Optimal Timing for an IPO with Market Sentiment Uncertainty

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Biographical Note

Jorge Miguel Pinho Conde Rodrigues was born in Porto, Paranhos in 1992. Raised in Porto, moved to Aveiro in 2010 to start his Bachelor Degree in Economics. After 3 years, he joined Faculdade de Economia do Porto to attend for the Master in Finance.

His interest by financial operations lead him to join FEP Finance Club, while participating in voluntary work to spread financial literacy among youngsters.

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Abstract

Along with this work we intend to propose a model to calculate the optimal timing of an IPO according to the Real Options Approach. As we know, an IPO can be a very important step of the lifetime of a company, and therefore, its timing is crucial to the company. In the recent years we have seen a vast increase in the number of IPO's, and so, with this work, we intend to help companies to decide about when they should perform an IPO. We will base our work in some previous models, aiming mainly to conclude if the uncertainty about market sentiment plays a role in the timing of an IPO.

Key-words: Real Options, Initial Public Offering, Market Sentiment, Uncertainty.
JEL-Codes: G15, G32, O16

Sumário

Esta dissertação pretende propor um modelo para calcular o tempo ótimo de um IPO de acordo com a metodologia das opções reais. Como sabemos, um IPO pode ser um passo muito importante na vida de uma empresa e, portanto, o seu "timing" é crucial para a empresa. Nos últimos anos temos assistido um grande aumento no número de IPOs, e assim, com este trabalho, pretendemos ajudar as empresas a tomar uma decisão relativamente a quando devem emitir um IPO. Basearemos o nosso trabalho em alguns modelos anteriores, com o principal objetivo de concluir se a incerteza à volta do sentimento do mercado desempenha um papel no tempo de decisão de um IPO.

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1. Introduction

The first Initial Public Offering (IPO) was a turning point in the way companies performed. Since the first IPO that this strategy has become well popular among private firms. In the early days this approach was mainly used by companies to obtain cash-flows in order to invest in new financial activities.

Through the years, shareholders became more aware of the possible benefits that this strategy can bring to their companies. By taking a company public, we are not only funding new investments but we are also providing a new exit to the initial shareholders. It can also be used to deleverage a company or to give more visibility to the enterprise in a global world.

It is unquestionable that IPOs change the way we look to financial markets. Changes in IPOs made researchers start to wonder, why do companies go public? What are their main value drivers? When should they perform the IPO?

However, in recent years, we have seen an increasing volatility around IPOs, motivating the appearance of the so called IPO waves. This waves raised some important topics for research, mainly related to the value drivers of IPOs. This study appears as a way to fill this gap in the literature. By building a Real Options model, we will be able to help companies' timing their decision in their IPO process.

In the next Chapter we intend to answer the first question, by presenting the results of several authors in this topic. Along with this work we will build the model and try to help companies decide about their optimal timing to perform the IPO.

In previous literature, authors do not refer the uncertainty surrounding market sentiment as a main value driver in the decision of an IPO, and so, unlike them we will include this variable and its uncertainty and conclude that this can play an important role in the decision of a company to go public.

Besides this Chapter, this work is structured as follows: In Chapter 2 we present a

literature review. The development of the model and its main results are presented in Chapter 3. Chapter 4 offers a sensitivity analysis, in order to give some vigor to our work. As a final point, we present the conclusions, giving some insights about the main findings and our contribution to this area.

2. Literature Review

In this Chapter we present a literature review, providing the results of some authors in relation to the main reasons of a company to perform an IPO.

In order to start the investigation, we decided to discover why companies go public. Many authors answered this question with a lot of different studies. Probably one of the most important articles was made by Roell (1996). In his work, Roell identify the main motivations for IPO's, with the compilation of several papers. The major incentives referred are the possibility of initial shareholders to exit, the creation of another way of payment for Mergers and Acquisitions, the raise of funds for futures investments, the creation of liquidity for its stocks, deleveraging of the company and the improvement of the image of the company.

Ritter (1991) clarified the long-term underperformance of IPO's, explaining that companies may look for good market moments (times in which the markets tend to overvalue) to issue their shares, in order to take advantage of the optimism and compensate its costs. With this, firms will generate a poor performance in the future. Pastor and Veronesi (2005) concluded that one of the most important factors in the decision to go public are the market conditions, also affirming that IPO volume declines in bad market conditions, since private firms prefer to wait for more favorable situations. Another study, by Baker and Wurgler (2007) considered a relation between market sentiment and the number of IPO's, stating that when market sentiment is high, the number of IPO's increase.

Normally companies perform IPO's in order to finance new investments, as stated before, and with accordance with the study of Albornoz and Pope (2004) that concluded that companies use the proceeds of the IPO's to finance new investments. On the other hand, Pagano et al. (1998) stated that new investments after the IPO actually decrease, suggesting that maybe companies perform this offering with the main purpose of deleveraging the firm, lowering the costs of debt. Brau and Fawcett (2006) and Boehmer and Ljunqvist (2004) supported that the probability of an IPO is indeed affected by the idea of a new investment opportunity.

Another motive mentioned earlier was the creation of another way of payment for Mergers and Acquisitions. This gives a large advantage to public firms, since later in their lifetime, they can buy other companies by having a different coin of exchange. In periods of high overvaluation of the market, companies can take advantage of such fact to acquire companies, having as a major incentive shares of their own. Brau and Fawcett (2006) concluded that IPO's can facilitate future acquisitions.

Along the years the studies in Real Options have increased, we could affirm that the first contribution was of Black & Scholes (1973), although not directly related to real options. Myers (1977) made the first real contribution to this field of study, using the model of Black & Scholes (1973) to distinguish the value of assets in place and opportunities to grow. This opportunities can be calculated through the real options approach, and differ from the normal NPV approach, since in most investment opportunities we have options embedded, and therefore, there should be a right calculation for it. Dixit and Pindyck (1994) made a huge contribution to this disparity.

As referred above, an IPO is an investment opportunity and of course, it is an option of a company to go public or not. This way, we can apply the Real Options approach to IPOs. Zingales (1995) made the first contribution, building a model to time the IPO, but in this specific case, the author claims that the IPO's are used as a way of transferring control within a company. Another important approach was made by Draho (2000), pointing to the valuation of the waiting option embedded in an IPO. The author concluded explaining that the optimal exercise of these options is subject to the hot/cold markets theory. Pastor and Veronesi (2005) developed a model in which IPO waves are caused by declines in expected market return, including the uncertainty related about the future profitability of the offerings. They found that IPO waves "*tend to be preceded by high market returns and followed by low market returns*" (Pastor, L. and Veronesi, P. (2005, p.1713). Additionally, companies IPO's can have an important impact in the market conditions, according to Casassus and Villalon (2010).

Moreover, Bustamante (2012) uses an interesting approach, mixing signaling game

theory with the time of the IPO's. She developed a real options model in which firms may use the timing of their initial public offerings to signal their investments prospects to outsider investors. Bustamante affirmed that in cold markets, good companies issue the IPO earlier in order to signal their quality, while in hot markets all companies go public at the same time.

Last but not least, we decided to also use the approach given by Ferreira (2014). Ferreira addresses the importance of market sentiment in the decision of the IPO. Although he builds two models that complete each other, we will extend his first model, which gives mainly emphasis to the market sentiment variable. This work pretends to include the uncertainty of the market sentiment, a point not mentioned in the previous studies.

All of the previous studies were very important, but some of the models showed before presented some flaws. Draho (2000) considered the costs of an IPO as direct costs, which in reality, are divided between direct and indirect costs. Additionally, Pastor and Veronesi (2005) included the factor of the IPO waves, but they did not considered the uncertainty surrounding this, which will lead to different results. Ferreira (2014) mentions the market sentiment variable as a factor that impacts the decision of the companies, but as the previous studies, he does not mention the uncertainty surrounding it. This point is worth mention, because when we are in good market conditions, there is a probability that in the next moment we will not be, that we will be in a bad market condition, therefore, there is uncertainty not only related to the cash-flows that the company can generate, but also uncertainty related with the market sentiment. In the late 1990s there were high IPO valuations, and some may argue that this was due to some irrationally, supporting the idea of behavioral finance. But, Pastor and Veronesi (2005) concluded in their paper that "*IPO timing is endogenous and partly due to prior uncertainty about the average future profitability of IPOs"* (Pastor, L. and Veronesi, P. (2005), "*Rational IPO Waves*", The Journal of Finance, Vol. 60, No. 4, pp. 1747). This uncertainty was unusually high in the late 90s, attracting many firms to go public and increasing their valuations. They also concluded that there are IPO waves related to certain industries, as was the case of the technology bubble.

Our literature review focused on the fact that market conditions play an important role in the decision to go public. Many authors support this idea, but still, why is not this factor considered in the calculations? Bustamante (2012) considered it indirectly, by supporting the idea of cold and hot markets, but still mixing signaling theory, which means that companies use their timing to signal their investment prospects. Pastor and Veronesi (2005) had a different approach, including a new topic, "IPO waves". They mentioned that when market conditions worsen, stock prices drop and IPO volume decrease because private firms choose to wait for better favorable market conditions (there is value in the option to wait). Ferreira (2014) indeed reveals that market conditions affect the decision of shareholders, and therefore, his assumptions are a very important factor to our dissertation. These IPO waves should be preceded by high market returns, followed by low market returns. IPO volume should be more related to recent changes in stock prices than to its levels.

In the next Chapter we will construct our model. We intend to build a model that can express the flexibility in the overvaluation of the market, by showing that transitions in the market sentiment (between high and low values) impact companies' decisions. Continuing previous work, we will introduce a Real Options model to show that uncertainty in the market sentiment plays a role in the timing of going public, by influencing the value of the waiting option.

3. The Model

Our work will be based in several models. Having in consideration our aim, the models of Dixit and Pindyck (1994), Draho (2000), Pastor and Veronesi (2005) and Bustamante (2012) and Ferreira (2014) are the most important ones. Despite the fact that all these models are important for our assumptions, we decided to focus more on the model of Bustamente, Ferreira and Dixit and Pindyck. Pastor and Veronesi (2005) refer the market sentiment as an important role in the decision of a company to go public, and this variable will be included by us in our model (ω), contrary to the previous studies. This variable can either have a low level or have a high level, impacting differently the price that investors are willing to pay for the IPO. In this work, the market sentiment (ω) tries to substitute the overvaluation of the market. If a company is overvalued in the market by 10%, it means that investors are willing to pay more 10% for that company, and therefore, our value for the market sentiment would be of 10%. The value of this company would be $V = \frac{P}{\delta} * (1 + \omega)$.

With this work, and with the help of this variable, we intend to show that the uncertainty of the market sentiment can also play a role in the timing of companies to go public, basically assuming that shareholders will explore market overvaluation, taking advantage of it (Ritter, 1991).

Additionally, contrary to the model of Bustamante we will include the costs of the IPO (similarly to Draho, 2000 and Ferreira, 2014). When a company intends to go public they need to pay some costs, whether they are fixed or variable. Moreover, we will assume that the shareholders do not have any financing restriction, there is no urge in turning the company public, which means that the option of going public is endless. If the owner had for any other reason the intent to perform the IPO, this could influence his decision, by having the temptation to sell prior to the optimal timing.

In our work, the present value of future cash-flows is assumed to follow a Geometric Brownian Motion (gBm) process:

$$dV_t = \mu V_t dt + \sigma V_t dz \quad (1)$$

Where, dz is the increment of the Wiener process, μ is the risk-neutral drift and σ is the standard deviation.

$$V_0 > 0$$

$$\mu = r - \delta$$

Where, r is the risk free rate and δ is the dividen-yield.

Pastor and Veronesi (2005) and Ferreira (2014) consider market conditions, and therefore, this will be our starting point. As stated before, companies will wait for overvaluations of the market to issue their IPOs, taking advantage of the market. Another aspect that we decided to consider are the costs of the IPO.

As assumed before, the option for going public has costs. These costs can be divided into fixed costs, that we assumed as $\chi > 0$, that covers all of the expenses related with auditing, monitoring and legal fees. $c > 0$ are considered as the variable costs, which will be the amount paid to the underwriters. As stated before, these assumptions are based on the work of Ferreira (2014).

Similar to the model of Bustamante (2012) and Ferreira (2014), the owner will sell a fraction of the company that he owns, being this value exogenously chosen, $\phi \in (0,1]$. The uncertainty of market conditions will not have impact in the percentage of the company that will be sold, but will impact the timing of the offer, since shareholders will try to exploit any mispricing, specifically if the market is oscillating between high and low values of overvaluation, as captured by ω_H and ω_L. ω_H represents a high overvaluation of the market, while ω_L represents a low overvaluation of the market. $\omega_H > \omega_L$.

Another consideration that we must have, is the fact that we assumed that the company does not have any debt, meaning that the owner is the only one entitled to receive the cash flows of the company, and also, having no impact in the decision and timing of going public.

Following the interpretation of Pastor and Veronesi (2005), market sentiment can have a great impact in the decision of going public. They also add that markets are always changing, and therefore, the market sentiment in period t is not the same as in period $t + 1$. What we mean by this statements, is that there are changes in the market that affect investors and therefore their decision to invest.

By this, we pretend to include the expectations of market shifts that may impact the decision to go public, considering the market sentiment at given rates ω_H and ω_L. When the market sentiment is high, excluding costs, the proceeds from the IPO will be increased by ω_H, while when the market sentiment is low, the proceeds from the IPO will be increased by ω_L. However, there are always changes in the market, and so, we will have two regimes that can change randomly, one where the market sentiment is high and the other where the market sentiment is low.

These two positions will be identified in the formulas with two different subscripts. Under high values of market sentiment, the subscript will be 1, while on the other hand, under low values of the market, the subscript will be 0.

The switches between the two stances follow Poisson processes. Starting with a state when the market sentiment is low, the probability that it will be high in the next short interval of time dt is $\lambda_1 dt$, and when the market sentiment is high, the probability that it will be low in the next short interval of time dt is $\lambda_0 dt$.

According to this, our first intuition is that between an interval of low values $(0, P_1)$ the firm will not issue the IPO, independent of the market sentiment. But, over an interval (P_1, P_0) the firm will only issue the IPO if the company is highly overvalued in the market. Beyond P_0, the prospect of immediate revenues will be so large, that the firm will invest, irrespective of the market sentiment (please refer to Figure 1).

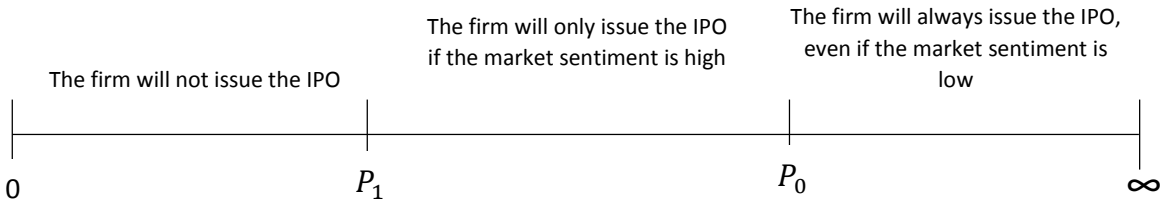

Figure 1: Company's thresholds

In order to determine these thresholds we had to consider the model of Dixit and Pindyck (1994). Contrary to their model, the impact in the option is not directly involved in the costs of the investment, but rather in the prospects of future cash-flows, determined by the decision to issue the IPO. $V_0(P)$ considers the net payoffs in the presence of low market sentiment, while $V_1(P)$ presents the impact of high market sentiment in the value of P. In both cases, ϕ represents the percentage of the company that is being considered in the IPO. $\frac{P}{\delta}$ represents the value of the company, whereas c are the variables costs and χ the fixed costs. ω characterizes the value of the sentiment market. As explained above the impact of the sentiment market in the value of the company should be $V = \frac{P}{\delta} * (1 + \omega)$. In incremental terms the benefits of the IPO under the two regimes are:

$$V_0(P) = \phi * \omega_0 * \frac{P}{\delta} * (1 - c) - \chi \quad (2)$$

$$V_1(P) = \phi * \omega_1 * \frac{P}{\delta} * (1 - c) - \chi \quad (3)$$

Beyond P_0 the firm will always issue the IPO, so there is not any decision to be made. Between P_1 and P_0 the firm issues if the market sentiment is high, so $V_1(P)$ is given by the equation (2). However, in $V_0(P)$, over the next short interval of time dt, with probability $\lambda_1 dt$ the market sentiment may turn positive, meaning that the company may change their decision to issue or not.

In this situation, the value would become $V_1(P + dP)$. If not, its value will be $V_0(P + dP)$. Consequently, we can obtain the general solution[1]:

[1] See Dixit and Pindyck (1994), page 305 for more details.

$$V_0(P) = B_1 P^{\beta(1)_1} + B_2 P^{\beta(1)_2} + \frac{\lambda_1 * \phi * \omega_1 * P * (1-c)}{\delta * (\delta + \lambda_1)} - \frac{\lambda_1 * \chi}{r + \lambda_1} \quad (4)$$

Finally, below P_1, the firm will wait, independent of the market sentiment level, even including the possibility of a change in the market. In this case, we do not know the expression for $V_1(P)$, since we are considering only the range between P_1 and 0. Therefore, we will have a pair of differential equations:

$$\frac{1}{2}\sigma^2 P^2 V_0''(P) + (r-\delta) P V_0'(P) - r V_0(P) + \lambda_1 [V_1(P) - V_0(P)] = 0,$$
$$\frac{1}{2}\sigma^2 P^2 V_1''(P) + (r-\delta) P V_1'(P) - r V_1(P) + \lambda_0 [V_0(P) - V_1(P)] = 0.$$

In order to solve these equations, we must define two new functions:

$$V_a(P) = \frac{V_1(P)}{\lambda_0} + \frac{V_0(P)}{\lambda_1}$$
$$V_b(P) = V_1(P) - V_0(P)$$

Substituting the equations, we obtain:

$$\frac{1}{2}\sigma^2 P^2 V_a''(P) + (r-\delta) P V_s'(P) - r V_a(P) = 0$$

$$\frac{1}{2}\sigma^2 P^2 V_b''(P) + (r-\delta) P V_b'(P) - (r + \lambda_0 + \lambda_1) V_b(P) = 0$$

Lastly, we can write down the solutions in the range between P_1 and 0:

$$V_0(P) = \frac{\lambda_0 * \lambda_1 * C * P^{\beta(0)_1} - \lambda_1 * D * P^{\beta(2)_1}}{(\lambda_0 + \lambda_1)} \quad (5)$$

$$V_1(P) = \frac{\lambda_0 * \lambda_1 * C * P^{\beta(0)_1} + \lambda_0 * D * P^{\beta(2)_1}}{(\lambda_0 + \lambda_1)} \quad (6)$$

With equations (2) to (6) we can now determine the values in the different regimes.

At the first threshold (P_1), the firm will invest if the market sentiment is high, therefore, the equations (3) and (6) should satisfy the value-matching and smooth-pasting conditions for $V_1(P)$, while for $V_0(P)$, this is not a threshold, and so, equation (4) should be equal to equation (5). The same applies to their derivatives. The second threshold (P_0) is only a threshold for $V_0(P)$, and so, the expressions that satisfy the value-matching and smooth pasting conditions are equations (2) and (4).

In order to apply the model we had to consider some numerical inputs:

Parameter	Value	Description
r	0.1	Risk-free rate
δ	0.1	Dividend-yield
σ	0.1	Volatility
ϕ	0.5	Stake to be sold
c	0.05	Variable costs
χ	0.5	Fixed Costs
ω_0	0.1	Low Market Sentiment
ω_1	0.12	High Market Sentiment
λ0	0.3	Probability of market change
λ1	0.3	Probability of market change

Table 1: The base case parameters

In table 1 we have the base case parameters that will help us calculate the value of our option. Since we do not have any real example, the values that we will obtain will only be significant if compared to other numerical examples, in order to understand the impact of the uncertainty of market sentiment in the decision to perform the IPO. The risk-free rate, opportunity cost, volatility, stake to be sold, variable costs and fixed costs present arbitrary but reasonable values, which help us in our comparison. The low and high market sentiment show us the two different regimes that we considering. In the first case, the market is overvalued in 10%, while in the second case the market is overvalued by 12%. The last two parameters, as explained before, represent the probability of market change. λ0 represents the probability of change between a high market sentiment to a low

market sentiment situation. On the other hand, λ1 characterizes the probability of change between a low market sentiment to a high market sentiment situation.

With these numbers, and with the help of *mathematica*® to solve simultaneously the equations, the optimal investment threshold would be $P^* = P_1 = 1.06$. As explained before, this number only has significance if compared, and so, in order to examine the effects of the uncertainty surrounding the market sentiment we decided to elaborate a sensitivity analysis, as shown in the next Chapter.

4. Sensitivity Analysis

Assuming the same numerical inputs as above, and knowing that the impact that we want to show in our dissertation is the uncertainty surrounding the market sentiment, we decided to analyze how changes in this uncertainty (λ) would affect the optimal trigger, *ceteris paribus*.

	λ1		
λ0	0.2	0.3	0.4
0.2	2.00	2.94	5.82
0.3	2.00	2.94	5.82
0.4	1.99	2.94	5.81

Table 2: λ impact under low market sentiment conditions (P_0)

	λ1		
λ0	0.2	0.3	0.4
0.2	1.07	1.07	1.08
0.3	1.06	1.06	1.07
0.4	1.05	1.06	1.07

Table 3: λ impact under high market sentiment conditions (P_1)

In table 2, we are considering the value of the option with a low market sentiment impact. As we can see, when the expectations relating the market increases (λ_1), i.e. probability of high market sentiment in the next period of time, the threshold P_0 increases. The prospect of higher returns in the future increase the value of waiting. According to our calculations, while under low market sentiment conditions, the threshold is more affected by λ_1. This is because the firm assumes is more valuable to wait, since there is a probability that the market will be more overvalued at the future, therefore an increase in the probability of good expectations, increased the value of the waiting option, as expected.

In table 3, under high market sentiment impact, we can see that as λ_0 increases, the value of waiting decreases. The prospect that in the near future the market might not be overvaluing the company that much, rushes shareholders in their decision, making the value of the option to wait less profitable. In this situation, since we are in better conditions than in P_0, the shareholders do not react that much to variations in the uncertainty, since the value of the waiting option is small.

These results show us that uncertainty in the market sentiment can influence shareholders in the timing of their offers. In fact, we can conclude that the probability of transition from low market sentiment conditions to higher conditions in the market has higher impact than the opposite.

Since the main purpose of our work is to show that the market sentiment uncertainty influences the timing of companies in their decision to perform IPO's, we show the impact of ω_0 and ω_1 in P_0 and P_1. When $\omega_0 = \omega_1 = 0.1$, the thresholds meet:

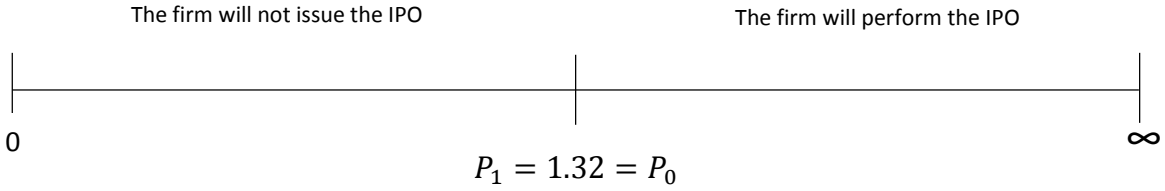

Figure 2: Company's threshold for equal market sentiment variables

In this situation, an increase of 10% in ω_1 will impact the threshold, lowering P_1 to 1.16 and increasing the value of waiting in P_0 to 1.69, as demonstrated in figure 3:

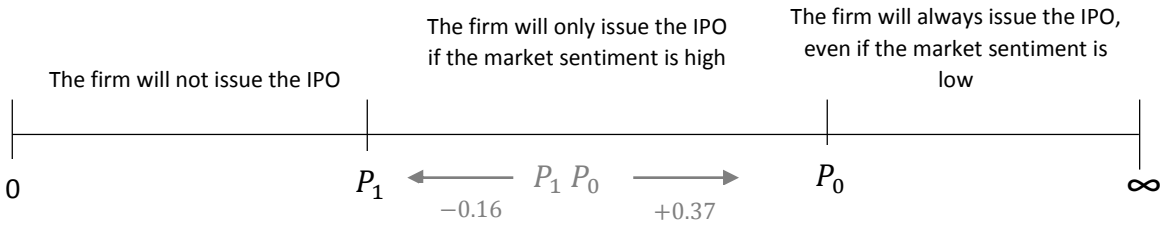

Figure 3: Company's thresholds under variation in ω_1

On the other hand, a decreased of 10% in ω_0 will increase the value of P_0 to 1.97, while P_1 lowers to 1.28:

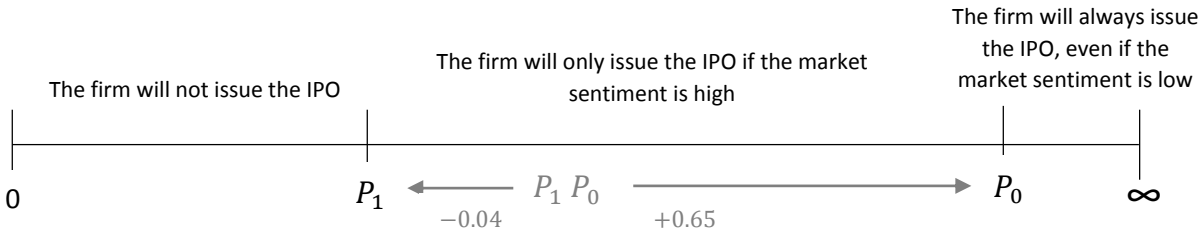

Figure 4: Company's thresholds under variation in ω_0

By this, and in this situation, we can observe that the low market sentiment (ω_0) has more impact in the value of P_0, whereas high market sentiment (ω_1) has more impact in the value of P_1. This is expected, since ω_0 impacts directly the value of P_0, as it happens to ω_1 and P_1. Moreover, we can also witness, that in both cases, decreases/increases of market sentiment affects both triggers in the same way, by decreasing the value of waiting in P_1 and increasing the value of the waiting option in P_0.

Additionally, we test the implications of changes in both market sentiments in the threshold:

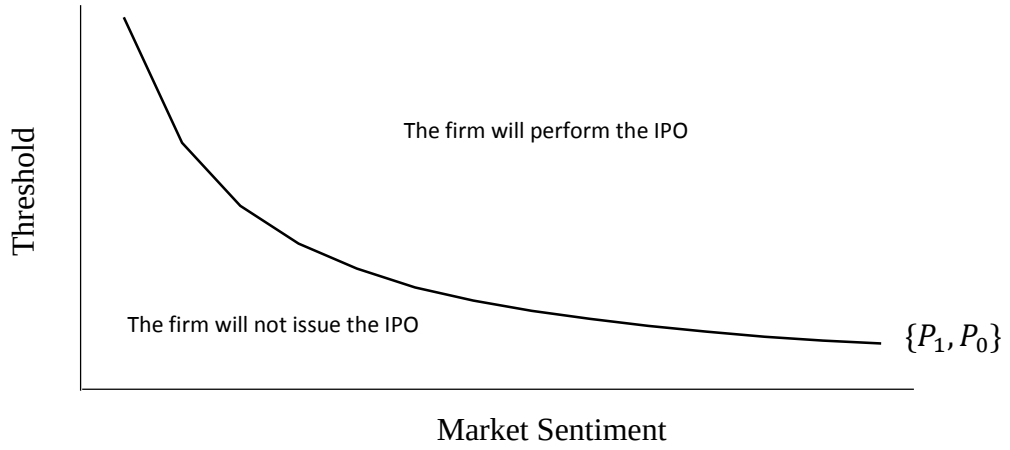

Figure 5: Impact of market sentiment in the company's thresholds

As expected, and showed in figure 5, decreases in the values of the market sentiment delay the option (increasing the threshold), meaning that under low values of market sentiment the company would never perform the IPO.

5. Conclusion

During our work we have developed a model that aim to support the decision for an IPO with market sentiment uncertainty.

Our main goal was to create a model that would include not only the impact of market sentiment, but also the uncertainty surrounding it. With this dissertation we planned to give a different approach from the works of Draho (2000), Pastor and Veronesi (2005) and Bustamante (2012) regarding IPOs and Real Options. Although we had a similar approach to Ferreira (2014), our view in the uncertainty of the market sentiment variable brought new conclusions to this topic. Our model showed us that owners would have an incentive to exercise their option to go public earlier under favorable market conditions. Additionally, we showed that the uncertainty in the market can also play a role, and in some cases, managers would only perform the IPO if the market is highly overvaluing their company.

In our work we have considered an all equity company that intends to provide the owners an opportunity to exit, while not being attached to financial constraints. Thus, the option will be only exercised in levels of higher optimism in the market.

However, companies can also perform an IPO in order to obtain funds to finance a project. This would have a great impact in the decision and in its value. There are more limitations to our model and we believe that these can be addressed in future studies. As stated before, the inclusion of debt in the model can also influence the decision, probably by anticipating the threshold. Another consideration would be the values of the market sentiment and uncertainty.

Finally, we believe that we showed the main idea of our work: market sentiment uncertainty influence managers/owners in their decision to perform IPOs, either by increasing or decreasing the value of the waiting option.

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