps entrepreneurs to better decide are welcome.

We differentiated from the work of Bustamante, the model that we've used as a basis for ours, by ignoring the signalling game idea. In her article, Bustamante builds over this idea, creating a dynamic between private firms. In our model, we define the moment as a sole decision. This way, our model applies also to companies that are the first in their sector to perform IPOs. Obviously, in this case, the market sentiment would have to be adapted, given that we had no benchmark to evaluate the market.

In conclusion, we tried to build a solid model, based in a very well-established theoretical environment. We reconciled evidence from many authors identified in the literature review with the objective of providing an intuitive, but realistic, model.

5.2 Further Work and Limitations of our Model

The path until this final point allowed us to find several aspects we would like to include but, because of time constraints and the objectives of a Master Dissertation, were not developed, yet. We believe to be in a position to address some possible paths for further studies.

First, we were considering the inclusion of agency issues. As Dalziel et al. (2011) shows there are some costs of an IPO that arise from principal-principal conflicts. These can have a great impact in the IPO decision.

Second, we omit here the presence of debt. As it can be seen from our examples, we do not consider the existence of debt, ignoring a factor that can promote the IPO, anticipating it. On the other hand it could be a factor of deferral of the IPO because the owner could leverage the company first and only after that promote the going public process, receiving more funds in the meanwhile. Also, Röell (1996) demonstrates that the IPO allows to reduce the leverage of the company, being this one of the motivations for the process. It would be interesting to include this factor here.

Third, the computation of the θ parameters should be based on behavioral methods. This would allow to reconcile two very innovative and interesting fields of finance: Real Options and Behavioral Finance. Considering the contributions of both these fields, they would probably provide a bigger contribute if they could be developed together. However, Considering that this is not the main goal of this work, we believe that the measure proposed suffices to demonstrate the model.

Finally, the consideration of two separate models with the objective of building an equilibrium model. One of the models would represent the perspective of the owner (or owners) of the company. The other would represent the market perception and willingness to enter in this process. The idea of equilibrium model is directly related to Traditional Finance. This "double-headed" model would allow to join Traditional and Behavioral Finance along with the Real Options perspective. It is possible that the model would be so complex that it was almost inoperable, however it would allow to understand better the market for IPOs.

Bibliography

- Abrahamson, M., Jenkinson, T. and Howard, J. (2011), Why Don't U.S. Issuers Demand European Fees for IPOs?, *The Journal of Finance*, Vol. LXVI, No. 6, December 2011, 2055-2082;
- Adkins, R. and Paxson, D (2011), Renewing Assets with Uncertain Revenues and Operating Costs, *Journal of Financial and Quantitative Analysis*, Vol. 46, No. 3, June 2011, 785-813;
- Albornoz, B. G. and Pope, P. F. (2004), The Determinants of Going Public Decision: Evidence from the U.K., Working Papers, Serie AD, Instituto Valenciano de Investigaciones Económicas, S.A.;
- Baker, M. and Wurgler, J. (2007), Investor Sentiment in the Stock Market, *Journal of Economic Perspectives*, Volume 21, Number 2, Spring 2007, 129-151;
- Benninga, S. and Helmantel, M. and Sarig, O. (2005), The Timing of Initial Public Offerings, *Journal of Financial Economics*, 75, 115-132;
- Bharath, S. and Dittmar, A (2006), To Be or Not to Be (Public), University of Michigan Ross School of Business Research Paper, December 2006;
- Black, F. and Scholes, M. (1973), The Pricing of Options and Corporate Liabilities, *The Journal of Political Economy*, Vol. 81, No. 3: 637-654;
- Blum, Rachel (2011), IPO Timing Determinants, Undergraduate Honors Thesis, Duke University;

- Ljungqvist, A. and Boehmer, E. (2004), On the Decision to Go Public: Evidence from Privately-held Firms, February 12, 2004;
- Bolton, P. and Von Thadden, E.-L. (1998), Blocks, Liquidity, and Corporate Control, *The Journal of Finance*, Vol. 53, No. 1, February 1998, 1–25;
- Bowman, E. H. and Moskowitz, G. T. (2001), Real Options Analysis and Strategic Decision Making, *Organization Science*, Vol. 12, No. 6 (Nov. - Dec., 2001), 772-777;
- Brau, J., Francis, B. and Kohers, N. (2003), The Choice of IPO versus Takeover: Empirical Evidence, *Journal of Business*, Vol. 76, No. 4, 583-612;
- Brau, J. and Fawcett S. (2006), Initial Public Offerings: An Analysis of Theory and Practice, *The Journal of Finance*, Vol. LXI, No. 1, February 2006, 399-436;
- Bustamante, M. C. (2012), The Dynamics of Going Public, *Review of Finance*, Vol. 16, No. 2, 577-618;
- Casassus, J. and Villalon, M. (2010), Optimal IPO Timing in an Exchange Economy, Working Paper, PUC-Chile;
- Celikyurt, U., Sevilir, M. and Shivdasani, A. (2010), Going Public to Acquire: The Acquisition Motive for IPOs, *Journal of Financial Economics*, Vol. 96, No. 3, June 2010, 345-363;
- Dalziel, T., White, R. E., Arthurs, J. D. and Hoskisson, R. E. (2010), Initially Distracted: The Influence of Boards on Agency Costs in Initial Public Offering (IPO) firms, published in Audretsch, David B., Dagnino, Giovanni B., Faraci, Rosario and Hoskisson, Robert E. (2010), *New Frontiers in Entrepreneurship: Recognizing, Seizing, and Executing Opportunities*, New York, NY: Springer;

- Dalziel, T., White, R. E. and Arthurs, J. D. (2011), Principal Costs in Initial Public Offerings, *Journal of Management Studies*, Vol. 48, 1346–1364;
- Dixit, A. and Pindyck, R. (1994), *Investment Under Uncertainty*, Princeton University Press, New Jersey;
- Draho, Jason (2000), The Timing of Initial Public Offerings: A Real Option Approach, December 2000, Working Paper;
- Holmstrom, B. and Tirole, J. (1993), Market Liquidity and Performance Monitoring, *The Journal of Political Economy*, Vol. 101, No. 4, August 1993, 678–709;
- Ibbotson, R. and Ritter, J. (1995), Initial Public Offerings, published in Jarrow, R., Maksimovic, V. and Ziemba, W. (1995), *Handbooks of Operations Research and Management Science: Finance*, Amsterdam: North-Holland;
- Jensen, Michael and Meckling, William (1976), Theory of the firm: Managerial Behavior, agency costs and ownership structure, *Journal of Financial Economics*, Vol. 3, No.4, 305-360;
- Kim, W. and Weisbach, M. (2008), Motivations for Public Equity Offers: An International Perspective, *Journal of Financial Economics*, Vol. 87, February 2008, 281-307;
- Lee, C. M. C., Shleifer, A. and Thaler, R. (1991), Investor sentiment and the closed-end fund puzzle. *The Journal of Finance*, Vol. 46, 75-109;
- Lerner, J. (1994), Venture Capitalists and the Decision to Go Public, *Journal of Financial Economics*, Vol. 35, 293-316;
- Luehrman, T. A. (1998), Strategy as a Portfolio of Real Options, *Harvard Business Review*, pp. 89-99;

- Markowitz, H. (1952), Portfolio Selection, *The Journal of Finance*, Vol. 7, No. 1, 77-91;
- McDonald, R. and Siegel, D. (1986), The Value of Waiting to Invest, *The Quarterly Journal of Economics*, Vol. 101, No. 4, 707-728;
- Mello, A. S. and Parsons, J. E. (1998), Going Public and the Ownership Structure of the Firm, *Journal of Financial Economics*, Vol. 49, 79-109;
- Myers, S. C. (1977), Determinants of Corporate Borrowing, *Journal of Financial Economics*, Vol. 5, 147-175;
- Pagano, M., Panetta, F. and Zingales, L. (1998), Why Do Companies Go Public? An Empirical Analysis, *The Journal of Finance*, American Finance Association, Vol. 53, No. 1, 27-64;
- Pástor, L. and Veronesi, P. (2003), Stock Valuation and Learning about Profitability, *Journal of Finance*, American Finance Association, Vol. 58, No. 5, 1749-1790;
- Rajan, R. and Servaes, H. (2002), The Effect of Market Conditions on Initial Public Offerings, January 2002;
- Ritter, J. (1991), The Long-Run Performance of Initial Public Offerings, *Journal of Finance*, Vol. 46, No. 1, 3-27;
- Röell, A. (1996), The Decision to Go Public: An Overview, *European Economic Review*, Vol. 40, 1071-1081;
- Rydqvist, K. and Högholm, K. (1995), Going Public in the 1980s: Evidence from Sweden, *European Financial Management*, Vol. 1, No. 3, 287-315;
- Zingales, L. (1995), Insider Ownership and the Decision to Go Public, *Review of Economic Studies*, Vol. 62, No. 3, 425-448.