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IPO underpricing based on the asymmetric information theories

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This research draws conclusions about the European IPO market. The relative importance of asymmetric information theories that explain IPO underpricing are tested. Evidence is provided in favor of the changing issuer objective model. This model states that reputable underwriters have a positive impact on underpricing. The total number of underwriters has a negative effect on IPO underpricing, which is opposite to the expectation. When controlled for the endogeneity of the underwriters choice both results become insignificant. The results are compared with the American IPO market to explain the differences between the two markets.

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1. Introduction

A famous example of underpricing is the initial public offering (IPO) of LinkedIn. On the first trading day, the share price increased from 45 dollars to 90 dollars, which meant that the company left 3 billion dollars on the table (Baldwin, 2011). Leaving money on the table is defined as the number of shares offered times the difference between the offer price and the first-day closing price (Loughran & Ritter, 2002). Ibbotson (1975) is the first researcher that provided convincing evidence of IPO underpricing with initial returns of almost 12% on the first trading day. Ritter (1984) discovered mean initial returns of IPOs from 1977 till 1982 of 16% on the first trading day. IPO underpricing is present in markets varying from the US to Asia and Africa (Loughran et al., 1994). Loughran and Ritter (2004) studied multiple countries over time and concluded that IPO underpricing is an empirical regularity. The last decades the volume of IPOs is fluctuating due to various reasons. Around the year 2000, the total number of IPOs increased due to the internet bubble. The hot issue market reaches its peak in the year 2000 with a total of 843 IPOs in Europe. The following years the total number of IPOs decreases to 392 in 2001, 297 in 2002 and 254 in 2003 (Gajweski & Gresse, 2006). In the recent years, the number IPOs is fluctuating from 126 in 2009 to 459 in 2011 in Europe (PWC, 2016). In the United States, the total number of IPOs is approximately one per business day in the period from 1980-2001 (Ritter & Welch, 2002). These numbers illustrate the issuing activity and the amount of underpricing in the IPO markets.

IPO is the process of selling shares of a private company on the public stock market for the first time. Underpricing of IPOs occurs when the offer price is lower than the first-day closing price. The main reason to go public is to raise capital. The capital can be used to make important investments, which otherwise would have been too expensive for the firm. Another reason to go public is the increased publicity. IPOs create publicity because they are discussed in financial newspapers and financial websites. However, increased publicity plays a minor role in the decision making of going public. Without cash considerations, most entrepreneurs favor not going public because of the complex public market process (Ritter & Welch, 2002). In addition, there are multiple costs involved in bringing a firm to the market like underwriter expenses, legal costs and auditing costs (Ang & Brau, 2002). IPOs are a subject of academic interest because underpricing is a persistent feature of the IPO market. Institutional investors are able to earn large profits by

buying shares at the offer price and sell shares at the end of the first trading day (Ritter & Welch, 2002). The topic is also of interest for the issuing firms, since in the American market alone, billions of dollars are left on the table every year. Despite the extensive literature on IPO underpricing the real cause of the phenomena is still a debate. There is not one single dominant theory that is able to explain the observed underpricing (Ljungqvist, 2004; Ritter & Welch, 2002). Therefore, it is interesting to examine which explanation is the most relevant.

This study attempts to address this issue by focusing on the asymmetric information theories since asymmetric information models are one of the most popular explanations of IPO underpricing (Ritter & Welch, 2002). When a firm decides to go public, multiple parties are involved: the issuing firm, the underwriter and the investors. Underwriters are financial specialist, who determine the offer price and try to sell the stocks to their regular investors. Asymmetric information models are based on the fact that one party has more relevant information than one of the other parties. Other theories that explain IPO underpricing will be briefly discussed. This research examines a sample of European IPOs. Despite the fact that the European market is still one of the largest IPO markets in the world (PWC, 2016), most of the dominant literature is focussed on the American and Asian markets (Chan et al. 2004; Loughran & Ritter, 2004). Therefore, it is interesting to verify whether the asymmetric information theories are present in Europe. The results based on the European market will be compared with previous research based on the American market. The differences between the European and the American market will be explored and explained if evidence is found in favor of contradicting theories. Gajewski and Gressi (2006) found evidence that the average amount of underpricing in Europe was 22% in the period from 1995 to 2004. This study examines whether IPO underpricing is still current in the European market based on more recent data. The sample period of 2010-2017 is chosen to provide more insights into the current European IPO market. The sample period starts in 2010 to avoid the impact of the financial crisis. In addition, the sample size needs to be large enough because a substantial amount of IPOs is needed to conduct this research. To answer the question which explanation based on the asymmetric information theory is most relevant, five hypothesis are formulated. The asymmetric information theories are captured by different proxies, namely: high technology firms, underwriter rank, number of underwriters and IPO proceeds. These proxies are the independent variables of interest The dependent variable is the initial return on the first trading day. This research involves performing

an ordinary least regression (OLS) in line with previous studies to test the hypothesis (Chambers & Dimson, 2009; Loughran & Ritter, 2004).

Evidence is found in favor of the changing issuer objective function model. This model states that reputable underwriters have a positive impact on underpricing. The reason is that issuing firms hire reputable underwriters, who are known for setting low prices, because of their highly ranked analysts. The positive recommendations of the analysts will increase the market shares. When controlled for the endogeneity of the underwriters choice the changing issuer objective function is not supported. Interesting is that a contradicting theory, the entrepreneurial losses model, is supported, based on the American market. Possible explanations are higher fees charged by underwriters in the American market and the “quiet period” for analysts in the American (Ritter, 2003). The other models of this research have no empirical support. An effect of the total number of underwriters on underpricing is found. However, this effect was opposite to the expectation. In addition, the effect is not present when controlled for the endogeneity of the underwriter choice.

The contributions of this research are three-fold. The most important contribution is that the relative importance of different asymmetric information theories are evaluated based on European data. The second contribution is that this study will provide more insights into the current European IPO market. Another minor contribution is that differences between the American IPO market and European IPO market are explored and explained. The rest of this research is structured as followed. In section 2, the theoretical models that explain IPO underpricing are discussed. In addition, a clear overview of the formulated hypothesis is provided. The next section describes the dataset and methodology used for this research. In section 4, the relative importance of the different theories are tested. The following section summarizes the conclusions. The last section provides the caveats and ideas for future research.

2. Literature review

2.1. Asymmetric information models

2.1.1. The winner's curse model

One of the most dominant theories is the winner's curse of Rock (1986). This theory considers an information asymmetry between investors. The winner's curse of Rock (1986) argues that there are two groups of investors, uninformed and informed investors. Informed investors have more information about the fair value of the shares than uninformed investors. The informed investors will only bid for the underpriced IPOs (share price is below its intrinsic value). On the other hand, the uninformed investors bid for the underpriced IPOs and the overpriced IPOs because they don't have the valuable information about the attractive IPOs. As a consequence of the previous, this imposes a winner's curse on the uninformed investors because they only receive the shares of the overpriced IPOs. The reason for this is that the informed investors don't bid on the overpriced IPOs, which results in the allocation of the shares to the uninformed investors. The informed investors will bid extensively on the underpriced IPOs which will crowd out the demand of the uninformed investors. This implies, that uninformed investors could earn negative returns if they are rationed completely. The overpriced IPOs are entirely allocated to the uninformed investors, which leads to negative returns. This results in a market that only exists of informed investors since the uninformed investors retrieve their bids because of their negative expected earnings. Rock's theory is based on the assumption that the IPO market cannot be populated only with informed investors because the demand is not sufficient enough for only the attractive offerings. The market is dependent on the participation of the uninformed investors. In other words, the expected returns of the uninformed investors have to increase to at least break even. Therefore, there must be the expectation that all IPOs are underpriced. Eventually, the uninformed investors will still be crowded out in the attractive offerings but their expected loss is no longer negative. Overall, underpricing is thus required to motivate the uninformed investors to participate in the market.

Beatty and Ritter(1986) used this asymmetric information model of Rock (1986) to formalize an empirical implication. They state that the (expected) underpricing of an IPO is related to the ex-ante uncertainty. The greater the ex-ante uncertainty, the greater the (expected) underpricing.

Investors don't know the value of the company or the share price in the future, which will drive investors to obtain information. The investors only bid on shares which, on average, are underpriced. The amount of underpricing is directly related to the ex-ante uncertainty about the value of the issue. If the uncertainty about the value of the issue raises more, investors will become informed. In addition, the winner's curse strengthens because an increase in the number of informed investors will cause more underpricing. Therefore, Beatty and Ritter (1986) state the uncertainty is positively related to underpricing.

This hypothesis is tested empirically by various studies. Most studies find empirical support for the positive relation between uncertainty and underpricing. Likewise, some other asymmetric models also predict a positive relation between uncertainty and underpricing. For that reason, most studies about IPO underpricing control for ex-ante uncertainty. The proxies used in the literature can be divided into three groups: firm characteristics, offer characteristics, market characteristics. The most common proxies for firm characteristic are age, market capitalization, log sales and industry type (Chan et al., 2004; Habib & Ljungqvist, 2001). Popular proxies for offer characteristics are gross proceeds, backing of venture capitalists, number of underwriters and underwriter ranking (Lowry & Shu, 2002). The most dominant market characteristics used are trading volume or volatility (Ritter, 1984). Ljungqvist and Wilhelm (2003) use the company age as a proxy for uncertainty. Younger firms compared to older firms are normally associated with more underpricing (Ljungqvist & Wilhelm, 2003). The reason might be that younger firms have less relevant information available, which results in more uncertainty. Another popular proxy used is the type of industry. High technology firms operate in industries with big investments, high risks and fluctuating profits. In other words, high technology firms face uncertainty. Chemmanur (1993) finds empirical evidence that high technology firms experience more underpricing than other industries. The following hypothesis can be formulated:

Hypothesis 1: There is a positive significant relationship between uncertainty and IPO underpricing

2.1.2.. Signaling model

When firms decide to go public they want to signal its quality to the market. Signaling is based on the information asymmetry between the issuers and investors. The issuer has more relevant information about the value of the firm than the investor. Therefore, the signaling model distinguishes high and low-quality firms by means of underpricing. The high-quality firms are able to cover the costs of underpricing. Therefore, the degree of underpricing represents the quality of the firm. Of course, this is costly for the firm at the time of the IPO. However, at a later date, the firm is able to earn back the missed capital gains by returning to the market. A relatively high underpriced IPO usually receives lots of publicity in the media. Institutional investors will be able to make profits by selling for a higher price than the offer price. The investors know that the firm has the possibility to return to the market on better terms at a later date. This type of signaling ‘leaves a good taste’ in the mouth of the investors (Allen & Faulhaber, 1989; Hutagaol, 2005). The intuition in the signaling model is that high-quality firms distinguish themselves from the low-quality firms by underpricing. In other words, they are able to bear the costs of underpricing. The costs of the signal will be earned back by seasoned equity offerings (SEO). The most common signal used in the literature is IPO underpricing. However, sometimes additional signals used like the retention rate of insiders (Allen & Faulhaber, 1989; Grinblatt & Hwang, 1989).

An important empirical test about signaling models is done by Jegadeesh, Weinstein and Welch (1993). They find that the size and likelihood of SEO issues increase in IPO underpricing. In addition, they found that there is a positive relationship between IPO underpricing and SEO proceeds. The additional signal, insider retention rate, is also tested empirically. Studies found a positive relationship with IPO underpricing and the insider retention rate (Grinblatt & Hwang, 1989; Li et al., 2005). Due to data availability of SEO and insider retention rates this study will not examine the signaling model.

2.1.3. The entrepreneurial losses model

Habib and Ljungqvist (2001) introduce an extension of the asymmetric information model of Rock (1986). The model of Rock (1986) assumes that some investors are better informed than other

investors, the adverse selection problem. However, in the extension of this model the reduction of the adverse selection problem is done by the issuers. The issuers reduce the information asymmetry by incurring information production costs. For example, issuers can hire reputable underwriters to decrease underpricing. This will decrease the information asymmetry because of the greater reputational capital of the underwriter. Therefore, wealth losses are minimized and underpricing decreases (Habib & Ljungqvist, 2001). Consequently, underpricing decreases with increased promotion costs. However, the increased production costs could be able to offset the benefits of lower underpricing. The tradeoff depends on the given combinations of how underpricing and promotion costs effect the wealth losses of going public.

Chemmanur & Krishnan (2012) examine the role of the underwriters in IPOs. They expect that high-reputation underwriters set higher offer prices than low-reputation underwriters. Therefore, reputable underwriters have a negative impact on the amount of underpricing. The hypothesis is empirically tested and confirmed by their study. Beatty and Ritter (1986) state that, IPOs that are guided by underwriters with a good reputation, will experience less underpricing. In addition, it seems a logical reasoning that well-established underwriters have less underpricing. The rank of the underwriters is measured in the literature by the number of issues an underwriter is involved in and/or the proportion of the amount of capital raised by each underwriter (Dimovski et al., 2010). As a consequence of the previous, the following hypothesis can be formulated:

Hypothesis 2a: There is a negative significant relationship between underwriter rank and IPO underpricing

2.1.4. The changing issuer objective function model

The literature about agency problems goes back decades. One of the first researchers that documented the asymmetric information theory was Baron (1982). His model is based on the principal-agent theory, information asymmetry between investment banks and issuers. He stated that the investment banks have more knowledge about the capital market. They are hired to provide advice, perform underwriting and make valuations. If the issuing firm has uncertainty about the demand of the market, the value of services of the investment bank will increase. In addition, the

investment bank will set a lower price to be able to sell the security. This means the issuer has an agency problem.

The changing issuer objective function model is introduced by Loughran and Ritter (2004). The model is based on the agency problems between the issuing firm and the investment bank. This model assumes that the investors cannot observe the actions of the managers. The model predicts a positive relationship between the underwriter ranking and IPO underpricing. The model also predicts a positive relationship between the number of underwriters and IPO underpricing. The reason for this relationship lies in the increased importance of analyst coverage. Issuers favor the importance of a lead underwriter with highly ranked analysts to cover the firm instead of their reputation for setting low prices. The second reason is known as spinning. Side payments are made to the venture capitalists and executives of issuing firms. The purpose of these side payments is to influence the choice of the lead underwriter. Therefore, side payments could lead to choosing underwriters with a reputation for underpricing. While collecting data about the side payments is impossible, it is interesting to examine whether there is a positive relationship between underwriter ranking and IPO underpricing. Moreover, it is reasonable to argue that if a positive relation is found, this is caused by the reasons named in this model. Based on the changing objective function model two hypothesis can be formulated:

Hypothesis 2b: There is a positive significant relationship between underwriter rank and IPO underpricing

Hypothesis 3: There is a positive significant relationship between the number of underwriters and IPO underpricing

The entrepreneurial losses model and the changing issuer objective function results in an investment bank conflict. This theory about investment banks is the “investment bank conflict theory”. This means that investment banks have a conflict of interest when they price IPOs. Investment banks have to satisfy their regular clients and themselves by setting a low offer price. By this way, the institutional investors receive a high expected return. At the same time, investment banks want to set the fair offer price to minimize the amount left on the table for the issuers.

Moreover, investment banks who constantly underprice firms could lose clients for future IPOs because their reputation is harmed (Goldstein, 2012).

2.1.5. Information production model

The model of Chemmanur (1993) is based on insiders who know the value of the firm. The firm prefers that insiders produce this information to reduce information asymmetry. The insiders will be compensated by underpricing the IPO. According to this model, firms with costlier projects have a higher underpricing rate. High technology firms have expensive projects, which implies more uncertainty and a higher underpricing rate. Therefore, the information production model supports the rational of hypothesis 1. Underpricing can be beneficial for firms when it expects to sell SEO for a higher price. In other words, there is a tradeoff between the proceeds of the IPO and the present value of the proceeds of the SEO. A testable implication of Chemmanur's (1993) information production model is that the greater IPO underpricing is associated with lower IPO gross proceeds (Kennedy et al., 2006). As a consequence of the previous, the following hypothesis can be formulated:

Hypothesis 4: There is a negative significant relationship between IPO proceeds and IPO underpricing

2.1.6. Information momentum model

The model of Aggarwal et al. (2002) is based on managers who create an information momentum. The information momentum can be created by increased research coverage because of the increase in the demand of the stock. The insiders start selling their stocks because of the increased prices. The model shows a positive relation between insiders retention of shares at the IPO and underpricing. Different researchers found evidence in support of this model by focusing on before as well as after the lockup expiration date (Brav & Gompers, 2003; Lee, 1997). The model predicts a positive relationship between research coverage and IPO underpricing. In addition, Bradley (2003) states that there is a strong relationship between the initiation of research coverage and the total number of underwriters. This study expects a positive relationship between

IPO underpricing and the total number of underwriters, similar to the research of Kennedy et al. (2006). Therefore, the information momentum model supports the rational of hypothesis 4.

2.2. Institutional explanations

The first institutional explanation is named the litigation risk hypothesis. The basic idea behind the litigation risk hypothesis is that investment banks and issuers use underpricing as insurance against future lawsuits. Because shareholders could be disappointed with the post-IPO performance and sue the issuing company. This explanation is US-centric because some European countries do not have significant risks of being sued (Ljungqvist, 1997; Jenkinson, 1990). However, it is always favorable to avoid lawsuits. Therefore, lawsuit avoidance could be a second-order driver of IPO underpricing. Lowry and Shu (2002) examined the relation between IPO underpricing and the litigation risk hypothesis. They first tested the insurance effect: firms with higher litigation risk unpriced their IPOs more than firms with lower litigation risk. Second, they tested the deterrence effect: firms with higher underpricing experience lower litigation costs. The authors find support for both aspects of the litigation-risk hypothesis (Lowry & Shu, 2002). Tinic (1988) used a more simplified procedure. He compared the average amount of underpricing of two samples with a different time horizon. However, it is hard to conclude that the results are not influenced by other factors than litigation risk.

The second explanation is price stabilization. Price stabilization of the underwriters after an IPO is legal in many countries. This results in fewer observations of overpricing and an upward shift in the mean initial returns. Price stabilization represents a mechanism that “bonds” the investors and underwriters. Fees are based on gross proceeds, hence this results in an incentive for the underwriters to raise the offer price. Ruud (1993) finds support for the claim that IPOs are not underpriced but stabilized in the after-market trading. Price stabilization ensures the elimination of the left tails in the distribution which will result in a positive average price jump. In other words, the observed underpricing could be caused by the intervention (price stabilization) of the underwriters in the aftermarket. However, direct evidence that supports the institutional explanation of price stabilization is limited because most of the stabilizing activities are only available for market regulators (Ljungqvist, 2004).

The third institutional explanation has to do with the tax advantages of IPO underpricing. There is a trade-off between the tax benefit and the costs of underpricing. Differences, if any, between employment income taxes and capital gain taxes, can be exploited. Resulting in a payment for employees with appreciated assets instead of salaries (Rydqvist & Högholm, 1995).

2.3. Ownership and control

In private companies, the ownership and control responsibilities are not separated. The owners of the company make the operating as well as the investment decisions. However, going public separates the ownership and control functions. Managers make the operating and investment decisions and shareholders own the company. This could lead to agency problems (Ljungqvist, 2004). Two models make opposing predictions based on underpricing and the agency costs. The model of Brennan and Franks (1997) is based on retaining control. Private benefits of the managers can play a role during an IPO. When an IPO is executed managers can discriminate in the allocation of the shares by assigning small shares to the investors, which results in two free-rider problems: reduced chance of scrutiny and reduced threats of being ousted by a hostile takeover. The managers use underpricing to create an excess demand which results in better allocation of the small shares. The model of Stoughton and Zechner (1998) state that shares should be allocated to large investors. Large investors are able to monitor the issuing firm. Agency costs will be reduced because the smaller institutions can free-ride on the monitor services. Underpricing creates an extra advantage for the large investors.

2.4. Behavioral explanations

Within behavioral finance, an interesting explanation of IPO underpricing is about “sentiment” investors. Investor sentiment could play an important role because IPO firms are hard to value. Ljungqvist et al. (2004) model the role of investor sentiment by IPO companies. Issuing firms try to capture as much as possible from the optimistic beliefs of the investors. Flooding the market with shares, results in a price decrease. Therefore, the issuer restricts the supply of the shares by allocating shares to the “regular” institutional investors. The investors postpone the sale of their shares to prevent the price from falling. Underpricing compensates the investors for the risk of holding IPO stocks.

Loughran and Ritter (2002) explain IPO underpricing by behavioral biases among the decision-makers of the issuing firm. Decision-makers compare the costs of underpricing with the wealth gain on retained shares (prices increase in the after-market). Their behavioral bias is based on the combination of the prospect theory of Tversky and Kahneman (1992) and mental accounting of Thaler (1985). In other words, based on the prospect theory, issuers make decisions based on the wealth gains/losses instead of their final wealth level. Since the offer price routinely differs from the reference point (price range reported in the IPO registration statement) decision-makers could still be satisfied with underwriter performance while large amounts of money are left on the table.

2.5. Hypotheses

This study provides insights into the relationship between asymmetric information theories and IPO underpricing. The different asymmetric information theories stated in section 2 are tested based on European data. It is important to know which theoretical models are linked to their corresponding testable implications. Table 1 summarizes the hypothesis and shows the link between the underlying theoretical models and the testable implications.

TABLE 1. OVERVIEW OF THE TESTABLE IMPLICATIONS AND THE CORRESPONDING THEORETICAL MODELS

Hypothesis	Testable implications	Theoretical models
1	There is a positive significant relationship between uncertainty and IPO underpricing	-Winner's Curse -Information production
2a	There is a negative significant relationship between underwriter rank and IPO underpricing	-Entrepreneurial losses
2b	There is a positive significant relationship between underwriter rank and IPO underpricing	-Changing objective function
3	There is a positive significant relationship between the number of underwriters and IPO underpricing	-Changing objective function -Information momentum
4	There is a negative significant relationship between IPO proceeds and IPO underpricing	-Information production

As stated above this research will test the asymmetric information theories. Worth mentioning is that some testable implications are linked to multiple theoretical models. A significant result for that particular hypothesis indicates that both models are supported (assuming that the underlying assumptions are the same). On the other hand, a significant result for hypothesis 2a supports the entrepreneurial losses model because the testable implication is linked to only one theoretical model. In addition, it automatically contradicts the changing objective function because this model is linked to an opposite testable implication.

3. Methodology

3.1. Data and sample

The data is collected from Thompson One and Eikon Datastream. The initial sample is selected from Thompson One and consists of all IPOs that are listed on European primary stock exchanges. The sample period consists of the years 2010-2017. This period is chosen to avoid the impact of the financial crisis on IPO underpricing. The financial crisis increased the risk aversion of investors substantially, which could have a significant effect on the number of IPOs and the initial returns (Guiso et al., 2018). In addition, the sample size needs to be large enough because a substantial amount of IPOs is needed to conduct this research. Therefore, the sample period of 2010-2017 is chosen. Besides, with this sample period, it is possible to provide more insights into the current European IPO market. Unit issues, closed-end funds and follow-on issues are eliminated from the sample, similar to recent studies as Chambers and Dimson (2009) and Liu and Ritter (2011). These issues are eliminated because their characteristics differ compared to the other issuing firms. IPOs with an offer price below \$5.00 per share are also excluded to avoid the impact of penny stocks (Chambers & Dimson, 2009; Liu Ritter, 2011). The remaining sample consists of IPOs that are large enough to be of interest to institutional investors. Thereafter, financials and utilities are excluded from the sample because regulations could have a different influence on the equity issuance. Therefore, issues with a SIC code of 6000-6999 (financials) and 4900-4999 (utilities) are eliminated from the sample (Spies & Pettway, 1997). This results in a sample of 538 firms. The closing prices are obtained from Eikon Datastream. Finally, firms with incomplete price data or incomplete data about underwriters are excluded from the sample. The final sample consists of 386 firms spread throughout Europe. Table 2 provides a detailed summary of the sample selection criteria.

Information about the offer dates, offer prices, IPO proceeds, underwriter names, total number of underwriters and technology firm classifications are all retrieved by Thompson One. The closing prices and the returns of the MSCI Europe index on the particular issue dates are retrieved from Eikon Datastream.

TABLE 2. DETAILED OVERVIEW OF THE SAMPLE SELECTION CRITERIA

Sample selection	
Number of IPOs issued in the period of 2010 to 2017 on primary European stock exchanges	2057
Unit issues/close-end funds/follow-ons	(378)
Financials and Utilities	(460)
Firms with an offer price of less than \$5	(681)
Missing data about prices or underwriters	<u>(152)</u>
Final sample	<u>386</u>

Based on the Thompson One Macro Industry classification the sample consists of consumer products and services 9%, consumer staples 8%, energy and power 5%, healthcare 20%, high technology 14%, industrials 20%, materials 6%, media and entertainment 6%, retail 8%, Telecommunications 4%. The sample distribution and the initial returns by years of the offering are reported in figure 1. Noteworthy is the striking high initial return in the year 2010. In this year the first-day return is almost 58%. Possible reasons for the high underpricing in 2010 could be the recovery of the economic crisis of 2008. Another reason for the high underpricing could be that the total number of IPOs is quite low, namely 34. IPOs with a high amount of underpricing have a rather large effect on the mean initial returns if the sample size is low. The following year the initial return decreases to 25%. The initial return rises to 48% in 2012, after that the initial-returns are decreasing to almost 3% in 2016. The last year of the sample the initial return rises again to an average of 15% in 2017. Overall, it is remarkable that the returns change over the years. The total number of IPOs seems to slowly increase throughout the years. However, the sample period is not large enough to draw any conclusions about the possible increase in the total number of IPOs over the years.

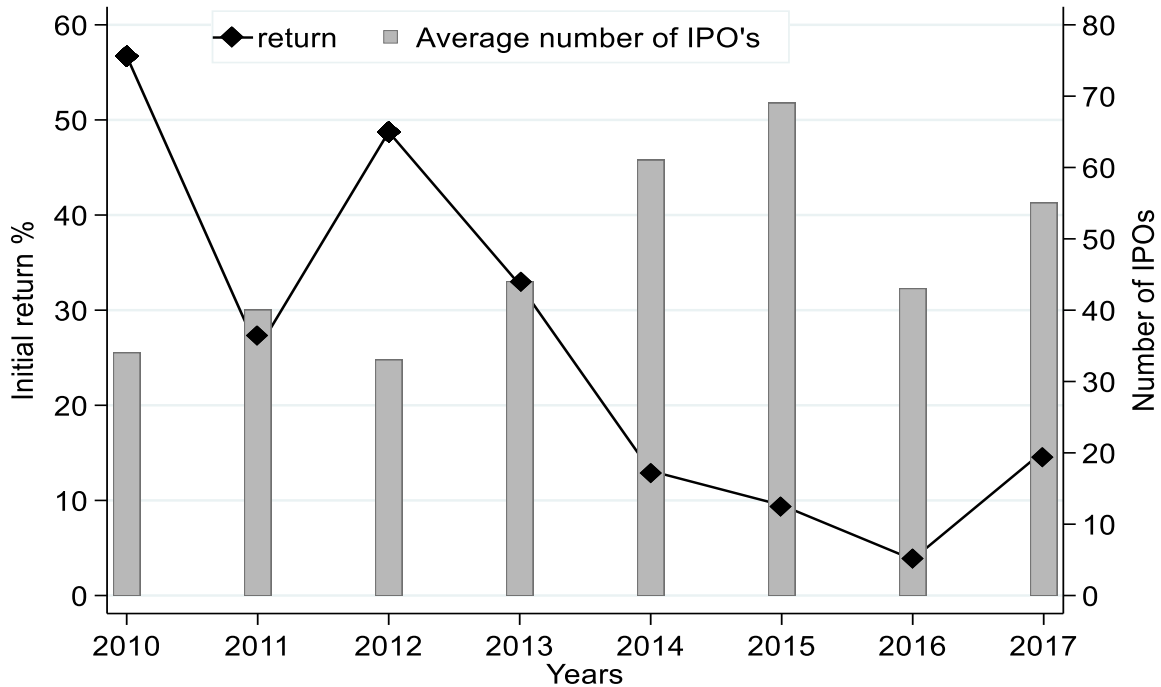


FIGURE 1. TOTAL NUMBER OF IPOs AND AVERAGE FIRST-DAY RETURNS BY YEARS

IPOs issued between 2010-2017 on European stock exchanges. Unit issues, closed-end funds, follow-ons, financials, utilities, IPOs with an offer price below \$5, missings and outliers are excluded. Data are from Thompson One/Eikon Datastream. The initial-return is calculated by taking the natural logarithm of the first-day closing price divided by the offer price.

The country by country statistics are presented in table 3. The table summarizes detailed information about the mean, median and total number of IPOs of 18 European countries. The mean and median values are calculated to provide an indication of the distribution of IPO underpricing across countries. France has the largest number of IPO issuings in our sample, namely 115. France is followed by Germany and Sweden with a total number of IPOs of 56 and 46 respectively. Turkey has the lowest mean value of underpricing of -33.97% and the median value of underpricing of -48.27%, followed by Norway with the second lowest mean value of underpricing of -10.24% and the second lowest median value of -1.95%. The United Kingdom has the highest mean and median value of underpricing equal to 269.65% and 459.07% respectively, followed by Czechia with the second highest mean value of underpricing of 160.73% and the second highest median value of underpricing of 160.73%. However, note that Turkey and the Czechia involve only 7 and 2 observations, respectively. All things considered, there are extreme differences between the value of underpricing across countries.

TABLE 3. SUMMARY STATISTICS OF IPO UNDERPRICING BY COUNTRY

Nation	Mean(%)	Median(%)	N
Belgium	20.77	0.34	9
Czechia	160.73	160.73	2
Denmark	9.19	7.37	10
Finland	6.64	3.50	18
France	1.56	0.00	115
Germany	13.03	1.07	56
Italy	13.67	5.46	21
Netherlands	5.36	3.05	12
Norway	-10.24	-1.95	15
Poland	9.50	3.84	16
Portugal	0.36	0.36	1
Romania	13.97	13.98	1
Russia	134.96	1.44	5
Spain	8.56	1.65	16
Sweden	6.34	5.62	46
Switzerland	6.49	7.66	10
Turkey	-33.97	-48.27	7
United Kingdom	269.65	459.07	19
All	35.37	34.72	379

The table presents the mean, median and total number of IPOs for each country. IPOs issued between 2010-2017 on European stock exchanges. Unit issues, closed-end funds, follow-ons, financials, utilities, IPOs with an offer price below \$5, missings and outliers are excluded. Data are from Thompson One/Eikon Datastream. The initial-return is calculated by taking the natural logarithm of the first-day closing price divided by the offer price.

3.2. Research Design

This research uses quantitative statistical analysis techniques to answer the main question. With the outcome of the statistical analysis, it is possible to test the formulated hypothesis of section 2. When all the hypothesis are answered this research is able to explain which theory is most relevant to explain IPO underpricing. In addition, the results show whether the US based results of Kennedy et al. (2006) hold for European IPOs. As stated above the data is collected from Thompson One/Eikon Datastream, which are secondary data sources. The data is collected from this source because of their availability of a large sample of IPOs (original sample is over 2000 IPOs), which increases the explanatory power of the statistical analysis of this research. The disadvantage of

using a secondary data source is that there is no control over the quality of the data. However, this data source is specialized in financial data collection and financial analyzing tools. Since the dependent variable is measured at a specific point in time, the initial return, cross-sectional data analysis is appropriate for this research. Therefore, this research involves performing an OLS regression in line with previous research (Chambers & Dimson, 2009; Loughran & Ritter, 2004). Most previous studies only use the OLS approach, which could lead to biased OLS coefficients. However, Habib and Ljungqvist (2001) and Fernando et al. (2005) argue that the reputation of the underwriter is endogenous in regression with initial returns as the dependent variable. A test for endogeneity of the underwriter choice will be performed, since the dependent variable in this research is the initial-returns. When endogeneity is present, a two-stage least squares (2SLS) regression is used to control the endogeneity of the underwriter, similar to the research of Habib and Ljungqvist (2001) and Fernando et al. (2005). The first stage regresses the underwriter reputation on the explanatory variables, while the second stage the predicted underwriter reputation is substituted in the original formula.

3.3 Operationalization

The dependent variable is the amount of underpricing after the first trading day. The amount of underpricing is measured with the initial return (IR) by taking the natural logarithm of the first-day closing price divided by the offer price from the issuing company (Ljungqvist, 1997). Hence, the returns are computed as followed:

$$(1) \quad IR = \ln\left(\frac{\text{First Day Closing Price}}{\text{Offer price}}\right)$$

The main variables of interest are high-technology firms, underwriter ranking, total number of underwriters and IPO Proceeds. The definitions and measurement methods will be discussed in the next section. The first independent variable is a dummy variable taking the value of 1 if the firm is classified as a high-technology firm and zero otherwise. The industry classification is based on three-digit primary SIC codes. This research follows the method of Field and Hanka (2001). Hence, firms with SIC codes of 357, 367, 382, 384 and 737 are classified as high technology firms. The second variable is the reputation of the underwriters. The rankings of the underwriters are obtained from the paper of Migliorati & Vismara (2014). They constructed a ranking of underwriters of

European IPOs (proceeds-weighted and equally weighted). The dummy variable in this research takes the value of one, if the highest ranked underwriter of the issue belongs to the top 10 underwriters of European IPOs, and zero otherwise. This method is consistent with previous research (Loughran & Ritter, 2004). The third independent variable is the total number of underwriters. Within the final sample, this variable varies from one underwriter per IPO to nine underwriters per IPO. The fourth variable is the IPO Proceeds. The variable is measured by the natural logarithm of the offer price times the total shares offered by the issue (Bradley et al., 2006).

In order to control for the average return of the market during the first trading day, the MSCIEurope index is added to the analyses. The MSCIEurope index represents the performance of large and mid-cap equities across 15 developed countries in Europe. France and Germany are highly represented in this index, which is similar to our sample distribution. The return of this index is measured by the percentage difference between the closing index one day before the first trading day and the closing index on the first trading day (Banerjee et al., 2011). As reported in figure 1 the average amount of underpricing varies throughout the years. To control for this difference in underpricing dummy variables are added to the analysis. An issuer will be attributed to the year in which the IPO is issued. Table 3 summarizes the mean and median return across different countries. There are extreme differences in average underpricing per country. To account for all the differences between the countries, dummy variables are created which attribute the issuer to a specific country when the IPO is listed on the exchange of that country. An overview of the used variables and their measurements is shown in table 4.

Table 4. OVERVIEW OF THE VARIABLES, SYMBOLS AND MEASUREMENTS

Variable	Symbol	Measurement
Initial-return	IR	Log changes of the offer price and the first-day closing price
High-technology firm	TECH	Dummy variable taking the value of 1 for firms with SIC codes 357, 367, 382, 384, 737 and 0 otherwise.
Reputation of the underwriter	REPP	Dummy variable taking the value of 1 if the underwriter of the issue belongs to the top ten reputable underwriters in Europe based on the rankings of Migliorati & Vismara (2014) and 0 otherwise.
Total number of underwriters	NUMB	Total number of underwriters of the issuing company
Total number of IPO proceeds	PROC	Natural logarithm of the offer price times the total shares offered by the issue.
MSCIEurope returns	MSCI	Return of the MSCIEurope index at the first trading day.
Year dummies	YEARS	Dummy variables which attribute the issuer to the specific year in which the IPO is issued.
Country dummies	CNTRY	Dummy variables which attribute the issuer to a specific country when the IPO is listed on the exchange of that country

This leads to the following regression formula:

$$(2) \quad IR = a + B_1TECH + B_2REPP + B_3NUMB + B_4PROC + B_5MSCI + B_6YEARS + B_7CNTRY + \varepsilon$$

4. Empirical findings

4.1. Descriptive statistics

The descriptive statistics of each variable used in the analysis are shown in table 5. All variables consist of 379 observations. Notable is the difference between the mean and median percentage of underpricing. The mean underpricing is 22.32%, while the median underpricing is only 1.14%. The median underpricing of 1.14% indicates that 50% of the observations are above this level. The big difference between the mean and the median is due to the fact that a few IPOs experience a very high degree of underpricing. The minimum and maximum indicate that one firm in the sample has an initial return on the first trading day of -175.14% and one firm has an initial return on the first trading day of 501.30%. High technology firms are measured by a dummy variable. The mean indicates that 19% of the issuing firms are high technology firms. The reputation of the underwriter is incorporated as a dummy variable. The mean indicates that 35% of the IPOs in our sample are covered by reputable underwriters, which implies that 65% of the issues are not covered by reputable underwriters. The total number of underwriters varies from one to nine, with a mean of 2.5 underwriter for each IPO. The variable IPO proceeds is altered by taking the natural logarithm. The control variable return of MSCI Europe index has a mean underpricing of 0.06% on the first trading day of each IPO. The sample distribution by years and across countries is already explained in detail in figure 1 and table 3, respectively.

Table 5. DESCRIPTIVE STATISTICS

Statistic	IR %	TECH	REPP	NUMB	PROC*	MSCI
Mean	22.32	0.19	0.35	2.50	17.94	0.06
Median	1.14	0.00	0.00	2.00	17.97	-0.01
Maximum	501.30	1.00	1.00	9.00	22.67	4.75
Minimum	-175.14	0.00	0.00	1.00	12.93	-4.39
Std. Dev.	94.76	0.39	0.34	1.60	1.90	1.03
N	379	379	379	379	379	379

IPOs issued between 2010-2017 on European stock exchanges. Unit issues, closed-end funds, follow-ons, financials, utilities, IPOs with an offer price below \$5, missings and outliers are excluded. Data from Thompson One/Eikon Datastream. The initial-return is calculated by taking the natural logarithm of the first-day closing price divided by the offer price.

The correlations between the measurements for underpricing are shown in table 6. Correlations indicate a predictive relationship rather than a causal relationship between the independent variables. One could expect a high correlation between the reputation of the underwriter and the total number of underwriters because well-established firms who can afford reputable underwriters could also be able to hire multiple underwriters. A reason for hiring multiple underwriters is the recommendation of multiple highly ranked analysts (Loughran & Ritter, 2004). The variables REPP and NUMB are indeed highly correlated. Besides, a strong relationship is present between PROC and REPP and between REPP and NUMB.

Table 6. CORRELATION MATRIX

	TECH	REPP	NUMB	PROC*	MSCI
TECH	1.000				
REPP	-0.165	1.000			
NUMB	-0.174	0.712	1.000		
PROC*	-0.191	0.709	0.714	1.000	
MSCI	0.097	0.015	0.005	-0.020	1.000

IPOs issued between 2010-2017 on European stock exchanges. Unit issues, closed-end funds, follow-ons, financials, utilities, IPOs with an offer price below \$5, missings and outliers are excluded. Data from Thompson One/Eikon Datastream. * transformed with the natural logarithm.

A high degree of correlation between variables might be an indication for multicollinearity. To test for multicollinearity the variance inflation factor (VIF) is conducted. The VIF is calculated by the following formula: $VIF = \frac{1}{1-R^2}$. The rule of thumb is that multicollinearity is high when the VIF is higher than 10 (O'Brien, 2007). All the variables in the sample have a VIF lower than 3. Therefore, no variables are removed from the analysis.

4.2. Regression analysis

Residual analysis is needed to identify possible influential cases. The graphical instruments of the residuals of all independent variables on the dependent variable (separately) show that there are indeed outliers in the data set. Note that every outlier does not necessarily have to be an influential case. Only the influential cases have a large effect on the slope of the regression line. The potential influential cases are identified using the Cooks distance and DFITS. For each influential case is

checked whether the model changed substantially after this case was removed from the sample. In addition, every influential case is removed by one at the time. All things considered, 7 observations needed to be eliminated from the analysis. Heteroscedasticity implies that the error terms do not have constant variance. In other words, the errors may increase when the independent variable increases. It is important to check for heteroscedasticity in the dataset since heteroscedasticity might be a problem in cross-sectional data (Williams, 2010). Postestimation analysis shows that there are indeed signs of heteroscedasticity. Visual inspection, as well as a White General Test for heteroscedasticity and a Breusch-Pagan test, provide evidence of heteroscedastic data. As a result, the estimation might no longer be the best available estimator with the smallest variance. Standard errors are said to be biased, however, the parameter estimates are not biased. Heteroscedasticity could be caused by measurement errors. To deal with the potential issue robust standard errors are included in the estimation, see table 8 for the results. Overall, the estimations are rather robust to this potential issue of heteroscedasticity because no major changes are observed in the results.

The regression results of all the independent variables on the initial-returns are shown in table 7. All dependent variables are tested separately on the initial-returns. All the variables show a significant effect on underpricing on at least the 10% level (model 1 till 4). The control variable MSCIEurope has no significant impact on the initial returns (model 5). Model 6 regresses all the independent together on the initial-returns. Interesting is that the effect of the total number of underwriters changes from positive to negative. Overall, all the variables stay significant on at least the 10% level. As stated in section 3, this research controls for the cross-country differences and differences in years. When controlled for cross-country differences only the variables underwriter reputation and number of underwriters are significant at the 5% and 10%, respectively (model 7). Note, that the adjusted R^2 increased with 41% after country dummies are added to the analyses. To control for the cross-country differences 18 dummies are added to the regression, what causes a large effect on the adjusted R^2 . Model 8 adds an extra control for the differences in years. The variables reputation of the underwriter and total number of underwriters are robust since the effects are significant at the 5% level. This implies, that reputable underwriters compared to non-reputable underwriters increase underpricing with 28.8%. An increase in the total number of underwriters with one, decreases the amount of underpricing with 7.3%. The adjusted R^2 of model 8 is 0.508 which implies that 50.8% of the variation of the initial returns is explained by the model.

TABLE 7. OLS REGRESSIONS ON THE INITIAL-RETURNS

Initial-return	Hypothesis	Predicted signs	1	2	3	4	5	6	7	8
TECH	1	+	-0.231*** (0.079)					-0.152** (0.073)	-0.064 (0.074)	-0.068 (0.078)
REPN	2a/b	-/+		0.483*** (0.123)				0.629*** (0.171)	0.294** (0.142)	0.288** (0.143)
NUMB	3	+			0.048* (0.027)			-0.149*** (0.050)	-0.059* (0.033)	-0.073** (0.033)
PROC*	4	-				0.096*** (0.029)		0.067* (0.037)	-0.002 (0.028)	0.016 (0.029)
MSCI							0.548 (4.247)	1.022 (4.056)	-0.150 (3.652)	0.171 (3.643)
Country dummies								N	Y	Y
Year dummies								N	N	Y
Intercept			0.268*** (0.059)	0.052 (0.034)	0.102 (0.070)	-1.492*** (0.494)	0.223*** (0.049)	-0.795 (0.584)	0.357 (0.491)	0.038 (0.607)
Adjusted R ²			0.009	0.060	0.007	0.037	0.000	0.089	0.500	0.508
N			379	379	379	379	379	379	379	379

IPOs issued between 2010-2017 on European stock exchanges. Unit issues, closed-end funds, follow-ons, financials, utilities, IPOs with an offer price below \$5, missings and outliers are included. Data from Thompson One/Eikon Datastream. The initial-return is calculated by taking the natural logarithm of the first-day closing price divided by the offer price. All standard error are robust. *** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level. * transformed with the natural logarithm.

In other words, the asymmetric information theories explain 50.8% of the total underpricing, given that the explanatory variables represent the asymmetric information theories correctly. However, a large part of this effect is caused by the control variables for cross-country differences and differences in years.

4.3. Hypotheses analysis

The hypothesis are tested based on the OLS regression results of table 7. Hypothesis 1 stated that there is a positive relationship between IPO underpricing and uncertainty. High technology firms who operate in industries with big investments, high risks and fluctuating profits face uncertainty. Hence, hypothesis 1 predicted a positive relationship between IPO underpricing and high technology firms. However, hypothesis 1 is not supported because the variable technology firms is not significant. This implies, that there is no evidence in favor of the winner's curse model and the information production model (Beatty & Ritter, 1986; Habib & Ljungqvist, 2001). Hypothesis 2a is not supported because there is not a negative impact of the underwriter reputation on IPO underpricing. Hypothesis 2a predicted a negative relationship between IPO underpricing and the reputation of the underwriter. In other words, underwriters are not hired to decrease underpricing. Therefore, there is no evidence in favor of the entrepreneurial losses model (Habib & Ljungqvist, 2001). Hypothesis 2b is supported since the reputation of the underwriter is significantly positively related to the amount of underpricing. The result is consistent with the changing objective function model. Therefore, underwriters (who are known to set low prices) are hired because of their highly ranked analyst coverage (Loughran & Ritter, 2004). The number of underwriters is negatively related to underpricing, hence hypothesis 3 is not supported. This implies, that based on the number of underwriters there is no evidence for the information momentum and the changing objective function model (Aggarwal et al., 2002; Loughran & Ritter, 2004). A reason for this opposite effect could be that the issuer hires multiple underwriters to decrease underpricing. However, this effect is contradicting to the changing issuer objective function model and is not backed by the literature. Hypothesis 4 is not supported since there is no significant negative relationship between the IPO proceeds and underpricing, which means that no evidence in favor of the information production model is found (Chemmanur, 1993). The information production model stated that greater IPO underpricing is associated with lower IPO proceeds because of the tradeoff between IPO proceeds and the proceeds of SEO.

4.4. Additional robustness check

An additional robustness check is needed to check for the possibility of endogeneity. Endogeneity means that an explanatory variable is correlated with the error term. In the OLS regression underpricing is estimated by including the explanatory variable reputation. However, as shown in the literature (Habib & Ljungqvist, 2001; Fernando et al., 2005), a control is needed for the endogeneity of the underwriter choice. The issuer's choice for a particular underwriter is not a one-sided mechanism. Issuing firms choose underwriters based on their abilities to promote and support the offering. On the other hand, the underwriters choose issuing firms based on the issuer's characteristics (quality). High ability underwriters choose high-quality firms based on their issue size, type of industry and the probability that the offer will be completed. In addition, the high-quality firms will be better able to capitalize on the characteristics of a high-quality firm (Akkus et al., 2013; Fernando et al. 2005). First, a test is needed to check for endogeneity in the regression. The Hausman test for endogeneity is not allowed since the possible endogenous variable is binary. Therefore, the residuals of the first stage probit regression are obtained and substituted in the original regression. The logged assets are used as an instrumental variable, similar to previous research (Akkus et al., 2013; Habib & Ljungqvist, 2001). The residuals of the first stage are significant at the 10% level, which implies that endogeneity is present in the regression. To control for the endogeneity of the underwriter choice a 2SLS regression is performed, shown in table 8. The first stage performs a probit regression with underwriter reputation as the dependent variable. The explanatory variables are IPO proceeds, high technology firms and the control variables. The logged assets are included as an instrumental variable for the reputation of the underwriter. The fitted values of the regression with reputation as the dependent variable are obtained to deal with the endogeneity problem. These fitted values are incorporated in the original regression of underpricing (Habib & Ljungqvist, 2001; Fernando et al., 2005).

The results are shown in table 8 and show two major changes (model 3). The estimated coefficients of the reputation of the underwriter and total number of underwriters are now negative and insignificant. Therefore, the reputation of the underwriter has no significant effect on the initial returns. The estimated coefficient of the number of underwriters is still negative. However, the effect is insignificant, which implies that the number of underwriters has no significant effect on underpricing when controlled for the endogeneity of the underwriter choice. In other words, there are some omitted variables in the original OLS (model 1)

regression that influences the effect of reputation and the number of underwriters on the initial returns. When controlled for this effect the variables have no significant influence on the amount of underpricing. Therefore, no evidence is found in favor of the changing issuer objective function model or one of the other models when controlled for the endogeneity of the underwriter choice.

TABLE 8. OLS REGRESSION AND 2SLS REGRESSIONS

			1	2	3
	Hypothesis	Predicted signs	IR (OLS)	REPP (2SLS)	IR (2SLS)
TECH	1	+	-0.068 (0.078)	0.050 (0.311)	-0.066 (0.081)
REPP	2a/b	-/+	0.288** (0.143)		-0.227 (0.293)
NUMB	3	+	-0.073** (0.033)		-0.004 (0.038)
PROC*	4	-	0.016 (0.029)	1.054*** (0.157)	0.053 (0.037)
ASSETS*				0.264*** (0.097)	
MSCI			0.171 (3.643)	5.896 (10.688)	0.421 (3.741)
Intercept			0.038 (0.607)	-22.887*** (2.965)	-0.925 (0.793)
Country dummies			Y	Y	Y
Year dummies			Y	Y	Y
Adjusted R ²			0.508		0.510
Pseudo R ²				0.662	
N			379	368	368

IPOs issued between 2010-2017 on European stock exchanges. Unit issues, closed-end funds, follow-ons, financials, utilities, IPOs with an offer price below \$5, missings and outliers are included. Data are from Thompson One/Eikon Datastream. The initial-return is calculated by taking the natural logarithm of the first-day closing price divided by the offer price. All standard errors are robust. *** Significant at the 1% level. ** Significant at the 2% level. *Significant at the 10% level. * transformed with the natural logarithm

4.5. Comparison between the European and American IPO market

Kennedy et al. (2006) tested asymmetric information theories based on American data. Therefore, the results of this research are compared with their findings. The most striking difference is the impact of the reputation of the underwriters on IPO underpricing. Evidence is found in favor of the changing issuer objective function based on European data (not controlled for endogeneity), while the entrepreneurial losses model is supported based on US data (Chemmanur & Krishnan, 2012). When controlled for endogeneity, the changing issuer objective function is not supported based on European data. Overall, the results indicate that the effect of underwriter reputation is negative based on American data and positive or no effect based on European data. The contradicting results could be explained by differences between the European and the American IPO market. The first important difference is the fact that the fees charged by underwriters are lower for European IPOs than for American IPOs (Torstilla, 2003; Ljungqvist et al., 2006). Therefore, American underwriters are more willing to decrease the total level of underpricing by revising the offer price upwards. The second important difference between European and American IPOs is the role of analyst conflicts of interest. European issuing firms are not subjected to a “quiet period”. This implies that analysts who are affiliated with underwriters are prohibited from publishing reports for 40 days. As stated in section two, analyst coverage is important because positive reports and recommendations increase the market shares. In other words, reputable underwriters in Europe are able to set lower prices for their IPOs and still have high market shares. The third difference between European and American IPO markets are the common class action lawsuits in the US. In the US several firms specialize in suing firms because the suing party does not have to bear all the costs. The threat of these lawsuits can be an important motivation for underpricing for reputable underwriters in the American market (Ritter, 2003). Summarizing, the first two difference between the two markets explain why American underwriters are more willing to decrease the level of underpricing, consistent with the results. The last difference, contradicts the results since it provides a reason for higher underpricing in the American market.

5. Conclusion

This research tested asymmetric information theories about IPO underpricing based on European data. The goal was to prove which theories are most valid in the European exchange market. This is done by comparing the results of the five formulated hypothesis of section 2. In addition, this research explained the most important theories about IPO underpricing. The asymmetric information theories are explained in more detail since these theories form the basis of this research. New insights are established by providing a clear overview of IPO underpricing based on European data. The results of this research are compared with the American IPO market to examine whether there is evidence for contradicting theories (Kennedy et al., 2006). Possible explanations about the differences in the European and American IPO market are provided because evidence is found in favor of contradicting theories.

As shown in table 7 the variables high technology firms, underwriters reputation, number of underwriters and IPO proceeds are all significant on at least the 10% level (model 6). However, when controlled for differences in years and differences across-countries only the reputation of the underwriter and the total number of underwriters are significant at the 5% level (model 8). Based on the number of underwriters the information momentum model and the changing objective function model are not supported because the sign of the coefficient is negative instead of positive. Evidence is found in favor of the changing objective function based on underwriter reputation. Therefore, the changing issuer objective function is the most convincing since it is the only model with only supportive evidence. In other words, the most convincing reason for underpricing in Europe is that issuers hire reputable underwriters, that are known for setting low prices, because of their highly ranked analyst coverage. Striking is that based on American data a contradicting result is found, since evidence is provided in favor of the entrepreneurial losses model (Hypothesis 2a). This research states that these contradicting results can possibly be explained by two differences between the European and American IPO market, namely: higher fees charged by underwriters in the American market and a “quiet period” for analysts in the American market (Ritter, 2003). Important to mention is that all the results are insignificant when controlled for the endogeneity of the underwriter choice (table 8). Therefore, this research found evidence in favor of the changing issuer objective function. Though, the results are not robust. The reason for this is that after a 2SLS control for the endogeneity of the underwriter choice the effects are insignificant. The findings may be interesting for investors since issuers hire reputable underwriters that are known for

underpricing. By this way, investors could increase their profits if they invest in IPOs with reputable underwriters. The results may also be of interest for issuing companies. The results indicate that issuers should work closer with the reputable underwriters (that are known for underpricing) to make more accurate valuations. Accurate valuations could decrease the total amount of underpricing, which is beneficial for the issuers.

Overall, this research provides evidence in favor of the changing issuers objective function. No evidence is found in support in any of the other models. In other words, the changing objective function is the most convincing theory that explains IPO underpricing. However, when controlled for the endogeneity of the underwriter choice, not one single model is supported. Therefore, this research concludes that underpricing is caused by one of the other theories or a combination of other theories. Ideas for further research are to test the other theories of IPO underpricing. It would be interesting to see whether behavioral theories, institutional explanation and ownership and control have an impact on IPO underpricing based on European data. Another idea for future research is to incorporate the seasoned equity offerings (SEOs) and insider trading in the sample. Information about SEOs and insider trading would provide more insights about IPO underpricing because IPOs could be part of a multi-stage selling scenario (Kennedy et al., 2006).

6. Caveats

Additional robustness checks are performed to check for the possibility of interaction effects. An interaction effect means that the effect of one independent variable depends on another independent variable. An interaction term of the underwriter reputation times the total number of underwriters is included in the regressions since the effect of reputable underwriters can be greater when multiple reputable underwriters lead the IPO. In addition, this research checked for the possible interaction effects between the underwriter reputation and IPO proceeds and between IPO proceeds and the total number of underwriters. However, all the interaction terms are not significant. Therefore, the interaction terms are not included in the regressions.

The overall return of the market could have an effect on the amount of underpricing in that particular market. Therefore, the return of the MSCIEurope index is used to control for market returns in Europe. However, the return of the MSCIEurope index does not take into account all the differences between the exchange markets. Therefore, this research could be improved by measuring the market return with the daily returns of the exchange where the IPO is issued at the specified IPO date. By this way, the analysis is controlled for the market return of each market separately. The second possible improvement is to use another instrumental variable in the 2SLS regression. The best available instrumental variable (log assets) had a significance of $T=2.71$ since the rule of thumb equals $T=3.3$ the results would be more precise if another instrumental variable is used (Angrist & Pischke, 2009). Another possible improvement is to increase the sample size. The Thompson one/Eikon datastream is used, which resulted in a final sample of 381 IPOs. The explanatory power of this research would increase if the final sample consisted of more IPOs. An option is to search for IPOs manually. With this method, one is also able to improve the quality of the data, which could increase quality of this research. However, due to time restriction and resource limitations, this was not possible for this thesis.

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