THE IMPACT OF RISK ON THREE INITIAL PUBLIC OFFERINGS MARKET ANOMALIES: HOT-ISSUE MARKET, UNDERPRICING, AND LONG-RUN UNDERPERFORMANCE

Thèse

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Résumé

Cette thèse comporte trois articles examinant l’impact du risque sur trois anomalies associées au marché des introductions en bourse (IPOs). Il s’agit de : (1) phénomène de "hot-issue market", (2) la sous-évaluation initiale et (3) la sous-performance à long terme. Nous proposons une approche innovatrice qui décompose le risque total au niveau de la firme ainsi qu’au niveau du marché des IPOs en : (1) risque systématique qui est attribué aux facteurs du risque commun à l’ensemble du marché et (2) risque idiosyncratique qui est associé aux facteurs du risque spécifique de la firme et qui est utilisé comme proxy du niveau d’asymétrie d’information. De plus, nous utilisons la volatilité implicite du marché pour évaluer l’impact du niveau d’incertitude globale de l’ensemble du marché sur l’activité des IPOs. Notre objectif est de révéler la composante du risque qui joue le rôle le plus important dans le cycle des IPOs (article 1) d’une part, et le processus d’évaluation du titre à court (article 2) et à long terme (article 3) d’autre part.

Le premier article caractérise le rôle du risque dans le cycle des IPOs. Notre objectif est d’étudier le cycle des IPOs non seulement en termes du volume d’émission et niveau des rendements initiaux, mais également en termes de risque des firmes émettrices avec ses deux composantes systématique et idiosyncratique. Nous montrons le rôle important du risque global du marché à anticiper les vagues des IPOs et le niveau du risque idiosyncratique des prochaines émissions. De plus, nous montrons que le risque systématique des firmes émettrices est positivement corrélé à celui des émissions précédentes. La prédiction des vagues des IPOs et du niveau du risque spécifique des émissions futures aide: (1) les organismes de réglementation à améliorer les règles en conséquence, (2) les investisseurs à prendre de meilleures décisions d’investissement en IPOs et (3) les émetteurs d'aligner leur IPO selon la réceptivité du marché.

Le second article traite l’impact des deux composantes du risque (systématique et idiosyncratique) de la firme émettrice et du marché des IPOs sur l’évaluation des IPOs par les souscripteurs durant la période de l’enregistrement d’une part et par les investisseurs sur le marché suite à son introduction d’autre part. Nos résultats montrent que les souscripteurs tendent à sous-évaluer les titres IPOs par rapport aux titres non-IPOs semblables (du point de vue de l’industrie, du niveau des ventes, de la profitabilité et du niveau de croissance), lorsqu’on considère le risque idiosyncratique du marché des IPOs au cours de la période d’enregistrement. Quant à l'évaluation de la firme en post-IPO, nous constatons que seulement le risque idiosyncratique de la société émettrice n’est pas incorporé dans le prix du marché des IPOs surévalués. Nous concluons que la mauvaise évaluation des IPOs pourrait être attribuée essentiellement à la non-incorporation de la composante idiosyncratique du risque dans le prix du titre.

Le troisième article étudie la performance anormale à long terme des IPOs versus les titres non-IPOs comparables sous un nouvel angle qui exploite la différence entre le risque systématique et le risque idiosyncratique de la firme. Nos résultats montrent que les titres d’IPOs présentent un risque systématique et idiosyncratique plus élevé que celui de leurs semblables. À l’encontre des titres non-IPOs, nous constatons une tendance baissière significative du risque idiosyncratique des IPOs durant les trois premières années de l’introduction, tandis que la composante systématique du risque présente une légère tendance haussière au fil du temps. Nous montrons aussi que la sous-performance apparente des IPOs n'est que le reflet d'une exposition au risque de la volatilité qui est moins élevée pour les IPOs par rapport à leur semblables non-IPOs. Par ailleurs, nous constatons des sous-performances plus importantes à long terme, surtout pour les IPOs à risque idiosyncratique élevé, les firmes technologiques et les IPOs durant la période chaude d'émissions.

Cette thèse contribue à la littérature des IPOs en démontrant la pertinence de notre approche qui adopte la décomposition du risque afin de comprendre certains résultats mitigés dans la littérature à propos des trois anomalies du marché des IPOs.

Abstract

This thesis contains three articles examining the impact of risk on three anomalies associated with the IPO market. These anomalies are: (1) the phenomenon of "hot-issue market", (2) the underpricing and (3) the long-run underperformance. We use a new approach that decomposes the total risk at the firm as well as the IPO market levels into: (1) a systematic risk component associated with common risk factors of the market and (2) an idiosyncratic risk component tied with firm specific risk factors and used as a proxy for the information asymmetry level. In addition, we use market implied volatility to assess the impact of market-wide uncertainty on IPO activity. Our objective is to reveal which risk component is involved in the IPO cycles (Paper 1), the short-run (Paper 2) as well as the long-run (Paper 3) IPO pricing process.

The first paper characterizes the role of risk in IPO cycles. We aim to study IPO cycles not only in terms of IPO volume and initial returns but also in terms of issuing firm's risks with both systematic and idiosyncratic components. We show the important role of the market-wide risk to anticipate IPO's waves and the level of the idiosyncratic risk of future issues. Moreover, we show that systematic risk is positively correlated across issuing firms. The predictability of IPO waves and the specific risk level of future new issues helps: (1) regulators to improve rules accordingly, (2) investors to make better IPO investment's decisions and (3) issuers to align their IPO timing with market receptivity.

The second paper evaluates the impact of both risk components (systematic and idiosyncratic) at the issuing firm as well as the IPO market levels on the IPO pricing by the underwriters during the period of registration on the one hand and by the investors in the early aftermarket stage on the other hand. Our results show that underwriters tend to undervalue IPOs compared to similar non-IPOs equities (controlling for the industry, sales, profitability and growth), when considering the idiosyncratic risk at the IPO market level during the registration period. For post-IPO valuation, we find that idiosyncratic risk of the issuing firm is not incorporated into the market price of overvalued IPOs only. We conclude that IPO mispricing is mainly attributed to the non-incorporation of the idiosyncratic risk component into IPO prices.

The third paper examines the long-run abnormal performance of IPOs versus comparable non-IPOs equities by using a new perspective that distinguishes between the systematic and idiosyncratic risk components of the firm. Our findings show that IPOs exhibit higher levels of systematic and idiosyncratic risks than their matched peers. Unlike non-issuing firms, we show a significant downward trend in IPO idiosyncratic risk during the first three years of seasoning. However, the IPO systematic risk component exhibits a slight upward trend over time. We also show that the apparent IPO underperformance is just a reflection of a lower risk volatility exposure for IPOs relative to similar non-issuing firms. Moreover, we find more pronounced long-run underperformance, especially for IPOs with high idiosyncratic risk, technology firms and hot-IPOs.

This thesis contributes to the IPO literature by highlighting the relevance of our approach that adopts the decomposition of risk in order to understand some mixed findings in the literature about the three anomalies of the IPO's market.

Avant-Propos

Les trois articles de cette thèse sont écrits conjointement avec ma directrice de thèse, Marie-Claude Beaulieu, Professeur titulaire au Département de finance, assurance et immobilier de l'Université Laval. Je suis l'auteure principale des trois articles présentés dans cette thèse.

Le premier article de cette thèse intitulé "*Firm-specific risk and IPO market cycles*" a été publié en version intégrale dans *Applied Economics, Volume 47, Issue 50, 2015, pages 5354-5377.*

Le second article de cette thèse intitulé "*Issuing firm valuations pre- and post-IPO: which risk component matters?*" a été publié dans *The Business Review, Cambridge, Volume 23, Issue 1, 2015, pages 233-241.* Toutefois, des extensions au niveau des résultats ont été rajoutées à la version présentée dans cette thèse.

Le troisième article de cette thèse intitulé "*How does risk affect IPOs versus non-IPOs' long-run performance?*" sera soumis prochainement à une revue scientifique.

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Chapter I: General introduction

This thesis focuses on the risk associated with initial public offerings (IPOs) and its impact on the IPO cycle and the pricing of the new issues in the short and long-run. IPOs are important events for companies giving them access to the stock market and the externalization of their capital. In fact, it requires a careful planning to establish the listing prospectus which contains information about the firm and the offer process. Furthermore, the allocation and the pricing of IPO shares are rather complex processes which require long preparations. For this reason, the issuing firms use underwriting services in order to carrying out their IPO. During the registration period, the role of the underwriters consists in the establishment of the IPO offer price as well as the allocation of IPO shares.

Since the issuing firm has no history in the stock market, the degree of uncertainty associated to its fair value on the one hand and the demand for IPO shares on the other hand is higher than with respect to traded firms. The lack of information about new issues increases the complexity of the IPO pricing process. In fact, the IPO literature documents three anomalies tied to the IPO market, namely: (1) the hot-issue market, (2) the initial underpricing and (3) the long-run underperformance. These three specific IPO phenomena could challenge the market efficiency assumption. Previous studies explain these phenomena by different theories such as: the asymmetric information between different IPO participants (issuing firms, underwriters and investors), agency problems between insiders and outsiders, behavioral theories, IPO timing, among others.

This thesis revisits these three IPO phenomena by studying how the issuing firm's risk impacts the IPO cycle as well as on the IPO pricing process in pre- and post-IPO. The majority of previous studies use total volatility as an IPO risk proxy. However, it is interesting to isolate the risk component which is associated to the issuing firm's specific characteristics given the asymmetric information that characterizes the IPO market. The source of this information asymmetry is mainly derived from the lack of information about the specific characteristics of the new issues rather than information about common market risk factors that are publicly available. Some information about the issuing firm are not disclosed during the registration period. This could generate an informational disparity between issuers and investors on the one hand, and informed investors who pay to hold this private information and uninformed investors who only have access to public information, on the other hand. For this reason, this study distinguishes between two types of issuing firm's risk: (1) systematic risk which is assigned to the common market risk factors and (2) the idiosyncratic risk which is associated with firm's specific risk factors. Since the information produced by previous issues could affect the decision to go public for followers (Benveniste, Busaba and Wilhelm, 2002), we also compute risk measures at the IPO market-level during the registration period of new issues to proxy for IPO ex-ante uncertainty. We consider both systematic and idiosyncratic risk measures at the IPO market level to reveal which risk component affects the IPO activity as well as IPO pricing and issuing firm's risk in the subsequent month. Besides, as the decision to go public depends not only on the issuing firm's conditions, but also on the overall market conditions, we suggest that firms are motivated to issue their equities in periods of overall favorable market conditions because they expect to benefit from high market valuation of their issues. Hence, we use the market implied volatility (VIX) as a proxy for market-wide uncertainty in order to evaluate its impact on the IPO volume. The risk decomposition we use in our research include : (1) systematic and idiosyncratic risks at the firm-level, (2) systematic and idiosyncratic risks at the IPO market-level and (3) market-wide risk measured by the VIX, aims to reveal how different risk components are involved in the IPO cycle as well as the pre-and post IPO valuation.

The following sub-sections present an overview of the literature with respect to the three IPO phenomena described above (hot issue market, IPO underpricing and long-run underperformance) and highlight the important role of the firm risk characteristics during the IPO process. Given the IPO literature, our research, which is presented in three papers, is motivated by whether different risk measures affect these three phenomena. Moreover, unlike previous research, we emphasize the importance of IPO risk decomposition on systematic and idiosyncratic components, which is the thread in this research around which the following three papers are articulated. The first paper characterizes the role of risk in IPO cycle. The second paper examines the role of risk in the IPO pricing in pre-offer period as well in the early aftermarket stage. The third paper focuses on the role of risk in long-run abnormal performance for IPOs versus comparable non-IPOs.

1- Hot-issue market phenomenon

Ibbotson and Jaffe (1975) are the first to show high IPO initial returns during some issuance periods to be characterized by higher IPO volume compared to other periods. Ritter (1984) note high average initial returns of 48.4% on U.S. new issues during the period starting from January 1980 and extending through March 1981, while during the rest of the period of study (1977-82), average initial returns are only 16.3%. Ritter (1984) argues that the periods of high IPO initial returns tend to be followed by high IPO volume. These observable cycles in IPO initial returns and IPO volume are also described in Ritter's (1998) study. These specific periods of high initial returns and IPOs volume are defined in the IPO literature as periods of "hot-issue" markets. A "hot-issue" market is also observed in other countries such as the United Kingdom during the "Big Beng" (the end of fixed commission rates in October 1986) and South Korea in 1988 associated with a bull market. Ritter (1984) argues that this "hot-issue" market phenomenon could be derived from either rational or irrational behaviors. However, cycles in monthly initial returns with nonzero mean seem to be inconsistent with the market efficiency hypothesis. Ritter (1984) also notes that the "hot-issue" market is not an isolated event since the same phenomenon occurs at different times. Then, it could be considered as an equilibrium phenomenon.

More recent studies such as Lowry and Schwert (2002) examine the relationship between IPO initial returns and IPO volume. They find a significant and positive lead-lag relationship between the level of IPO initial returns and the subsequent IPO volume. Since the IPO registration period extends from three to six months, Brailsfond, Heavey, Powel and Shi (2000) also find that high initial returns lead to high IPO activity by about 6 months. A period of high initial returns motivates more firms to go public in the subsequent period because they anticipate earning more money than expected in other periods. Lowry and Schwert (2002) suggest that the information learned during the registration period affect the IPO timing either by listing the issue, switching the time of registration (time between the listing date and the effective offering date) or cancelling the issue. These authors show that periods of high initial returns are followed by more

IPO listings, shorter registration periods and less IPO cancelling. Brailsfond et al. (2000) pointed out that IPO timing decision depends on the current IPO initial returns which contain relevant information; positive information leads to high initial returns which motivate more firms to go public subsequently.

1.1- Hot-issue market explanations

Previous studies provide different explanations for the IPO waves associated with capital demand, information asymmetry, investor's sentiment, risk-matching and industry-level dynamics hypotheses. These explanations exploit different assumptions with respect to market efficiency, investors' rationality and the market's demand versus the supply of capital.

1.1.1- Capital demand hypothesis

The capital demand hypothesis assumes that IPO's volume fluctuations are affected by the change in the demand of the private firm's aggregate capital which is due to the firm's economic environment changes. Favorable economic conditions lead to an increase in the firm's demand for capital. Since managers look for the appropriate funding source that allows them to minimize the expected costs of capital, private firms will conduct an IPO when public equity provides lower capital costs than other funding sources such as bank loans, public debt or venture capital. The economy growth offers new investment opportunities for private firms to motivate them to go public and benefit from a reduced cost of capital during a given period. Therefore, an IPO wave is expected during periods of economic expansion. Then, the capital demand hypothesis suggests that "hot-issue" market occurs during periods of economic expansion. Lowry (2003) recognizes the importance of the firm's capital demand[1] to explain the variation in IPO's volume. Buttimer, Hyland and Senders (2005) suggest that if it is the change in capital demand that leads to IPO (or seasoned equity offerings SEO) waves, we should not observe abnormal performance neither in the short-run or the long-run. By examining the three waves of REIT IPO market since 1980,

[1] Lowry (2003) uses the following capital demand proxies which should be positively correlated with business conditions: future growth in the Gross Domestic Product (GDP), future growth in investment, past and contemporaneous growth in new corporation, future sales growth and business cycle dummy equals one if the subsequent quarter is an NBER expansion and zero otherwise.

these authors show no evidence of high initial returns or long-run underperformance as usually documented in previous IPO research. These findings are consistent with the capital demand hypothesis to explain IPO waves.

1.1.2- Information asymmetry hypothesis

Information asymmetry consists in the information's disparity on firm value between the firm's managers (insiders) who hold firm’s private information and the market (outsiders) who hold more information about the stocks’ demand. This information asymmetry affects the IPO pricing and may lead to issuance clustering. The variation in investor's uncertainty with respect to the true value of the issue implies changes in the adverse selection costs and therefore the fluctuation of the IPO volume over time. As the information asymmetry varies over time, periods of higher adverse selection risk will be associated to large IPO discounts and reflect a lemon problem which affects negatively IPO pricing. As a consequence, firms avoid going public or postponing their IPO until the decrease of the issuing equity costs and the increase of the capital demand. However, periods of lower adverse selection risk is associated with low IPO discounts which lead to more IPO issuance. Then, firms optimally choose their IPO timing during periods of low information uncertainty in order to maximize the firm value and benefit from the high initial returns in the early aftermarket stage. Therefore, consistent with the information asymmetry hypothesis, Lowry (2003) show that IPO volume is negatively correlated with information asymmetry proxies. Lowry uses two measures of information asymmetry: (1) the first is the dispersion of abnormal returns around firm's earning announcements and (2) the second is the dispersion of analyst forecasts of public firms’ earnings. Battimer, Hyland and Senders (2004) consider that periods of high information asymmetry are associated with low IPO volume and periods of low information asymmetry are associated with high IPO volume. Moreover, the level of information asymmetry could be inferred from the information learned by the underwriter and the investors during IPO registration periods. Benveniste, Busaba and Wilhelm (2002) argue that information produced by recent new issues affect not only their decisions but also those of their rivals. The success or the failure of recent issuance constitutes new information which should be incorporated into the decision of firms that intend to go public. When the market receptivity is high, the information uncertainty falls and IPO waves occur. Therefore, IPO volume fluctuations may be partially linked to a learning process. Lowry and Schwert (2002) note that "IPO volume are driven by information learnt during the registration period. More positive information results in high initial returns and more companies filing IPOs soon thereafter (p.1171) ".

1.1.3- Investor's sentiment hypothesis

The investor's sentiment hypothesis suggests that the variation in the investor's optimism level affects the costs of going public and therefore IPO volume fluctuations over time. Some investors could be irrationally optimistic during specific periods and be willing to overvalue new issues. Then, the market demand increases and the costs of going public will be especially low, which stimulate firms to align their IPO timing with these periods of high investor's sentiment. As a consequence, increased IPO activity occurs. However, during periods of low investor's sentiment, investors may undervalue the issue, the market demand falls and the costs of going public increase, leading to low IPO volume. Chiu (2005) finds that the IPO offer price is positively affected by the investor's sentiment during the bookbuilding period. This author shows more (less) IPOs and high (low) proceeds when the predicted investor's sentiment is high (low). Then, both the IPO timing decision and the IPO pricing depend on the investor optimism level. Different proxies are used to measure investors' sentiment. Lee, Shleifer and Thaler (1991) suggest that closed-end funds and small stocks which are mostly held by individual investors are more likely than large stocks to be affected by investor sentiment. They find that when investor sentiment is high, demand for closed-end funds (CEF) shares increases and the discount is low. Lowry (2003) note that "the investor's sentiment hypothesis predicts that IPO volume will be negatively related to this discount (p.16) ". Lowry (2003) also uses post-IPO market returns as an alternative proxy for investor sentiment. Baker and Wurgler (2000) explain the negative correlation between the IPO volume and the future market returns by the fact that some firms decide to go public during market peaks to take advantage of the temporary overvaluation of the issue during these specific periods of high investors' sentiment. Parnanandan and Swaminathan (2004) find that the overvalued IPOs exhibit high initial returns and especially low subsequent returns over the next five years. Battimer et al. (2004) suggest that when IPO volume is driven by the investor's sentiment hypothesis, positive initial returns and negative abnormal long-run returns are expected for firms that go public in periods of high investor's sentiment.

1.1.4- Risk-matching hypothesis

The risk-matching hypothesis focuses on the issuing firm's risk characteristics on the first hand (Ritter, 1984) and the level of investor's risk tolerance on the other hand (Chiu, 2005).

Ritter (1984) shows a positive relationship between the issuing firm's risk level and the expected initial returns which is generally followed by high IPO volume. He uses two risk proxies: (1) the annual sales as ex-ante observable accounting information and (2) the standard deviation of returns in the aftermarket (20 days) as ex-post stock market returns. Ritter (1984) finds that a large fraction of risky firms issue their equity in "hot-issue" market. The author's results lead to two important implications: (1) riskier firms tend to have higher initial returns and (2) initial returns variability of high-risk issues is high.

Chiu (2005) focuses on the role of the investor's behavior toward the risk in the IPO process, its impact on the IPO volume and the underpricing level. He shows that "cold" IPO market is characterized either by low investor sentiment and high level of investor risk aversion, whereas, "hot" IPO market is characterized by high investor sentiment and low level of risk aversion. When investors are more risk averse, they only buy low-risk IPOs. Hence, it is not in the interest of risky firms to go public in periods of low level of investor's risk tolerance[2] since they could possibly not insure the full allocation of their equities. As a consequence, the majority of firms that issue equities in "cold-issue" periods are characterized by low risk. Risky firms[3] are constrained to undervalue their issues to stimulate the demand of high-risk averse investors in "cold-issue" periods. Therefore, risky firms should align their IPO timing with a low level of investor's risk aversion in order to minimize the underpricing of their issues and benefit from higher IPO valuation. Chiu's (2005) results suggest a positive effect of the investor's risk tolerance on either the number of high-risk IPOs and initial returns. These findings are consistent with Ritter (1984) who shows that riskier firms tend to go public in "hot-issue" market.

[2] Chiu (2005) uses the difference between current month equity fund flows and current bond fund flows as a risk tolerance proxy.
[3] Chiu (2005) defines the risky IPO as an issue with a standard deviation of stock returns above the median standard deviation of all stocks listed in the market after the IPO.

1.1.5- Industry-level dynamics hypothesis

The IPO literature documents that the IPO process is generally affected by the overall market dynamics (Pástor and Veronesi, 2005). Other authors investigate the impact of specific industry dynamics in the IPO's volume fluctuations. Helwege and Liange (2004) note that an innovation in an industry (or a sub-industry) leads to an increased in capital demand especially for that industry. As a consequence, IPOs clustering occurs within that industry but not for the overall market. This industry-level dynamics hypothesis is also supported by Rajan and Servaes (2002). They suggest that investors tend to overvalue stocks associated to specific industries at specific periods. They note that "investors may be overoptimistic about particular industries: oil and gas companies in the early 1980[4], computer and biotechnology companies in the late 1980, casino stocks in the early 1990s and technology and internet stocks in the late 1990s and early 2000 (p.13)". Rajan and Servaes (2002) use the market-to-book ratio relative to the industry at the IPO timing to proxy for the industry's sentiment. Chiu (2005) also examines sectors flows from utility, healthcare, technology, finance and natural resource industries. Theses authors find a positive impact of the industry's sentiment on IPO first-day closing prices. Moreover, Lowry (2003) investigates the importance of capital demand, information asymmetry and investors' sentiment at the industry-level. He shows that both capital demand and investors' sentiment associated with a specific industry significantly contribute to the explanation of IPO volume fluctuations. Lowry (2003) also recognizes the significant effect of the industry market-to-book ratio and the industry returns on the IPO volume. He concludes that "industry factors have a substantial effect on IPO volume incremental to market-wide dynamics (p. 26)".

1.2- Firm-specific risk and IPO market cycles

The first paper in this thesis "Firm-specific risk and IPO market cycles" examines the IPO cycle not only in terms of IPO initial returns and IPO volume as documented in the previous IPO literature, but also in terms of risk at the issuing firm-level as well as at the market-wide level.

[4] Ritter (1984) shows that the "hot-issue" market of 1980's is mainly associated with natural resource issues.

Given the literature with respect to the explanations of the "hot-issue" market phenomenon, our research emphasizes the role of risk by shedding a new light on which risk measure is involved in the determination of IPO cycles. While previous studies often use the volatility of IPO initial returns to measure risk, this paper distinguishes between two risk components at the firm level on the first hand and also consider the risk of the overall market on the second hand. We suggest that the decision to go public may depend not only on the issuing firm's conditions, but also on overall market conditions. As the IPO market is characterized by a high level of asymmetric information, we separate the shocks on the volatility in the individual IPO returns from its total volatility to be able to distinguish between : (1) risk at the issuing firm level which is derived from common market risk factors that are publicly disclosed for all market participants and (2) risk at the issuing firm level which is derived from specific risk factors of the firm that lead to the asymmetric information problem between insiders and outsiders. Then, we use two risk proxies at the issuing firm level: (1) the issuing firm's systematic risk which corresponds to the firm's sensitivity to extrinsic risk factors and (2) the issuing firm's idiosyncratic risk as a measure of information asymmetry associated to the intrinsic risk factors of the issuer. Moreover, we use the market implied volatility index (VIX) as a measure of risk at the market-wide level in order to investigate the role of information derived by the market on the IPO process in terms of IPO activity, short-run pricing and risk characteristics of the issuers.

Unlike previous studies, this paper focuses not only on the IPO volume predictability, but also on the IPO risk predictability. Hence, we contribute to the IPO literature by examining not only the IPO cycles but also its 'reversed' pattern with respect to different risk components in order to reveal which risk measure is involved in the IPO process. The main implication from our research is to better anticipate the "hot-issue" markets and risks of future new issues in order to help investors in their IPO investment decision, issuers in their optimal IPO timing, regulators in the improvement of the IPO environment.

2- Underpricing phenomenon

The IPO literature shows high IPO initial returns during the early aftermarket stage. Ritter and Welch (2002) recognize that Stoll and Curley (1970), Reilly (1973) and Ibbotson (1975) are the first to note "a systematic increase from the offer price to the first closing price (p.10)". In previous studies, the percentage difference between the closing market price on the first trading day and the IPO offer price is used to measure the IPO underpricing. Ljunqvist (2004) shows that U.S. underpricing ranges between 10 % and 20 %. Nevertheless, there are some periods when IPOs are overpriced and other when IPOs are excessively underpriced. The period between 1998 and 2000, which is characterized by the increased number of high tech issues, exhibits the highest level of IPO underpricing. This period is well-known as the "Internet Bubble". The magnitude of underpricing varies not only over time but also through countries. Ljunqvist (2004) shows that in the period between 1990 and 2003, Polish IPOs were the most underpriced among European IPOs and between 1990 and 2001, the underpricing level in Asia[5] was higher than in Latin America. Therefore IPO underpricing is considered an international phenomenon. The cross-country variation in the magnitude of IPO underpricing may be associated with the institutional differences between countries and the methods of pricing and allocating IPOs.

2.1- IPO underpricing explanations

Previous studies attribute different explanations for IPO underpricing which include the asymmetric information problem in the IPO market, the allocation of IPO shares, the institutional framework, firm governance and investor's behavior.

2.1.1- Asymmetric information theories

In the winner's curse model which is an application of Akerlof's (1970) lemons problem, Rock (1986) distinguishes between informed and uninformed investors. Informed investors only trade for underpriced IPOs, whereas the uninformed investors indiscriminately trade for underpriced and overpriced IPOs. The uninformed investors receive a full allocation of overpriced IPOs but only a partial allocation of underpriced IPOs because their demand is partly crowded out by the informed investors' demand. To avoid this adverse selection problem, Rock (1986) considers IPO underpricing as a compensation for uninformed investors to prevent IPO's allocation bias.

[5] The IPO underpricing reaches a maximum in China (256.9%) between 1990 and 2000.

Furthermore, Benveniste and Spindt (1989) and Benveniste and Wilhelm (1990) consider IPO underpricing as a compensation for informed investors to motivate them to reveal their favorable private information about the issue. In the pre-IPO stage, the bookbuilding process allows underwriters to gather information from informed investors in order to establish the final IPO offer price. During this stage, the underwriters propose a preliminary offer price range. Through a "road-show", some additional information with respect to the demand of stocks is exchanged between underwriters and institutional investors (generally, individual investors do not intervene in this IPO pre-market). During this pre-offer period, underwriters could revise IPO pricing depending on investors' demand. Benveniste and Spindt (1989) suggest that the informational externality requires an incentive in order to reveal the correct signal from institutional investors. These latter could not agree to show their interest to buy the IPO shares. They know that when they show their willingness to pay a high price, this results in a higher offer price. Hence, the IPO underpricing suggested by the underwriters aims to avoid the incorrect signal from informed investors. For this reason, IPO offer price does not incorporate the full information gathered from informed investors. IPOs shares will be priced below the expected value to lead informed investors to truthfully reveal their private signal. Hence, this "partial adjusted phenomenon" motivates informed investors to reveal their private information because they know that when they buy IPO shares at an offer price below its expected value, their wealth will increase in the aftermarket stage. The underpricing does not only generate more investors' demand in the pre-market stage but also more aftermarket trading. Ritter and Welch (2002) show that underpricing is usually higher when the IPO offer price is upwardly revised (above its initial price range)[6].

Moreover, Allen and Faulhaber (1989) consider IPO underpricing as a signal for high quality issuers. They suggest that only high-quality issuers are willing to deliberately sell their shares at a low offer price. However, low-quality issuers are not able to follow this underpricing strategy because they are uncertain to recover the underpricing cost in the future. Hence, high-quality issuers deliberately undervalue their offerings to distinguish themselves from the pool of low-quality issuers. Welch (1989) shows that underpricing is a strategy of successful firms which

[6] In the period between 1980 and 2001, the average underpricing is 53 % when the offer price is upwardly revised, 3 % when the offer price is downwardly revised and 12 % when the offer price is inside the initial price range.

are confident of their future perspectives. The loss or the opportunity cost due to the underpricing will be retrieved in the future issuing activity and especially during future equity issues (SEO). Ritter and Welch (2002) point out that issuing firms that intend to conduct future equity issues underprice their offerings to create "a taste in investor's mouths". These authors note that "the issuers can recoup their up-front sacrifice post-IPO, either in future issuing activity (Welch, 1989), favorable market responses to future dividend announcements (Allen and Faulhaber, 1989) or analyst coverage (Chemmanur, 1993) (p.11)"[7].

To reduce the problem of asymmetric information in the IPO market, the signaling hypothesis could be revealed not only through the underpricing strategy but also through the financial policy of the issuing firm. Smith and Watts (1992) note that risky firms with high growth potential tend to go to the stock market instead of the debt market. Then, market participants require a high risk premium to buy these risky issues. This drives issuers to undervalue their issues. Therefore, IPOs with low debt ratios exhibit the highest initial returns. Furthermore, some issuers use the signaling policy by the underwriter's quality. Titman and Truman (1986) note that high-quality firms choose prestigious underwriter's services when they decide to go public. Kim and al. (1993) and Michaely and Shaw (1994) show that the underpricing level decreases when the underwriter is more qualified and renowned.

Baron (1982) considers underpricing as an indispensable cost of going public because of the asymmetric information between the underwriter and the issuers. He notes that the IPO offer price depends on IPO uncertainty; increased uncertainty about the issuing firm leads to high IPO underpricing. Benveniste and Spindt (1989) find that the conflict between the underwriter's aim to allocate all IPOs' shares on the one hand and the issuing firm's wish to acquire maximum proceeds on the other hand, affects the type of the chosen underwriting contract. They argue that the request to control the choice of rules is relevant for the decision to use a firm-commitment or best-efforts underwriting contract. When managers are more risk averse, they adopt a firm-commitment contract. In this case, IPOs are more underpriced because the underwriters control the issue in order to sell all IPO shares. However, when the issuing firms are confronted by high

[7] Using a simultaneous equation model, Michaely and Shaw (1994) do not find support for the signaling hypothesis. They do not find a significant relationship between the underpricing and the increase in the seasoned offering on the one hand and in the dividend payment on the other hand.

price uncertainty, they adopt a best-effort underwriting contract that stipulates a minimum sales constraint. In this case, the underpricing is reduced but the proceeds are more uncertain. Mandelker and Raviv (1977) consider the IPO underpricing as a resultant of the underwriter's risk aversion. Nevertheless, Muscadelle and Vetsuypens (1989) show that the underpricing percentage is higher when the issuing firm establishes the IPO offer price without the underwriter's assistance (13.23% against 2.17%). Loughran and Ritter (2002) investigate the conflict of interest between underwriters and issuers through the discretion in the IPO shares' allocation. Underwriters may deliberately leave more money on the table than necessary, and then allocate IPO's shares to their favored buy-side clients. In this context, a part of IPO underpricing can be attributed to an agency cost.

2.1.2- IPO's allocation theories

The IPO underpricing can be explained by the perceived unfairness of IPO share allocations to institutional versus individual investors. Many empirical papers that examine IPO allocation focus on the distinction between institutional and individual (or retail) investors and suggest that the magnitude of IPO underpricing could depend on who purchases the IPO's shares. Using U.S. data, Aggarwal, Prabhala and Puri (2002) and Hanley and Wilhelm (1995) find that underpricing facilitates preferential allocation to institutional investors against individual investors[8] . However, Lee, Taylor and Walter (1996) do not support this finding using data from Singapore.

Furthermore, IPO underpricing can be explained by the presence of asymmetric information between issuers who do know the true value of their issue and underwriters who opportunistically behave to benefit from their knowledge of market conditions. The latter may deliberately leave more money on the table than necessary in order to make the allocation of IPO shares easier implying less marketing effort. They could discretionally allocate underpriced IPO shares to their favorite buy-side clients in return for quid pro quos.

[8] Cornelli and Goldreich (2001) find the same result for U.K. data.

2.1.3- Institutional explanations

The first institutional explanation of IPO underpricing is associated with the lawsuit avoidance hypothesis. Ljungqvist (2007) points out that after the security Act of 1933 which makes all the offer's participants liable for any material omissions, IPO underpricing in the U.S. market increases to reduce the frequency of future lawsuits. Tinic (1988) considers the deliberate underpricing as an implicit insurance premium against such securitiy litigation and allows issuers to reduce their legal liability to avoid subsequent lawsuits. However, Drake and Vetsuypens (1993) find no support this legal insurance hypothesis. These authors find that underpriced IPOs lead to more lawsuits than overpriced firms. Lowry and Shu (2002) also note that litigation risk has not a significant effect on IPO underpricing. Ritter and Welch (2002) and Kelohaju (1993) argue that the legal liability is not an important determinant of IPO underpricing.

The second institutional explanation of IPO underpricing is related to the overallotment option and price stabilization. The IPO aftermarket price is not only affected by the underwriters' pre-IPO decision on pricing and allocation but also by the stabilization activities in the early aftermarket stage. It is common for firms to include an overallotment option in their underwriting agreement. Since the first offering which contains this overallotment option was the offering of the Green Shoe manufacturing company (February 1963), the overallotment option is also called the "greenshoe" option. If public demand for the IPO shares exceeds expectation, the underwriters have the ability to exercise this greenshoe option which allows them to buy back up the extra 15 % of IPO shares in the aftermarket. If the IPO aftermarket price is above the offering price, the greenshoe option allows the underwriters to buy back the shares at the offering price to protect them from the loss. If the IPO aftermarket price is below the offering price, this leads investors to either sell the shares or abstain from buying more. To stabilize share prices, the underwriters exercise their greenshoe option and buy back the shares at the offering price in order to return them to the issuer. Zhang (2004) recognizes that the allocation of these extra shares boosts the aftermarket demand for the stock. Ritter (1998) notes that "stabilizing a stock is also referred to as supporting the stock (p.21) ". The price support could be considered as a put option written by the underwriter and held by the investors as an insurance against the price fall. Besides, the price stabilization practice allows the underwriters to buy back the IPO shares held by flippers who purchase shares in order to immediately sell them in the aftermarket to make a quick profit. To avoid the IPO price decline due to the selling pressure of these flippers, the underwriter exercise the overallotment option and buying back the extra shares allocated during the pre-IPO. Hence, the overallotment option allows for the flippers’ "artificial" demand incorporation. It is clear that price stabilization activities affect the demand and the supply schedules of IPO shares, as a consequence, IPO pricing and initial returns in the aftermarket. Ruud (1993) show that IPOs are priced at the expected market value but it is the price stabilization practice that leads to a positive price jump. This author argues that the positive mean of IPO's initial returns is conditional upon the underwriter intervention in the aftermarket. Asquith, Jones and Kieschrik (1998) note that Ruud's (1993) results are supported only if the stabilized issues exhibit a positive mean of initial returns because of the underwriter's price stabilization. However, these authors find that non-stabilized issues have positive average initial returns, while the stabilized issues have a zero mean initial return. This suggests that the price support is not the only factor that explains IPO underpricing.

The third institutional explanation of IPO underpricing is tied to the tax argument. Ljungqvist (2007) gives some examples to show that tax can explain IPO underpricing. He notes two arguments. The first is investigated by Rydqvist (1997) in the context of Swedish IPOs. Since capital gain tax rates are much lower than income tax rates in Sweden before 1990, managers have more incentives to pay employees by allocating assets such as underpriced stock at the IPO instead of salaries. But, this incentive to allocate underpriced stock to employees was removed in 1990 when underpricing-related gains became subject to income tax. Therefore, underpricing decreases from 41% in 1980-1989 to 8% in 1990-1994. The second argument is shown by Taranto (2003) in the context of U.S. tax laws which also lead to underpricing. Holders of managerial or employees stock option pay tax in two steps. First, an income tax on the difference between the "strike price" and the "fair market value" should be paid when the option is exercised. Second, a capital gain tax on the difference between the "fair market value" and the "sale price" should be paid when the underlying stock is sold. In the context of IPO, U.S. tax law considers the "offer price" as the "fair market value" for exercised options. Since capital gain tax rates are lower than the income tax rates, managers prefer the "offer price" to be as low as possible.

2.1.4- Ownership dispersion, control and liquidity

The issuers may deliberately undervalue their shares in order to generate excess demand which provides large number of small shareholders (outsiders). It is a way to protect managers (insiders) from dilution. Greater ownership dispersion allows managers to retain control and increase stock liquidity. Brennan and Franks (1997) argue that underpricing gives managers the opportunity to protect their private benefits by reducing the external monitoring of outsiders. Nevertheless, control preservation is not the only reason to promote greater dispersion. Booth and Chua (1996) note that more investor dispersion provides more aftermarket trading, which results in more liquid stocks in the secondary market.

Furthermore, Stoughton and Zechne (1998) argue that underpricing provides an incentive to allocate shares to a large outside investors who are able to monitor managerial actions. The protection of private benefits of insiders is not provided only from underpricing as in the Brennan and Franks (1997) mechanism. Issuing no-voting shares is considered another way to guarantee managers' control. Smart and Zatter (2003) find that U.S. firms that issue no-voting stocks are less underpriced, which is consistent with the fact that no-voting stocks is a substitute for IPO underpricing.

2.1.5- Behavioral explanations

The IPO literature documents some behavioral explanations for IPO underpricing. We report findings associated with investor sentiment, informational cascade and for the application of the prospect theory[9] to IPO market.

Some studies focus on the importance of sentiment to explain the IPO underpricing anomaly. Since IPO equities have no prior price history and issuing firms tend to be young, new issues are hard to value. It seems evident that investors will have different opinions about IPO market

[9] The prospect theory, developed by Kahneman and Tversky (1979), suggests that people are more interested in their wealth changes than their wealth level.

values and tend to be affected by sentiment in pricing IPOs. Empirical research (Chen, Hung and Wu, 2002 and Derrien, 2005) explain high IPO initial returns in the early aftermarket stage by the over optimism among some irrational investors who tend to overvalue the new issues in some specific period of high investors' sentiment. Derrien (2005) note that underwriters use two types of information in pricing IPO stocks: private information held by institutional investors and investor sentiment which depends on the market state. In bullish market, underwriters recognize that investors are willing to buy IPO shares at a price above their expected value. Therefore, the proposed offer price doesn't reflect only the intrinsic value of the issuing firm but also the favorable information gathered by overoptimistic investors. Hence, IPO offer price tend to be equal to the upper bound of the initial price range. However, in bearish market, individual investors' participation decreases either in the pre-IPO market or in the aftermarket. Then, underwriters content only with signals received from institutional investors and IPO price tend to be closer to the expected value of the issuing firm. We infer that IPOs could not be underpriced, but they could be priced above their expected value in bullish market. This market misevaluation is then explained by the noisy trading phenomenon due to the irrational behavior of some overoptimistic investors. De Long, Shleifer, Summer and Waldman (1990) point out that investors are classified into two groups: rational investors who make their decisions on the basis of rational strategies and noisy traders who make their decisions on the basis of sentiment. The noisy trading phenomenon is conducted by irrational behavior of some noisy traders. The mixture between rational and irrational trading results on the IPO aftermarket price. Following this assumption, the IPO market informational efficiency will not be supported. Hence, behavioral explanations might be more appropriate to explain IPO's anomalies either in the short or long-run.

Furthermore, Welch (1992) suggests that underwriters deliberately undervalue IPO shares to create informational cascades during the IPO process. Informational cascades are created when the late investors (followers) decide to buy IPO shares on the basis of the first potential investors' information and not on the basis of their own private information even when they possessed unfavorable information about the new issue. By underpricing IPOs, underwriters intend to create convergent behavior about IPO stocks. Facing similar decision problems, similar information, similar actions alternatives and similar payoffs, individuals make similar choices. The underwriters take advantage of this observational learning theory and undervalue IPOs to motivate the first potential investors to buy the newly issued stocks. The first problem associated with these informational cascades is the weakness of the correct information revelation. The late investors (followers) may own unfavorable information about the issue, but they would make their decision on the basis of their predecessors who have bought the IPO shares. They ignore their private information in spite of its accuracy and they mimic the actions of others who possess favorable information about the issuing firm. The second problem tied to these informational cascades is the decrease of investors' incentives to collect information about the firm that can be more accurate than information inferred by observing predecessors, but also more costly.

The third behavioral explanation is shown by Loughran and Ritter (2002) who apply the prospect theory to IPO market. These authors explain why issuers accept leaving money on the table in IPOs. Pre-issue stockholders should be upset because of their wealth dilution as a result of the IPO underpricing. Loughran and Ritter (2002) argue that issuers accept underpricing if they simultaneously learn about a higher aftermarket valuation than expected. Then, "Bad News" of lot of money left on the table will be associated with "Good News" that the offer price will be revised upwards. Hence, insiders of issuing firms consider not only the shares sold during the IPO at a low offer price, but also those they retain which benefit from a price jump during the early aftermarket stage. Then, based on prospect theory, issuers are more concerned with their wealth change than with immediate profits. They sum the wealth loss due to the offered shares at a low offer price with the large wealth gain on the retained shares due to the price jump after going public, therefore producing a positive wealth change for the pre-issue shareholders.

2.2- Issuing firm valuations pre- and post-IPO: which risk component matters?

The second paper "Issuing firm valuations pre- and post-IPO: which risk component matters?" focuses on the role of the issuing firm and IPO market risk characteristics during the IPO valuation process in the pre-offer and the early aftermarket stage. In the same spirit of the risk hypothesis developed by Ritter (1984)[10] to explain IPO underpricing, this research also focuses on the relationship between the level of uncertainty surrounding the new issue and its IPO valuation. Previous studies often use the first-day return as a common measure of IPO underpricing and the volatility of initial returns as a measure of IPO risk. Unlike previous research, this paper distinguish between pre- and post-IPO valuations and pre- and post-IPO risks.

For IPO valuations, we follow Purnanandam and Swaminahan (2004) and Zheng (2007) valuation methods based on the Price-to-Value ratio to proxy for the ex-ante IPO valuation. The IPO aftermarket prices during the first days of trading could not correspond to the intrinsic value of the firm (Purnanandam and Swaminahan, 2004). Hence, the Price-to-Value ratio method allow us to determine if the issuing firm is over or undervalued with respect to its comparable non-issuing firm and avoids market price bias. Next, we use initial returns on the first day of IPO trading for the post-IPO valuation.

We compute pre- and post-IPO risk measures to proxy for IPO ex-ante and ex-post uncertainty. The volatility of the issuing firm's initial returns during the first IPO trading month is used to compute individual total risk at the firm level which is our proxy for IPO ex-post uncertainty. The aggregate volatility of IPOs' initial returns in the month before the offering is used to measure aggregate total risk at the IPO market-level which is our proxy for IPO ex-ante uncertainty. We suggest that these pre- and post-IPO risk measures affect IPO valuation in pre- and post-IPO. Besides, we decompose the individual (aggregate) total risk on: (1) systematic component at the firm-level (at the IPO market-level) which corresponds to the issuing firm's (previous issues') sensitivity to common risk factors and (2) idiosyncratic component at the firm-level (at the IPO market-level) which is used as a proxy for information asymmetry in post (pre)-IPO. This risk decomposition allows us to reveal which risk component affects the pre- and post-IPO valuations.

[10] Ritter (1984) find that riskier IPOs are more underpriced than less-risky IPOs. Risky firms undervalue their issue to stimulate investors' demand and then avoid that investors refrain from buying their IPO's shares.

Unlike previous studies, our study focuses not only on IPO underpricing but also on the valuation of the issuing firm in the pre-offer stage in relation to risk and information asymmetry hypotheses. This paper contributes to the IPO literature by: (1) showing on which risk component the cross-sectional relationship between risk and IPO valuation depends, (2) investigating the relationship between the risk at the IPO market-level and the risk at the issuing firm-level and (3) revealing the risk component that allows the transfer of the uncertainty from pioneer IPOs to followers.

3- Long-run underperformance phenomenon

Previous studies such as Ritter (1991), Loughran and Ritter (1995), Brav, Geczy and Gompers (2000) and Ang, Gu and Hochberg (2007) show that IPOs exhibit underperformances in the long-run. These studies compare the returns of event firms after going public with the returns of firms without the event. Ritter (1991) notes that issuing firms underperform benchmark indices[11] as well as similar firms matched by industry or by size, book-to- market value or both size and book to market value during the three first years of seasoning.

While previous research supports that IPO underpricing is an international phenomenon, there is mixed evidence relative to IPO long-run underperformance. The majority of Anglo-Saxon studies support IPO long-run underperformance. Using a sample of 1526 U.S. IPOs during the period of 1975-1984, Ritter (1991) find that IPOs exhibit a negative performance of -29.1% during the first three years of IPO. However, European studies exhibit mixed findings. Results from Kelharjir (1993) show negative long-run returns of -21.1% for the IPO Finish market, whereas, Sentis (2001) notes a positive long-run performance of +29.3% for the French market. Hence, there is no consensus about the long-run IPO performance behavior, which have led to several authors studying this phenomenon since Ritter (1991).

[11] The CRSP value-weighted and NASDAQ indices.

3.1- Underperformance explanations

The IPO literature documents different potential explanations for IPO long-run underperformance. These reasons are mainly related to behavioral explanations and can be associated with both investor's and firm's standpoint. For investors, high IPO initial returns during the early aftermarket stage lead to "fads" in the long-run. Teoh, Welch and Wong (1998) suggest that a part of the long-run underperformance is due to the market over-optimism during the first days of offerings. For firms, issuers profit from the "window of opportunities" during the early aftermarket stage which is characterized by a low cost of capital as shown by Ritter (1991) and Loughran and Ritter (1995). The "fads" and "window of opportunities" hypotheses result in the temporary misevaluation of IPOs.

Furthermore, some authors attribute the long-run IPO underperformance to financial explanations. Teoh, Welch and Wong (1998) show that investors tend to revise IPO prices downwards when the issuing firms are unable to achieve the prospects of high revenues. These authors also note that the informational content of some financial events such as large accruals in the IPO year lead to a negative performance in the long-run. Besides, some authors use the agency cost theory to explain the low operational performance in post-IPO with respect to pre-IPO. For example, Jain and Kim (1994) argue that the decrease of the managerial stock shares due to the scattering of the firm property structure after the issuance explains the decrease of the manager's motivation to maximize the firm value, which leads to IPO underperformance in the long-run.

Other researchers note that long-run IPO performance behavior can be explained by the "IPO market timing". Loughran and Ritter (2000) show that issues in low-volume periods (cold-issue market) do not underperform in the long-run, whereas, issues in high-volume periods (hot-issue market) severely underperform in the long-run. Issuers profit from the "euphoria" created during the hot-issue markets. They benefit from the low capital cost during this period because investors are more willing to overprice IPO shares than during other periods. Therefore, Ritter (1998) assumes that "firms going public in high-volume periods are more likely to be overvalued than other IPOs (p.16)". Hence, several authors such as Loughran and Ritter (2000) show IPOs severe underperformance after high-volume periods. Loughran and Ritter (2000) note that "behavioral timing is not the cause of misevaluations; it is the response to them (p.364)".

Even though the behaviorists and the financial economists provide different explanations for the long-run IPO anomaly, some authors such as Gompers and Lerner (2003) note that IPO long-run performance considerably depends on the long-run return measurements. The absence of consensus for the long-run IPO performance may be attributed to the variety of methodologies used to gauge long-run abnormal returns. Therefore, from our point of view, the different methods used to compute abnormal returns may be the main source of the mixed findings about the long-run IPO performance behavior. Hence, how to measure long-run abnormal returns is an important issue in the IPO literature.

3.2- Long-run performance measures

Barber and Lyon (1997), Kothari and Warner (1997), Lyon et al. (1999), Loughran and Ritter (2000), Brav et al. (2000) show different approaches to measure abnormal performance, whereas, they do not conclude on the most appropriate one. Gompers and Lerner (2003) show that the mixed findings on IPO long-run performance may be attributed to the methodology used to compute long-run returns. Hence, it is interesting to focus on how to obtain an accurate measure of IPO long-run abnormal performance that considers the risk characteristics of issuing firms and the profile of the issue.

The IPO literature distinguishes between two approaches to measure long-run abnormal returns: (1) the event-time methodology and (2) the calendar-time portfolio methodology. The first method assesses long-run returns across individual stocks during the period following the offering. The second method computes long-run returns of IPOs' portfolio in calendar months.

The event-time approach includes the cumulative abnormal return (CAR) and buy-and-hold abnormal return (BHAR). The abnormal return $AR_{i,t}$ for firm i in event month t is defined as the difference between the raw return r_{it} of firm i and the expected benchmark return $E\left(R_{i,benchmark}\right)$ in the same event month t. The expected benchmark return is considered as the "normal" return the firm should have in the absence of the event. The abnormal return of the event firm i measures whether raw return deviate from their benchmark. Ritter (1991) computes the cumulative abnormal return from an event month q to an event month s as follows: $CAR_{q,s} = \sum_{t=q}^{s} \overline{AR_t}$, where $\overline{AR_t}$ is the average abnormal return of a portfolio of n stocks. The CAR's method implicitly assumes monthly portfolio rebalancing. Ritter (1991) reports CAR for 36 months after the offering date for 1526 IPOs during the period of 1975-1984. By using different benchmarks[12], Ritter (1991) notes a steady decline in the cumulative abnormal return. The matching firm-adjusted CAR decreases to -29.13% by the end of month 36. Brav et al. (2000) also point out a negative long-run IPO performance when using CAR for 60 months. The second event-time method (BHAR) is calculated by adjusting holding-period return of firm i on holding-period return of the benchmark return as follows: $BHAR_T = \sum_{i=1}^{n} x_{it}\left[\left[\prod_{t=1}^{T}(1+r_{it})-1\right]-\left[\prod_{t=1}^{T}\left(1+E\left(R_{benchmark,t}\right)\right)-1\right]\right]$, where the weight x_{it} is equal to $\frac{1}{n}$ for equally-weighted BHAR and $\frac{MV_{it}}{\sum_{i=1}^{n} MV_{it}}$ [13] for value-weighted BHAR. Brav et al. (2000) find a negative long-run IPO performance when they use both equally-weighted and value-weighted BHAR. An alternative measure of long-run performance which is known as the wealth relative (WR) measure is used by Ritter (1991) and computed as follows: $WR_T = \frac{\frac{1}{n}\sum_{i=1}^{n}\left[\prod_{t=1}^{T}(1+r_{it})-1\right]}{\frac{1}{n}\sum_{i=1}^{n}\left[\prod_{t=1}^{T}\left(1+E\left(R_{benchmark,t}\right)\right)-1\right]}$. If WR is above (below) one, IPOs outperform (underperform) the benchmark. Ritter (1991) finds an average holding-period return of 34.47% (61.86%) for IPOs (control sample matched by industry and market value) during the first three years of going public. A wealth relative (WR) below one leads Ritter (1991) to conclude that

[12] The benchmarks used by Ritter (1991) to measure abnormal returns are as follow: (1) CRSP value weighted NASDAQ-adjusted returns; (2) CRSP value weighted Amex-NYSE-adjusted returns; (3) matching firm-adjusted returns and (4) Small firm-adjusted returns.

[13] MV_{it} is the market value (MV) of the firm (i) in the event month (t).

IPOs underperform their matched firms in the long-run. Loughran and Ritter (1995) and Brav et al. (2000) find the same findings when they use WR measure.

Unlike event time methods which are based on a strategy of investing equal amounts in each offering, calendar-time methods are based on a strategy of investing equal amounts in IPOs during each month. Furthermore, this last method that allows us to aggregate returns on a single portfolio, offers the advantage of avoiding the problem of cross-sectional dependence in the CARs and the BHARs event-time methods. Lyon, Barber and Tsai (1999) consider two alternatives in the calendar-time portfolio methods. The first is based on the three-factor model of Fama and French (1993) and the second is based on the mean monthly calendar-time abnormal returns. For each calendar month, the returns on a portfolio composed of event firms (IPOs) are estimated following the model of Fama and French (1993) that considers the market, size and book-to-market risk factors. The market factor is measured as the difference between the market index and the risk-free rate. The size factor is measured as the return of a portfolio of small stocks minus the return of a portfolio of big stocks. The book-to-market factor is calculated as the return of a portfolio of firms with high book-to-market ratio minus the return of a portfolio of low book-to-market ratio. By analogy to the Jensen's alpha in the CAPM framework, the intercept α is interpreted as a measure of the average abnormal performance. The estimate of the intercept term in the Fama and French regression (1993) provides a test of the null hypothesis of zero mean monthly abnormal return in the calendar-time portfolio method. As regards the mean monthly calendar-time abnormal returns, we first compute the mean abnormal return of n stocks in calendar month t as the difference between raw returns r_{it} of firm (i) and the returns of a reference portfolio R_{pt}. Then, the mean monthly abnormal return ($MMAR_T$) for overall the period (T) is calculated as follow: $MMAR_T = \frac{1}{T}\sum_{t=1}^{T}\sum_{i=1}^{n} x_{it}\left(r_{it} - R_{pt}\right)$, where the weight x_{it} is equal to $\frac{1}{n}$ for equally-weighted abnormal returns and $\frac{MV_{it}}{\sum_{i=1}^{n} MV_{it}}$ for value-weighted abnormal returns.

Since a benchmark model is required to test for abnormal returns, Loughran and Ritter (2000) argue that researcher must choose between normative models such as the capital asset pricing model or empirically based models such as controlling for size and book-to-market. Based on previous research, different benchmarks have been used to calculate abnormal returns such as reference portfolios, control or "matched" firm. Recently, it is common to use the Fama-French three-factor model (1993) which is an extension of the CAPM. Fama and French (1993) consider that equity risk is not captured only by the market factor but also by the size and book-to-market factors. Hence, it is important to consider some specific risk characteristics of the issuing firms to be able to obtain more accurate measure of long-run abnormal performance.

3.3- How does risk affect IPOs versus non-IPOs' long-run performance?

The third paper "How does risk affect IPOs versus non-IPOs' long-run performance?" studies the long-run performance as well as systematic and idiosyncratic risks of IPOs and matched non-IPOs during the first three years of IPO trading. This paper offers a new explanation for the mixed findings in the long-run IPO underperformance literature by using a new perspective that distinguishes between risk components (systematic and idiosyncratic) when we compute long-run abnormal performance. We aim to reveal which risk component is involved in the IPO pricing during the first three-year of seasoning.

Since IPOs have no price history, issuing firms are characterized by higher level of asymmetric information than non-issuing firms. This fact results in higher degree of uncertainty around new issues, which complicates their pricing process. We suggest that firm risk pattern and its impact on equity pricing depends on the type of equity (IPOs or non-IPOs). Therefore, we revisit the methodology previously used to compute long-run returns by controlling for risk. In the first stage, we control for aggregate risk of firms through the calendar-time portfolio method including a new factor associated to the time-varying aggregate volatility in a modified Fama and French model (1993). Since the idiosyncratic volatility component vanishes in the variance of portfolio returns as a result of diversification, the aggregate volatility factor represents the portfolio systematic risk. Hence, in the second stage, we model individual instead of portfolio returns to control for idiosyncratic risk at the firm-level through the event-time method including a new factor associated with the time-varying idiosyncratic volatility in a modified Fama and French model (1993). The distinction between systematic and idiosyncratic risks helps to isolate the effect of asymmetric information due to specific risk factors of the issuer on the IPO pricing.

This paper focus on the firm's risk time pattern depending on the type of risk (idiosyncratic or systematic) on the first hand and the type of firm (IPOs or non-IPOs) on the second hand. We suggest that there is a relationship between the firm's risk time pattern and the process of equity pricing over time. Therefore, we check if investors are compensated for risk when they evaluate issuing firms versus non-issuing firms. Besides, we determine what type of risk (systematic or idiosyncratic) is priced for IPOs versus matched non-IPOs. Our new methodologies used to compute long-run abnormal returns allows us to : (1) check if risk-adjusted abnormal return is significantly different between issuing and matched non-issuing firms and (2) reveal what type of risk (systematic or idiosyncratic) affects the difference in long-run abnormal performance between IPOs and their matched non-issuing firms. In other words, we check if we find support for the previous literature showing that IPOs underperform their peers when we control for different type of risks in the long-run performance measurements.

We also investigate whether investors require compensation for systematic and idiosyncratic risk given some IPO characteristics relative to the pre-IPO valuation (overvalued versus undervalued IPOs), the risk level in the early aftermarket stage (high- versus low-idiosyncratic risk IPOs), the industry (technology versus no-technology firms) and the issuance period (hot, quiet and crisis periods). Hence, we check if risk-adjusted abnormal returns depend on the profile of the new issue or the period of its issuance.

This paper contributes to the IPO literature by focusing not only on the long-run performance but also on both firm's risk (systematic and idiosyncratic) patterns over the event time for IPOs and matched non-IPOs in order to recognize the difference between the two types of equities. Unlike previous research, the risk decomposition allows us to reveal what type of risk (systematic and idiosyncratic) is priced for the two types of equities (IPOs and matched non-IPOs). Moreover, this research provides some explanations to the mixed previous findings about the IPO long-run abnormal performance by controlling for risk (systematic or idiosyncratic) as well as some specific IPO characteristics in the abnormal return assessment for IPOs versus their matched peers.

Chapter II: Firm-specific risk and IPO market cycles

Abstract

This paper characterizes the role of risk in the initial public offering (IPO) cycle. While most of the previous literature uses the volatility of IPO initial returns to measure risk, we focus on different risk measures, namely, firm-level systematic and idiosyncratic volatilities and the market-wide implied volatility index (VIX) to assess their role in the IPO cycle. Our results shed new light on (1) which risk measure is important in the determination of IPO cycles, (2) the temporal pattern of each risk component across issuing firms and (3) the relationship between market-wide uncertainty and IPO risk. Our findings reveal a lead-lag relationship between IPO waves, VIX and the IPO systematic risk measure. We also highlight the fact that market-level uncertainty predicts IPO activity and the level of idiosyncratic risk of the next-period-issuing firms. Issuing firms' systematic risk can only be predicted by the systematic risk of firms now proceeding to their offering. The main implication resulting from our study is that one can better anticipate "hot-issue" markets, as well as the specific risk components of future new issues. This will help improve upon the regulatory environment, IPO investment decisions and IPO timing given market receptivity.

Keywords: Initial public offerings, Hot-issue market, IPO cycle, Idiosyncratic risk, Systematic risk, Implied volatility index

Résumé

Ce papier caractérise le rôle du risque dans le cycle des introductions en bourse (IPOs). Bien que la plupart des études précédentes utilisent la volatilité des rendements initiaux des IPO pour mesurer le risque, nous utilisons différentes mesures de risque, à savoir, la volatilité systématique et idiosyncratique au niveau de la firme ainsi que l'indice de la volatilité implicite du marché (VIX) pour évaluer leur rôle dans le cycle des IPOs. Nos résultats précisent (1) quelle composante du risque est importante dans la détermination du cycle des IPOs, (2) la structure temporelle de chaque composante du risque et (3) la relation entre l'incertitude au niveau de l'ensemble du marché et le risque des IPOs. Nos résultats révèlent une relation retardée entre les vagues d'IPOs, e VIX et la mesure systématique du risque des IPOs. Nous soulignons également le fait que l'incertitude au niveau du marché prédit l'activité des IPOs et le niveau du risque idiosyncratique des prochaines émissions. Le risque systématique des firmes émettrices ne peut être prédit que par le risque systématique des émissions précédentes. L'intérêt pratique de cette étude consiste à mieux anticiper les cycles d'émissions, ainsi que les risques spécifiques des futures émissions. Ce qui aidera à améliorer l'environnement réglementaire, les décisions d'investissement dans les titres d'IPOs et le choix du moment approprié pour s'introduire en bourse étant donné la réceptivité du marché.

Mots-clés: nouvelles introductions en bourse, période chaude d'émissions, cycle des IPOs, risque idiosyncratique, risque systématique, indice de volatilité implicite

1- Introduction

In the initial public offering (IPO) context, the "hot-issue" market documented by Ibbotson and Jaffe (1975) reveals that IPO activity is prone to cycles, showing that the number of new issues is linked to new issue returns in the current and previous months. Since then, a stream of research on this topic has been performed. For instance, Lowry and Schwert (2002) find a positive relationship between initial returns and subsequent IPO volume. They note that the information obtained during the registration period is a determinant of both IPO pricing and timing: more positive information induces higher initial returns and more firms going public soon thereafter. To provide an analytical framework for IPO waves, Pástor and Veronesi (2005, p. 1713) develop a model of optimal IPO timing in which IPO waves are caused by expected market return decline, expected aggregate profitability increase, or increases in prior uncertainty about the IPO average future profitability. Their empirical evidence supports these three channels for the presence of IPO waves.

Building on the concept of IPO uncertainty, Lowry, Officer and Schwert (2010) find that the "hot-issue" phenomenon is characterized by high initial returns and large IPO volume as well as high variability of initial returns. Using the standard deviation of IPO initial returns to proxy for the difficulty in pricing IPOs, they note that volatility changes over time with variations in the complexity of the pricing problem (p. 426). They also note that greater IPO pricing errors are expected when the IPO sample contains a larger fraction of highly uncertain firms. In the same spirit, Yung, Colak and Wang (2008) find a high level of cross-sectional variance in the long-run returns of issuing firms during a "hot-issue" market. They infer that the dispersion in quality is higher during waves, which leads to higher level of the asymmetric information problem (p. 206).

Given this literature, our research is motivated by whether the risk of issuers is important for the IPO cycle. Previous authors, such as Ritter (1984), show that new issues are characterized by a high degree of information asymmetry between various IPO market contributors (issuers, underwriters and investors) that affect IPO pricing and its level of accuracy. Compared to established firms, the uncertainty over the IPO value as well as the demand for the newly issued equities is greater because new issues have no stock market history. On the one hand, the issuer and its underwriter have more information about the future prospects of the firm than the potential investors in the market. On the other hand, investors hold information about the newly issued stocks' demand that is unknown to issuers (Rock, 1986). In the context of large market information asymmetry, we study whether measures of information asymmetry at the firm level are involved in the IPO cycle.

More recently, Campbell and Taksler (2003) use idiosyncratic volatility as a measure of information asymmetry between a firm and traders. Campbell, Lettau, Malkiel and Xu (2001) use the variance of shocks in firm returns as a proxy for firm idiosyncratic risk. Hence, it is interesting to separate the variance of shocks in the individual issuing firm returns from its total variance given the asymmetric information that characterizes the IPO market.

In previous literature, the authors also recognize the importance of systematic risk in IPOs. Pástor and Veronesi (2005) show that IPO timing is positively related to firm expected returns. They rely on Vuolteenaho (2002), who shows that expected return-news series are predominantly driven by systematic, market-wide components that are highly correlated across firms, while cash-flow information, which is considered firm-specific, can largely be diversified away in aggregate portfolios. Regarding the IPO cycle, Cederburg and O'Doherty (2015) show that many high-beta firms will enter the market when IPO activity is enhanced. Those authors note that firms whose values are more sensitive to market discount rates are incited to go public when the equity premium is low to benefit from high valuation.

Using IPO risk measures, we aim to reveal which risk component (idiosyncratic or systematic) is involved in the IPO cycle now redefined in terms of initial returns, IPO volume and issuing firm risk. To achieve this goal, the latter is decomposed into (1) systematic risk to proxy for common financial-accounting factors (which correspond to the firm's sensitivity to extrinsic risk factors) and (2) idiosyncratic risk to proxy for individual financial factors (which correspond to the intrinsic risk factors of the issuers)[14].

At the market level, Pástor and Veronesi (2005) find that the issuing firm's conditions, which affect its decision to go public, depend considerably on market conditions. Firms choose to go public in periods of overall favorable market conditions because they expect to benefit from high market valuation of their issued stocks during that period, inducing IPO waves. In the same vein, Lowry et al. (2010) note that IPO volume declines following stock market drops. It is well recognized that the market implied volatility index VIX is a proxy for market-wide uncertainty (Lowry et al., 2010). For example, Whaley (2008) finds that stock market price movements could be predicted by the VIX index used as "a barometer of investors' fear". He shows that the increase (decrease) in expected market volatility induces a drop (rise) in stock prices. Regarding the IPO market, as reported by Patel (2013), higher market volatility hurts IPOs because large market changes in valuation can make it difficult to set an IPO pricing range. Cai, Jiang and Lee (2013) show a negative relationship between market volatility and debt IPO activities. Therefore, it seems that the conditions for IPOs improve when market volatility goes down. These findings allow us to investigate the role of information derived by the VIX, used as a proxy of common behavioral risk factor, on the IPO activity.

In this context, we draw and validate empirically different testable hypotheses for an issuing firm in the IPO market. First, we test whether more firms choose to go public following periods of high IPO systematic risk. Second, we test whether systematic risk is correlated across issuing firms given the evidence presented in Vuolteenaho (2002) for non-IPO firms. Third, we stipulate that the expected returns of IPO candidates should decline in periods of high issuing firm idiosyncratic risk, which indicates a high level of information asymmetry. Firms characterized by high idiosyncratic risk will not be motivated to enter the market in periods of high information asymmetry because they are constrained to underprice their offer to compensate investors for the uncertainty surrounding their characteristics (Lowry et al., 2010). Thus, we

[14] Systematic risk is a proxy for aggregate movement in firm-level financial market movement (market returns) and accounting variables (size and book-to-market), and idiosyncratic risk is a proxy for firm-level idiosyncratic financial risks, including volatility, as defined in the risk type classification in Campbell, Hang and Heqing (2013).

stipulate that high-idiosyncratic-risk firms instead choose to enter the market in more favorable market-wide conditions. Furthermore, we suggest that more firms will enter the market following periods of low VIX index, which is associated with low market-wide uncertainty, to benefit from high investor sentiment and therefore high valuation of their issues. Aronson and Wolberg (2009, p. 7) note that VIX is an indirect sentiment indicator that infers the investors' expectations by analyzing market statistics that reflect investors' behavior.

Using a sample of 1001 U.S. IPOs during the period from January 2000 to December 2009 and based on VAR modeling, our results show that the lead-lag relationship between monthly initial returns and IPO activity previously documented by Lowry and Schwert (2002) is significant only for high-risk IPO portfolios. It appears that risky firms are incited to go public following "hot-issue" periods. Moreover, adding two new equations for issuing firm risk components and for the VIX index to the VAR model of Lowry and Schwert (2002), we find that IPO systematic risk is a predictor of IPO volume: when the systematic risk of previous issuing firms increases, the next-month IPO volume increases as well. Furthermore, market-wide uncertainty also plays an important role in predicting IPO volume: a high VIX index induces a significant decrease in the IPO volume of the subsequent month. Interestingly, we find that, unlike the idiosyncratic risk component, systematic risk is significantly correlated across issuing firms, meaning that only the systematic risk component of previous issues contains information to predict the level of systematic risk in subsequent issues, enhancing IPO cycles.

In addition to the IPO volume predictability, which is central to the IPO cycle, we study the "reversed" IPO cycle with respect to risk. Our findings show a lead-lag relationship, revealing that periods of high IPO activity are followed by periods of high IPO risk, mainly due to the idiosyncratic fraction.

Finally, in the context of this "reversed" IPO cycle, our findings complement those of Lowry et al. (2010), who find no clear evidence of a relationship between market-wide uncertainty and the volatility of IPO initial returns. When we decompose the IPO total risk into two components, we find that the idiosyncratic risk portion of the IPO is predictable by the VIX index, which proxies for market-wide uncertainty. Conversely, our results further reveal that information derived from the IPO market in terms of initial returns and issuing firms' risk helps predict the common behavioral risk factor (VIX).

2- Data and methodology

In this section, we first present IPO sample and data sources. Second, we describe how to measure each risk component at the firm level (systematic and idiosyncratic risk). Third, we provide the vector autoregressive (VAR) models used to study the impact of each risk component at the firm level as well as the market risk on the IPO cycle.

2.1- IPO sample and data sources

Our sample consists of 1001 ordinary shares from initial public offerings (codes 10 and 11) in the U.S. market between January 2000 and December 2009[15]. Because certain types of IPOs (i.e., units, closed-end funds, real estate investment trusts (REITs), American depositary receipts (ADRs) and shares of beneficial interest (SBIs)) have specific characteristics, we exclude them from our sample (Brown and Kapadia 2007).

For each IPO, we calculate the IPO daily (monthly) initial returns, DIR (MIR), as the percent difference between the closing price on the first (21st) day of trading and the offer price. Next, we assess the equally weighted (*EW*) and value-weighted (*VW*) average daily (monthly) initial returns for each month. The IPO offering prices are collected from Bloomberg. The IPO stock prices are collected from the Center for Research in Security Prices (CRSP) database. For each IPO, we estimate the IPO systematic and idiosyncratic risk components based on the Fama and French (1993) model during the first month of IPO trading. Daily Fama and French factors (market, size and book-to-market) are collected from French's website[16]. We compute the equally weighted (*EW*) and value-weighted (*VW*) average systematic and idiosyncratic risk

[15] The number of ordinary common share issues listed in Bloomberg during the period between 2000 and 2009 is 1440. However, only 1001 IPOs are available in the CRSP database.

[16] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

components for each month during the period of study. Finally, we use the VIX index to proxy for uncertainty at the market level. VIX quotations are collected from the Chicago Board of Option Exchange (CBOE) website[17].

2.2- IPO risk measures

Building upon previous studies that typically use the volatility of IPO initial returns as a risk proxy, our study expands our understanding of risk in the IPO cycle using different risk measures. First, we follow Campbell et al. (2001) and measure risk by the variance of stock excess returns relative to the risk-free rate during the first month of the offer. Thereafter, the issuing firm risk is decomposed into a systematic risk component associated with extrinsic factors and an idiosyncratic risk associated with firm intrinsic factors. Different approaches have been developed to quantify the systematic and idiosyncratic risk components. Firstly, we use the Capital Asset Pricing Model (CAPM)[18] as well as the three-factor model of Fama and French[19] to extract both risk components (systematic and idiosyncratic). Our risk measures are estimated with daily returns, which provide more information about the early aftermarket stage of the issuance period than monthly returns. However, the presence of non-synchronous trading may lead to biased estimates of betas[20] from the standard CAPM and three-factor models. We then follow Ritter and Welch (2002)[21] by including one-period-lagged risk factors in the CAPM $[(R_{m,j-1} - R_{f,j-1})]$ and in the Fama and French model $[(R_{m,j-1} - R_{f,j-1})$, SMB_{j-1} and $HML_{j-1}]$ to address this problem. Risk measures are calculated using individual firm returns instead of portfolio returns because the idiosyncratic risk component is neglected in the variance of portfolio returns[22].

[17] http://www.cboe.com

[18] Most studies such as Campbell et al. (2001) and Bali, Cakici, Yan and Zhang (2005) use the CAPM to assess systematic and idiosyncratic risks.

[19] Spiegel and Wang (2005) use the standard deviation of the residuals from the three-factor model of Fama and French (1993) to measure idiosyncratic risk.

[20] Brown and Warner (1985) note that shares trading infrequently have downwardly biased Beta estimates, while those trading frequently have upward biased beta estimates.

[21] Ritter and Welch (2002) find that systematic risk of new issues is higher when a significantly positive lagged beta is included (the sum of the betas is 1.73). These authors conclude that systematic risk may be underestimated when the lagged effect is ignored.

[22] See the theoretical framework of risk measures in the Appendix.

The total risk of an issuing firm i during event month τ, which corresponds in our paper to the first month of trading (τ=1), is decomposed into two components as follows:

$$\textit{Total Risk}_{i,\tau} = \textit{Systematic Risk}_{i,\tau} + \textit{Idiosyncratic Risk}_{i,\tau} \quad (1)$$

where $TOTRISK_{i,\tau} = VAR(R_{i,j} - R_{f,j})$ corresponds to the first-month total risk of IPO i (τ=1) computed throughout the first 21 trading days (j), $SV_{i,\tau}^{CAPM} = \beta_i^2 VAR(R_{m,j} - R_{f,j})$ is the first-month systematic risk of IPO i (τ=1) according to the standard CAPM and $IV_{i,\tau}^{CAPM} = VAR(\varepsilon_{i,j}^{CAPM})$ is the first-month idiosyncratic risk of IPO i (τ=1) according to the standard CAPM.

The following modified CAPM includes the one-period lagged market factor:

$$R_{i,j} - R_{f,j} = \alpha_i + \beta_i (R_{m,j} - R_{f,j}) + \beta_i' (R_{m,j-1} - R_{f,j-1}) + \varepsilon_{i,j}^{CAPM\,(lag)} \quad (2)$$

where ($R_{i,j} - R_{f,j}$) is the IPO excess return relative to the risk-free rate in day j, $(R_{m,j} - R_{f,j})$ is the market risk premium on day j and $(R_{m,j-1} - R_{f,j-1})$ is the lagged market factor, which corresponds to the market risk premium on day j-1.

According to this modified CAPM, the systematic and idiosyncratic risks are estimated as follows:

$$VAR(R_{i,j} - R_{f,j}) = \beta_i^2 VAR(R_{m,j} - R_{f,j}) + \beta_i'^2 VAR(R_{m,j-1} - R_{f,j-1})$$

$$+ 2\beta_i \beta_i' COV(R_{m,j} - R_{f,j}, R_{m,j-1} - R_{f,j-1}) + VAR(\varepsilon_{i,j}^{CAPM\,(lag)}) \quad (3)$$

where $SV_{i,\tau}^{CAPM(lag)} = VAR(R_{i,j} - R_{f,j}) - VAR(\varepsilon_{i,j}^{CAPM(lag)})$ is the first-month systematic risk of IPO i (τ=1) according to the modified CAPM(lag) and $IV_{i,\tau}^{CAPM(lag)} = VAR(\varepsilon_{i,j}^{CAPM(lag)})$ is the first-month idiosyncratic risk of IPO i (τ=1) according to the modified CAPM(lag).

Following the analysis of Spiegel and Wang (2005), we also use the three-factor model of Fama and French to distinguish between idiosyncratic risk (IV_i^{FF}) and systematic risk (SV_i^{FF}), which is approximated by market, size and book-to-market factors. Moreover, as shown in the following model, we include three one-period-lagged factors in the standard Fama and French model and estimate new measures of systematic and idiosyncratic risks ($SV_i^{FF(lag)}$ and $IV_i^{FF(lag)}$), taking into account the lagged-factor effect[23] (Ritter and Welch 2002):

$$R_{i,j} - R_{f,j} = \alpha_i + \beta_i (R_{m,j} - R_{f,j}) + \beta_i'(R_{m,j-1} - R_{f,j-1}) + s_i SMB_j + s_i' SMB_{j-1} + h_i HML_j + h_i' HML_{j-1} + \varepsilon_{i,j}^{FF(lag)} \quad (4)$$

where ($R_{i,j} - R_{f,j}$) is the IPO excess return relative to the risk-free rate on day j, ($R_{m,j} - R_{f,j}$) is the market risk premium in day j, SMB_j is the size factor measured by the return on a portfolio of small stocks minus the return on a portfolio of large stocks in day j and HML_j is the book-to-market factor measured by the return on a portfolio of high book-to-market stocks minus the return on a portfolio of low book-to-market stocks in day j. ($R_{m,j-1} - R_{f,j-1}$), SMB_{j-1} and HML_{j-1} are the lagged market, size and book-to-market factors, respectively.

The average first-month IPO total risk ($TOTRISK_t$), systematic risk (SV_t) and idiosyncratic risk (IV_t) in calendar month t are measured as follows:

$$TOTRISK_t = \sum_{i=1}^{n_t} \omega_{i,t-1} TOTRISK_{i,\tau}, \quad (5)$$

$$SV_t = \sum_{i=1}^{n_t} \omega_{i,t-1} SV_{i,\tau}, \quad (6)$$

[23] The measures of idiosyncratic and systematic risks based on the modified Fama and French (1993) models are very similar to those based on the Carhart (1997) model (correlations are greater than 90%). Because our conclusions are similar for all measures, we only report the results based on the modified Fama-French model.

$$IV_t = \sum_{i=1}^{n_t} \omega_{i,t-1} IV_{i,\tau}. \quad (7)$$

where $\omega_{i,t-1}$ corresponds to the weight of IPO i in calendar month t-1, $\omega_{i,t-1}$ equals $\frac{1}{n_t}$ for equally weighted measures and $\frac{MV_{i,j=1}}{\sum_{i=1}^{n_t} MV_{i,j=1}}$ for value-weighted measures, n_t is the number of IPOs in calendar month t and $MV_{i,j=1}$ is the market value on the first trading day (j=1) of IPO i. $TOTRISK_{i,\tau}$ corresponds to the first-month total risk of IPO i (τ=1) computed throughout the first 21 trading days (j). $SV_{i,\tau}$ and $IV_{i,\tau}$ are the first-month systematic and idiosyncratic risk, respectively, of IPO i (τ=1) measured using the standard or modified CAPM or Fama and French model.

2.3- Modeling the impact of risk on the IPO cycle

The following subsections present the methodology used to gauge the impact of risk on the IPO cycle. First, we highlight the importance of firm risk characteristics on the decision to go public. Next, we determine the impact of the different risk measures on the IPO cycle. We first use the issuing firm risk measures (systematic and idiosyncratic) to assess their role in the IPO cycle. Finally, we test the predictive power of market implied volatility on the IPO cycle.

2.3.1- Firm risk characteristics and IPO timing

Ritter (1984) reports high autocorrelation for the average monthly initial returns (0.62) and monthly IPO volume (0.88) and finds that periods of high initial returns are followed by periods of high IPO volume. Lowry and Schwert (2002) use the VAR model to evaluate the information content of new issues' initial returns to predict future IPO volume and vice versa. The authors' findings show a significantly positive relationship between initial returns and subsequent new issues but an insignificant relationship between future initial returns and IPO volume. Therefore, using the VAR model (M_1), we first evaluate the impact of IPO monthly initial returns on the subsequent number of new issues. Furthermore, Ritter (1984) finds that high-risk issuers tend to go public in periods of high initial returns. We investigate whether the impact of IPO monthly initial returns varies by issuing firm risk. Based on IPO initial return volatility during the first month of trading, we classify new issues in two groups (Chiu 2005): high-risk issues for which the initial return volatility is above the median and low-risk issues for which the initial return volatility is below the median. The following VAR models provide a first test of the impact of risk on the IPO cycle:

$$MMIR_t = \lambda_0 + \lambda_1 MMIR_{t-1} + \lambda_2 NIPO^*_{t-1} + \tilde{\mu}^1_t, \quad (8)$$

$$NIPO^*_t = \gamma_0 + \gamma_1 MMIR_{t-1} + \gamma_2 NIPO^*_{t-1} + \tilde{\mu}^2_t. \quad (9)$$

where $MMIR_t$ is the average monthly initial returns of new issues in month t and $NIPO^*_t$ is the number of IPOs in month t.

$$NIPO^*_t = \begin{cases} NIPO_t & [M_1] \\ or & \\ NIPO^{HR}_t & [M_2] \\ or & \\ NIPO^{LR}_t & [M_3] \end{cases}$$

First, we use the total number of IPOs in each month ($NIPO_t$) in model (M_1). Next, $NIPO_t$ is replaced by the number of high-risk IPOs ($NIPO^{HR}_t$) in model (M_2) and the number of low-risk IPOs ($NIPO^{LR}_t$) in model (M_3). The significance of the coefficient γ_1 in the VAR models (M_2 and M_3) reveals whether the risk profile (high or low) of the issuing firms is involved in the determination of the IPO cycle.

2.3.2- The role of risk on the IPO cycle

As discussed in the introduction, Lowry et al. (2010) show that a "hot-issue" market is characterized by not only high initial returns and high IPO activity but also high initial return variability. Therefore, we highlight the impact of risk on the IPO cycle in terms of both initial return and IPO volume. First, the issuing firm risk is decomposed into two components: the systematic risk (*SV*) and the idiosyncratic risk (*IV*). On one hand, in a rational market, a high level of issuing firm systematic risk will induce a high level of expected returns. As shown by Cederburg and O'Doherty (2015), more firms with high levels of systematic risk might enter the market, hoping to profit from higher valuation. On the other hand, a high level of issuing firm idiosyncratic risk could reflect high information asymmetry and consequently low expected returns for IPO candidates[24], discouraging them from entering the market. Hence, we stipulate that the risk impact on the IPO cycle depends on the type of issuing firm risk. Next, in addition to the role of the issuing firm risk components (systematic and idiosyncratic), we study the role of risk at the market level, which is approximated by the VIX index, in forecasting the IPO cycles redefined in terms of IPO volume, initial returns and issuing firm risk. Diavatopoulos, Doran and Peterson (2008) describe the implied volatility as "the market's assessment of future risk and is likely a superior measure to historical realized volatility". Schwert (2002), Pàstor and Veronesi (2005) and Pàstor, Taylor and Veronesi (2009) note the important role of market conditions on the IPO pricing process. Chiu's (2005) results underscore the effect of investor sentiment towards risk on both initial returns and the number of high-risk IPOs. Lowry (2003) focuses on the effect of investor sentiment on IPO volume as more firms go public when their issues are being overvalued during periods of high investor sentiment. In the same vein, Cai, Jiang and Lee (2013) show that investor sentiment also explain debt IPO waves. They use standard deviation of the value-weighted CRSP index return as a proxy for investor sentiment. Based on these studies and given Lowry and Schwert's (2002) VAR model, we add the issuing firm volatility components (*SV* and *IV*) as proxies for risk at the firm level as well as the VIX index as a proxy for common behavioral risk factors in the following VAR models (M_4, M_5 and M_6) to highlight the impact of different risk measures on the IPO cycles:

[24] Underwriters are constrained to underprice the newly issued stocks when information asymmetry is high to (1) compensate non-informed investors and avoid the allocation bias (Rock 1986), (2) incite informed investors to reveal their private information (Benveniste and Spindt 1989), (3) signal the firm quality (Allen and Faulhaber 1989) and (4) reduce the legal liability and avoid eventual legal prosecution (Tinic 1988).

$$MMIR_t = \alpha_0 + \alpha_1 MMIR_{t-1} + \alpha_2 RISK^*_{t-1} + \alpha_3 NIPO_{t-1} + \alpha_4 VIX_{t-1} + \tilde{\varepsilon}^1_t, \quad (10)$$

$$RISK^*_t = \beta_0 + \beta_1 MMIR_{t-1} + \beta_2 RISK^*_{t-1} + \beta_3 NIPO_{t-1} + \beta_4 VIX_{t-1} + \tilde{\varepsilon}^2_t, \quad (11)$$

$$NIPO_t = \eta_0 + \eta_1 MMIR_{t-1} + \eta_2 RISK^*_{t-1} + \eta_3 NIPO_{t-1} + \eta_4 VIX_{t-1} + \tilde{\varepsilon}^3_t, \quad (12)$$

$$VIX_t = \theta_0 + \theta_1 MMIR_{t-1} + \theta_2 RISK^*_{t-1} + \theta_3 NIPO_{t-1} + \theta_4 VIX_{t-1} + \tilde{\varepsilon}^4_t. \quad (13)$$

where VIX_t is the market implied volatility index in month t.

$$RISK^*_t = \begin{cases} TOTRISK_t & [M_4] \\ or & \\ SV_t & [M_5] \\ or & \\ IV_t & [M_6] \end{cases}$$

First, $RISK_t$ corresponds to $TOTRISK_t$ in model (*M4*), which is the average total risk of the issuing firm in month t, as defined in Equation (5). Next, total risk is replaced in model (*M5*) by SV_t, which is the average IPO systematic risk in month t, as defined in Equation (6). Finally, total risk is replaced in model (*M6*) by IV_t, which is the average IPO idiosyncratic risk in month t, as defined in Equation (7). The coefficients η_1, η_2 and η_4 measure the sensitivity of IPO volume to the previous IPO monthly initial returns, issuing firm risk (the total IPO risk, its systematic risk or its idiosyncratic risk) and implied volatility index, respectively. The coefficients α_4 and β_4 measure the sensitivity of the IPO monthly initial returns and the issuing firm risk (the total IPO risk, its systematic risk or its idiosyncratic risk), respectively, on the previous market implied volatility index (VIX_{t-1}), which corresponds to the expected market volatility for month t measured at the end of month t-1.

3- Descriptive statistics and IPO market cycles over time

3.1- Descriptive statistics

The descriptive statistics of IPO initial returns and risk measures are presented in Table II. 1. First, the equally (value-) weighted average of daily initial returns, *DIR*, for U.S. firms going public between 2000 and 2009 is 15.18% (19.86%), compared with 18.04% (22.90%) for the equally (value-) weighted average of the monthly initial return, *MIR*. Our results are consistent with those of previous studies. Loughran and Ritter (2004) find that the average daily initial returns of U.S. new issues are 18.7% for the period from 1980 to 2003. Lowry et al. (2010) show that the monthly average initial returns of U.S. new issues are 22% for the period from 1965 to 2005. Consistent with Ruud (1993), who shows that the first-day IPO price is affected by underwriter stabilization activities, Lowry et al. (2010) note that the proportion of the IPO sample with monthly initial returns equal to 0% is smaller than that with daily initial returns equal to 0% (4% compared with 12%). These authors also show that there are more negative monthly initial returns than negative daily initial returns. The daily initial returns are more strongly affected by the underwriter's stabilization practices, which can lead to the establishment of a first-day price equal to the offer price or slightly above it, especially for firms that go public during "cold-issue" periods. Consistent with these results, we find that the proportion of our IPO sample with initial returns equal to 0% is 6.14% for the daily frequency and only 1.62% for the monthly frequency. In addition, the percentage of negative initial returns is higher for *MIR* (30.03%) than *DIR* (18.33%). Hence, the stabilization activities appear to play an important role in the early aftermarket stage. We also find that the percentage of positive initial returns is higher for *DIR* (75.53%) than *MIR* (68.35%). The market overreaction is gradually diluted over time, especially for firms that go public during "hot-issue" periods. Hence, the IPO price on the 21st trading day is less strongly affected by market overreaction and underwriters' stabilization practices. Therefore, we suggest that it reflects the market value of newly issued stocks more fairly.

Table II. 1. Descriptive Statistics

This table shows the mean, standard deviation (STD), skewness, kurtosis, minimum and maximum of IPO volumes, VIX index, as well as the equally weighted (EW) and the value-weighted (VW) measures of IPO initial returns and IPO risk. Panel (1) corresponds to the equally weighted measures (EW) where the weight is $1/n_t$ for each IPO, and n_t is the number of IPOs in a calendar month t. Panel (2) corresponds to value-weighted measures (*VW*) where the weight is $MV_{i,j=1} \Big/ \sum_{i=1}^{n_t} MV_{i,j=1}$ for each IPO ($MV_{i,j=1}$ is the market value of the IPO_i in the first transaction day (j=1) and n_t is the number of IPOs in a calendar month t). NIPO is the number of IPOs per month from 2000 to 2009. DIR is the IPO initial return of the first transaction day and is calculated by the percentage difference between the closing price on the first day of trading and the offer price. MIR corresponds to the percentage difference between the closing price on the 21st day of trading and the offer price. We calculate the average equally weighted (EW) and value-weighted (VW) daily (MDIR) and monthly initial returns (MMIR) in each month for the period 2000 to 2009. The IPO offering prices were collected from the Bloomberg database. IPO stock prices were collected from the CRSP database. TOTRISK represents the total risk of the issuing firm which is estimated by the variance of the excess return on the stock relative to the risk-free return during the first month of the offer. The EW (VW) average TOTRISK is specified in Equation (5). The total risk is split into two components: the systematic risk (SV), which is related to common market factors, and the idiosyncratic risk (IV), which is associated with specific firm factors. The two risk components (systematic and idiosyncratic) are calculated using the standard CAPM, the modified CAPM including lagged market return [$(R_{m,\,j-1} - R_{f,\,j-1})$], the standard three-factor model of Fama and French and the modified model of Fama and French including the lagged three factors [$(R_{m,\,j-1} - R_{f,\,j-1})$, SMB_{j-1} and HML_{j-1}]. The two components of risk (systematic risk and idiosyncratic risk) are estimated for each IPO in the first month of IPO trading. The idiosyncratic risk corresponds to the variance of the residual term from the model used to quantify this risk. The systematic risk corresponds to the difference between the total risk and the idiosyncratic risk. The average monthly systematic and idiosyncratic risk components are specified in Equations (6) and (7), respectively. VIX is the market implied volatility index per month from 2000 to 2009. The market implied volatility index VIX was created by the Chicago Board of Option Exchange (CBOE) in 1993 to measure the expected market volatility for the next month. The VIX is estimated by the average of the group NTM "nearest-to-the-money" implied volatilities of eight options (four calls and four puts) on the market index S&P 500. The VIX index quotations were collected from the CBOE website.

	PANEL (1) : Equally weighted measures (EW)						***PANEL (2) : Value-weighted measures (VW)***					
Variables	**Mean**	**STD**	**Skewness**	**Kurtosis**	**MIN**	**MAX**	**Mean**	**STD**	**Skewness**	**Kurtosis**	**MIN**	**MAX**
IPO activity												
NIPO	9.2778	7.5105	1.2709	1.8378	1	38	-	-	-	-	-	-
IPO initial returns measures												
MDIR %	15.1848	13.4847	1.5914	5.1266	-19.9200	75.0695	19.8612	22.1132	3.1639	14.7924	-19.9200	146.9918
MMIR %	18.0481	22.1108	1.9663	6.6174	-22.3882	128.0441	22.9005	29.2479	2.1383	6.7194	-26.0894	165.1981
IPO risk measures (1st month of the offer)												
Total Risk												
TOTRISK $\times 10^4$	20.2141	28.5992	3.6157	15.6268	0.3469	192.6073	18.5951	24.5223	3.0059	10.3027	1.1918	150.0085
Systematic risk												
$SV_{CAPM} \times 10^4$	1.8594	3.6748	5.8874	42.2263	0.0011	31.4439	1.6594	2.6941	3.6569	15.5116	0.0003	17.4088
$SV_{CAPMlag} \times 10^4$	2.9576	5.1240	4.8159	27.8460	0.0079	38.3788	2.7544	4.3124	3.5171	13.5313	0.0672	25.0007
$SV_{FF} \times 10^4$	4.2013	7.1454	4.5010	24.3396	0.0593	52.3713	3.7698	5.7655	3.7796	16.9729	0.0510	38.4333
$SV_{FFlag} \times 10^4$	7.0776	10.8720	3.8202	16.2987	0.0743	68.2387	6.3174	8.7306	3.1210	10.7508	0.1876	52.5067
Idiosyncratic risk												
$IV_{CAPM} \times 10^4$	18.3547	26.0040	3.7715	17.9596	0.3458	186.5569	16.9357	22.6215	3.0654	10.7501	1.1915	139.0064
$IV_{CAPMlag} \times 10^4$	17.2565	24.8401	4.0320	21.0674	0.3390	185.7874	15.8407	21.0359	3.0338	10.3666	1.1246	125.0075
$IV_{FF} \times 10^4$	16.0128	22.7886	4.0712	21.7891	0.2877	172.6011	14.8253	19.6448	2.9358	9.3224	1.1408	111.5751
$IV_{FFlag} \times 10^4$	13.1365	18.4240	3.7298	17.8198	0.2727	132.7181	12.2777	16.3726	2.9502	9.6741	1.0042	97.5014
Market implied volatility												
VIX	20.7314	8.0438	1.3943	3.1008	10.4200	55.2800	-	-	-	-	-	-

Table II. 1 shows that value-weighted measures of initial returns that allocate more weight to large firms are higher. Large firms tend to leave more money on the table than small firms. Sohail and Raheman (2009) show a positive and significant relationship between market capitalization and IPO initial returns. This finding supports the signaling hypothesis of Welch (1989), who finds that large firms signal their value through increased underpricing. Welch (1989) notes that IPO underpricing is a strategy for high-quality firms that are confident about their future prospects and believe they will subsequently recover the underpricing costs in the context of future seasoned equity offerings (SEO).

Table II. 1 also shows a fairly high variability of IPO initial returns. The skewness and kurtosis coefficients for both daily and monthly initial returns show asymmetric distributions and a higher frequency of positive outliers than in the normal distribution.

Based on Table II. 1, we note that all issuing firm risk components (total risk, systematic risk and idiosyncratic risk) are lower for the value-weighted measures than for the equally weighted measures. In addition, Table II. 1 shows that idiosyncratic risk represents the largest proportion of the IPO total risk. Our descriptive statistics show that according to the standard CAPM, the idiosyncratic risk is approximately 91% of the IPO total risk. However, we underscore the sensitivity of systematic and idiosyncratic risk to the model used to quantify these measures. In this context, the relative idiosyncratic risk decreases by approximately 85% when considering the lagged effect of the market return. This finding reveals that systematic risk is underestimated when the lagged effect is ignored. In addition, we find that the average sum of the betas equals 1.15 for our IPO sample from January 2000 to December 2009. Our findings complement those of Ritter and Welch (2002), who note that "this accords with the common sense notion that IPOs tend to be risky stocks". Using the CAPM and the industry-factor models, Campbell et al. (2001) find that the relative idiosyncratic risk on the U.S. securities market is between 90% and 95% of the total risk for the period from 1962 to 1997. Goyal and Santa-Clara (2003) assume that equity returns depend on a common market factor and an error related to specific risk factors for each firm. These authors use the total variance of equity returns as a proxy for idiosyncratic risk, which constitutes approximately 90% of the total risk for the period from 1962 to 2000. Ferreira and Laux (2007) show that the relative idiosyncratic risk constitutes 85.4% of the U.S. equity total risk for the 1990-2001 period. Therefore, given that both risk components (systematic risk and idiosyncratic risk) depend on the model used to quantify risk and the period of study, we quantify both components of IPO risk according to different models to separately analyze their variations over time as well as their impacts on the IPO cycle.

Table II. 2. Partial autocorrelations

This table reports the Q-statistic with 95 % confidence intervals calculated using a standard error of $\frac{1}{\sqrt{n}}$ (n is the number of observations in the series). Lags (#) specifies the number of autocorrelations to calculate. EW- (VW-) MMIR is the equally (value-) weighted average monthly initial returns from 2000 to 2009. IPO monthly initial returns correspond to the percentage difference between the closing price on the 21st day of trading and the offer price. The weight is equal to 1/ n_t for each IPO (where n_t is the number of IPOs in a calendar month t) for equally weighted (EW) measures and $MV_{i,j=1} \Big/ \sum_{i=1}^{n_t} MV_{i,j=1}$ for each IPO for value-weighted (VW) measures ($MV_{i,j=1}$ is the market value of the IPO i on the first trading day). IPO offering prices were collected from Bloomberg. IPO stock prices were collected from the CRSP. TOTRISK represents the total risk of the issuing firm which is estimated by the variance of excess returns relative to the risk-free return during the first month of the offer. EW (VW) TOTRISK is the equally (value-) weighted average total risk as specified in Equation (5) multiplied by 10^4. Both risk components (systematic and idiosyncratic) are calculated based on the modified model of Fama and French including the three lagged factors [($R_{m, j-1} – R_{f, j-1}$), SMB_{j-1} and HML_{j-1}]. Both risk components are estimated in the first month of IPO trading. EW (VW) SV_{FFlag} and EW (VW) IV_{FFlag} are, respectively, the equally (value-) weighted average systematic and idiosyncratic risk components as specified in Equations (6) and (7) multiplied by 10^4. $NIPO_t$ is the number of IPOs in month t. We classify new issues into two groups: (1) high-risk issues for which the initial return volatility during the first month of trading is above the median and (2) low-risk issues for which the initial return volatility during the first month of trading is below the median. $NIPO_t^{HR}$ is the number of high-risk IPOs in month t. $NIPO_t^{LR}$ is the number of low-risk IPOs in month t. VIX is the market implied volatility index. The VIX index was created by the "*Chicago Board of Option Exchange:* CBOE" in 1993 to measure the expected market volatility over the following thirty days. VIX corresponds to the average implied volatilities of eight NTM options "nearest-to-the-money" (four calls and four puts on the market index S&P 500). VIX index quotations were collected from the CBOE website.

Variables \ Correlations	Lags				
	1	2	3	4	5
EW-MMIR	0.2966***	0.0451	0.1092	-0.0167	-0.1342
VW-MMIR	0.3624***	-0.0359	0.2203	-0.0686	-0.0267
EW-TOTRISK	0.4852***	0.2264***	0.1199	-0.1040	0.1041
VW-TOTRISK	0.6231***	0.1600	0.2341***	-0.1606	0.0463
EW- SV_{FFlag}	0.5946***	0.1520	0.0402	-0.0892	0.0613
VW- SV_{FFlag}	0.6716***	0.0955	0.1102	-0.1665	0.1533
EW- IV_{FFlag}	0.4009***	0.2281***	0.1657	-0.0815	0.1068
VW- IV_{FFlag}	0.5579***	0.1550	0.3286***	-0.1005	-0.0051
NIPO	0.5387***	0.0591	0.0803	0.1703	0.0846
$NIPO^{HR}$	0.6468***	-0.0561	0.1886	0.1055	0.0613
$NIPO^{LR}$	0.4875***	0.2357***	0.2106	0.0515	0.1769
VIX	0.8633***	-0.1491	0.1014	-0.0130	0.0964

*** indicates p-value of 1 %.

Table II. 2 reports partial autocorrelations for the variables used in our model to determine the adequate order for the VAR. Our results clearly show that the Q-statistics are significant at the 1% level for the first lag of all of the variables, which supports the choice of the first order for our VAR models. Consistent with the previous findings of Ibbotson and Jaffe (1975) and Lowry and Schwert (2002), both the number of IPOs and the average initial returns are autocorrelated. Our findings also support Campbell et al. (2001), who note that volatility measures are autocorrelated.

3.2- Evidence on the IPO cycle

Figure II. 1 (a) shows the temporal behavior of the IPO initial returns and issuing firms' total risk during the first month of trading and the number of IPOs each month. First, we find that periods of high initial returns[25] are followed by periods of high IPO activity[26]. This finding confirms those of Ritter (1984) and Lowry and Schwert (2002, 2004) regarding "hot-issue" markets, which are characterized by a large number of IPOs and high initial returns. Second, we note that the high IPO volume observed during the IPO bubble generates a high level of issuing firm risk, which continued to be slightly high even after a few months of the IPO boom[27]. Lowry et al. (2010) note that the dispersion of IPO initial returns reveals underwriters' difficulties with evaluating IPOs. Our evidence supports Lowry et al. (2010), who show that these difficulties are accentuated in "hot-issue" markets. We also agree with Lowry et al. (2010), who show that "hot-issue" markets are characterized by not only a large number of IPOs and high initial returns but also high initial return variability. We add that a high level of issuing firm's risk is observed during not only the "hot-issue" market but also a few months after this period which leads us to suspect an eventual lead-lag relationship between IPO volume and IPO risk. Moreover, we note that the risk level of the issuing firms is also high during the crisis, although less pronounced

[25] The mean of value-weighted monthly initial returns is 79.62% for the end of the IPO bubble period in 2000 against 17.09% for the IPO quiet period from 2001 to 2006 and 20.74% for the period of economic crisis from 2007 to 2009. The IPO initial return difference between the end of the IPO bubble period (the period of economic crisis) and the IPO quiet period is statistically significant at the 1% level (insignificant).

[26] The average monthly IPO volume is 23.75 at the end of the IPO bubble period in 2000 against 8.91 for the IPO quiet period from 2001 to 2006 and 6.44 for the period of economic crisis from 2007 to 2009. IPO volume difference between the end of IPO bubble period (the period of economic crisis) and the IPO quiet period is statistically significant (insignificant) at the 1% level.

[27] Our findings are robust to the weighting method.

than at the end of the IPO bubble period[28]. When we report the time variation of the two risk components of the issuing firm (systematic and idiosyncratic) throughout the period of study in Figure II. 1 (b), we find that high IPO activity during the IPO boom is followed by a high level of IPO idiosyncratic risk. The systematic risk component tends to be more stable than the idiosyncratic one over time, with the exception of the systematic risk measure estimated using the Fama and French model including lagged factors. We infer that this high IPO risk in some specific subperiods is due mainly to the increased idiosyncratic risk component of issuing firms, as shown in Figure II. 1 (b)[29]. This finding leads us to redefine IPO cycles in terms of not only IPO volume and initial returns, as documented in the prior literature (Ibbotson and Jaffe 1975, Ibbotson, Sindelar and Ritter 1988, 1994, Lowry 2003 and Lowry and Schwert 2002, 2004) but also in term of issuing firm-level risk.

Figure II. 2 presents the temporal variation in the VIX index between 2000 and 2009 associated with the number of IPOs (Figure II. 2 (a)), the IPO monthly initial returns (Figure II. 2 (b)), the issuing firm total risk (Figure II. 2 (c)) and the issuing firm systematic and idiosyncratic risk components (Figure II. 2 (d)). First, we note an inverse relationship between VIX and the number of IPOs as well as the IPO monthly initial returns: high (low) implied volatility tends to be followed by low (high) IPO activity and initial returns. In Figure II. 2 (a), we clearly note a decrease in the number of new issues after a high level of the VIX index. This pattern provides evidence that market implied volatility could predict IPO volume. Second, Figures II (c) and (d) show high levels of the VIX index and of the issuing firm risk, especially its idiosyncratic portion, during the end of the IPO bubble. However, unlike the issuing firm-level risk, market-wide uncertainty remained high long after the IPO boom. This finding is consistent with Figure 6 in Lowry et al. (2010). Nevertheless, as our sample period extends to the end of 2009, we observe a high level of the issuing firm risk, especially its idiosyncratic fraction, with an increase in the VIX index during the economic crisis period from 2007 to 2009. This latter co-movement may provide preliminary evidence of a relationship between market-wide uncertainty and issuing firm-level risk, especially its idiosyncratic fraction.

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[28] The average value-weighted monthly issuing firm volatility is 0.80% at the end of the IPO bubble period in 2000 against 0.11% for the IPO quiet period from 2001 to 2006 and 0.18% for the period of economic crisis from 2007 to 2009. The IPO volatility difference between the end of the IPO bubble period (the period of economic crisis) and the IPO quiet period is statistically significant at 1% level (insignificant).

[29] The difference in the average value-weighted IPO risk components between the end of the IPO bubble and the IPO quiet periods is statistically significant and correspond to 0.26% for systematic risk and 0.43% for idiosyncratic risk.

Figure II. 1. IPO initial returns, issuing firm's risk components and number of issues per month for the period 2000-2009

This figure plots patterns of IPO initial returns, issuing firm's risk components and the number of issues over time during the period 2000-2009. VW-MDIR (MMIR) is the average value-weighted daily (monthly) initial returns per month. Daily initial returns are measured as the percentage difference between the closing price of the first transaction day and the offer price. Monthly initial returns are measured as the percentage difference between the closing price of the twenty-first day of trading and the offer price. IPO offering prices were collected from Bloomberg, and IPO stock prices were collected from CRSP. NIPO is the number of IPOs per month. VW-TOTRISK in (a) is the average value-weighted issuing firm's total risk per month. Total risk is approximated by the variance of excess IPO returns relative to the risk-free rate during the first month of IPO trading. VW-SV(FFlag) (VW-IV(FFlag)) in (b) is the average value-weighted issuing firm's systematic (idiosyncratic) risk per month. Both risk components [systematic (SV) and idiosyncratic (IV)] are calculated based on the modified model of Fama and French including the lagged three factors [($R_{m, j-1} - R_{f, j-1}$), SMB_{j-1} and HML_{j-1}]. Bars represent the total number of IPOs in each month.

(a) (b)

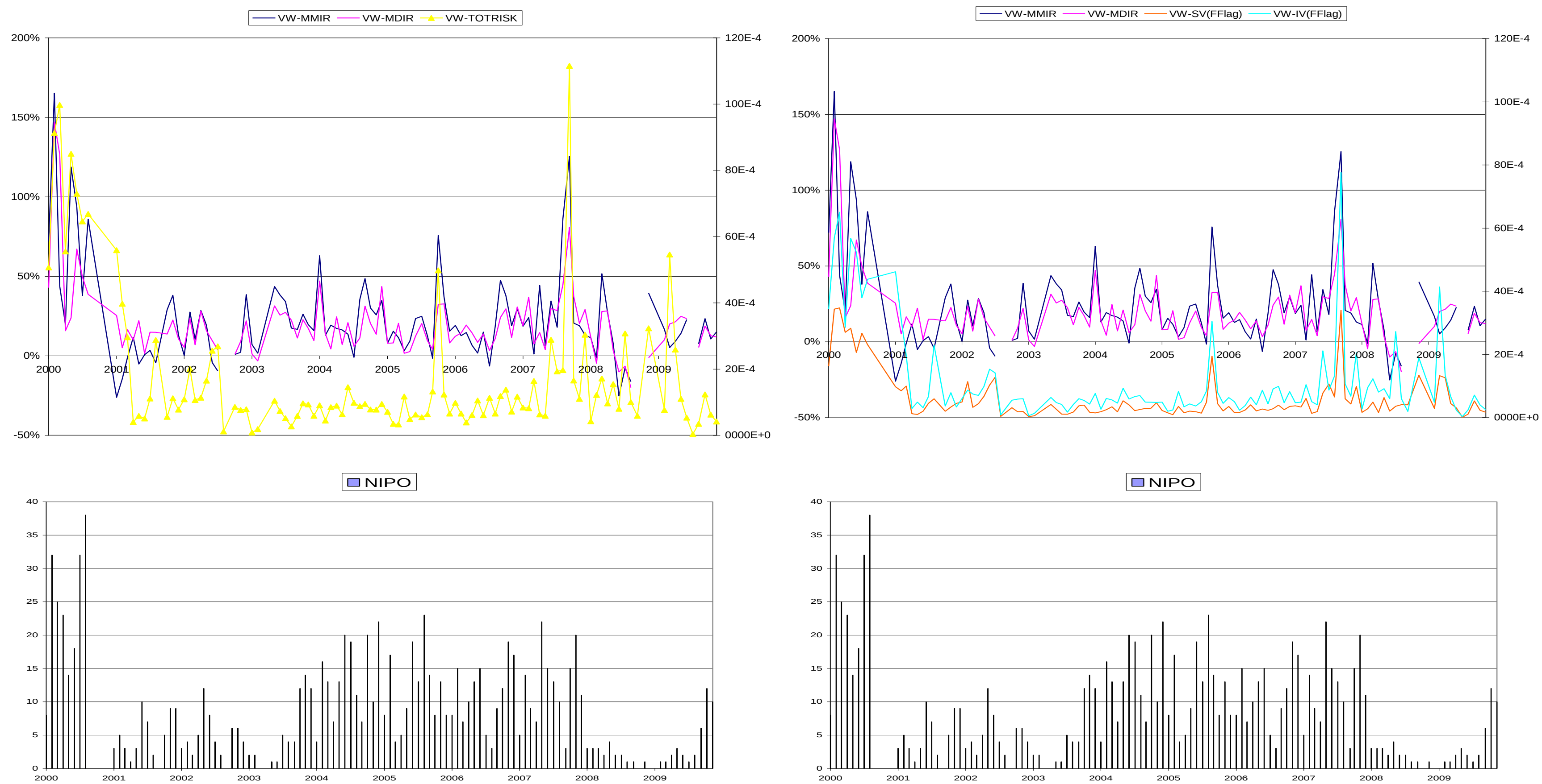
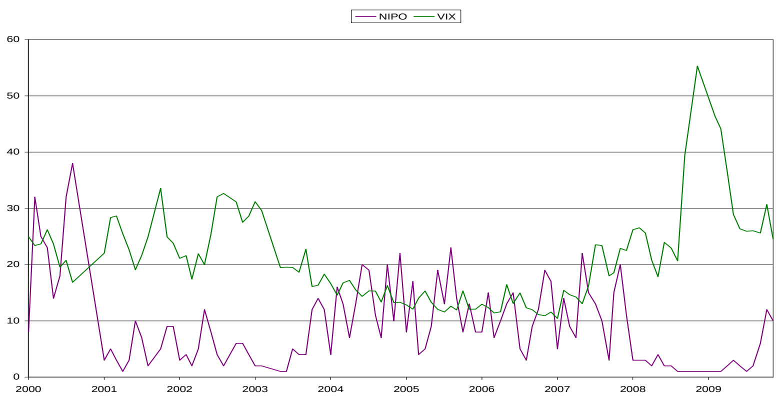


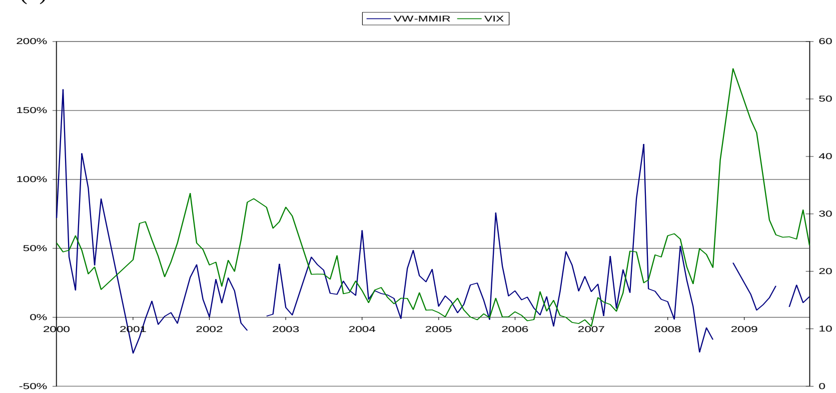
Figure II. 2. Implied volatility index VIX and IPO cycles in terms of number of IPOs, initial returns and issuing firm's risk per month for the period 2000-2009

This figure plots patterns of implied volatility index VIX and IPO market variables (number of IPOs, IPO initial returns and issuing firm's risk) over time for the period 2000-2009. VIX corresponds to the average implied volatilities of eight options NTM "nearest-to-the-money" (four calls and four puts on the market index S&P 500). The VIX index quotation is collected from the Chicago Board of Option Exchange (CBOE) website. NIPO is the number of IPOs per month**.** EW (VW)-MMIR is the average equally (value)-weighted monthly initial returns per month. The monthly initial returns are measured as the percentage difference between the closing price of the twenty-first day of IPO trading and the offer price. IPO offering prices were collected from Bloomberg. IPO stock prices were collected from CRSP. VW-TOTRISK is the average value-weighted issuing firm's total risk per month. Total risk is approximated by the variance of excess IPO returns relative to the risk-free rate during the first month of trading. VW-SV(FFlag) (VW-IV(FFlag)) is the average value-weighted issuing firm's systematic (idiosyncratic) risk per month. Both risk components [systematic (SV) and idiosyncratic (IV)] are calculated based on the modified model of Fama and French including the lagged three factors [$(R_{m,\, j-1} - R_{f,\, j-1})$, SMB_{j-1} and HML_{j-1}].

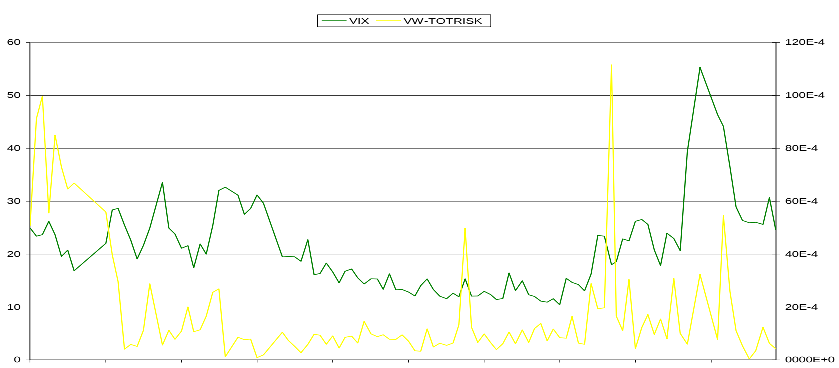
(a) Variations in the VIX index and IPO activity over time



(b) Variations in the VIX index and IPO initial returns over time



(c) Variations in the VIX index and IPO total risk over time



(d) Variations in the VIX index and IPO systematic vs. idiosyncratic risks over time

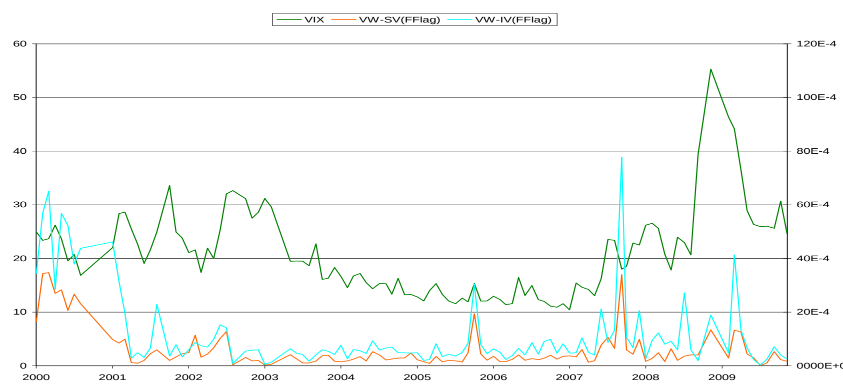


Table II. 3 VAR (1) Granger causality Wald tests

This table reports VAR (1) Granger causality Wald tests for equally (EW) and value-weighted (VW) panels. The null hypothesis is H_0*: endogenous variables do not Granger cause the dependent variable*. MMIR is the average monthly initial returns from 2000 to 2009. IPO monthly initial returns correspond to the percentage difference between the closing price on the 21st day of trading and the offer price. The IPO offering prices were collected from Bloomberg. IPO stock prices were collected from the CRSP. $NIPO_t$ is the number of IPOs in month t. TOTRISK represents the total risk of the issuing firm estimated by the variance of excess returns relative to the risk-free return during the first month of the offer. TOTRISK is the equally (value-) weighted average total risk as specified in Equation (5) multiplied by 10^4.Total risk is split into two components: systematic risk (SV), which relates to common market factors, and idiosyncratic risk (IV), which is associated with the specific firm factors. Both risk components (systematic and idiosyncratic) are calculated based on the modified model of Fama and French including the lagged three factors [$(R_{m, j-1} - R_{f, j-1})$, SMB_{j-1} and HML_{j-1}]. Both risk components (systematic and idiosyncratic) are estimated for each IPO in the first month of IPO trading. SV and IV are, respectively, the equally (value-) weighted average systematic and idiosyncratic risk components as specified in Equations (6) and (7) multiplied by 10^4. VIX_t is the market implied volatility index in month t. The VIX index was created by the "Chicago Board of Option Exchange: CBOE" in 1993 to measure the expected market volatility for the following month. VIX is estimated by the average of the group NTM "nearest-to-the-money" implied volatilities of eight options (four calls and four puts) on the market index S&P 500. VIX index quotations were collected from the CBOE website.

	Panel 1 (EW)		**Panel 1 (VW)**	
Null hypotheses	**Chi2-statistic**	**p-value**	**Chi2-statistic**	**p-value**
MMIR → NIPO	8.2937***	0.004	4.8869**	0.027
NIPO → MMIR	2.2764	0.131	0.8181	0.366
NIPO → TOTRISK	20.531***	0.000	7.5997***	0.006
TOTRISK → NIPO	1.4179	0.234	1.7346	0.188
NIPO → SV	14.730***	0.000	3.7612	0.052
SV → NIPO	2.0131	0.156	1.3419	0.247
NIPO → IV	20.620***	0.000	9.0402***	0.003
IV → NIPO	1.0051	0.316	1.7150	0.190
NIPO → VIX	0.2425	0.622	5.3e-05	0.994
VIX → NIPO	9.5680***	0.002	8.9830***	0.003
MMIR → TOTRISK	2.1702	0.141	2.9152	0.088
TOTRISK → MMIR	0.1243	0.724	0.1930	0.660
MMIR → SV	0.2183	0.640	1.3289	0.249
SV → MMIR	0.9478	0.330	0.6133	0.434
MMIR → IV	3.8609**	0.049	4.4503**	0.035
IV → MMIR	1.1526	0.283	1.0224	0.312
MMIR → VIX	6.6543**	0.010	9.2172***	0.002
VIX → MMIR	3.1633	0.075	0.9357	0.333
VIX → TOTRISK	9.8581***	0.002	5.6152**	0.018
TOTRISK → VIX	4.6373**	0.031	8.2833***	0.004
VIX → SV	6.9617***	0.008	2.7278	0,099
SV → VIX	3.2382	0.072	4.7140**	0.030
VIX → IV	10.065***	0.002	7.1573***	0.007
IV → VIX	4.9982**	0.025	9.2198***	0.002

"No Granger causality" is rejected at 5 % (1 %) when the p-value is less than 0.05 (0.01).
** and *** indicate significant "Granger causality" at 5 % and 1 %, respectively.

Figure II. 2 (c) also shows a peak in the IPO risk level at the start of the American recession (end of 2007). This peak, which is associated with both risk components (systematic and idiosyncratic), as shown in Figure II. 2 (d), leads to a peak in the VIX index level at the end of 2008.

Table II. 3 reports Granger causality Wald tests for equally and value-weighted IPO portfolios to provide preliminary evidence of possible lead-lag relationships between several variables in our model. The results show evidence of Granger causality from not only average initial returns but also the VIX index to IPO volume. However, it appears that there is no evidence of Granger causality from all measures of the issuing firm-level risk (total risk, systematic risk and idiosyncratic risk) to IPO volume. This result leads us to believe that market-wide risk might be more relevant for predicting IPO volume than the risk of IPO firms. In addition, we note that the hypothesis of "no Granger causality" is strongly rejected from IPO volume to IPO risk, especially its idiosyncratic fraction. We suspect that IPO waves induce riskier firms to enter the market in the subsequent period characterized by especially high idiosyncratic risk.

Moreover, the results in Table II. 3 provide preliminary evidence of a lead-lag relationship between the VIX index and IPO risk, especially its idiosyncratic fraction. For example, the strong rejection of the hypothesis of "no Granger causality" from the VIX index to IPO idiosyncratic risk leads us to believe that periods of high market-wide uncertainty are followed by periods of high IPO idiosyncratic risk.

4- Results of multivariate VAR modeling

Table II. 4 presents the estimation results of VAR models M_1, M_2 and M_3 used to empirically identify a relationship between monthly initial returns and IPO activity. The first model (M_1) presents a significant and positive relationship between monthly initial returns and the number of new issues in the next month. This result is robust to the weighting choice. High initial returns are followed by a large number of IPOs. This result is consistent with the findings of Lowry and Schwert (2002). More firms are likely to go public in "hot-issue" market periods to potentially benefit from the overvaluation of their shares by overoptimistic investors. Recently, Lowry et al. (2010) note that a "hot-issue" phenomenon is characterized by not only high initial returns and large IPO volume, as shown in the prior literature, but also a high variability of initial returns.

This finding led us to differentiate between high- and low-risk issues in the IPO cycle determination. When issuing firms are classified into high- and low-risk IPOs according to their risk characteristics, we find that the link between monthly initial returns and IPO activity is still significant only for high-risk IPOs (see model (M_2) in Table II. 4). The relationship between monthly initial returns and low-risk IPO volume is not statistically significant for equally weighted and value-weighted measures (see model (M_3) in Table II. 4).

Overall, our evidence supports the hypothesis that the "hot-issue" period is characterized by a large fraction of risky issuing firms, as shown previously by Ritter (1984) and Chiu (2005). One explanation for why risky firms choose to go public in a "hot-issue" period may be that they think it will be easier to market their issue without leaving much money on the table. These findings highlight the important role of risk in the IPO cycle. Hence, Table II. 5 shows the estimation results of VAR models[30] M_4, M_5 and M_6 for the impact of different measures of risk on the IPO cycle.

[30] Only results based on systematic and idiosyncratic volatilities estimated by the modified Fama-French model that include the lagged factors are reported. Our conclusions from the results based on measures of systematic and idiosyncratic volatilities estimated by the standard CAPM, the modified CAPM including the lagged market factor and the standard Fama-French regressions are similar.

Table II. 4. VAR modeling of the relationship between monthly initial returns and IPO volume

This table reports estimation results of *VAR* models estimated by the generalized method of moments (GMM) using the Newey-West corrected standard errors for heteroskedasticity and autocorrelation. Panel (1) corresponds to the equally weighted measures (EW). Panel (2) corresponds to the value-weighted measures (VW). Values in parentheses correspond to the approximate standard error. IPO monthly initial return is measured as the percentage difference between the closing price on the 21st day of trading and the offer price. IPO offering prices were collected from Bloomberg. IPO stock prices were collected from the CRSP. Equally (value-) weighted average monthly initial returns (MMIR) are calculated in a given month forthe period 2000 to 2009. $NIPO_t$ is the number of IPOs in month t. We classify new issues into two groups: (1) high-risk issues for which the initial return volatility during the first month of trading is above the median and (2) low-risk issues for which the initial return volatility during the first month of trading is below the median. $NIPO_t^{HR}$ is the number of high-risk IPOs in month t. $NIPO_t^{LR}$ is the number of low-risk IPOs in month t. The *VAR* model (M_1) is used to determine the relationship between average monthly initial returns ($MMIR_t$) and IPO volume ($NIPO_t$) in each month. The $NIPO_t$ is then replaced by the $NIPO_t^{HR}$ in model (M_2) and $NIPO_t^{LR}$ in model (M_3) to emphasize the role of the issuing firm's risk characteristics in the IPO cycles.

Model (M_1)	**Panel 1 (EW)**			**Panel 2 (VW)**		
	Const	$MMIR_{t-1}$	$NIPO_{t-1}$	Const	$MMIR_{t-1}$	$NIPO_{t-1}$
$MMIR_t$	10.5623*** (2.7778)	0.2824*** (0.1010)	0.1846 (0.2597)	12.2685*** (3.1584)	0.3476*** (0.0769)	0.1909 (0.3476)
$NIPO_t$	3.1795*** (1.1002)	0.0942*** (0.0311)	0.4756*** (0.0958)	3.6071*** (1.0183)	0.0752*** (0.0159)	0.4318*** (0.0938)
Nobs		107			101	

Model (M_2)	**Panel 1 (EW)**			**Panel 2 (VW)**		
	Const	$MMIR_{t-1}$	$NIPO_{t-1}^{HR}$	Const	$MMIR_{t-1}$	$NIPO_{t-1}^{HR}$
$MMIR_t$	10.7407*** (2.3544)	0.2487*** (0.0897)	0.4609 (0.4101)	12.5720*** (2.5261)	0.3199*** (0.0854)	0.4485 (0.5971)
$NIPO_t^{HR}$	0.7811 (0.6333)	0.0675** (0.0321)	0.5594*** (0.1181)	0.9818** (0.4527)	0.0505*** (0.0132)	0.5358*** (0.1187)
Nobs		107			101	

Model (M_3)	**Panel 1 (EW)**			**Panel 2 (VW)**		
	Const	$MMIR_{t-1}$	$NIPO_{t-1}^{LR}$	Const	$MMIR_{t-1}$	$NIPO_{t-1}^{LR}$
$MMIR_t$	13.4385*** (3.1619)	0.2890*** (0.1034)	-02776 (0.3713)	14.6772*** (4.3236)	0.3641*** (0.0701)	-0.2178 (0.5641)
$NIPO_t^{LR}$	2.0123*** (0.5765)	0.0195 (0.0116)	0.5032*** (0.0716)	2.0667*** (0.5747)	0.0152 (0.0104)	0.4941*** (0.0723)
Nobs		107			101	

** and *** indicate that the regression coefficient is significant at 5 % and 1 % respectively.

First, we find that, unlike idiosyncratic risk, the systematic risk of previous issues plays a role in predicting IPO volume in the subsequent month. While the coefficients associated with IPO total risk and IPO idiosyncratic risk appear insignificant for both equally and value-weighted measures (see models (M_4) and (M_6) in Table II. 5), the coefficients associated with the systematic risk component are positive and significant at a 5% level of significance for both methods of weighting (see model (M_5) in Table II. 5). In addition to the risk at the issuing firm level, our VAR models include the effect of expected market volatility on the IPO cycles. We show that there is a significant and negative relationship between the number of IPOs in month (t), $NIPO_t$, and the implied volatility index in month (t-1), VIX_{t-1}, for both the equally weighted and the value-weighted measures[31]. This negative relationship is consistent with the "flight to quality" explanation (Caballero and Krishnamurthy 2008) that suggests that an increase in the perceived market uncertainty could lower demand of risk-averse investors for risky securities. Such low cautious investor sentiment may discourage issuers, especially the risky ones, to go public, as a result, a low level of IPO activities is observed[32]. On the one hand, firms are incited to enter the market in period of high issuing firm systematic risk. On the other hand, IPO candidates are not interested in going public in periods of high market-wide uncertainty. These findings lead us to believe that more IPO candidates choose to enter the market after periods characterized by a high level of systematic risk in the recent issues as well as low market-wide uncertainty because they expect to profit from higher valuation.

Furthermore, our results show an insignificant relationship between aggregate initial returns in month (t), $MMIR_t$, and the systematic risk in month (t-1), SV_{t-1}, as well as the implied volatility index in month (t-1), VIX_{t-1}[33]. It seems that high levels of risk at either the market level or the firm level do not lead to important monthly aggregate initial returns of future IPOs. These findings allow us to infer that most issuers choose a rational IPO timing that simply allows them

[31] Table 5 shows that an increase of 1% in the market expected volatility in month (t-1), VIX_{t-1}, leads to a considerable decrease of approximately 25% in the number of new issues in month (t).

[32] Cai, Jiang and Lee (2013) also use the "flight to quality" explanation (Caballero and Krishnamurthy 2008) for the negative relationship between stock market volatility and the level of debt IPO activities.

[33] At the individual firm level, Booth and Booth (2010) show that high values of the VIX index, which is used as a proxy for market-wide divergence of opinion, induces issuing firms to underprice their issues, which leads to high initial return on the first day of the offering.

to avoid the misevaluation of their equities. We suggest that avoiding IPO deliberate underpricing is the reason why firms enter the market after periods of low market-wide uncertainty and high systematic risk of recent issues. However, our findings show persistence in the average monthly initial returns through time. We infer that the valuations of previous issues significantly affect valuations of IPOs in the next period due to the underwriters' learning processes throughout IPO registration periods, which last two months on average. This learning process causes this serial correlation in aggregate monthly initial returns that are positively related to future IPO volume, as shown by Lowry and Schwert (2002).

Second, we note that, unlike specific risk factors, systematic risk is significantly correlated across issuing firms. Our results with respect to firm level risk allow us to infer that only the information about systematic components is relevant for IPO candidates. Because expected returns are predominantly driven by systematic risk components (Vuolteenaho 2002), firms whose values are more sensitive to systematic factors enter the market following periods in which the systematic risk of recent issues is high to profit from better valuation of their issues. However, firms characterized by high idiosyncratic risk do not enter the market following periods of high idiosyncratic risk of recent new issues. These firms should underprice their equity to compensate investors for their risk characteristics or choose instead to wait for more favorable market conditions to achieve higher proceeds. Therefore, our findings show that it is not a high level of asymmetric information in the previous period that leads more firms to enter the market but the correlation in systematic risk components across issuing firms that produces more IPOs in the next period.

Third, the estimation results in Table II. 5 show that there is consistent positive and significant predictive power of the IPO volume on the risk of future IPOs, especially its idiosyncratic fraction. Nevertheless, this relationship is not robust to the weighting method for the systematic fraction of the issuing firm's risk (see model (M_5) in Table II. 5). Hence, we conclude that in addition to the former lead-lag relationship between monthly IPO initial returns and IPO volume previously documented by Lowry and Schwert (2002), our results show a "reversed IPO cycle" predictability that reveals a new lead-lag relationship between IPO activity and the idiosyncratic fraction of the next-period issuing firm's risk[34].

Fourth, the estimation results in Table II. 5 show that the relationship between VIX and the following month IPO total risk as well as that between VIX and the following month IPO systematic risk is not robust to the weighting method. However, we find a significant and positive relationship between VIX and the IPO idiosyncratic risk of the subsequent month for both the equally weighted and the value-weighted measures (see model (M_6) in Table II. 5). These findings are supported by the Granger causality Wald test in Table II. 3, which shows strong evidence of Granger causality from VIX to IPO idiosyncratic risk for both the equally and value-weighted panels. We conclude that VIX can predict the specific risk of new issues. This finding can be explained by the fact that specific risk factors included in the IPO proceeding during the pre-IPO market could be incorporated in the VIX index.

Whaley (2008) notes that hedgers buy S&P500 index puts when they expect a potential drop in the stock market (p. 5). Therefore, unexpected moves up or down will be reflected in the implied market volatility. Because increased idiosyncratic risk in the U.S. market is mainly attributed to the increase in issuing firms' idiosyncratic risk (Brown and Kapadia 2007), we suggest that the expectation of an increase in the specific risk of IPO candidates could affect the expected market volatility. Hence, the expected specific risk of the IPO in subsequent periods is reflected in the implied market volatility, which is used as a proxy of the market-wide uncertainty for the subsequent month. If potential investors find that IPOs of the subsequent period are characterized by a high (low) degree of uncertainty regarding the information disclosed by the issuing firms during the registration period, then high (low) values of the implied volatility index are observed. The degree of investors' fear about issuing firms' specific risk in month (t) could then be revealed by the VIX value in month (t-1). The profile of issuing firms (age, industry, size, profitability, etc.), which is explicitly disclosed in the IPO prospectus before the offering date, reflects implicitly idiosyncratic risk characteristics. Therefore, our

[34] The impact of both components of issuing firms' risk on IPO cycles is robust to the frequency of measurements of idiosyncratic and systematic risks (daily or weekly) and the time selected since the first day of trading of the IPO stocks (one month or six months). Only results including risk measures computed on a daily basis for the first month of trading are reported.

findings reveal that secondary market volatility predicts the idiosyncratic component of the IPO risk.

Finally, our findings emphasize the role of IPO market variables in predicting market-wide uncertainty. Our results in Table II. 5 show that IPO monthly initial returns[35] as well as issuing firm risk[36] in the previous month affect the market implied volatility of the current month. Nevertheless, VIX is more strongly affected by the variation of the issuing firm risk in the previous month. Moreover, we show that although VIX is sensitive to IPO idiosyncratic risk component variation, the expected market volatility is economically more sensitive to the IPO systematic risk of recent issues. Our findings complement previous studies, such those of Banerjee, Doran and Peterson (2007), who state that VIX mainly represents systematic risk factors of firms in the market, and the recent study of Süss (2012), who finds that the implied return distribution is linked to the idiosyncratic risk. Hence, in the IPO context, we show that market-wide uncertainty for the current period incorporates the information associated with both IPO risk components (systematic and idiosyncratic) of the previous period. Although Table II. 3 shows evidence of Granger causality from IPO total risk as well as IPO idiosyncratic risk to VIX for both the equally and value-weighted panels, the hypothesis of "no Granger causality" is rejected from IPO systematic risk to VIX with the exception of the value-weighted panel.

[35] In Table 5, we show that an increase of 1% in IPO monthly initial returns in month (t-1) leads to a slight decrease of 0.03 to 0.05 points in VIX in month (t).

[36] Table 5 shows that (1) an increase of 1% in the equally (value-) weighted total risk of previous IPOs leads to a significant increase of 3.6 points (5.1 points) in VIX at the 1% level, (2) an increase of 1% in the equally (value-) weighted systematic risk of previous IPOs leads to a significant increase of 8.2 points (11.4 points) in the VIX index at the 5% level and (3) an increase of 1% in the equally (value-) weighted idiosyncratic risk of previous IPOs leads to a significant increase of 5.6 (7.6) points in VIX at the 1% level.

Table II. 5. VAR modeling of the relationship between monthly initial returns, IPO volume, the issuing firm's risk and the VIX index

This table reports the GMM estimation results of VAR models for the impact of market uncertainty on the IPO cycle. The Newey-West corrected standard errors for heteroskedasticity and autocorrelation are used to obtain efficient estimates of the parameters. Panel (1) corresponds to the equally weighted measures (EW). Panel (2) corresponds to the value-weighted measures (VW). Values in parentheses correspond to the approximate standard error. IPO monthly initial return is measured as the percentage difference between the closing price on the 21st day of trading and the offer price. The IPO offering prices were collected from Bloomberg. IPO stock prices were collected from the CRSP. Equally (value-) weighted average monthly initial returns (MMIR) are calculated in a given month for the period 2000 to 2009. $NIPO_t$ is the number of IPOs in month t. TOTRISK represents the total risk of the issuing firm estimated by the variance of excess returns relative to the risk-free return during the first month of the offer. TOTRISK is the equally (value-) weighted average total risk as specified in Equation (5) multiplied by 10^4. Total risk is split into two components: systematic risk (SV), which relates to common market factors, and idiosyncratic risk (IV), which is associated with the specific firm factors. Both risk components (systematic and idiosyncratic) are calculated based on the modified model of Fama and French including the lagged three factors $[(R_{m,\ j\text{-}1} - R_{f,\ j\text{-}1})$, $SMB_{j\text{-}1}$ and $HML_{j\text{-}1}]$. Both risk components (systematic and idiosyncratic) are estimated for each IPO in the first month of IPO trading. SV and IV are, respectively, the equally (value-) weighted average systematic and idiosyncratic risk components as specified in Equations (6) and (7) multiplied by 10^4. VIX_t is the market implied volatility index in month t. VIX is estimated by the average of the group NTM "nearest-to-the-money" implied volatilities of eight options (four calls and four puts) on the market index S&P 500. VIX index quotations were collected from the CBOE website. The *VAR* model (M_4) is first used to evaluate the impact of market implied volatility index (VIX) in an IPO initial return, IPO volume and issuing firm total risk (TOTRISK). The total risk is then replaced by systematic risk (SV) in model (M_5) and idiosyncratic risk (IV) in model (M_6).

Model (M_4)	**Panel 1 (EW)**					**Panel 2 (VW)**				
	Const	$MMIR_{t-1}$	$NIPO_{t-1}$	$TOTRISK_{t-1}$	VIX_{t-1}	Const	$MMIR_{t-1}$	$NIPO_{t-1}$	$TOTRISK_{t-1}$	VIX_{t-1}
$MMIR_t$	0.0442 (7.2338)	0.2875*** (0.0802)	0.4028 (0.3342)	-0.0297 (0.1398)	0.4352 (0.2804)	5.5363 (9.8616)	0.3729*** (0.1409)	0.3362 (0.4398)	-0.0703 (0.1914)	0.3127 (0.4222)
$NIPO_t$	9.1540*** (1.9508)	0.0831** (0.0341)	0.3435*** (0.1074)	0.0292 (0.0195)	-0.2485*** (0.0548)	10.1777*** (1.9089)	0.0576** (0.0247)	0.2761*** (0.0995)	0.0457 (0.0267)	-0.2663*** (0.0583)
$TOTRISK_t$	-22.6016** (9.1349)	0.1719 (0.1022)	1.5191*** (0.4511)	0.2675 (0.1787)	0.9527*** (0.3545)	-13.3063 (8.1480)	0.1458 (0.1374)	0.8428** (0.3240)	0.3587 (0.1900)	0.6662 (0.3480)
VIX_t	3.9891*** (1.0043)	-0.0524** (0.0228)	-0.0370 (0.0437)	0.0359*** (0.0113)	0.8341*** (0.0452)	4.6250*** (1.0045)	-0.0406*** (0.0141)	-0.0111 (0.0393)	0.0509*** (0.0179)	0.7596*** (0.0354)
Nobs			107					101		

Model (M_5)	**Panel 1 (EW)**					**Panel 2 (VW)**				
	Const	$MMIR_{t-1}$	$NIPO_{t-1}$	SV_{t-1}	VIX_{t-1}	Const	$MMIR_{t-1}$	$NIPO_{t-1}$	SV_{t-1}	VIX_{t-1}
$MMIR_t$	2.7231 (7.4451)	0.2181*** (0.0811)	0.2609 (0.3744)	0.2208 (0.3642)	0.3248 (0.2930)	10.9321 (10.0339)	0.2835** (0.1388)	0.0904 (0.4758)	0.3651 (0.6377)	0.0880 (0.3999)
$NIPO_t$	9.5488*** (2.0079)	0.0803** (0.0350)	0.3248*** (0.1112)	0.0940** (0.0459)	-0.2604*** (0.0570)	10.3206*** (2.0253)	0.0611*** (0.0226)	0.2662** (0.1069)	0.1176** (0.0602)	-0.2671*** (0.0598)
SV_t	-7.0301 (4.2581)	0.0194 (0.0465)	0.4783** (0.2172)	0.4310*** (0.1449)	0.2928** (0.1388)	-2.9958 (2.8701)	0.0335 (0.0378)	0.2173 (0.1382)	0.4732*** (0.1706)	0.1652 (0.1111)
VIX_t	4.1454*** (1.0950)	-0.0480** (0.0240)	-0.0429 (0.0493)	0.0817** (0.0376)	0.8325*** (0.0435)	4.6095*** (1.0425)	-0.0341** (0.0142)	-0.0140 (0.0402)	0.1140** (0.0531)	0.7658*** (0.0353)

Nobs	107	101

Model (M_6)	Panel 1 (EW)					Panel 2 (VW)				
	Const	$MMIR_{t-1}$	$NIPO_{t-1}$	IV_{t-1}	VIX_{t-1}	Const	$MMIR_{t-1}$	$NIPO_{t-1}$	IV_{t-1}	VIX_{t-1}
$MMIR_t$	-0.5183 (7.3295)	0.3241*** (0.0796)	0.4389 (0.3230)	-0.1351 (0.1789)	0.4713 (0.2738)	4.1805 (10.0956)	0.4128*** (0.1356)	0.3880 (0.4457)	-0.2294 (0.2483)	0.3845 (0.4375)
$NIPO_t$	8.9327*** (1.9472)	0.0865** (0.0343)	0.3546*** (0.1059)	0.0370 (0.0299)	-0.2407*** (0.0534)	9.9563*** (1.8787)	0.0586** (0.0255)	0.2877*** (0.0988)	0.0647 (0.0427)	-0.2595*** (0.0576)
IV_t	-14.7166*** (5.1749)	0.1524** (0.0687)	1.0017*** (0.2514)	0.1773 (0.1674)	0.6376*** (0.2102)	-10.3000** (5.1541)	0.1232 (0.0980)	0.6188*** (0.1872)	0.2695 (0.1892)	0.5101** (0.2272)
VIX_t	3.8013*** (0.9838)	-0.0524** (0.0220)	-0.0285 (0.0421)	0.0559*** (0.0162)	0.8389*** (0.0461)	4.4315*** (0.9547)	-0.0408*** (0.0141)	-0.0003 (0.0373)	0.0761*** (0.0265)	0.7647*** (0.0342)
Nobs	107					101				

** and *** indicate that the regression coefficient is significant at 5 % and 1 %, respectively.

5- Implications for the IPO cycle predictability

5.1- Implications for issuers

It is important for issuers to find the optimal IPO timing to offer their equities. In particular, risky issuers should align their IPO timing with high market receptivity and risk tolerance to truncate the IPO indirect costs by moderating the underpricing of their issues. Hence, when investors are willing to overvalue the issues in periods of low market-wide uncertainty, underwriters could take advantage of a high investor sentiment in these specific periods to avoid being constrained to underpricing risky issues to compensate investors for the risk they take. Given the serial correlations in IPO initials returns, IPO systematic risk and market-wide risk series, an issuer should be able to explore past data to decide the appropriate time to enter the market. Optimal strategies for issuance would be derived by not only firm-specific but also market conditions. What occurs in the market during the book-building periods of IPO candidates allows firms to choose their optimal IPO timing. The issuer could wait before issuing equities to learn from similar recent issues and take advantage of the highest prices in more favorable market conditions.

5.2- Implications for investors

Because investors wish to acquire IPO equities at the lowest price, it is important to examine whether they can find undervalued issues. Our findings show that IPO specific risk is predictable by the VIX index level of the previous month. In addition, we find that risky issues tend to enter the market following IPO waves. Hence, investors would be able to anticipate periods of risky issuances that follow periods of high market-wide uncertainty as well as those that follow periods of high IPO activity. Using this information, they will require higher returns to invest in risky issues, leading underwriters to propose a discount to stimulate demand. Otherwise, investors refrain from buying risky issues to avoid reducing their wealth in the aftermarket. Furthermore, because "hot-issue" markets are predictable, investors could increase their wealth by buying hot issues, which have higher initial returns than cold issues. Overall, investors would make better decisions investing in IPOs and hedging against an increase in the market risk in periods of high risky issuances.

5.3- Implications for regulators

We note that the IPO market is very sensitive to economic changes. In our sample, the economic recession first affected the IPO market. It then spread to other financial markets. This evidence supports the idea that the state of IPO markets is a leading indicator of what to expect in other financial markets in the near future. Hence, regulators might anticipate periods of recession when they observe high IPO risk levels. If so, they should be able to take make the necessary decisions to prevent future crises. Moreover, the predictability of "hot-issue" markets and the specific risk level of future new issues will allow regulators to improve the rules accordingly.

5.4- Implications for future research

While previous studies examine IPO cycle only in terms of IPO activity and initial returns, we focus on firm-level risk through both IPO risk components (systematic and idiosyncratic) as well as market-level risk through the implied volatility index. This research aims to dispel difficulties with the IPO valuation, especially for hot IPOs, by revealing to various IPO market contributors (issuers, underwriters and investors) whether a risk type (IPO systematic risk, IPO idiosyncratic risk or the VIX) drives a "hot-issue" market. Our findings contribute to the IPO literature by highlighting the predominant role of the common behavioral risk factor to predict not only IPO waves but also IPO specific risk. Moreover, we provide a response to Pástor and Veronesi’s (2005) question of "whether firm conditions move together sufficiently to cause IPO waves (p. 1734)" by showing that positive correlation in systematic risk components across issuing firms allows us to predict future IPO activity. We believe that future studies should be directed towards the optimal strategy for issuance, combining firms' specific conditions and market-wide conditions.

6- Discussion and conclusion

Our research redefines the IPO cycles in terms of IPO initial returns and IPO volume, as documented in the previous IPO literature (Ibbotson and Jaffe, 1975 and Lowry and Schwert, 2002), and in terms of risk at the issuing-firm level as well as the market-wide level. We first distinguish between two components of the issuing firm risk: systematic risk, which relates to the firm sensitivity to extrinsic factors, and idiosyncratic risk associated with intrinsic firm factors. Second, we use the implied volatility index (VIX) as a proxy of market-wide uncertainty. The aim of this risk decomposition is the determination of whether a type of risk is predominant in predicting IPO cycles.

Based on VAR modeling, our results support Lowry and Schwert's (2002) finding that a period of high initial returns is followed by a high number of IPOs. However, we find that the positive relationship between monthly initial returns and the subsequent number of IPOs is significant only for high-risk IPOs; risky firms are more likely to go public during "hot-issue" periods. We infer that the issuing firm's risk is involved in the determination of the IPO cycle.

When we include two equations related to the issuing firm's risk and the VIX index to the former system of equations of Lowry and Schwert (2002), we find that, in addition to previous IPO initial returns, the VIX index and the systematic risk of recent issues have a predictive power for IPO volume. Our findings reveal that periods of high implied volatility are followed by a small number of IPOs. Investors who become more risk averse in periods of high market uncertainty might require higher returns to purchase new issues. Therefore, issuing firms should leave more money on the table to market their equity or postpone the IPO, hoping for a more favorable market in the future. Thus, a small number of IPOs are observed following periods of high implied volatility because of the increased cost of capital and the lack of market receptivity.

Few academic studies have examined the relationship between the VIX index and IPO volume. Among those that do, Busaba, Li and Yang (2009) find no significant relationship between the variation in VIX and IPO volume. Blum (2011) finds a negative and significant relationship between the VIX index and quarterly IPO volume. Our results support Blum’s findings (2011) and provide supplementary evidence of a lead-lag relationship between the VIX index and IPO volume. We are the first to show the predictive power of the VIX index on IPO activity. Furthermore, our findings are consistent with those of Pástor and Veronesi (2005, p. 1713), who argue that the IPO volume changes over time in response to time variation in market conditions.

Moreover, in addition to the risk at the market-level, our models focus on the impact of the risk at the issuing firm level on IPO activity. We show that the impact of the issuing firm’s risk on future IPO volume is significant only for the systematic risk portion. A high level of systematic risk among recent issues leads to high IPO volume in the following period. This evidence is consistent with Pástor and Veronesi (2005) who link firm conditions to market conditions through the systematic risk component of firms as discussed in Vuolteenaho (2002). Pástor and Veronesi (2005) assume that firm conditions and market conditions are perfectly correlated when pre-IPO idiosyncratic risk is not present. However, if this risk is present, the correlation is lower. Our results show that, unlike the idiosyncratic risk components, the systematic components are positively correlated across issuing firms. The presence of recent issues with high systematic risk leads to the presence of similar new issues in terms of systematic risk in the next period. We infer that the systematic risk component of previous issues contains relevant information about the systematic risk of subsequent ones. This finding, combined with our evidence that systematic risk in IPOs predicts IPO volume, supports the idea put forward by

Pástor and Veronesi (2005), namely, that positively related systematic risk in IPO firms might produce more IPOs in the next period.

Our findings also allow us to conclude that firms whose values are most sensitive to individual financial factors choose to wait before going public in periods of high information asymmetry, which are derived by high idiosyncratic risk of previous issues, to avoid low proceeds due to the deliberate IPO underpricing. However, those risky firms are instead motivated to go public following periods of high IPO activity. We infer that "hot-issue" markets generate risky issuances. This finding explains the greater dispersion in the firm quality in "hot-issue" periods, shown previously by Yung et al. (2008) and Lowry et al. (2010).

Finally, our study reveals that market implied volatility helps predict subsequent IPOs' risks, especially their specific risks. The specific risk of IPOs can be inferred from the information disclosed by the issuing firms during the registration period. The investors' perceptions toward the specific risk of IPOs in the next period could be reflected in market expected volatility: high (low) uncertainty is inferred by high (low) market implied volatility. Hence, the link between the idiosyncratic risk of IPOs' candidates and expected market volatility is derived by the VIX values, which reflect the market uncertainty in subsequent months, when IPO timing occurs. Furthermore, our results show that periods of high (low) IPO initial returns and low (high) IPO risk are followed by a low (high) value of the VIX index. We conclude that information derived from the IPO market variables allows us to anticipate the level of market-wide uncertainty.

Appendix. Theoretical framework of firm-level risk measures

Goyal and Santa-Clara (2003) report that the return of each stock i is driven by a common factor *f* and a firm specific shock ε_i such that:

$$R_{i,j} = f_j + \varepsilon_{i,j}, \qquad \text{(A1)}$$

where $R_{i,j}$ is the daily return of stock i.

The portfolio's returns are generated by:

$$R_{p,j} = \sum_{i=1}^{n_t} \omega_{it} R_{i,j}, \qquad \text{(A2)}$$

where n_t is the number of stocks in month t and ω_{it} is the weight of stock i in month t such that $\omega_{it} = \frac{MV_{it}}{\sum_{i=1}^{n_t} MV_{it}}$ (MV_{it} is the market value of stock i in month t).

$$R_{p,j} = \sum_{i=1}^{n_t} \omega_{it} \left(f_j + \varepsilon_{i,j} \right) = f_j + \sum_{i=1}^{n_t} \omega_{it} \varepsilon_{i,j} . \qquad \text{(A3)}$$

In the case of an equally weighted portfolio, $R_{p,j} = f_j + \frac{1}{n_t} \sum_{i=1}^{n_t} \varepsilon_{i,j}$. (A4)

In the case of a value-weighted portfolio, $R_{p,j} = f_j + \sum_{i=1}^{n_t} \frac{MV_{it}}{\sum_{i=1}^{n_t} MV_{it}} \varepsilon_{i,j}$. (A5)

The monthly variance of stock i using the within-month daily return is computed as follow:

$$V_{it} = \sum_{j=1}^{J_t} \left(f_j^2 + \varepsilon_{i,j}^2 + 2 f_j \varepsilon_{i,j} \right). \qquad \text{(A6)}$$

The equally weighted average variance is the arithmetic average of the monthly variance of each stock return such that:

$$\begin{aligned} V_t^{EW} &= \frac{1}{n_t} \sum_{i=1}^{n_t} V_{it} \qquad \text{(A7)} \\ &= \frac{1}{n_t} \sum_{i=1}^{n_t} \sum_{j=1}^{J_t} \left(f_j^2 + \varepsilon_{i,j}^2 + 2 f_j \varepsilon_{i,j} \right) \\ &= \sum_{j=1}^{J_t} \left(f_j^2 + \frac{1}{n_t} \sum_{i=1}^{n_t} \varepsilon_{i,j}^2 + \frac{2}{n_t} f_j \sum_{i=1}^{n_t} \varepsilon_{i,j} \right). \end{aligned}$$

The equally weighted variance of the equally weighted portfolio's returns is computed as follow:

$$V_{pt}^{EW} = \sum_{j=1}^{J_t} \left(f_j^2 + \frac{1}{n_t^2} \sum_{i=1}^{n_t} \varepsilon_{i,j}^2 + \frac{2}{n_t} f_j \sum_{i=1}^{n_t} \varepsilon_{i,j} \right). \qquad (A_8)$$

The contribution of the idiosyncratic component ($\frac{1}{n_t} \sum_{i=1}^{n_t} \varepsilon_{i,j}^2$) is divided by the number of stocks (n_t) in the last equation. In a large cross-section, however, the idiosyncratic component vanishes.
The value-weighted average variance using the market value weights is calculated as follow:

$$\begin{aligned} V_t^{VW} &= \sum_{i=1}^{n_t} \omega_{it} V_{it} \qquad (A_9) \\ &= \sum_{i=1}^{n_t} \omega_{it} \sum_{j=1}^{J_t} \left(f_j^2 + \varepsilon_{i,j}^2 + 2 f_j \varepsilon_{i,j} \right) \\ &= \sum_{j=1}^{J_t} \left(f_j^2 + \sum_{i=1}^{n_t} \omega_{it} \varepsilon_{i,j}^2 + 2 f_j \sum_{i=1}^{n_t} \omega_{it} \varepsilon_{i,j} \right). \end{aligned}$$

The value-weighted variance of the value-weighted portfolio's returns is calculated as follow:

$$V_{pt}^{VW} = \sum_{j=1}^{J_t} \left(f_j^2 + \sum_{i=1}^{n_t} \omega_{it}^2 \varepsilon_{i,j}^2 + 2 f_j \sum_{i=1}^{n_t} \omega_{it} \varepsilon_{i,j} \right). \qquad (A_{10})$$

The contribution of the idiosyncratic component ($\sum_{i=1}^{n_t} \omega_{it} \varepsilon_{i,j}^2$) is multiplied by the weight of stocks i in month t (ω_{it}) in the last equation. For a large cross-section, the weight of stocks i in the portfolio tends toward zero and the idiosyncratic component vanishes.

In the IPO context, the number of new issues varies over time, while "hot-issue" periods are characterized by a large number of IPOs. Because the idiosyncratic component is neglected in the variance of portfolio returns as a result of diversification, the proxy of the total issuing firm risk used in this paper is the average variance of individual IPO returns, rather than the variance of IPO portfolios' average returns, which most likely reduces the idiosyncratic component. The total issuing firm's risk is subsequently split into two components of IPO risk - systematic and idiosyncratic - to evaluate the impact of each component on the IPO cycle.

Chapter III: Issuing firm valuations pre- and post-IPO: which risk component matters?

Abstract

This paper studies the role of different risk components at the issuing firm as well as the IPO market levels on IPO pricing in pre- and post-IPO. We decompose total risk into systematic and idiosyncratic components in order to reveal which risk component affects pre- and post-IPO valuations. Our results show that IPOs are undervalued relative to a matched sample of traded firms (non-IPOs) when accounting for IPO market idiosyncratic risk during the IPO registration period. When we examine post-IPO valuation for all IPOs in our sample, we find that only the firm-level idiosyncratic risk component significantly affects the IPO first-day return. However, when IPOs are classified into two groups according to their pre-IPO valuation (with respect to their peers): (1) undervalued and (2) overvalued IPOs, this result is supported only for overvalued IPOs. First-day returns of undervalued IPOs are instead affected only by systematic risk components at the issuing firm and IPO market levels. We also note that the level of idiosyncratic risk in the IPO market during the IPO registration period positively affects the firm-level idiosyncratic risk of overvalued issues during the early aftermarket stage. These findings allow us to infer that underwriters benefits from the high degree of asymmetric information around recent IPOs by overvaluing the following new issues in order to realize high proceeds. If underwriters incorporate information associated to the idiosyncratic risk components into the IPO prices, new issues should be rather undervalued with respect to matched non-issuing firms to compensate investors for the IPO specific risk and then stimulate their demand for IPO shares. We conclude that the IPO mispricing during the pre-IPO stage is mainly explained by the non-incorporation of the idiosyncratic component of risk into IPO prices.

Keywords: Initial Public Offerings, Underpricing, Idiosyncratic risk, Systematic risk, Risk-return relationship

Résumé

Cet article étudie le rôle des différentes composantes du risque au niveau de la firme émettrice ainsi qu'au niveau du marché des IPOs sur l'évaluation de la nouvelle émission en pré- et post-IPO. Nous décomposons le risque total en composantes systématique et idiosyncratique afin de révéler le type du risque qui affecte l'évaluation des firmes émettrices en pré et post-IPO. Nos résultats montrent que les IPOs sont sous-évaluées par rapport à un échantillon apparié de firmes cotées (non-IPOs) lorsque nous considérons le risque idiosyncratique du marché des IPOs au cours de la période d'inscription de l'IPO. Lorsque nous examinons l'évaluation en post-IPO de tous les IPOs de notre échantillon, nous constatons que seulement la composante idiosyncratique du risque au niveau de la firme qui affecte significativement le rendement initial de l'IPO au premier jour de l'offre. Toutefois, lorsque les IPOs sont classés en deux groupes en fonction de leur valorisation en pré-IPO (par rapport à leurs pairs): (1) des IPOs sous-évaluées et (2) des IPOs surévalués, ce résultat reste valide uniquement pour les IPOs surévalués. Les rendements initiaux des IPOs sous-évaluées sont plutôt affectés par les composantes systématiques du risque au niveau du marché des IPOs et de la firme émettrice. Nous montrons également que le niveau du risque idiosyncratique du marché des IPOs en pré-IPO affecte positivement le risque idiosyncratique des firmes surévalués durant les premiers jours de l'introduction. Ces résultats nous permettent de conclure que les souscripteurs profitent du niveau élevé d'asymétrie d'information autour des dernières émissions en surévaluant les émissions suivantes dans le but d'augmenter la recette des IPOs. Si les souscripteurs incorporent les informations associées aux composantes idiosyncratiques du risque dans les prix d'introduction en bourse, les IPOs devraient être plutôt sous-évalués par rapport à leurs semblables pour compenser le risque spécifique des IPOs et ainsi stimuler la demande des investisseurs pour les titres d'IPOs. Nous concluons que la mauvaise évaluation des IPOs en phase pré-IPO est expliquée principalement par la non-incorporation de la composante idiosyncratique du risque dans le prix d'introduction en bourse.

Mots-clés: nouvelles introductions en bourse, sous-évaluation, risque idiosyncratique, risque systématique, relation risque-rendement.

1- Introduction

Previous research on IPOs reveals a short-term anomaly, namely IPO underpricing (Ibbotson, 1975 and Ritter, 1984), which challenges our understanding of asset pricing. Information asymmetry, agency problems, signal and litigation are proposed explanations for this phenomenon. Typically, underwriters set an offer price below the fundamental value of a firm to motivate investors to purchase newly issued shares. This deliberate underpricing induces high initial IPO returns during the early aftermarket stage. To measure underpricing, authors such as Ritter (1984) often use IPO initial returns as measured by the percentage difference between the IPO price on the first day of trading and the IPO offer price. Purnanandam and Swaminathan (P&S) (2004) note that IPO aftermarket prices during the first days of trading do not correspond to the fundamental value of the issuing firm. They use the market value of a selected established firm with characteristics similar to a given IPO to estimate the IPO relative value ratio. They find that IPOs are overvalued compared to their matched firms. Zheng (2007) reviews P&S's valuation method and shows possible biases due to the omission of new primary shares, cash holding and debt value. Using a modified IPO valuation method to avoid the upward biases in the P&S (2004) valuation method, Zheng (2007) finds that IPOs are not overvalued relative to their peers. However, he shows that the mean of first day IPO return is 12.16%, which is consistent with similar analyses in the literature. One question remains: if there is no over or undervaluation of issuing firms in the pre-IPO, then why are there high initial returns in the early aftermarket stage?

This paper focuses not only on IPO valuation but also on the possible explanations of IPO pricing in pre- and post-IPO stages by highlighting the important role of the issuing firm and IPO market risk characteristics during the IPO process. We investigate which risk component is involved in the ex-ante and ex-post IPO valuations. Compared to established firms, uncertain IPO stock value and demand for these newly issued equities are important because new issues have no stock market history. Thus, the high degree of information asymmetry among contributors in the IPO market (issuers, underwriters and investors) affects ex-ante IPO pricing. As IPOs are characterized by a higher degree of information asymmetry than established firms, it is interesting to separate the variance of shocks in the individual issuing firm returns from the total variance[37] to distinguish between idiosyncratic risk, which is tied to firm specific factors and used as a proxy for information asymmetry, and systematic risk, which corresponds to firm sensitivity to common factors. This risk decomposition reveals which risk component is important for IPO valuation.

Our research distinguishes between pre- and post-IPO valuations using the Price-to-Value ratio to proxy for pre-IPO valuation and IPO initial return for post-IPO valuation. We consider pre- and post IPO risk and measure risk in the IPO market during the IPO registration period to proxy for IPO ex-ante uncertainty and risk of the issuing firms during the early aftermarket stage to proxy for IPO ex-post uncertainty. Modeling typically requires more than one relation, or equation, between these variables. Therefore, we use a simultaneous equation model to capture the interaction between IPO pricing and risk.

Our findings show that the idiosyncratic risk of previous issues is negatively correlated with pre-IPO valuation. This suggests that higher information asymmetry in the IPO market during the IPO bookbuilding process leads underwriters to undervalue IPOs relative to their matched firms in order to stimulate demand from the non-informed investors. Moreover, we find that post-IPO valuation is affected only by the idiosyncratic risk of the issuing firm. This finding supports the idea that information asymmetry of new issues and IPO underpricing are positively correlated as documented in previous studies. Finally, we note a positive relationship between the IPO market idiosyncratic risk during the IPO registration period and the issuing firm’s idiosyncratic risk computed during the first month of trading. We find that the degree of asymmetric information at the firm level, which is approximated by the IPO idiosyncratic risk, is positively correlated with the level of information asymmetry in the IPO market in pre-IPO. This implies that the degree of uncertainty associated with previous IPOs affects the level of equity pricing accuracy for following IPOs through its idiosyncratic risk component.

[37] Campbell, Lettau, Malkiel and Xu (2001) use the variance of the shocks to firm returns as a proxy for idiosyncratic firm risk.

2- Methodology

2.1- The issuing firm's valuation pre- and post-IPO

The pre-IPO valuation is approximated by the Price-to-Value (P/V) ratio as computed by Zheng (2007) as follows:

$$\left(\frac{P}{V}\right)^{Z}_{EBITDA} = \frac{\left[\dfrac{Offer\ Price \times (CRSPSharesOutstanding - NewPrimaryShares) - Cash + TotalDebt}{EBITDA(PriorOfferingQuarter)}\right]_{IPO}}{\left[\dfrac{Market\ Price(OneDayPriortheIPOOfferDate) \times CRSPSharesOutstanding - Cash + TotalDebt}{EBITDA(PriorOfferingQuarter)}\right]_{Match}} \quad (1)$$

The P/V ratio for IPO is measured by dividing the IPO *Offer Price* multiple by the matched firm's market price multiple. The matched firm's *Market Price* refers to the closing price on the day before the IPO. *CRSP shares outstanding* for IPO (matched firm) corresponds to the shares outstanding at the closing price on (prior) the first day of IPO trading. *New Primary Shares* are excluded in the IPO valuation to avoid the "overpricing" bias. *Cash* (Compustat data item 1) for both IPOs and matched firms are also excluded to correctly measure the value of the two firms that may have different cash holdings. *Total Debt* (Compustat data item 9 plus 34) is added to the price of equity to avoid problem about leverage because IPOs and matched firms may have different amounts of debt. As recognized by Purnanandam and Swaminathan (2004), *EBITDA* (Earnings before Interest, Taxes and Depreciation and Amortization) which measures operating income is "less subject to accounting distortions". Therefore, we use Price-to-EBITDA. Both IPOs and matched firms should have information on EBITDA (data item 13 in Compustat) available on Compustat (both active and research) for the prior quarter of the offering. If $\left(\frac{P}{V}\right)^{Z}_{EBITDA} > 1$, then the IPO offer price is established above the fair value of the issue, which we define as an overvalued IPO by the underwriter. If $\left(\frac{P}{V}\right)^{Z}_{EBITDA} < 1$, then the IPO offer price is established below the fair value of the issue, which we define as an undervalued IPO by the underwriter.

The post-IPO valuation is assessed by the IPO initial return on the first day of IPO trading, which has frequently been used in previous studies as an IPO underpricing measure:

$$DIR_i = \left[\frac{P_1^i - P_o^i}{P_o^i} \right] \times 100 \quad (2)$$

where P_o^i is the offer price of IPO (i) and P_1^i is the closing price on the first day of trading.

2.2- Risk measures pre- and post-IPO

While previous authors such as Ritter (1984) use the volatility of IPO initial return to proxy for issuing firm risk, our research stipulates that the risk impact on IPO valuation depends on the type of the issuing firm risk. Therefore, we consider not only the IPO total risk, but we decompose it into two components (systematic and idiosyncratic). These risk components are assessed based on the modified Fama and French (2003) model that include the lagged-factor effect as in the study by Ritter and Welch (2002), who conclude that systematic risk may be underestimated when the lagged effect is ignored (p. 1819):

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i (R_{m,t} - R_{f,t}) + \beta_i' (R_{m,t-1} - R_{f,t-1}) + s_i SMB_t + s_i' SMB_{t-1} + h_i HML_t + h_i' HML_{t-1} + \varepsilon_{i,t}^{FF(lag)} \quad (3)$$

where $(R_{i,t} - R_{f,t})$ is the stock excess return for firm (i) relative to the risk-free rate in t, $(R_{m,t} - R_{f,t})$ and $(R_{m,t-1} - R_{f,t-1})$ are the market risk premium in t and t-1, respectively; SMB_t and SMB_{t-1} are the size factor measured by the return on a portfolio of small stocks minus the return on a portfolio of large stocks in t and t-1, respectively; and HML_t and HML_{t-1} are the book-to-market factor measured by the return on a portfolio of high book-to-market stocks minus the return on a portfolio of low book-to-market stocks in t and t-1, respectively.

First, we compute three risk components at the firm level: (1) firm total risk, (2) firm idiosyncratic risk and (3) firm systematic risk. The total risk of firm (i) during the first trading month following the IPO (equivalent to 21 trading days) is measured as follows:

$$TOTRISK_i = VAR(R_{i,t} - R_{f,t}) \times 10^4 . \tag{4}$$

The idiosyncratic risk component of firm (i) is estimated by the variance of the model residuals during the first trading month from the offering date:

$$IV_i^{FF_{lag}} = VAR(\varepsilon_{i,t}^{FF_{lag}}) \times 10^4 . \tag{5}$$

The systematic risk of firm (i) during the first trading month following the IPO is approximated by the difference between total and idiosyncratic risk given by:

$$SV_i^{FF_{lag}} = VAR\left(R_{i,t} - R_{f,t}\right) \times 10^4 - VAR(\varepsilon_{i,t}^{FF_{lag}}) \times 10^4 . \tag{6}$$

Second, because new issues have no stock market price history before the offering date, we compute three risk components at the IPO market-level during the month before the offering (m-1), which correspond to the registration period of new issues: (1) IPO market total risk, (2) IPO market idiosyncratic risk and (3) IPO market systematic risk. Benveniste, Busaba and Wilhelm (2002) argue that information produced by firms that go public influences not only their own production decisions but also those of their rivals. These authors note that "the transfer between pioneers and followers leads to a more equitable distribution of information-production costs (p. 62)". Therefore, we suggest that the degree of uncertainty associated with pioneers could affect equity pricing and its level of accuracy for followers. Hence, we use IPO market risk instead of overall market risk as a proxy for IPO ex-ante uncertainty. The IPO market total, systematic and idiosyncratic risks in month (m-1) before the offering of IPO (i) are, respectively, measured as follows: (1) $VWTOTRISK_{m-1,i}^{IPOMARKET} = \sum_{j=1}^{n_{m-1}} \omega_j TOTRISK_j$, (2) $VWSV_{m-1,i}^{IPOMARKET} = \sum_{j=1}^{n_{m-1}} \omega_j SV_j^{FF_{lag}}$ and (3)

$VWIV_{m-1,i}^{IPOMARKET} = \sum_{j=1}^{n_{m-1}} \omega_j IV_j^{FF_{lag}}$, where ω_j corresponds to the weight of IPO (j) in the previous calendar month (m-1), which equals $\frac{MV_j}{\sum_{j=1}^{n_{m-1}} MV_j}$ for value-weighted (*VW*) measures; n_{m-1} is the number of IPOs in the previous calendar month (m-1); and MV_j is the market value on the first trading day of IPO (j). $TOTRISK_j$, $IV_j^{FF_{lag}}$ and $SV_j^{FF_{lag}}$ correspond to the first-month total, idiosyncratic and systematic risks of IPO (j), as computed in Equations (4), (5) and (6), respectively.

2.3- Risk impact on IPO pricing

The impact of each risk component on IPO pricing in the pre- and post-IPO market and the IPO risk attributes are displayed in the following simultaneous equations:

$$\left(\frac{P}{V}\right)_{EBITDA,i}^{Z} = \alpha_0 + \alpha_1 VWRISK_{m-1,i}^{IPOMARKET^*} + \sum_{k=1}^{K} \alpha_{k'+1} VC_{i,k} + \tilde{\varepsilon}_i. \quad (7)$$

$$DIR_i = \beta_0 + \beta_1 \left(\frac{P}{V}\right)_{EBITDA,i}^{Z} + \beta_2 VWRISK_{m-1,i}^{IPOMARKET^*} + \beta_3 RISK_i^* + \sum_{k'=1}^{K'} \beta_{k'+3} VC_{i,k'} + \tilde{\vartheta}_i. \quad (8)$$

$$RISK_i^* = \theta_0 + \theta_1 \left(\frac{P}{V}\right)_{EBITDA,i}^{Z} + \theta_2 VWRISK_{m-1,i}^{IPOMARKET^*} + \sum_{k'''=1}^{K'''} \theta_{k'''+2} VC_{i,k'''} + \tilde{\eta}_i. \quad (9)$$

where, $\left(\frac{P}{V}\right)_{EBITDA,i}^{Z}$ is the Price-to-Value ratio for IPO (i) as computed in Equation (1). DIR_i is the initial daily return of IPO (i), as defined in Equation (2). $RISK_i^*$ is the risk at the firm-level for IPO (i). $VWRISK_{m-1,i}^{IPOMARKET}$ is the average value-weighted risk at the IPO market-level in previous month of IPO (i). We use the following risk components: first, total risk in Model A; second, systematic risk in Model B; third, idiosyncratic risk in Model C. $VC_{i,k}$, $VC_{i,k'}$ and $VC_{i,k''}$ are, respectively, the explanatory variables that control for some IPO attributes that may affect the

IPO ex-ante valuation, IPO initial return and issuing firm's risk according to previous IPO literature (control variables are defined in Table A in Appendix).

3- Data and descriptive statistics

3.1- IPO sample and peer firm selection

Our sample consists of initial public offerings in the U.S. from 2000 to 2009 collected from CRSP (Center for Research in Security Prices). We follow P&S (2004) and select IPOs that issue ordinary common shares (codes 10 and 11). IPOs with specific characteristics (i.e., Units, Closed-end funds, Real Estate Investment Trusts, American Depositary Receipts and Shares of Beneficial Interest) are excluded from the sample. For an IPO to be included in our sample, returns should be available from CRSP for the first month after the IPO and sales, EBITDA (earnings before interest, taxes, depreciation and amortization), EPS (earning per share) percentage change and leverage, which are collected from the Compustat database industrial files (both active and research), should be available for IPOs during the quarter prior to the offer. The number of ordinary common shares issued on Bloomberg between 2000 and 2009 is 1,440 shares. After matching our sample with the available information in CRSP and Compustat, our final sample contains 538 IPOs. Of these IPOs, 17% went public in 2000, which is defined in the literature as a "hot-issue" period. The majority of new issues in 2000 (70%) are high-tech firms.

We match firms in the same industry based on fundamentals (net sales, EBITDA profit margin, EPS percentage change and leverage), to avoid market price effect (Bhojraj and Lee, 2002). Each IPO is matched with a non-IPO firm in the same industry[38], firstly with comparable net sales and EBITDA profit margin; secondly with comparable net sales, EBITDA profit margin and EPS percentage change; and thirdly with comparable net sales, EBITDA profit margin, EPS

[38] CNMR includes sustainable and unsustainable consumption, wholesale, retail, and some services (laundries, repair shops). MANUF includes manufacturing, energy and utilities. HITEC includes business facilities, telephone and television transmission. HLTH includes health care, medical equipment and medicines. OTHER includes mining, construction, transportation, hotels, services, entertainment and financial sector. The industrial classification is based on a webpage for Kenneth R. French (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/).

percentage change and leverage. Only firms that went public over the last five years[39] are included in our sample. The selection of the appropriate peer firm for each IPO is accomplished using the propensity score match according to the nearest neighbor (greedy) matching method. Table III. 1 reports IPOs versus a propensity score matched firm's characteristics according to three matching procedures: (1) Industry/Size/Profitability Matching, (2) Industry/Size/Profitability/Growth Matching and (3) Industry/Size/Profitability/Growth/Leverage Matching. Table III. 1 shows that the second matching procedure based on Industry/Size/Profitability/Growth presents the lowest levels of the standardized differences (SB) between IPOs and control firms for three criteria (Net Sales, EBITDAM and EPS). SB between IPOs and control firms for EBITDAM exceeds 10% for Industry/Size/Profitability/Growth/Leverage matching procedure. We conclude that the second matching procedure allows us to obtain the matched firms that are the closest to our IPO sample.

Table III. 1: IPOs versus propensity score matched firm characteristics

This table compares firm fundamentals (Net Sales, EBITDAM, EPS and LEVERAGE) of an IPO portfolio with their matching firms according to three matching alternatives (*Industry/Size/Profitability ISP Matching, Industry/Size/Profitability/Growth ISPG Matching and Industry /Size/Profitability/Growth/Risk ISPL Matching*). Propensity score match is used to match one IPO with a single established firm (non-IPO). Net Sales, EBITDAM, EPS and LEVERAGE are obtained from Compustat. The industrial classification is based on the website of Kenneth R. French. SB (standardized difference) is the difference of the average value of a given covariate between the IPO and control group divided by the square root of the average variance between the IPO and control group.

Matching criteria	IPO Firms					Matched Firms					Mean.Diff	SB (%)
	N	Mean	25%	median	75%	N	Mean	25%	median	75%		
ISP Matching	844					844						
Net Sales ($ Millions)		122.10	7.76	26.25	85.20		122.52	7.97	26.45	85.08	-0.42	-0.10
EBITDAM ($ Millions)		-351.78	-10.30	10.10	22.27		-185.35	-1.54	10.05	23.24	-166.43	-7.97
ISPG Matching	571					571						
Net Sales ($ Millions)		91.41	6.91	24.49	71.68		92.53	8.00	24.48	75.74	-1.11	-0.44
EBITDAM ($ Millions)		-364.28	-25.31	8.97	20.56		-447.06	-3.81	9.60	21.79	82.77	1.61
EPS (%)		24.4572	-46.79	18.51	80.00		25.73	-31.10	15.80	68.08	-1.27	-0.63
ISPGL Matching	538					538						
Net Sales ($ Millions)		84.83	6.58	23.12	67.28		100.52	7.44	22.09	84.51	-15.69	-6.77
EBITDAM ($ Millions)		-387.18	-29.45	8.42	19.65		-73.59	-0.53	10.55	20.94	-313.59	-14.36
EPS (%)		27.77	-46.06	17.44	79.35		44.572	-22.34	16.73	76.63	-16.79	-8.28
LEVERAGE (%)		49.82	0.00	20.08	104.50		42.79	0.00	14.12	74.36	7.03	3.67

[39] Loughran and Ritter (2000) consider firms that went public at least five years ago as non-IPO firms.

3.2- Price-to-Value ratio, initial returns and risk measures

Table III. 2 reports the pre-IPO valuation based on P/EBITDA multiple according to the P&S (2004) and Zheng (2007) methods. The median of P/V ratio according to P&S's valuation method[40] is equal to 1.16 (1.15 and 1.25) when Industry/Size/Profitability/Growth (ISPG) (Industry/Size/Profitability (ISP) and Industry/Size/Profitability/Growth/Leverage (ISPGL)) matching procedure(s) is (are) selected. The Wilcoxon p-value for the P&S valuation method allows us to reject the null hypothesis that the median of the P/V ratio is equal to 1 for all matching procedures. This result supports P&S (2004) who note that IPO offer prices are overvalued compared to the estimated issuing firm's intrinsic values. However, this overvaluation disappears when we consider the modified evaluation method of Zheng (2007) who excludes the new primary shares from shares outstanding, subtracts cash holdings from the market value and includes the value of debt. The Wilcoxon p-value for Zheng's valuation method does not reject the null hypothesis that the median of the P/V ratio is equal to 1 for the ISPG & ISPGL matching procedures. For the ISP matching procedure, the median of P/V ratio is 0.37 which is significantly different from 1. Using Zheng's method, we note that IPOs are correctly valued (undervalued) compared to the estimated issuing firms' intrinsic values based on ISPG and ISPGL (ISP) matching procedures. Our findings are consistent with Zheng (2007) who shows an upward bias in P&S's (2004) valuation method. Our results are robust to the Price-to-Value ratio based on the P/Sales multiple. Furthermore, we note the high median of the P/V ratio, especially during the internet bubble of 2000[41] and during the financial crisis in 2008[42]. We conclude that although our results have rejected the IPO overvaluation for the entire period of 2000-2009, we note that underwriters tend to overvalue IPO equities during specific periods characterized by high levels of asymmetric information.

[40] Price-to-Value ratio as computed by (P&S) (2004) does not exclude the new primary shares from shares outstanding, does not subtract cash holdings from the market value and does not include the value of debt.
[41] 5.56 (3.21) according to P&S (Zheng)'s method based on the ISPG matching procedure.
[42] 2.06 (0.99) according to P&S (Zheng)'s method based on the ISPG matching procedure.

Table III. 2: Pre-IPO valuation based on P/EBITDA multiple according to matching procedures

This table reports the distribution of the P/EBITDA ratio computed according to the P&S (2004) and Zheng (2007) methods through three matching procedures: (1) *Industry/Size/Profitability (ISP) Matching, (2) Industry/Size/Profitability/Growth (ISPG) Matching and (3) Industry /Size/Profitability/Growth/Risk (ISPL) Matching*). The null hypothesis of the Wilcoxon non-parametric statistical test is: the median of the P/EBITDA ratio is equal to one.

Matching Procedures	Purnanandam&Swaminathan (2004) method					Zheng (2007) method				
	No. of issues	**25%**	**Median**	**75%**	**Wicoxon *p-value***	**No. of issues**	**25%**	**Median**	**75%**	**Wicoxon *p-value***
ISP	483	0.52	1.15	2.58	<0.0001	434	0.14	0.37	0.86	<0.0001
ISPG	297	0.55	1.16	3.23	<0.0001	270	0.29	0.76	2.37	0.3366
ISPGL	268	0.66	1.25	2.97	<0.0001	234	0.35	0.87	2.24	0.1203

In addition, the IPO average initial return between 2000 and 2009, which reaches 17.52%, is significantly different from zero (t-test value is 17.09). The highest initial return (39.35%) is observed during the internet bubble in 2000, which is known as a hot-issue period. Previous authors often attribute this high initial return to the IPO underpricing phenomenon. However, we show that IPOs are overvalued compared to their peers during this hot-issue period. Therefore, we assume that other factors are related to the level of asymmetric information around the new issue or the IPO market in general that could affect IPO pricing in the early aftermarket stage. For this reason, we are interested in issuing firms' risk characteristics that could be involved in the IPO pricing process in the pre- and post-IPO market. We find that IPO average total risk for the period between 2000 and 2009 is 24.28. This average total risk is mainly attributed to an idiosyncratic fraction (the proportion of idiosyncratic risk relative to total risk is 78% (63%) for the idiosyncratic risk measure based on the standard (modified) model of Fama and French (2003). We note two specific periods that are characterized by the highest IPO risk. First, at the end of the internet bubble period, IPO total risk reaches 78.85 in 2000 and continues to be high (22.36) in 2001. Second, around the financial crisis period, IPO total risk reaches 20.49 in 2007 and 20.54 in 2008. Furthermore, with the exception of firms that went public in 2000, the risk difference between issuing firms and matched firms is not significant on average for either the idiosyncratic fraction or the systematic one.

4- Results of the cross-sectional relationship between IPO valuation and risk

Table III. 3 reports estimation results of simultaneous equation regressions for the risk impact on the Price-to-Value ratio[43] on the one hand, and IPO initial return on the other hand. Different risk measures are used to assess the impact of each risk component. We use value-weighted average measures of IPO market-level risk: IPO market total (Model A), systematic (Model B) and idiosyncratic (Model C) risks computed in the month prior to the IPO offering as well as issuing firm-level risk measures: total (Model A), systematic (Model B) and idiosyncratic (Model C) risk components assessed in the first month of IPO trading.

We show a negative and significant relationship between the Price-to-Value ratio and the previous month average IPO market total risk (Model A), which is mainly due to idiosyncratic risk (Model C) for all IPOs (Panel 1) and overvalued IPOs (Panel 2). We note an insignificant relationship between the Price-to-Value ratio and the previous month average IPO systematic risk (Model B) for the three panels (all IPOs, overvalued IPOs and undervalued IPOs). We conclude that the high level of asymmetric information proxied by the previous month's IPO market idiosyncratic risk negatively affects the P/V ratio especially for subsequent overvalued IPOs. This implies that the underwriter's IPO valuation is lower than the estimated intrinsic value based on a similar firm, which suggests that the asymmetric information in the IPO market leads underwriters to undervalue IPOs relative to their matched firms. This result is consistent with the winner's curse model of Rock (1986), which shows that lower offer prices motivate non-informed investors' demand and hence, reduce their informational disadvantage.

Since our findings show a negative and significant relationship between IPO market idiosyncratic risk and Price-to-Value ratio especially for overvalued IPOs (Panel 2), we infer that underwriters do not incorporate all the information provided by the IPO market during the pre-offer period when they overvalue some IPOs relative to their comparable firms. The information asymmetry in the IPO market should lead underwriters to propose lower offer prices for the new

[43] Price-to-Value ratio is computed based on Zheng's (2007) method valuation. Only results using P/V ratio based on *Industry/Size/Profitability/Growth* (ISPG) matching procedure are reported. Our findings are robust to IPO valuation methods and matching procedures used to select peers firms.

issues, as a result, IPOs should be undervalued relative to their peer firms. This implication is supported by our results for undervalued IPOs (Panel 3) that show insignificant relationship between IPO market risk components and the Price-to-Value ratio. Unlike for overvalued IPOs, underwriters appear to integrate their information on IPO market risk into the ex-ante IPO price when they undervalue IPOs relative to their comparable firms.

Besides, our results show that underwriters undervalue old issuing firms, which may be due to their low growth prospects. However, we note that underwriters overvalue issues characterized by large market capitalization and high ex-ante uncertainty inferred in the large range magnitude and high IPO price adjustment during the registration period. This opportunistic underwriter’s behavior could be explained by their informational advantage, which allows for maximizing the benefit for issuers and by extension their own profits.

In addition, when we consider all IPOs (Panel 1), we find an insignificant relationship between the three measures of IPO market-level risk (IPO market total, systematic and idiosyncratic risks computed in the month prior to the IPO offering) and IPO initial return. Although underwriters do not appear to incorporate information learned about the IPO market risk during the registration period in the IPO offer price, IPO market risk is incorporated into the IPO pricing in the post-IPO market. Only the idiosyncratic risk at the firm level significantly affects the post-IPO valuation for all IPOs (Panel 1). Table III. 3 shows a positive relationship between IPO idiosyncratic risk (Model C) and initial return for all IPOs. This finding is consistent with Jog and Wang (2002) who find that IPO initial returns are most sensitive to the issuing firm specific risk during the first 20 days of trading. We suggest that the reason why IPO prices do not incorporate the idiosyncratic fraction of the IPO risk is that specific risk factors of new issues are not fully disclosed to the public during the early aftermarket stage. The market would be able to learn more about the new issue over time.

However, when we distinguish between overvalued and undervalued IPOs panels, we note that the positive relationship between firm-level idiosyncratic risk and IPO initial return is supported statistically only for overvalued IPOs (Panel 2). The first-day return of undervalued

IPOs (Panel 3) is positively correlated with the systematic risk at the firm, as well as IPO market-level. The idiosyncratic risk does not affect first-day return of undervalued IPOs. It seems that, unlike overvalued IPOs, the price of undervalued IPOs in pre-IPO incorporates information about the issuing firm's idiosyncratic risk. Only systematic risk components at the firm and IPO market-level matter for undervalued IPOs pricing in the early aftermarket stage. Initial returns of undervalued (overvalued) IPOs are higher when considering systematic (idiosyncratic) risk. We conclude that when underwriters consider IPO market specific risk factors in the offer price settlement, the firm idiosyncratic risk will not be involved in the post-IPO valuation because it is already into the IPO price. Therefore, only systematic risk factors will matter in the early aftermarket pricing as the new issue has just gone public. However, when underwriters do not regard IPO market specific risk factors in the offer price settlement, the firm's idiosyncratic risk will play the most important role in the post-IPO valuation. Hence, it is the information asymmetry around issuing firms which explain overvalued IPOs high initial returns.

Moreover, we note a positive relationship between IPO market capitalization and IPO initial returns, which is consistent with Sohail and Raheman (2009) results. Table III. 3 shows a significant and negative relationship between the top three underwriters' rank and IPO initial returns. This finding supports Michaely and Shaw (1994) who argue that more qualified and renowned underwriters produce less IPO underpricing (p. 279). The results in Table III. 3 also show a significant and negative relationship between the number of shares offered in the IPO and initial returns on the one hand, and issuing firm idiosyncratic risk on the other hand. These findings are consistent with Lowry, Officer and Schwert (2010) who find that underwriters barely evaluate small offerings that are riskier (p. 435). Moreover, we find that IPOs whose prices are revised upwards during the pre-IPO market tend to have high initial returns on the first trading day. This finding supports the partial adjustment phenomenon previously documented by Benveniste and Spindt (1989). These authors argue that underwriters incorporate only a portion of the information collected from institutional investors into the IPO price to induce them to reveal their private information because they will be confident of increasing their wealth by selling IPO shares bought at a price below the expected value (p. 344).

We also consider the risk profile of the issuing firm. Table III. 3 shows a positive and significant relationship between the dummy variable associated with the high-tech industry and IPO idiosyncratic risk. It seems that technology issues represent riskier firms because their value depends on growth options (Lowry et al., 2010, p. 453). We also note that firms with high net income during the year prior to the IPO are characterized by lower idiosyncratic risk. The negative and significant relationship between the issuing firm idiosyncratic risk and the leverage ratio prior to the offering year supports the findings of Ross (1977) and Leland and Pyle (1977) who consider that bank debt contracts reduces the level of asymmetric information. Our findings also support those of Anderson (1996) who shows a positive relationship between trading volume and return volatility. However, the relationship between the issuing firm's risk and IPO volume, which reflects the asymmetric information level between investors (Miller and Reilly, 1987), is significant only for the idiosyncratic fraction of IPO risk. Finally, we show a positive and significant relationship between risk at the issuing firm level and previous month risk at the IPO market level, especially for the idiosyncratic risk fraction. We note, however, that this significant relationship is supported only for overvalued IPOs (Panel 2). If the IPO is undervalued relative to similar established firms in pre-IPO, its risk profile is not linked to IPO market risk during the registration period. When IPOs are overvalued relative to their peers, the level of information asymmetry in the IPO market during the IPO registration period affects positively the degree of information asymmetry at the firm-level during the early aftermarket stage, which is measured by its idiosyncratic risk fraction. We infer that there is a transfer of asymmetric information from pioneers to followers, especially for overvalued IPOs through the idiosyncratic risk component. Hence, we suggest that this idiosyncratic risk transfer from pioneers to followers could explain IPO misevaluation.

5- Conclusion

This paper contributes to the IPO literature by showing that the cross-sectional relationship between risk and IPO valuation depends greatly on the risk component (systematic or idiosyncratic) associated with the issuing firms and the market. Unlike previous research, our study examines not only IPO underpricing but also pre-IPO valuation and issuing firm risk in relation to information asymmetry. Consistent with asset pricing theory, the Price-to-Value ratio, which is our proxy for pre-IPO valuation, is not affected by systematic risk. This implies that IPOs are priced similarly to their matched peers when considering IPO market systematic risk. More interestingly, we show that IPOs are undervalued relative to comparable firms, when considering IPO market idiosyncratic risk. This suggests that the asymmetric information in the IPO market leads underwriters to propose low offer prices to stimulate investors' demand during the IPO registration period.

When we consider post-IPO valuation, we find that IPO market risk is incorporated in the IPO market price in the first day of trading. However, this IPO first-day price does not reflect the idiosyncratic risk at the firm level. Our results show a positive and significant relationship between initial returns and the idiosyncratic risk fraction of the issuing firm. This finding supports previous studies that show a positive relation between IPO underpricing and the degree of information asymmetry of the new issue. We add that this positive relationship is supported only for overvalued IPOs, suggesting that underwriters do not incorporate all information about the risk characteristics of the issuer into the offer price when they overvalue the issues. However, when information about the risk characteristics of the issuer are fully incorporated into the offer price, underwriters tend to undervalue the issues, which explain the no significant relationship between IPO initial return and firm-level idiosyncratic risk for the panel of undervalued IPOs. In this case, only systematic risks at the firm and IPO market levels matter in the pricing of undervalued IPOs.

Finally, our findings show that the degree of asymmetric information at the firm level, which is approximated by the IPO idiosyncratic risk during the first month of trading, is positively related to the level of information asymmetry in the IPO market during the IPO registration period. This finding is supported only for overvalued IPOs. We infer that the degree of uncertainty associated with pioneer IPOs is transferred only to following overvalued IPOs through their idiosyncratic risk, which is not fully incorporated in the offer prices.

Table III. 3: Simultaneous equations models for the relationship between risk measures, IPO ex-ante valuation and initial returns

This table reports results of simultaneous equations regressions with robust standard errors for the cross-sectional relationship between different risk measures, IPO ex-ante valuation and IPO initial return. For problems related to normality, heteroscedasticity, or some observations that exhibit large residuals, the standard error obtained from the asymptotic covariance matrix is considered more robust. The asymptotic covariance matrix is estimated under the hypothesis of heteroscedasticity. P-values correspond to t-tests based on heteroscedasticity-consistent standard errors of parameter estimates. In panel (1), results are reported for all IPOs in our sample. Then, on the basis of the Price-to-Value ratio, we distinguish between overvalued IPOs with P/V > 1 in panel (2) and undervalued IPOs with P/V < 1 in panel (3). $(P/V)^{Z}_{EBITDA}$ is the Price-to-Value ratio based on EBITDA, as computed in Equation (1). DIR is the IPO initial return of the first transaction day, as defined in Equation (2). The IPO offering prices were collected from Bloomberg database. IPO stock prices were collected from the CRSP database. TOTRISK is the total risk at the firm-level, as computed in Equation 4. SV_{FFlag} is the systematic risk at the firm-level, as assessed in Equation 6. IV_{FFlag} is the idiosyncratic risk at the firm-level, as assessed in Equation 5. $VWDIR_{m-1}$ is the average value-weighted IPO initial returns in previous month of IPO. $VWTOTRISK_{m-1}$, $VWSV_{m-1}$ and $VWIV_{m-1V}$ are the average value-weighted total, systematic and idiosyncratic risk at the IPO market-level in previous month of IPO. The simultaneous equations regressions include some control variables associated to issuing firm's characteristics (age, market capitalization, dummy equals one for HITEC firms, dummy equals one for issuers with negative net income in prior IPO year and leverage ratio in prior IPO year) and offer's attributes (dummy equals one for the top3 underwriter's rank, number of shares offered, dummy equals one for hot-issues, IPO price range magnitude, IPO price revision and IPO price update). More details about control variables are reported in Table A-1in the appendix. *** and ** indicates that the coefficient is significant at 1 % and 5 % level respectively.

Model A*: Relationship between total risk, Price-to-Value ratio and first-day returns*

	Panel (1): All IPOs			Panel (2): Overvalued IPOs			Panel (3): Undervalued IPOs		
Dependent Variables **Explanatory Variables**	$(P/V)^{Z}_{EBITDA}$	***DIR***	***TOTRISK***	$(P/V)^{Z}_{EBITDA}$	***DIR***	***TOTRISK***	$(P/V)^{Z}_{EBITDA}$	***DIR***	***TOTRISK***
Intercept	-62.8741**	-1.3949***	-46.4478	-114.2069	-2.5245***	-43.0832	-2.8188***	-0.8503***	-53.2382***
IPO ex-ante valuation									
$(P/V)^{Z}_{EBITDA}$		-0.0030	0.2430		-0.0034***	0.3912		0.0086	1.5538
Firm-level risk measures									
TOTRISK		0.0024			0.0017			0.0071**	
Market-level measures									
$VWDIR_{m-1}$	0.0878	0.0010		0.0766	0.0004		0.0025	0.0017	
$VWTOTRISK_{m-1}$	-0.0896**	0.0007	0.2430***	-0.1745**	0.0005	0.2189***	-0.0012	0.0020	0.1906
Firm's characteristics									
Log (Age+1)	-1.2785**	-0.0141	-0.6433	-2.6451**	-0.0085	1.5337	-0.0020	-0.0114	-1.3800**
Log (IPO Capitalization)	5.1326**	0.1414***	-0.3787	9.1010	0.2529***	-1.4774	0.2934***	0.0792***	-0.5902
Dummy HITEC	-1.2024	0.0015	4.1338	-3.0682	-0.0456	7.8237	-0.1500**	-0.0069	2.3350
Net Income $_{t-1}$	-0.0033	-0.0001	-0.0079**	-0.0049	-0.0009***	-0.0024	-0.0001	-0.0000	-0.0093**

Leverage Ratio $_{t-1}$	0.0010	-0.0004**	-0.0284	-0.0234	-0.0001	-0.0320	-0.0002	-0.0006	-0.0280
Offer's attributes									
TOP3 Underwriters	-1.1022	-0.0476**	-0.5133	-2.1557	-0.0640	0.9754	0.0057	-0.0335	-0.4950
Log (Share Offer)	-3.5954	-0.1448***	-4.6858	-3.7451	-0.2722***	0.4013	-0.3191***	-0.0725***	-6.1841**
Dummy Hot	11.9543	-0.0145	15.3735	17.5448	-0.0217	17.7522	-0.0227	-0.1525	14.1058
Range Magnitude	57.1139**	-0.1668	10.6807	111.9422**	-0.3433	22.7338	1.7073***	0.0975	2.2830
Revision	0.1274	0.0902***	-1.0979	-1.7564	0.0568***	1.0868	-0.0797***	0.0883***	-0.6013
Price Update	1.3545**	0.0181	-0.5715	2.6115	0.0267**	-3.1975	-0.0516***	0.0081	1.0924
Log (Volume)			5.2198			4.3280			6.3477***
Effective Spread			1.5731			11.2782***			0.0344
F	5.12	19.72	16.80	2.90	13.16	7.27	6.58	8.98	7.35
Pr > F	<.0001	<.0001	<.0001	0.0018	<.0001	<.0001	<.0001	<.0001	<.0001
R^2	0.2313	0.5746	0.5350	0.3199	0.7167	0.5829	0.4024	0.5187	0.4686
Adjusted R^2	0.1861	0.5455	0.5031	0.2094	0.6623	0.5027	0.3413	0.4610	0.4048
N.obs	302	302	302	110	110	110	192	192	192

Model B*: Relationship between systematic risk, Price-to-Value ratio and first-day returns*

	Panel (1): All IPOs			Panel (2): Overvalued IPOs			Panel (3): Undervalued IPOs		
Dependent Variables **Explanatory Variables**	$(P/V)^Z_{EBITDA}$	***DIR***	SV_{FFlag}	$(P/V)^Z_{EBITDA}$	***DIR***	SV_{FFlag}	$(P/V)^Z_{EBITDA}$	***DIR***	SV_{FFlag}
Intercept	-61.9042**	-1.4032***	-10.2961	-114.7836	-2.5034***	11.8569	-2.7880***	-0.8822***	-19.8211**
IPO ex-ante valuation									
$(P/V)^Z_{EBITDA}$		-0.0028	0.1853		-0.0029***	0.2111**		0.0039	1.9608
Firm-level risk measures									
SV_{FFlag}		0.0032			0.0010			0.0130**	
Market-level measures									
VWDIR $_{m-1}$	0.0557	0.0009		0.0515	0.0005		0.0027	0.0011	
VWSV $_{m-1}$	-0.0478	0.0040	0.3124	-0.0417	0.0029	0.2445	-0.0069	0.0120**	0.3718
Firm's characteristics									

Log (Age+1)	-1.1904**	-0.0142	-0.6560	-2.5314**	-0.0071	-1.3418	-0.0031	-0.0147	-0.3444
Log (IPO Capitalization)	5.0391**	0.1426***	-0.2628	9.1280	0.2511***	-0.5549	0.2922***	0.0829***	-0.4286
Dummy HITEC	-1.0113	0.0102	0.7749	-2.9490	-0.0333	2.4299	-0.1511***	0.0091	0.3990
Net Income $_{t-1}$	-0.0030	-0.0001	-0.0032	-0.0497	-0.0010***	-0.0022	-0.0001	0.0000	-0.0034*
Leverage Ratio $_{t-1}$	-0.0089	-0.0004**	-0.0145	-0.0234	-0.0002	-0.0076	-0.0002	-0.0006*	-0.0162
Offer's attributes									
TOP3 Underwriters	-1.2200	-0.0500**	0.1605	-1.9563	-0.0656	1.2224	0.0068	-0.0401	0.1217
Log (Share Offer)	-3.5798	-0.1455***	-1.3097	-3.8829	-0.2695***	2.9898	-0.3187***	-0.0704***	-2.4897**
Dummy Hot	8.8208	-0.0164	6.9247	17.2344	-0.0141	10.1939	0.0257	-0.1859	4.2673
Range Magnitude	54.5874**	-0.1616	4.8127	113.0584**	-0.3262	5.7938	1.6678***	0.1271	3.6100
Revision	0.2542	0.0927***	-0.9269	-1.7622	0.0598***	-0.5692	-0.0814***	0.0889***	0.1992
Price Update	1.3453**	0.0188	-0.7019	2.6702**	0.0023	-2.6388**	-0.0510***	0.0066	0.6888
Log (Volume)			1.5954			-0.3960			2.4144**
Effective Spread			0.6469			4.4354			-0.0242
F	4.96	19.36	9.72	2.83	12.71	5.37	6.64	10.35	3.65
Pr > F	<.0001	<.0001	<.0001	0.0022	<.0001	<.0001	<.0001	<.0001	<.0001
R^2	0.2257	0.5701	0.3997	0.3147	0.7096	0.5082	0.4046	0.5540	0.3048
Adjusted R^2	0.1802	0.5406	0.3585	0.2034	0.6537	0.4137	0.3437	0.5005	0.2214
N.obs	302	302	302	110	110	110	192	192	192

Model C: *Relationship between idiosyncratic risk, Price-to-Value ratio and first-day returns*

	Panel (1): All IPOs			**Panel (2): Overvalued IPOs**			**Panel (3): Undervalued IPOs**		
Dependent Variables / **Explanatory Variables**	$(P/V)^{Z}_{EBITDA}$	***DIR***	IV_{FFlag}	$(P/V)^{Z}_{EBITDA}$	***DIR***	IV_{FFlag}	$(P/V)^{Z}_{EBITDA}$	***DIR***	IV_{FFlag}
Intercept	-63.1340**	-1.3863***	-35.8173**	113.5574*	-2.5021***	-53.8353	-2.8248***	-0.8361**	-33.7227**
IPO ex-ante valuation									
$(P/V)^{Z}_{EBITDA}$		-0.0027	0.1852		-0.0034***	0.1845		0.0164	-0.3246
Firm-level risk measures									
IV_{FFlag}		0.0034**			0.0035**			0.0055	
Market-level measures									

VWDIR $_{m-1}$	0.0976	0.0013		0.0801	0.0008		0.0024	-0.0023	
VWIV $_{m-1}$	-0.1649**	0.0006	0.2218**	-0.2615**	-0.0001	0.2548**	-0.0011	0.0028	0.0829
Firm's characteristics									
Log (Age+1)	-1.3162**	-0.0160	0.0137	-2.7243**	-0.0140	2.9228	-0.0013	-0.0170	-1.0712***
Log (IPO Capitalization)	5.1543**	0.1414***	-0.1213	9.0759	0.2517***	-1.0584	0.2933***	0.0809***	-0.0882
Dummy HITEC	-1.2622	-0.0006	3.3932***	-3.1127	-0.0518	5.5998	-0.1490***	-0.0006	1.8656
Net Income $_{t-1}$	-0.0034	-0.0001	-0.0048**	-0.0488	-0.0010***	-0.0016***	-0.0001	0.0000	-0.0062
Leverage Ratio $_{t-1}$	0.0103	-0.0004**	-0.0138	-0.0228	-0.0001	-0.0239	-0.0002	-0.0008	-0.0131
Offer's attributes									
TOP3 Underwriters	-1.0787	-0.0461**	-0.7035	-2.3057	-0.0622	-0.3602	-0.0049	-0.0319	-0.5683
Log (Share Offer)	-3.5695	-0.1447***	-3.3284**	-3.6993	-0.2668***	-2.5910	-0.3190***	-0.0775***	-3.6772**
Dummy Hot	12.5862	0.0100	7.8180	16.8782	-0.0078	5.4454	-0.0469	-0.0507	10.8177
Range Magnitude	57.9528**	-0.1482	5.7177	110.0307**	-0.3394	14.5370	1.7101***	0.0880	0.5941
Revision	0.0934	0.0874***	-0.1496	-1.7372	0.0521**	1.6536	-0.0787***	0.0927***	-0.8388
Price Update	1.3508**	0.0163	0.1241	2.5981**	0.0235	-0.5683	-0.0518***	0.0150	0.4075
Log (Volume)			3.5914**			4.7684			3.8869***
Effective Spread			0.9143			6.6811**			-0.0028
F	5.24	19.44	14.31	2.91	13.54	6.29	6.56	6.98	5.61
Pr > F	<.0001	<.0001	<.0001	0.0017	<.0001	<.0001	<.0001	<.0001	<.0001
R^2	0.2356	0.5711	0.4950	0.3214	0.7225	0.5473	0.4018	0.4557	0.4023
Adjusted R^2	0.1906	0.5418	0.4604	0.2111	0.6692	0.4603	0.3405	0.3904	0.3306
N.obs	302	302	302	110	110	110	192	192	192

Appendix

Table A: Control variable definitions

Variables	Definitions
Firm's characteristics:	
Log (Age+1)	As in Lowry et al. (2010), we compute the logarithm of the number of years since the firm was founded at the time of the IPO plus one. Foundation dates are collected from the following website: (http://bear.warrington.ufl.edu/ritter/foundingdates.htm).
Log (IPO Capitalization)	Firm size is approximated by market capitalization, which is measured by the number of outstanding shares multiplied by the closing price during the first trading day.
Dummy HITEC	Equals one if the firm is in a high-tech industry (as defined in Kenneth French's website: (http://mba.tuck.dartmouth.edu/pages/), and zero otherwise.
Net Income $_{t-1}$	The net income of the firm during the year prior to the IPO.
Leverage Ratio $_{t-1}$	The leverage ratio of the firm during the year prior to the IPO as measured by the difference between total debt and total assets.
Offer's attributes :	
TOP3 Underwriters	Equals one if the underwriter is ranked 1st, 2nd or 3rd based on its market share listed in "*Bloomberg Underwriter Rankings*" database, and zero otherwise.
Log (Share Offer)	The logarithm of the number of shares (in millions) offered in the IPO.
Dummy Hot	Equals one if the firm went public during a hot market, and zero otherwise. Following Yang, Colak and Wang (2008), the issues are classified according to three issuance periods (hot, normal and cold) by comparing the moving average MA(4) of equally weighted quarterly measure of underpricing with the historical average IPO underpricing in previous quarters since 1960. If the moving average is 33% above (below) the historical average, the quarter is defined as hot-issue (cold-issue). The remaining quarters are defined as normal-issue.
Range Magnitude	The range magnitude is the percentage difference between the upper and lower bounds of the IPO price range, which is disclosed by the underwriter in the offering proceeding during the registration period. The range magnitude is used by Beatty and Ritter (1986) as a proxy for the ex-ante uncertainty about the issuing firm's value.
Revision	Revision, which is used by Löffler, Panther and Theissen (2005), is measured as follows: (Offer price – Upper bound) / (Upper bound – Lower bound). The upper and lower bound are those of the IPO price range proposed by the underwriter during the registration period. If the revision is $\geq$ 0.5, the offer price is upwardly adjusted to the midpoint of the range. If the revision is $\leq$ 0.5, the offer price is downwardly adjusted to the midpoint of the range.
$\lvert \text{Price update} \rvert$	Lowry et al. (2010) use the IPO price adjustment during the registration period, which is measured by the absolute value of the percentage change between the middle of the range of prices and the offer price, as a proxy of the learning level in the pre-IPO market.
Log (Volume)	The logarithm of the average transaction volume of IPO stocks during the first month of trading. Miller and Reilly (1987) use the transaction volume as a proxy for information asymmetry among investors.
Effective Spread	The effective spread is the average difference between the closing price and the bid-ask midpoint price during the first month of IPO trading. Houge, Loughran, Suchanek and Yan (2001) use the "*Bid-Ask Spread*" as a proxy for ex-post IPO uncertainty.

Chapter IV: How does risk affect IPOs versus non-IPOs' long-run performance?

Abstract

This paper highlights the role of the firm specific risk in the pricing of issuing and comparable non-issuing firms. This comparison leads to a new explanation for IPO long-run underperformance shown in the IPO literature. We use a new perspective that distinguishes between firms' risk components (systematic and idiosyncratic). Our purpose is to reveal how firm specific risk is involved in IPO pricing during its first three years of trading. Our findings show that IPOs exhibit a higher level of idiosyncratic risk than matched non-issuing firms while this difference tends to decrease over time. However, IPO systematic risk tends to increase over time, suggesting that high-idiosyncratic risk firms become more sensitive to market risk factors over time. Furthermore, when controlling for firm volatility, we find that the apparent underperformance of IPOs with respect to non-issuing firms shown by the standard Fama and French model is just a reflection of a lower exposure to the volatility risk for IPOs relative to their peers. Our results also show that the firm-level idiosyncratic volatility risk pricing leads to a significant long-run underperformance, especially for high-idiosyncratic risk IPOs, technology firms and hot new issues. We conclude that the mixed evidence in the literature relative to the IPO long-run performance is explained by the omission of controlling for some specific IPO characteristics including especially the firm-level idiosyncratic risk.

Keywords: initial public offerings; risk-return tradeoff; abnormal performance; systematic risk; idiosyncratic risk

Résumé

Cet article souligne le rôle du risque spécifique de la firme dans l'évaluation des firmes nouvellement introduites en bourse (IPOs) versus des firmes comparables non-IPOs. Cette comparaison conduit à une nouvelle explication pour la sous-performance à long terme des IPOs démontrée dans la littérature. Nous utilisons une nouvelle perspective qui établit une distinction entre les composantes systématiques et idiosyncratiques du risque des firmes. Notre but est de révéler comment le risque spécifique de la firme affecte l'évaluation des IPOs au cours de leurs trois premières années d'introduction en bourse. Nos résultats montrent que les IPOs présentent un niveau du risque idiosyncratique plus élevé que celui des firmes non-IPOs comparables. De plus, le risque idiosyncratique des IPOs présente une tendance baissière au fil du temps. Cependant, le risque systématique des IPOs présente une légère tendance haussière dans le temps, ce qui implique que les firmes à risque idiosyncratique élevé sont plus sensibles aux facteurs de risque de marché. En outre, en contrôlant pour la volatilité, nous constatons que la sous-performance apparente des IPOs par rapport aux non-IPOs comparables montrée par le modèle standard de Fama et French n'est que le reflet d'une exposition au risque de la volatilité qui est moins élevée pour les IPOs par rapport à leurs pairs. Nos résultats montrent également que la considération de la volatilité idiosyncratique de la firme dans l'évaluation des IPOs résulte en des sous-performances importantes à long terme, surtout pour les IPOs à risque idiosyncratique élevé, les firmes technologiques et les IPOs émis pendant des périodes à haute intensité d'émissions. Nous concluons que les résultats mitigés présents dans la littérature à propos de la performance à long terme des IPOs sont expliqués par l'omission de contrôler pour certaines caractéristiques spécifiques aux IPOs, en particulier le niveau du risque idiosyncratique de la firme.

Mots-clés: nouvelles introductions en bourse; relation risque-rendement; performances anormales; risque systématique; risque idiosyncratique

1- Introduction

The pricing of initial public offerings (IPO) has attracted the attention of many researchers in finance for decades. It has led to the identification in the literature of three anomalies in the IPO process. The first two anomalies are observed in the short-run, namely the hot-issue market for IPOs (Ritter, 1984) and IPO underpricing (Ritter and Welch, 2002). The third anomaly documented in the literature is the IPO long-run underperformance (Ritter, 1991).

It is interesting to note that empirical studies on IPO long-run performance present mixed evidence. Ritter (1991) and Loughran and Ritter (1995) report that IPOs underperform the market in the long run when they compare IPOs' returns to common market index returns[44]' returns. However, Brav and Gompers (1997) and Gompers and Lerner (2003) do not find evidence of long-run IPO underperformance. In fact, Barber and Lyon (1997), Kothari and Warner (1997) and Gompers and Lerner (2003) document that the long-run performance in IPOs depends on the methodology used to measure abnormal returns which could explain the mixed evidence on the behavior of IPO performance[45].

To shed more light on this debate, we study IPO long-run performance controlling for the issuing firm risk. Since the issuing firm does not have a historical record on the stock market, the uncertainty associated with its fair value is higher than for traded firms. Previous IPO literature documents the problem of asymmetric information around the new issues (Rock, 1986), which increases the complexity of the IPO pricing process. The majority of previous studies such as Ritter (1984) and Chiu (2005) use total volatility to proxy for IPO risk. However, it is interesting to distinguish the risk component which is associated to the issuing firm's specific characteristics because unlike information associated to the common market risk factors that are publicly available, some specific information about the issuer are not fully

[44] Five common indices are used by Loughran and Ritter (1995) as benchmarks: (1) CRSP Amex-NYSE equally-weighted (EW) index, (2) CRSP Amex-NYSE value-weighted (VW) index, (3) S&P 500 price index (without dividend income), (4) CRSP Nasdaq equally-weighted (EW) index and (5) CRSP Nasdaq value-weighted (VW) index.

[45] Beyond that debate, it remains that studies provide different explanations for the presence of IPO long-run abnormal performance. For example, some financial economists explain the IPO long-run underperformance by the agency problem between new shareholders and managers (Jain and Kim, 1994) or by the overestimation of future outcomes during the period of initial offering (Teoh, Welch and Wong, 1998). The behaviourists attribute IPO negative performance to fads (De Bondt and Thaler, 1985) and market timing (Loughran and Ritter, 2000) hypotheses.

disclosed during the registration period. Hence, the informational disparity between issuers and investors on the one hand, and informed investors and uninformed investors on the other hand is especially due to the luck of specific information about the new issue. In the context of asset pricing models, Campbell and Taksler (2003) use the idiosyncratic volatility to proxy for information asymmetry between the firm and market participants. Shleifer and Vishny (1997) show that stock mispricing depends heavily on the idiosyncratic component of risk rather than on the systematic one. Malkiel and Xu (2002) emphasize the important role of idiosyncratic volatility in explaining cross-sectional returns. In addition, they show that the predictive power of idiosyncratic volatility is higher than that of the "beta". Goyal and Santa-Clara (2003) conclude that idiosyncratic risk is priced by showing that it is a better predictor of expected returns than total market variance.

To gauge the importance of risk in IPO long-run performance, we conduct a comparative study between IPOs and their matched peers. While previous studies such as Brav and Gompers (1997), Barber and Lyon (1997) and Lyon et al. (1999) often use size (proxied by market capitalization) and book-to-market ratio to match firms, Bhojraj and Lee (2002) use firm's fundamentals to isolate the market pricing effect. We follow Bhojraj and Lee (2002) and match firms in the same industry based on fundamentals (net sales, EBITDA profit margin, EPS percentage change and leverage). Unlike previous studies such as Purnanandam and Swaminathan (2004) and Zheng (2007) which only compare an IPO's value to that of its peer to determine fair IPO value, this paper also considers the evolution of firm-level risk over time for issuing as well as their matched non-issuing firms to characterize the long-run performance of IPOs. While previous studies often use total volatility to proxy for IPO risk, this paper isolates the risk component which is tied to the issuing firm's specific characteristics given the asymmetric information that characterizes the IPO market.

With respect to the measurement of abnormal returns, the literature provides different approaches, although there is no consensus on the best methodological avenue. Besides the cumulative abnormal returns (CAR) and buy-and-hold abnormal return (BHAR) which are used in classic event studies, previous researchers have developed the method of calendar-time portfolios based on Jensen’s (1968) alpha. Jensen's alpha is the best known common measure to determine the abnormal return of a stock or a portfolio over the expected return which is based on the capital asset pricing model (CAPM). The CAPM considers the relative risk of the asset. Abnormal return measured by Jensen's alpha is then interpreted as being 'risk adjusted'. Since the CAPM only includes a single market risk factor, the coefficient associated to market factor is defined by Han (2011) as "the coefficient of relative risk aversion of a representative agent, and therefore positive". Furthermore, previous studies such as Spiegel and Wang (2005) frequently used the three-factor model of Fama and French (2003) who add to the standard CAPM other risk factors related to the size and book-to-market ratio. Campbell, Lo and MacKinlay (1997, p. 156) note that: "In practice the gains from employing multifactor models for event studies are limited. The reason for this is that the explanatory power of additional factors beyond the market factor is small, and hence there is little reduction in the variance of the abnormal return". However, although the market model is frequently used in event studies, it has been criticized by previous authors such as Coutts et al. (1995) who point out the misspecification of the model. In a survey conducted by MacKinlay (1997) on the methodologies used in event studies, we note that the reduction in the variance of abnormal returns will be greatest when the sampled firms share common characteristics, for example when they are in the same industry or share similar market capitalization group.

In our framework, we consider U.S. issuing as well as matched non-issuing firms that share common characteristics based on industry and firm’s fundamentals. Therefore, we start by assuming that abnormal returns should be computed on the basis of a standard three-factor model (3FF) of Fama and French (1993) which should give a more accurate measure of systematic risk. Furthermore, we assess long-run abnormal performance on the basis of the calendar-time portfolio method for the period of 2000-2012 as well as individual returns over the IPO event time of three years of seasoning. Moreover, since we need to include time-varying volatility, we use an approach in which both the level and the variance of IPO long-run returns are modeled with a GARCH (Engle, 1982, Bollerslev, 1986) specification in order to: (1) obtain a more accurate measure of long-run abnormal returns and (2) determine the long-run dynamics between risk and return in the specific case of IPOs equities.

Some theoretical studies such as Merton (1987) and Malkiel and Xu (2002) show that expected returns are higher for firms with high level of idiosyncratic risk. Other empirical studies (Lintner, 1965, Lehmann, 1990 and Fu, 2009) find a positive relationship between idiosyncratic volatility and returns. These authors argue that investors require a high premium for accepting to hold high idiosyncratic risk stocks. However, Arena, Haggard and Yan (2008) and Ang, Hodrick, Xing and Zhang (2006) show a negative relationship. Ang et al. (2006) explain the negative pricing of the idiosyncratic risk in the cross-section by the fact that high idiosyncratic risk stocks are more sensitive to market volatility risk, which lowers their returns. With respect to IPOs, Beaulieu and Mrissa Bouden (2015, a) find that IPOs exhibit high idiosyncratic risk during the early aftermarket stage, especially during hot-issue markets and crisis periods. Since the IPO market is characterized by higher asymmetric information than the established firms market, we suggest that IPO underperformance is due to the IPO idiosyncratic risk component. For this reason, this paper proposes refining the standard 3FF using a GARCH-M (in mean) model allowing time-varying idiosyncratic risk for unbiased abnormal return measurement. In addition to getting a better appreciation of IPO abnormal performance, our approach studies the relationship between risk and return bearing in mind two types of risk (systematic or idiosyncratic). We also investigate whether investors require compensation for systematic and idiosyncratic risks given the type of stock (IPO or non-IPO) and some IPO characteristics related to the pre-IPO valuation, the risk level in the early aftermarket stage, the industry and the issuance period. The objective of this paper is to focus on the impact of both firm-level risk components (systematic and idiosyncratic) on the long-run abnormal performance to reveal whether each type of risk is priced in both IPOs and non-IPOs equities.

The debate in the literature about IPO abnormal performance and whether risk is priced given the evidence provided in this paper allows us to ask the following questions: is risk-adjusted abnormal return significantly different between issuing and the matched non-issuing firms? Does the firm’s risk time behavior depend on the type of risk (idiosyncratic or systematic) or the type of firm (IPOs or non-IPOs)? Does risk-adjusted abnormal return depend on the profile of the new issue or the period of its issuance?

This paper provides answers to these questions by presenting a comparative study between IPOs and comparable non-IPO equities in terms of long-run performance, systematic and idiosyncratic risks during the first three years of the IPO initial offerings. Our findings emphasize the importance of pricing idiosyncratic risk in IPOs. We show that non-IPOs exhibit stable idiosyncratic risk over time, while IPO idiosyncratic risk is initially higher but presents a significant downward trend over the IPO event time of three years. These findings support the previous literature (Rock, 1986 and Benveniste and Spindt, 1989) that highlight the problem of asymmetric information in the IPO market especially in the early aftermarket stage. We contribute to the IPO literature by showing that the information asymmetry which we proxy by idiosyncratic risk continue to be high in the IPO market even after three years of the offering, although it decreases during that period. Moreover, we note that IPO systematic risk exhibits a slight significant increase over IPO event-time as the idiosyncratic risk component decreases. Despite of this IPO's idiosyncratic risk drop, it remains higher than that of their comparable non-issuing firms. This evidence suggests that market participants require an additional risk premium for IPO stocks to compensate the high levels of IPO's idiosyncratic risk.

We also note that the pricing of the aggregate as well as of the firm-level idiosyncratic volatility risk lower the abnormal performance measurements of both IPOs and matched non-IPOs. Our findings show that the difference on three-year horizon for abnormal return between IPOs and similar non-IPOs is insignificant when we use the calendar-time portfolio method which includes the aggregate volatility risk factor in the modified 3FF. The insignificance of the difference in three-year abnormal return between IPOs and similar non-IPOs is also supported by the IPO event method which includes the firm-level idiosyncratic volatility risk factor in the modified 3FF model.

The importance of pricing firm-level idiosyncratic volatility risk is emphasized when we examine the issuing firm's profile in terms of pre-IPO valuation, the risk level in the early aftermarket stage, the IPO industry and the IPO period of issuance. We show that unlike aggregate volatility risk which represents only the systematic volatility risk of the portfolio, the pricing of firm-level idiosyncratic risk leads to significant and negative long-run abnormal performance measures especially for high idiosyncratic risk IPOs, technology and hot new issues. We conclude that the IPO mispricing is mainly attributed to this firm-level idiosyncratic risk component.

The remainder of the paper is organized as follows: data and matched firm selection are reported in Section 2. Firm-level systematic and idiosyncratic risk over IPO event-time: IPOs versus matched non-IPOs equities, is investigated in Section 3. Section 4 focuses on the risk impact on long-run abnormal performance: IPOs versus non-IPOs equities. Section 5 presents the long-run performance and IPO's profile. Section 7 concludes.

2- Data and matched firms selection

2.1- IPO sample and data sources

Our sample consists of U.S. firms that issue ordinary common shares (codes 10 and 11) from January 2000 to December 2009. Following Brown and Kapadia (2007), IPOs with specific characteristics (i.e., units, closed-end funds, real estate investment trusts, American depositary receipts and shares of beneficial interest) are excluded from the sample. The number of ordinary common shares issued on Bloomberg between 2000 and 2009 is 1,440 shares. However, our sample only include IPOs whose returns are available from the Center for research in Security Prices (CRSP) database and sales, EBITDA (earnings before interest, taxes, depreciation and amortization), EPS (earning per share) percentage change are available from the Compustat database industrial files (both active and research) during the quarter prior to the offer.

After matching our sample with the available information in CRSP and Compustat, our final sample includes 571 IPOs (see Table IV. 1). Of these IPOs, 19% went public in 2000, which is defined in the literature as a "hot-issue" period. The majority of new issues in 2000 (70%) are high-tech firms.

2.2- Matching procedure and peer firm selection

Previous authors such as Brav and Gompers (1997) often use the following methods to identify a control firm: (1) similar firm with the closest IPO size proxied by market capitalization, (2) similar firm with the closest IPO Book-to-Market ratio and (3) similar firm with the closest IPO size and Book-to-Market ratio. When IPOs' returns are compared to those of similar firms selected on the basis of size and Book-to-Market ratio, Brav and Gompers (1997) do not find that IPOs underperform their peers in the long-run. Furthermore, Ang and Zhang (2004) consider that the size and Book-to-Market ratio are insufficient to identify a control firm for IPO. These authors suggest that there are further latent factors such as industry, momentum and common idiosyncratic factors linked to the geographic location, the capital structure, the governance, among others that could affect stocks' returns. Therefore, Ang and Zhang (2004) prefer control firms which consider the specific characteristics of the event firm. Bhojraj and Lee (2002) also criticize the selection of control firms on the basis of market value and Book-to-Market ratio because of the bias due to the market price effect since it is well known that IPO prices are supported by the underwriters' stabilization practices during the early aftermarket stage. In fact, Bhojraj and Lee (2002) suggest a more accurate technique for selecting comparable firms by isolating the pricing effect of other specific variables of interest for the researcher. In this framework, the market price does not necessary reflect the (unobserved) intrinsic value of the firm. Bhojraj and Lee (2002) show the efficacy of matching firms on the basis of their fundamentals compared to matching on the basis of other techniques, including industry and size matches (p. 407). Hence, in this paper, we follow Bhojraj and Lee (2002) and we match firms in the same industry based on firms' fundamentals (net sales, EBITDA profit margin, EPS (earning per share) percentage change and leverage ratio) instead of market capitalization and book-to-market ratio to avoid the market price effect.

Table IV. 1: IPO Sample

This table reports descriptive statistics on our IPO sample. We provide the numbers of IPOs per year and industry during the period 2000 and 2009. Each NYSE, AMEX, and NASDAQ IPO stock is assigned to an industry portfolio based on its four-digit SIC code (we use Compustat SIC codes for the fiscal year ending). The industrial classification is based on the website of Kenneth R. French (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/). Our IPO sample is classified into five industry: (1) CNMR includes sustainable and unsustainable consumption, wholesale, retail, and some services (laundries, repair shops), (2) MANUF includes manufacturing, energy and utilities, (3) HITEC includes business facilities, telephone and television transmission, (4) HLTH includes health care, medical equipment and medicines, and (5) OTHER includes mining, construction, transportation, hotels, services, entertainment and financial sector. Net Sales, EBITDA and EPS are obtained from Compustat during the quarter prior to the offer. EBITDA represents Earnings Before Interest and Taxes and Depreciation (Quarterly) (Net Sales less Cost of Goods Sold and Selling, General, and Administrative Expense before deducting Depreciation, Depletion, and Amortization). EPS represents Earning Per Share percentage change divided by Net Sales (Quarterly).

EAR	Number of issues	Returns available in CRSP & Data on net sales, EBITDA and EPS available in COMPUSTAT	INDUSTRIES				
			CNSMR	HITEC	HLTH	MANUF	OTHER
2000	323	108	3	76	14	6	9
2001	85	27	4	8	9	2	4
2002	84	33	10	10	5	0	8
2003	88	31	4	8	2	1	16
2004	228	96	13	25	25	7	26
2005	197	78	15	19	12	11	21
2006	173	71	10	14	16	9	22
2007	174	87	5	33	16	8	25
2008	30	16	0	2	3	2	9
2009	58	24	2	3	3	1	15
Total	1440	571	66	198	105	47	155

First, we match on industry because firms in the same industry face similar operating risks. Second, we match on net sales which are our ex-ante proxy of size. Then, we match on EBITDA profit margin to select firms with profitability as close as possible to the IPO. Besides, we match on EPS percentage change to choose firms with similar growth perspectives to IPOs. Finally, we match on leverage to select firms with similar capital structure.

We first consider all active firms on Compustat and research files for the fiscal year prior to the IPO year. Only firms that went public during at least five years ago[46] and were ordinary common shares are reviewed. For these firms, as well as for our IPO sample, we obtain SIC codes from CRSP as of the end of the prior calendar year and we group them into five industries using the industry classifications of Kenneth French[47]. We use the propensity score

[46] Loughran and Ritter (2000) consider non-IPOs firms those that went public at least five years ago.
[47] CNMR includes sustainable and unsustainable consumption, wholesale, retail, and some services (laundries, repair shops). MANUF includes manufacturing, energy and utilities. HITEC includes business facilities, telephone and television transmission. HLTH includes health care,

match according to the nearest neighbor (greedy) matching method to select the appropriate peer firm for each IPO based on firms' fundamentals (Industry, net sales, EBITDA profit margin and EPS (earning per share) percentage change) during the quarter prior to the offer. In our previous research (Beaulieu and Mrissa Bouden, 2015, b), we use three matching procedures to select matched firms: (1) Industry/Size/Profitability Matching, (2) Industry/Size/Profitability/Growth Matching and (3) Industry/Size/Profitability/Growth/Leverage Matching. Table IV. 2 shows that the second matching procedure (Industry/Size/Profitability/Growth) allows us to obtain the matched firms that are the closest to our IPO sample because it provides the lowest levels of the standardized differences (SB) between IPOs and control firms. Hence, we retain the non-IPOs' firms that are matched according to industry, net sales, EBITDA profit margin and EPS percentage change, as peer firms to our IPO sample[48].

Table IV. 2: IPOs versus propensity score matched firm characteristics

This table compares firm fundamentals (Net Sales, EBITDAM, EPS and LEVERAGE) of an IPO portfolio with their matching firms according to three matching alternatives (*Industry/Size/Profitability ISP Matching, Industry/Size/Profitability/Growth ISPG Matching and Industry /Size/Profitability/Growth/Risk ISPL Matching*). Propensity score match is used to match one IPO with a single established firm (non-IPO). Net Sales, EBITDAM, EPS and LEVERAGE are obtained from Compustat. The industrial classification is based on the website of Kenneth R. French. SB (standardized difference) is the difference of the average value of a given covariate between the IPO and control group divided by the square root of the average variance between the IPO and control group.

Matching criteria	IPO Firms					Matched Firms					Mean.Diff	SB (%)
	N	Mean	25%	median	75%	N	Mean	25%	median	75%		
ISP Matching	844					844						
Net Sales ($ Millions)		122.10	7.76	26.25	85.20		122.52	7.97	26.45	85.08	-0.42	-0.10
EBITDAM ($ Millions)		-351.78	-10.30	10.10	22.27		-185.35	-1.54	10.05	23.24	-166.43	-7.97
ISPG Matching	571					571						
Net Sales ($ Millions)		91.41	6.91	24.49	71.68		92.53	8.00	24.48	75.74	-1.11	-0.44
EBITDAM ($ Millions)		-364.28	-25.31	8.97	20.56		-447.06	-3.81	9.60	21.79	82.77	1.61
EPS (%)		24.4572	-46.79	18.51	80.00		25.73	-31.10	15.80	68.08	-1.27	-0.63
ISPGL Matching	538					538						
Net Sales ($ Millions)		84.83	6.58	23.12	67.28		100.52	7.44	22.09	84.51	-15.69	-6.77
EBITDAM ($ Millions)		-387.18	-29.45	8.42	19.65		-73.59	-0.53	10.55	20.94	-313.59	-14.36
EPS (%)		27.77	-46.06	17.44	79.35		44.572	-22.34	16.73	76.63	-16.79	-8.28
LEVERAGE (%)		49.82	0.00	20.08	104.50		42.79	0.00	14.12	74.36	7.03	3.67

medical equipment and medicines. OTHER includes mining, construction, transportation, hotels, services, entertainment and financial sector. The industrial classification is based on the website of Kenneth R. French (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/).

[48] The difference in leverage between IPOs and matched non-issuing firms selected on the basis of Industry/Size/Profitability/Growth Matching is about -5% for the median (and -11% for the standardized difference in mean). Following Purnandam and Swaminanthan (2004, p.844) who note a difference ranging between 8% and 12% in leverage between over and undervalued IPOs, we note that 11% (in absolute value) of difference in leverage between IPOs and their peers should not cause significant differences in financial risk and cost of equity.

3- Firm-level systematic and idiosyncratic risks' variation over IPO event-time: IPOs versus matched non-IPOs equities

While the volatility of returns is commonly used in the literature as a risk proxy, this paper distinguishes between two types of risks: (1) systematic risk which is associated with common market factors and (2) idiosyncratic risk which relates to specific-firm risk factors. Previous research (Campbell, Lettau, Malkiel, and Xu, 2001 and Bali et al., 2005) frequently uses the CAPM to quantify risk. However, systematic risk could be underestimated when we only consider the market factor to assess it. In this paper, we use the following three-factor model (3FF) of Fama and French (1993) that add the size and the market-to-book factors to the market factor, in order to estimate both risk components (systematic and idiosyncratic):

$$R_{i,j}-R_{f,j}=\alpha_i+\beta_{MKT_i}(R_{m,j}-R_{f,j})+\beta_{SMB_i}SMB_j+\beta_{HML_i}HML_j+\varepsilon_{i,j} \quad (1)$$

where $(R_{i,j}-R_{f,j})$ is the stock excess return for firm (i) relative to the risk-free rate on day j, $(R_{m,j}-R_{f,j})$ is the market risk premium on day j, SMB_j is the size factor measured by the return on a portfolio of small stocks minus the return on a portfolio of large stocks on day j, HML_j is the book-to-market factor measured by the return on a portfolio of high book-to-market stocks minus the return on a portfolio of low book-to-market stocks on day j, the intercept α_i measures the abnormal return for the stock i during the period of study. We estimate abnormal returns and risk measurements for each individual stock in each quarter during the first three-year of seasoning (the first 12 quarters of the initial offering).

We compute three risk components for each stock i during the first 12 quarters of the initial offering (equivalent to 62 days of trading in each quarter): (1) the realized total risk, (2) the realized idiosyncratic risk and (3) the realized systematic risk.

The realized total risk[49] $RTV_i^{Q_t}$ for stock (i) in quarter t (j = 62) is measured as follows:

$$RTV_i^{Q_t} = VAR(R_{i,j} - R_{f,j}) \times 10^4, \tag{2}$$

The realized idiosyncratic risk $RIV_i^{Q_t}$ for stock (i) is estimated by the variance of the model residuals in quarter t (j = 62):

$$RIV_i^{Q_t} = VAR(\varepsilon_{i,j}) \times 10^4. \tag{3}$$

The realized systematic risk $RSV_i^{Q_t}$ for stock (i) in quarter t (j = 62) is approximated by the difference between total and idiosyncratic risk given by:

$$RSV_i^{Q_t} = VAR\left(R_{i,j} - R_{f,j}\right) \times 10^4 - VAR(\varepsilon_{i,j}) \times 10^4. \tag{4}$$

Figure IV. 1 reports the temporal behavior of the realized total, idiosyncratic and systematic risks during the first 12 quarters of IPO trading for both samples (IPOs and their comparables non-IPOs). We find that IPOs are riskier than their peers in terms of total, systematic and idiosyncratic risks. The idiosyncratic risk represents the largest proportion of the total risk of issuing as well as matched non-issuing firms. Unlike for matched firms, a downward trend is noted for the IPO's realized total risk over the first 12 quarters of the offering. The IPO realized total risk behavior over the event time is due especially to its idiosyncratic risk component[50].

We also show that the difference in the idiosyncratic risk components between issuing and matched non-issuing firms is large in the early aftermarket stage, and becomes smaller towards

[49] We follow Campbell et al. (2001) who asses risk by the variance of a stock excess returns relative to the risk-free rate.

[50] These downward trends in realized total and idiosyncratic risks persist when we include only new issues that survive during the first three years of issuance. Brown and Kapadia (2007) find that "new firms that delist exhibit both much higher average volatility and the greatest increase (and subsequent decline) in volatility (p. 387)". Our finding is robust to this delisting bias. These downward trends in realized total and idiosyncratic risks are not due to non-survivors IPOs (firms that delist before three years of their initial offering).

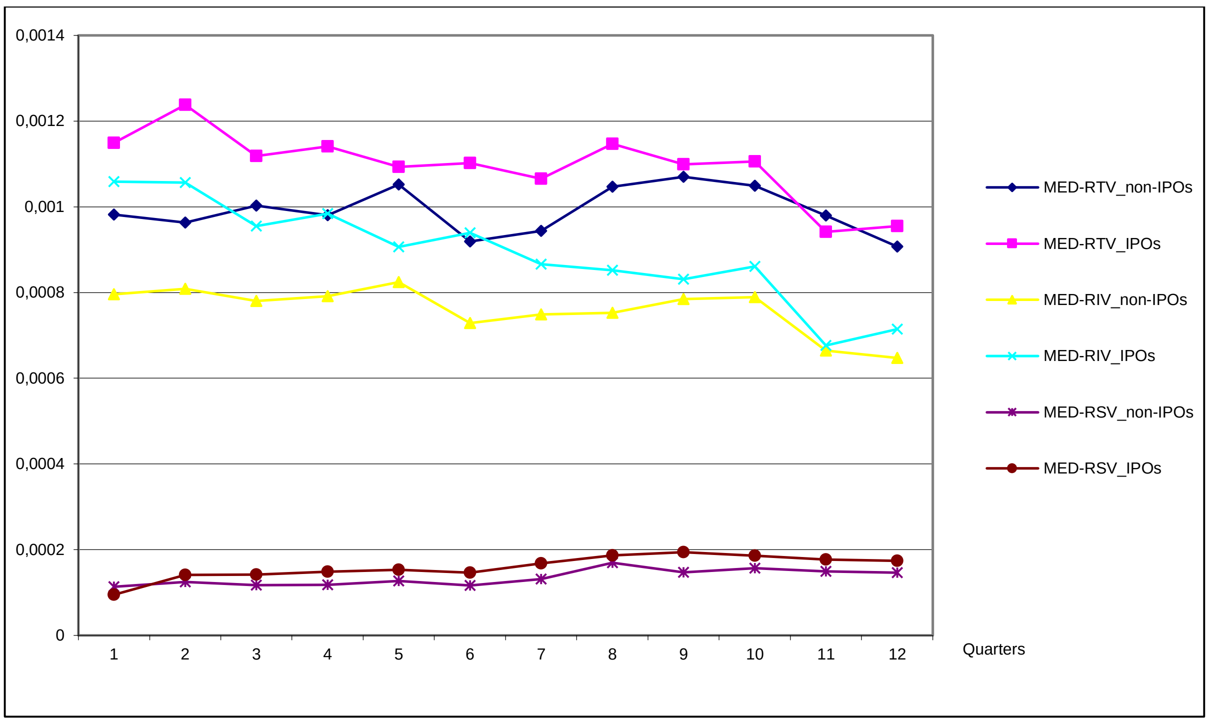
the end of the third year of the offer. We note, however, a slight upward trend for IPO realized systematic risk which is similar to the temporal behavior of the realized systematic risk for comparable non-IPOs firms.

We point out that the difference in systematic risk between issuing and matched non-issuing firms is thin in the early aftermarket stage, and becomes slightly larger towards the end of the third year of the offer. We also show that although the IPO realized total risk appears to be higher than for similar non-issuing firms during the entire period, the two lines associated with the RTV intersect in quarter 11. It seems that in this quarter, realized total risk is slightly larger for matched non-issuing firms. This reversal pattern is due to the systematic risk component being larger for IPOs during this quarter. This motivates the distinction between both risk components in order to reveal which risk component drives the IPO total risk time variation over each period of time.

The non parametric Mann-Kendall test and the Sen's slope estimator are used to determine the significance level and the slope of the trend (see Table IV. 3). The Mann-Kendall test allows us to reject the null hypothesis of no trend for the IPO's realized total and idiosyncratic risks. In addition, we find a negative Sen slope estimator which is lower for the IPO's idiosyncratic risks than for the IPO's realized total risk. However, the Mann-Kendall test failed to reject the no-trend hypothesis for comparable non-IPO's realized total and idiosyncratic risks. The Mann-Kendall test and the Sen's slope estimator suggest a significant negative trend in IPO risk, especially its idiosyncratic component over the first 12 quarters of the offering. As IPO stocks are traded for the first time during this initial public offering event, market participants do not yet know the risk characteristics of the new issue. We note that the problem of asymmetric information is more important in the IPO stocks than for established firms which is consistent with higher levels of IPO idiosyncratic risk during the early aftermarket stage. Nevertheless, as the market provides more information about the new issues over time, the level of IPO idiosyncratic risk tends to decrease, approaching the idiosyncratic risk level of its comparable firm.

As for systematic risk, we show a significant but slight upward trend in both samples (IPOs and their comparable non-IPOs). The positive Sen's slope estimator supports these upward trends. Moreover, we show that the Sen's slope is higher for IPO systematic risk with respect to comparable non-IPOs firms. Since IPOs have no market history, the market risk aversion is higher for these new arrivals, which could explain why IPOs are slightly more sensitive than their peers to systematic risk factors.

Figure IV. 1: Realized total, idiosyncratic and systematic risks during the first 12 quarters of IPO trading: IPOs versus non-IPOs



This figure reports the median quarterly realized total (RTV), idiosyncratic (RIV) and systematic risk (RSV) for IPOs and non-IPOs (Non-IPOs are firms comparable with IPOs according to Industry/Size/Profitability/Growth (ISPG)) computed for the first 12 quarters of IPO trading (three years) based on Fama-French three factors model.

Table IV. 3: The Mann-Kendall trend test for realized total, idiosyncratic and systematic risks during the first 12 quarters of IPO trading: IPOs versus non-IPOs

This table reports the non parametric Mann-Kendall trend test and the Sen's slope estimator used to determine the significance level and the slope of the trend in the quarterly realized total (RTV), idiosyncratic (RIV) and systematic risk (RSV) for IPOs and comparable non-IPOs firms. These three risk components (RTV, RSV and RIV) are computed on the basis of the 3FF model over the first 12 quarters of IPO trading (three years).

Trend test	IPOs			Non-IPOs		
	RTV	**RSV**	**RIV**	**RTV**	**RSV**	**RIV**
Kendall's tau	-0.491	0.600	-0.818	-0.018	0.491	-0.418
(p-value)	(0.041)	(0.010)	(0.000)	(1.000)	(0.041)	(0.087)
Sen slope	-1.979×10^{-5}	4.601×10^{-6}	-3.055×10^{-5}	-9.634×10^{-8}	3.805×10^{-6}	-1.202×10^{-5}

Table IV. 4 reports some descriptive statistics for the realized total, idiosyncratic and systematic risks during the first 12 quarters of IPO trading for both samples (IPOs and their matched non-IPOs equities) and the significance level in the risk difference between these paired samples. The p-values of the Wilcoxon test for the risk ratio $\left(\frac{Risk_{IPO}}{Risk_{non-IPO}}\right)$ allow us to reject the null hypothesis of equality between IPO and non-IPO risks for the three types of risks ($RTV_i^{Q_t}$, $RSV_i^{Q_t}$ and $RIV_i^{Q_t}$). Our results find that IPOs are riskier than their peers, especially during the early aftermarket stage. Nevertheless, the magnitude of the difference between IPO and non-IPO risks is larger for the idiosyncratic risk component. As idiosyncratic risk measures the asymmetric information between a firm and traders (Campbell and Taksler, 2003), we infer that the asymmetric information level is high in the IPO market, especially during the early aftermarket stage, which is well documented in the IPO literature (Rock, 1986, Tinic, 1988, Benveniste and Spindt, 1989 and Allen and Faulhaber, 1989).

Brown and Kapadia (2007) show an increase in idiosyncratic volatility in the US stock market and attribute this positive trend to the new listing effect. Our results are consistent with Brown and Kapadia (2007) since we effectively show that IPOs are characterized by significantly higher idiosyncratic risk than comparable non-IPO firms. However, although IPOs seem riskier than their peers, we show that the realized total and idiosyncratic risk difference between our two samples tend to vanish over time. We infer that the asymmetric information level varies over the IPO event time and tends to decrease when more information about the new issues emerges in the market.

Table IV. 4: Total, idiosyncratic and systematic risks over time: IPOs vs. non-IPOs

This table reports the first, the second and the third quartiles of total (TR), idiosyncratic (IR) and systematic (SR) risks computed on the basis of the three factors model of Fama and French (2003) for IPOs and non-IPOs equities separately over the 12 first quarters of the IPOs' offerings. Risk Ratio is equal to IPO's risk reported by its comparable (non-IPO)'s risk. The non-IPOs equities are selected basing on industry, sales, profitability and growth similar to those of the IPOs equities using the propensity score matching method. The Wilcoxon signed-rank test is used to compare matched samples (IPOs and non-IPOs). We are interested in testing whether the median of the Risk Ratio is equal to 1. The null hypothesis: H_0: $Mu_0 = 1$.

Quarter	Risk components	IPOs			Non-IPOs			Risk Ratio $_{IPO/non-IPO}$			
		25%	MED	75%	25%	MED	75%	25%	MED	75%	*Wilcoxon p-value*
Q1	**TR×10⁴**	6.50	11.49	26.83	4.24	9.82	20.03	0.61	1.36	3.09	<.0001
	IR×10⁴	5.67	10.59	23.00	3.32	7.96	16.95	0.66	1.47	3.46	<.0001
	SR×10⁴	0.35	0.95	2.94	0.43	1.13	2.94	0.29	0.95	3.32	<.0001
	N		571			553			558		
Q2	**TR×10⁴**	6.77	12.38	27.28	4.36	9.62	21.55	0.65	1.35	2.95	<.0001
	IR×10⁴	5.61	10.57	23.04	3.26	8.09	18.93	0.66	1.42	3.36	<.0001
	SR×10⁴	0.53	1.41	3.41	0.46	1.25	3.03	0.37	1.18	3.33	<.0001
	N		571			544			544		
Q3	**TR×10⁴**	5.97	11.18	25.66	4.49	10.02	22.59	0.61	1.27	2.66	<.0001
	IR×10⁴	5.07	9.55	21.40	3.34	7.80	18.57	0.63	1.33	2.97	<.0001
	SR×10⁴	0.54	1.42	3.63	0.42	1.18	3.13	0.37	1.08	3.44	<.0001
	N		569			530			530		
Q4	**TR×10⁴**	6.44	11.41	25.02	4.54	9.80	23.02	0.55	1.21	2.57	<.0001
	IR×10⁴	5.13	9.84	21.15	3.44	7.91	18.88	1.28	2.79	6.33	<.0001
	SR×10⁴	0.57	1.49	3.64	0.42	1.18	3.15	0.40	1.17	3.95	<.0001
	N		567			512			512		
Q5	**TR×10⁴**	5.87	10.93	24.91	4.88	10.52	22.60	0.52	1.15	2.46	<.0001
	IR×10⁴	4.63	9.06	20.31	3.64	8.24	16.78	0.53	1.19	2.69	<.0001
	SR×10⁴	0.64	1.53	3.97	0.53	1.27	3.39	0.34	1.20	3.39	<.0001
	N		563			496			496		
Q6	**TR×10⁴**	5.94	11.02	26.97	4.49	9.19	20.88	0.55	1.24	2.66	<.0001
	IR×10⁴	4.95	9.39	21.11	3.58	7.29	16.59	0.55	1.30	3.03	<.0001
	SR×10⁴	0.68	1.46	4.20	0.49	1.16	3.17	0.42	1.24	3.85	<.0001
	N		555			482			482		
Q7	**TR×10⁴**	5.76	10.66	23.47	4.53	9.44	19.87	0.49	1.20	2.87	<.0001
	IR×10⁴	4.29	8.66	18.66	3.48	7.49	15.34	0.47	1.16	3.22	<.0001
	SR×10⁴	0.74	1.68	3.48	0.48	1.32	3.56	0.48	1.29	4.32	<.0001
	N		550			468			468		
Q8	**TR×10⁴**	5.86	11.47	24.78	4.95	10.46	24.60	0.51	1.07	2.47	<.0001
	IR×10⁴	4.42	8.52	18.42	3.56	7.53	18.42	0.50	1.10	2.70	<.0001
	SR×10⁴	0.73	1.87	4.50	0.51	1.70	4.14	0.38	1.16	2.99	<.0001
	N		550			445			445		
Q9	**TR×10⁴**	5.46	10.99	24.46	5.10	10.70	22.96	0.55	1.02	2.44	<.0001
	IR×10⁴	4.11	8.31	19.11	3.53	7.84	16.12	0.52	1.10	2.63	<.0001
	SR×10⁴	0.69	1.94	4.43	0.53	1.47	4.38	0.34	1.02	3.97	<.0001
	N		528			421			421		
Q10	**TR×10⁴**	5.63	11.06	27.28	4.66	10.49	22.65	0.44	1.28	2.84	<.0001
	IR×10⁴	4.16	8.61	20.69	3.34	7.89	16.51	0.44	1.23	3.20	<.0001
	SR×10⁴	0.78	1.86	4.42	0.49	1.57	3.80	0.41	1.24	4.29	<.0001
	N		518			406			406		
Q11	**TR×10⁴**	5.05	9.41	22.16	4.65	9.79	20.44	0.51	1.02	2.44	<.0001
	IR×10⁴	3.58	6.76	17.47	3.31	6.65	16.01	0.49	1.09	2.71	<.0001
	SR×10⁴	0.70	1.77	3.94	0.55	1.50	3.52	0.42	1.17	3.45	<.0001
	N		510			395			395		
Q12	**TR×10⁴**	5.49	9.54	20.56	4.26	9.07	20.08	0.54	1.21	2.39	<.0001
	IR×10⁴	3.84	7.14	16.97	2.89	6.47	14.94	0.48	1.20	2.52	<.0001
	SR×10⁴	0.78	1.74	3.83	0.59	1.46	3.28	0.43	1.30	3.67	<.0001
	N		487			368			368		
Overall period	**TR×10⁴**	8.50	15.83	29.29	6.96	13.47	27.96	0.55	1.26	2.31	<.0001
	IR×10⁴	7.06	12.46	26.21	5.38	11.77	22.70	0.56	1.27	2.49	<.0001
	SR×10⁴	0.63	1.62	3.93	0.28	1.04	2.86	0.51	1.43	5.77	<.0001
	N		571			558			558		

As the temporal risk behavior mostly differs for IPOs compared to their peers, we test for IPO risk in IPO pricing, especially during the first quarters of the offering. Beaulieu and Mrissa Bouden (2015, b) show that IPO mispricing during the offering period is explained by the measure of idiosyncratic risk. Therefore, we argue that it is not only the systematic risk that should price IPOs: market participants are also compensated for an additional risk premium based on the idiosyncratic risk component.

4- Risk impact on long-run abnormal performance: IPOs versus non-IPOs equities

We show in the precedent section that the volatility of stock returns changes over time and presents a significant downward trend for new issues during the IPO event time. Besides, we find that this downward trend is mostly attributed to the idiosyncratic part of the volatility of IPO's returns. Therefore, in this section, we focus on a modified model that incorporates time-varying volatility as well as a time-varying conditional premium for: (1) the aggregate volatility risk when we use the calendar-time portfolio method and (2) the firm-level idiosyncratic volatility risk when we use individual returns over the IPO-event time method, in order to better measure IPO abnormal performance.

Such models known as autoregressive conditional heteroskedasticity (ARCH) models introduced by Engle (1982) are frequently used in the literature to model financial time series that exhibit time-varying volatility. Bollerslev (1986) suggests a generalized autoregressive conditional heteroskedasticity (GARCH) model that assumes an autoregressive moving average model (ARMA model) for the error variance. The recent literature tends to allow for time-varying volatility by including modifications to the standard models in order to consider the GARCH effect around an event (Böhmer, Musumeci and Poulsen, 1991). These authors argue that "when an event causes even minor increases in variance, the most commonly-used methods reject the null hypothesis of zero average abnormal return too frequently when it is true (p. 253)". In the context of IPO short-run perspective, Lowry, Officer and Schwert (2010) estimate not only the level but also the variance of IPO initial returns. Theses authors show an increasing volatility during the early aftermarket stage, especially during the hot-issue market. Hence, it is interesting to focus on the level as well as the variance of returns for IPO long-run perspective in order to show whether time-varying issuing firm risk affects long-run abnormal performance measurement.

Moreover, Engle et al. (1987) introduces the ARCH-M (in mean) model that accounts for a time-varying volatility term in the expected returns dynamics (mean equation). As we assume that IPO risk is involved in the IPO pricing, this type of model is a better application to IPO aftermarket returns. In order to highlight the role of expected volatility to predict IPO expected return, we need a model that relaxes the assumption of a constant volatility and captures its time-varying property. Hence, the standard 3FF model is modified by including a GARCH-M (in mean) extension in order to achieve this goal.

On the first hand, we use the calendar-time portfolio method to model IPO and non-IPO portfolio's excess returns on the basis of the modified 3FF with the GARCH-M extension. This method allows us to show the time pattern of the conditional aggregate volatility of the portfolio of issuing firms versus similar non issuing firms and its impact on stock pricing. This conditional aggregate volatility only represents the portfolio's systematic volatility of IPOs (or similar non-IPOs) because the idiosyncratic volatility component vanishes in the variance of portfolio returns as a result of diversification. Hence, abnormal performance measured on the basis of the calendar-time portfolio method is only systematic-risk adjusted.

On the second hand, we use individual excess returns for each issuing and comparable non-issuing firm over the IPO event-time. This method allows us to show the time pattern of the conditional variance of the individual excess returns from the modified 3FF model which is considered a firm-level idiosyncratic volatility process as in Fu (2009). Hence, abnormal performance measured on the basis of individual returns over the IPO event-time method is idiosyncratic-risk adjusted.

4.1- Calendar-time portfolio's abnormal performance: IPOs versus non-IPOs equities

In this sub-section, we present the modified 3FF model used for the daily calendar-time portfolio's excess returns ($R_{p,j}-R_{f,j}$):

$$R_{p,j}-R_{f,j}=\alpha_p+\beta_{MKT_p}(R_{m,j}-R_{f,j})+\beta_{SMB_p}SMB_j+\beta_{HML_p}HML_j+\delta_p\sqrt{h_{p,j}}+\varepsilon_{p,j}, \quad (5)$$

where $\varepsilon_{p,j}=\sqrt{h_{p,j}}z_{p,j}$ with Gaussian innovation distribution.

$$h_{p,j}=\gamma_p+\theta_p h_{p,j-1}+\eta_p\varepsilon^2_{p,j-1} \quad (6)$$

This model is estimated for IPOs and matched non-IPOs' portfolios during the period of study from 2000 to 2012. The return residuals $\varepsilon_{p,j}$ are split into a stochastic part $z_{p,j}$ and a time-dependent standard deviation $\sqrt{h_{p,j}}$. The random variable $z_{p,j}$ is a white noise process, $z_{p,j}\sim N(0,1)$ and $h_{p,j}$ is a time-dependent portfolio's variance on day j. The conditional variance $h_{p,j}$ from the model is a portfolio's aggregate volatility process which represents only the conditional systematic portfolio's volatility as the idiosyncratic volatility disappears with the diversification effect in the portfolio. The intercept α_p measures the portfolio's abnormal return which is derived by the time-varying aggregate volatility process. β_{MKT_p}, β_{SMB_p} and β_{HML_p} are respectively the sensitivity of the portfolio expected returns to the market, size and book-to market factors. δ_p is the sensitivity of the portfolio's expected returns to conditional systematic portfolio's volatility and measures the exposure to the systematic volatility risk.

We report results for regressions on the portfolio's excess returns for both IPOs and non-IPOs using the modified 3FF model with GARCH-M extension.

First, results for the IPO portfolio are presented as follows:

$$R_{IPOs'portfolio,j} - R_{f,j} = \underset{(0.0262)}{0.0002} + \underset{(<0.0001)}{0.8803}(R_{m,j} - R_{f,j}) + \underset{(<0.0001)}{0.6896}SMB_j - \underset{(0.2436)}{0.0190}HML_j + \underset{(0.5208)}{1.3526}\sqrt{h_{p,j}} + \varepsilon_j ,$$

$$h_{p,j} = \underset{(0.0010)}{1.0993 \times 10^{-7}} + \underset{(<0.0001)}{0.9294}h_{j-1} + \underset{(<0.0001)}{0.0746}\varepsilon_{j-1}^2$$

Second, results for non-IPO portfolio are presented as follow:

$$R_{non\text{-}IPOs'portfolio,j} - R_{f,j} = \underset{(0.6485)}{0.0475 \times 10^{-3}} + \underset{(<0.0001)}{0.7820}(R_{m,j} - R_{f,j}) + \underset{(<0.0001)}{0.6364}SMB_j + \underset{(0.0052)}{0.0461}HML_j + \underset{(<0.0001)}{12.5304}\sqrt{h_{p,j}} + \varepsilon_j ,$$

$$h_{p,j} = \underset{(0.0002)}{1.1761 \times 10^{-7}} + \underset{(<0.0001)}{0.9293}h_{j-1} + \underset{(<0.0001)}{0.0774}\varepsilon_{j-1}^2$$

An investor who decides to hold a portfolio of IPOs from 2000 to 2012 could achieve a low positive abnormal return of 0.02% by 2012. However, the investor who holds a portfolio of similar non-IPO's firms over the same period realizes zero abnormal return. We suggest that the positive abnormal performance on IPO's portfolio is only due to the diversification effect which leads to the neutralization of the idiosyncratic risk of individual new issues on the IPO portfolio's variance. We note that the volatility term $\sqrt{h_{p,j}}$ in the mean equation is only referred to the conditional systematic volatility (CSV). We show that this conditional systematic volatility affects positively the expected returns. However, the coefficient associated to this volatility term is significant only for the portfolio of non-IPOs equities. It seems that investors require a positive premium on systematic volatility risk only for non-IPOs equities. Market participants react differently to new information flows by revaluing IPOs versus non-IPOs prices. Unlike non-IPOs, the systematic volatility risk seems to be not incorporated on the prices of issuing firms. The divergence of market's opinions and the high level of information asymmetry between investors and the issuing firm concerning the true value of the new issues may curb the market participants' response to new information flows from the IPO market. This fact could explain this insignificant exposure to systematic volatility risk for IPOs.

Nevertheless, given the higher level of IPO idiosyncratic risk with respect to comparable non-IPOs, we assume that the issuing firm level-idiosyncratic risk could significantly affects IPO expected returns and then lower long-run IPO abnormal performance. Therefore, we could not ignore this specific risk component impact on IPO abnormal performance.

On the other hand, we focus on the significance of the difference in abnormal returns between both portfolios (IPOs and matched non-IPOs). We assess (IPO - matched non-IPO) zero investment abnormal return' portfolio on the basis of the standard as well as modified 3FF models in order to reveal the impact of including the aggregate volatility risk factor on the abnormal performance.

We first present results for (IPO - matched non-IPO) zero investment portfolio on the basis of the standard 3FF model as follow:

$$R_{IPO\text{-}nonIPOs'portfolio,j} - R_{f,j} = \underset{(0.0021)}{-0.578\times10^{-3}} + \underset{(<0.0001)}{0.1603}(R_{m,j} - R_{f,j}) + \underset{(<0.0001)}{0.2757}SMB_j - \underset{(<0.0001)}{0.2435}HML_j + \varepsilon_j ,$$

We show that the regression intercept which measure abnormal return of the (IPO – matched non-IPOs) zero investment portfolio is negative and significant, suggesting that IPO firms underperform comparable non-issuing firms in the three-year period.

However, when we assess abnormal returns of the (IPO – matched non-IPOs) zero investment portfolio on the basis of the modified 3FF with GARCH-M extension, the intercept loses its significance. We report result for (IPO - matched non-IPO) zero investment portfolio on the basis of the modified 3FF with GARCH-M extension model as follow:

$$R_{IPO\text{-}nonIPOs'portfolio,j} - R_{f,j} = \underset{(0.3360)}{0.107\times10^{-3}} + \underset{(<0.0001)}{0.1111}(R_{m,j} - R_{f,j}) + \underset{(<0.0001)}{0.0922}SMB_j - \underset{(<0.0001)}{0.1168}HML_j - \underset{(0.0025)}{3.9771}\sqrt{h_j} + \varepsilon_j ,$$

$$h_j = \underset{(0.7413)}{1.0537\times10^{-8}} + \underset{(<0.0001)}{0.9523}h_{j-1} + \underset{(<0.0001)}{0.0564}\varepsilon_{j-1}^2$$

The non significance of the intercept from the modified 3FF allows us to infer that the significance of the standard 3FF intercept is due to the omission of the volatility factor. If IPOs are overvalued relative to their peers during the registration period as shown by Purnanandam and Swaminathan (2004), then issuing firms should underperform matched non-issuing firms in the long-run. However, when we consider the volatility factor in the mean equation, we find that the regression intercept which measure the risk adjusted abnormal return of the (IPO – matched non-IPOs) zero investment portfolio is not significant. This finding suggests that IPO firms do not really underperform comparable non-issuing firms in the three-year period. We infer that firms are fairly valued relative to their peers when volatility risk is considered on the stock's valuation. . We conclude that the apparent IPO underperformance shown by the standard 3FF is a reflection of a lower exposure to the volatility risk for IPOs relative to their peers.

4.2- IPO event-time individual's abnormal performance: IPOs versus non-IPOs equities

In this sub-section, we present the modified 3FF model used for the daily individual excess returns $(R_{i,j}-R_{f,j})$ over the IPO event-time:

$$R_{i,j}-R_{f,j}=\alpha_i+\beta_{MKT_i}(R_{m,j}-R_{f,j})+\beta_{SMB_i}SMB_j+\beta_{HML_i}HML_j+\delta_i\sqrt{h_j}+\varepsilon_{i,j}, \quad (7)$$

where $\varepsilon_{i,j}=\sqrt{h_{i,j}}\,z_{i,j}$ with Gaussian innovation distribution.

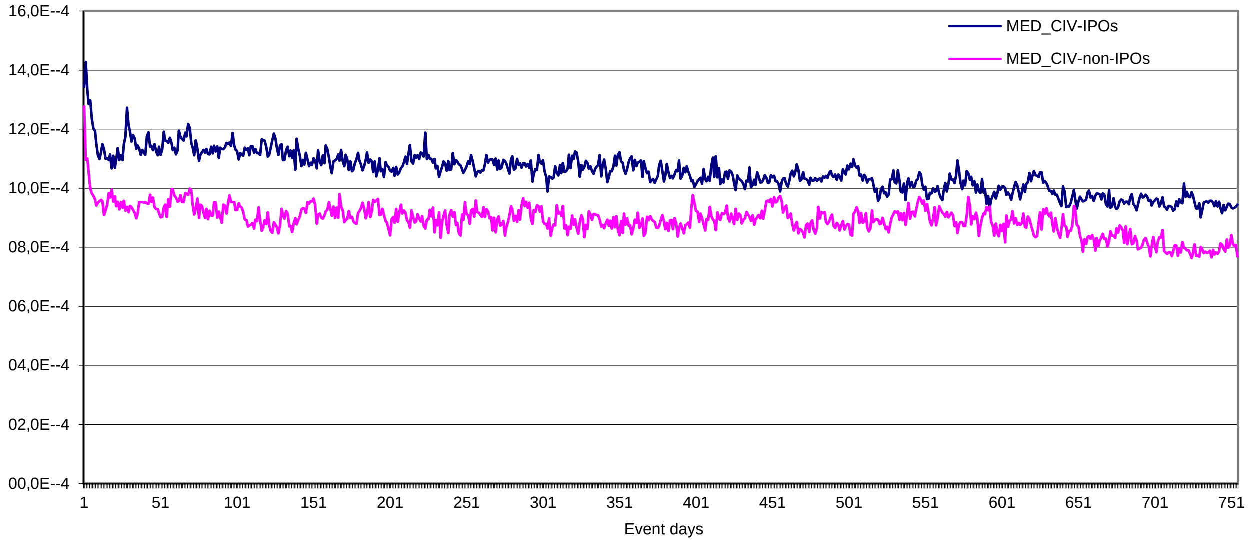
$$h_{i,j}=\gamma_i+\theta_i h_{i,j-1}+\eta_i\varepsilon^2_{i,j-1} \quad (8)$$

This model is estimated for IPOs and matched non-IPOs individual stocks during the first three-year of seasoning. The return residuals $\varepsilon_{i,j}$ are split into a stochastic part $z_{i,j}$ and a time-dependent standard deviation $\sqrt{h_{i,j}}$. $h_{i,j}$ is a time-dependent variance for stock i on day j. The conditional variance $h_{i,j}$ from the model is a stock's idiosyncratic volatility process. The intercept α_i measures abnormal returns for stock i and is obtained from the time-varying idiosyncratic volatility process. β_{MKT_i}, β_{SMB_i} and β_{HML_i} are respectively the sensitivity of expected returns to the market, size and book-to market factors. δ_i is the sensitivity of expected returns to conditional idiosyncratic volatility and measures the exposure to the firm-level idiosyncratic risk.

Figure IV. 2 reports the median daily conditional idiosyncratic variance for IPOs and their matched firms computed on the basis of a GARCH-M model during the three first years of IPO trading. As for the realized idiosyncratic risk, the IPO expected idiosyncratic risk (CIV) also exhibits a downward trend over the IPO event time. However, the expected idiosyncratic risk for comparable non-IPOs equities is lower and seems more constant over the IPO event time.

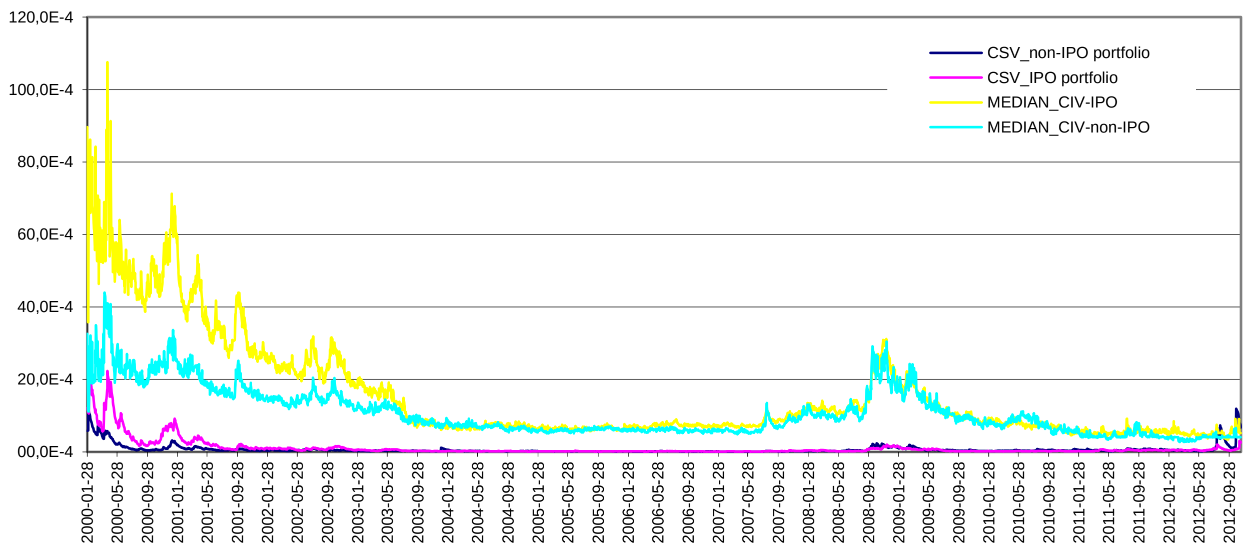
In Figure IV. 3, we look at the calendar-time variation of conditional systematic (CSV) and idiosyncratic volatilities (CIV) for IPOs and their peers between 2000 and 2012. The conditional systematic volatility is more stable over time than the conditional idiosyncratic volatility for both IPO and non-IPO's portfolios. However, we find that the conditional idiosyncratic volatility reaches higher levels both for IPOs and comparable non-IPOs equities, especially in 2000 and at the beginning of 2001. We only note higher levels of conditional idiosyncratic risk for IPOs with respect to their peers between 2000 and 2003 which could explain Brown and Kapadia's (2007) findings that positive trend in idiosyncratic risk is due to new issues effect (these authors are interested to the period of study between 1963 and 2004). However, from the end of 2003, we find that there is no difference in conditional idiosyncratic risk between IPOs and their comparable firms. The idiosyncratic risk does not exhibit a trend over time. Nevertheless, we note higher levels of conditional idiosyncratic risk during the period of financial crisis (from the end of 2007 until 2009) for both IPOs and their peers, but this increase does not persist after 2009 and it is not as important as in 2000 and 2001 (by the end of hot-issue market). The conditional idiosyncratic risk tends to return to its normal levels before the crisis. Therefore, our results do not support studies (Campbell et al. 2001, and Brown and Kapadia, 2007) that find a positive time trend in idiosyncratic risk. But, our results are rather consistent with Brandt, Brav, Graham and Kumar (2010) who show that the increase in the idiosyncratic risk is an episodic phenomenon, when we consider more recent periods.

Figure IV. 2: Conditional Idiosyncratic Variance over IPO event time: IPOs vs. non-IPOs



This figure reports the median daily conditional idiosyncratic variance for IPOs and their matched firms non-IPOs based on GARCH-M model and calculated for the three first years of IPO trading (from the first day of the IPO event to day 756). CIV are assessed from regressions on individual excess returns for IPOs and non-IPOs firms.

Figure IV. 3: Conditional Idiosyncratic and Systematic Variances over calendar time from 2000 to 2012: IPOs vs. non-IPOs



This figure reports the temporal behavior of: (1) the daily conditional systematic variance CSV computed for IPOs and non-IPOs portfolios and (2) the median daily conditional idiosyncratic variance CIV computed separately for IPOs and non-IPOs. We use the modified 3FF with GARCH-M extension to assess CSV and CIV. CSV are assessed from regressions on the portfolio's excess returns for both IPOs and non-IPOs. CIV are assessed from regressions on individual excess returns for IPOs and non-IPOs firms.

We conclude that a high level of idiosyncratic risk derives from two episodic phenomena captured our sample: (1) hot-issue markets and (2) crisis period. In order to reveal how firm-level idiosyncratic risk affects the individual abnormal performance measurement, we report in Table IV. 5 tests for the significance of the difference between three-year abnormal returns computed by the standard 3FF model versus the modified 3FF with GARCH-M extension for IPOs and comparable non-IPOs equities.

We show that the difference in three-year abnormal returns between the standard and the modified 3FF intercepts is positively significant for IPOs and their peers. We note that the standard 3FF model overestimates the long-run abnormal performance of IPOs as well as that of their peers because it does not consider the conditional idiosyncratic risk premium. We show that when we account for time-varying firm-level idiosyncratic risk in the modified 3FF with GARCH-M extension, the null hypothesis of zero IPO abnormal returns cannot be rejected. In addition, although the significantly negative modified 3FF abnormal return for comparable non-IPOs, it seems that the latter is very close to zero.

Table IV. 5 shows the difference in the three-year abnormal performance between IPOs and their peers depending on the model used to assess abnormal returns. When abnormal returns are measured with the standard 3FF, we find that IPOs underperform their matched peers after three years of the initial offerings with a low significance level of 10%. When the modified 3 FF with GARCH-M extension is used to assess abnormal returns, the difference in abnormal returns disappears (the p-value of the Wilcoxon test indicates no significant difference).

These findings support previous research (Gompers and Lerner, 2003) that finds that IPO abnormal performance, shown previously in the IPO literature, depends on the methodology used to assess long-run abnormal returns. Our results show that IPOs slightly underperform their matched peers when we use the standard 3FF model commonly used in the literature to assess abnormal returns. However, this model allows only for systematic risk pricing and ignores the idiosyncratic risk pricing, which – when considered - leads to more rejections of the null hypothesis of zero abnormal returns. Therefore, we believe that abnormal returns originating from the modified 3FF with a GARCH-M extension is a more accurate measure of abnormal performance because it incorporates a premium of conditional idiosyncratic volatility which may be especially important for IPOs. In the previous section, we show that idiosyncratic risk tends to be higher for IPOs equities compared to their peers, especially during the first quarters of their offerings. Therefore, we assume that investors may require not only a premium for systematic risk but also an additional premium associated with idiosyncratic risk. Hence, when we consider both premiums for systematic and idiosyncratic risk, we obtain a measure of abnormal returns depending on both risk components.

In addition, we focus on the quarterly variation in abnormal returns for IPOs and their peers during the first three-year of IPO trading. Abnormal returns are measured by the intercepts (alpha) from the modified 3FF model with GARCH-M extension in each quarter for individual IPOs and matched non-IPOs stocks. Table IV. 6 shows the significance level of the intercepts (alpha) over the 12 first quarters of IPO trading for both IPOs and comparable non-IPOs samples. We only note significant and negative average IPO abnormal returns in the second and third quarters of the offering. The p-values of the Wilcoxon test do not allow us to reject the null hypothesis of zero abnormal returns for the rest of the period. We also find no abnormal returns for non-IPOs equities over the 12 quarters. Besides, except for the second quarter that presents a significant and negative difference between IPOs' abnormal returns and their peers, we find no evidence to support the hypothesis that IPOs underperform matched firms for the rest of the period.

Our time series analysis is also extended to determine how market risk aversions to systematic as well as idiosyncratic risks vary over IPO event time. We use the coefficients β_{MKT_i}, β_{SMB_i} and β_{HML_i} that are respectively associated with market, size and book-to-market factors as proxies for market risk aversion in systematic risk. The p-values of the Wilcoxon tests in Tables IV. 7 and IV. 8 do not allow us to reject the null hypothesis of zero $BETA_{MKT}$ and $BETA_{SMB}$ neither for IPOs or non-IPOs samples. However, Table IV. 9 shows that the coefficient associated with book-to market, β_{HML_i} is significantly positive for IPOs and their peers only for the first quarter. We argue that systematic risk is priced for IPOs and comparable non-IPOs equities especially through the market and size factors for the overall the period. Moreover, we note that the difference in $BETA_{MKT}$ ($BETA_{SMB}$) between IPOs and their peers are significantly positive, especially for the last quarters. This finding indicates that market participants tend to require a larger premium on IPO systematic risk over time. We believe that if IPO growth perspectives are not realized in the long-run or if the achievements are below market expectations, then the market will require additional risk premiums, which could explain this higher level of market risk aversion with IPO systematic risk, especially over the last quarters.

We use the "Delta" coefficient associated to the conditional firm-level idiosyncratic volatility (see Equation 7) as a proxy for the market risk aversion to time-varying idiosyncratic risk. The p-values of the Wilcoxon tests in Table IV. 10 allow us to reject the null hypothesis that the mean of Delta is equal to zero for IPOs and their comparable non-IPOs equities for almost all 12 quarters. This finding is consistent with our assumption that idiosyncratic risk is priced. However, we do note a significant difference between IPOs and their peers with respect to the market risk aversion of time-varying idiosyncratic risk. Although we find higher levels of idiosyncratic risk in IPOs when compared to their peers - especially during the first quarters of the offering - market participants do not require an additional premium for IPO idiosyncratic risk compared to the premium required for its comparable non-IPO stock. We note that the level of risk aversion associated with systematic risk factors (Betas) is higher than the risk aversion tied to idiosyncratic risk (Delta) for IPOs equities although their high level of idiosyncratic risk. We infer that the market tends to be more vigilant towards systematic risk factors than for firm-level idiosyncratic risk. Furthermore, we point out that there is a dependence relationship between the risk aversion related to systematic risk factors (Betas) and the level of idiosyncratic risk. Our results show that as the IPO idiosyncratic risk decreases over time, the Betas associated with IPOs tends to increase. We could explain this phenomenon by the fact that the market continues to demand a compensation for IPO idiosyncratic risk although the decrease of the level of information asymmetry over time. However, this compensation takes the form of an additional premium on systematic risk factors instead of varying the risk aversion towards IPO idiosyncratic risk.

Table IV. 5: Wilcoxon test for three-year abnormal return according to the standard and the modified 3FF models: IPOs vs. non-IPOs

This table reports the first, the second and the third quartiles of the ALPHA coefficients computed from the standard (3FF) three factors model of Fama and French (1993) and the modified 3FF with the GARCH-M extension for IPOs' versus non-IPOs' equities during the three first years of IPO. The Wilcoxon signed-rank test is used to: (1) focus on the significance of the difference in abnormal returns between an IPO and a matched non-IPO according to the model used to assess long-run abnormal performance, and (2) compare the difference in abnormal return measured on the basis of the intercept from the standard and the modified 3FF models for IPOs and non-IPOs equities. The non-IPOs equities are selected based on industry, sales, profitability and growth similar to those of the IPOs equities using the propensity score matching method. The location counts produce the number of observations greater than, not equal to, and less than zero. We are interested in testing the null hypothesis of zero three-year abnormal return.

Model	Coefficient	IPOs				Non-IPOs				DIFF. (α_{IPO}-$\alpha_{Non\text{-}IPO}$)			
		25%	**MED**	**75%**	***Wilcoxon p-value***	**25%**	**MED**	**75%**	***Wilcoxon p-value***	**25%**	**MED**	**75%**	***Wilcoxon p-value***
Standard 3FF	**ALPHA$_{FF}$**	-0.45×10^{-3}	0.40×10^{-3}	1.08×10^{-3}	**<.0001**	-0.22×10^{-3}	0.41×10^{-3}	1.16×10^{-3}	**<.0001**	-1.28×10^{-3}	-0.08×10^{-3}	1.02×10^{-3}	0.0836
Modified 3FF	**ALPHA $_{FF\_GARCH\text{-}M}$**	-1.99×10^{-3}	-0.06×10^{-3}	1.50×10^{-3}	0.1498	-1.73×10^{-3}	-0.10×10^{-3}	0.93×10^{-3}	**0.0054**	-2.81×10^{-3}	-0.08×10^{-3}	3.14×10^{-3}	0.6670
	DIFF .(α_{FF}-$\alpha_{FF\_GARCH\text{-}M}$)	-1.04×10^{-3}	0.17×10^{-3}	2.28×10^{-3}	**<.0001**	-0.46×10^{-3}	0.32×10^{-3}	2.11×10^{-3}	**<.0001**				

Table IV. 6: Wilcoxon test for ALPHA: IPOs vs. non-IPOs

This table reports the first, the second and the third quartiles of the ALPHA coefficients from the three factors model of Fama and French (2003) with the GARCH-M extension for IPOs' versus non-IPOs' equities and the p-value of the Wilcoxon signed-rank test over the 12 first quarters of the IPOs' offerings. This non-parametric statistical hypothesis test is used to: (1) focus on the significance of the ALPHA coefficients that measure abnormal returns in each sample (IPO and non-IPO), and (2) compare matched samples (IPOs versus non-IPOs). The non-IPOs equities are selected based on industry, sales, profitability and growth similar to those of the IPOs equities using the propensity score matching method. The location counts produce the number of observations greater than, not equal to, and less than zero. We are interested in testing the null hypothesis that the mean of ALPHA (Mu_0) is equal to zero.

Quarter	**Coefficient**	**IPOs**				**Non-IPOs**				**DIFF.**			
		25%	**MED**	**75%**	***Wilcoxon p-value***	**25%**	**MED**	**75%**	***Wilcoxon p-value***	**25%**	**MED**	**75%**	***Wilcoxon p-value***
Q1	**ALPHA**	-0.49×10^{-2}	0	0.46×10^{-2}	0.5929	-0.40×10^{-2}	0	0.34×10^{-2}	0.5648	-0.89×10^{-2}	0	0.84×10^{-2}	0.8472
	Obs.num $\neq Mu_0$		571				554				554		
	Obs.num $> Mu_0$		288				271				274		
	Obs.num $< Mu_0$		283				283				280		
Q2	**ALPHA**	-0.67×10^{-2}	-0.09×10^{-2}	0.29×10^{-2}	**<.0001**	-0.40×10^{-4}	0	0.33×10^{-2}	0.3267	-0.01	-0.09×10^{-2}	0.72×10^{-2}	**0.0468**
	Obs.num $\neq Mu_0$		571				545				545		
	Obs.num $> Mu_0$		252				264				255		
	Obs.num $< Mu_0$		319				281				290		
Q3	**ALPHA**	-0.58×10^{-2}	-0.04×10^{-2}	0.29×10^{-2}	**0.0072**	-0.45×10^{-2}	-0.02×10^{-2}	0.37×10^{-2}	0.3369	-0.01	-0.04×10^{-2}	0.72×10^{-2}	0.1007
	Obs.num $\neq Mu_0$		569				530				530		
	Obs.num $> Mu_0$		268				255				259		
	Obs.num $< Mu_0$		301				275				271		
Q4	**ALPHA**	-0.52×10^{-2}	0.02×10^{-2}	0.35×10^{-2}	0.4107	-0.40×10^{-2}	0.02×10^{-2}	0.35×10^{-2}	0.7163	-0.88	-0.04×10^{-2}	0.68×10^{-2}	0.4050
	Obs.num $\neq Mu_0$		567				512				512		
	Obs.num $> Mu_0$		298				264				252		
	Obs.num $< Mu_0$		269				248				260		
Q5	**ALPHA**	-0.49×10^{-2}	-0.01×10^{-2}	0.36×10^{-2}	0.2339	-0.42×10^{-2}	-0.01×10^{-2}	0.33×10^{-2}	0.4290	-0.82	-0.02×10^{-2}	0.76×10^{-2}	0.5825
	Obs.num $\neq Mu_0$		563				496				496		
	Obs.num $> Mu_0$		280				242				242		
	Obs.num $< Mu_0$		283				252				254		
Q6	**ALPHA**	-0.45×10^{-2}	0.04×10^{-2}	0.41×10^{-2}	0.9431	-0.36×10^{-2}	0.03×10^{-2}	0.45×10^{-2}	0.2376	-1.02	-0.02×10^{-2}	0.80×10^{-2}	0.6497
	Obs.num $\neq Mu_0$		556				484				483		
	Obs.num $> Mu_0$		280				258				238		
	Obs.num $< Mu_0$		276				226				245		
Q7	**ALPHA**	-0.36×10^{-2}	0.01×10^{-2}	0.36×10^{-2}	0.9655	-0.44×10^{-2}	-0.02×10^{-2}	0.36×10^{-2}	0.2985	-0.93	0.03×10^{-2}	0.84×10^{-2}	0.7848
	Obs.num $\neq Mu_0$		550				469				467		
	Obs.num $> Mu_0$		283				229				244		
	Obs.num $< Mu_0$		267				240				223		
Q8	**ALPHA**	-0.44×10^{-2}	-0.04×10^{-2}	0.37×10^{-2}	0.1353	-0.48×10^{-2}	-0.04×10^{-2}	0.33×10^{-2}	0.2650	-1.10	-0.03×10^{-2}	0.96×10^{-2}	0.9453
	Obs.num $\neq Mu_0$		540				447				445		
	Obs.num $> Mu_0$		256				210				219		
	Obs.num $< Mu_0$		284				237				226		
Q9	**ALPHA**	-0.44×10^{-2}	-0.01×10^{-2}	0.40×10^{-2}	0.5119	-0.39×10^{-2}	0	0.37×10^{-2}	0.6301	-0.84	-0.02×10^{-2}	0.74×10^{-2}	0.5965
	Obs.num		529				424				422		
	Obs.num $> Mu_0$		259				213				208		
	Obs.num $< Mu_0$		270				211				214		
Q10	**ALPHA**	-0.40×10^{-2}	-0.01×10^{-2}	0.34×10^{-2}	0.2767	-0.32×10^{-2}	0.05×10^{-2}	0.43×10^{-2}	0.1173	-0.78	-0.01×10^{-2}	0.74×10^{-2}	0.7409
	Obs.num $\neq Mu_0$		518				410				403		
	Obs.num $> Mu_0$		252				230				199		
	Obs.num $< Mu_0$		266				180				204		
Q11	**ALPHA**	-0.32×10^{-2}	-0.01×10^{-2}	0.30×10^{-2}	0.6782	-0.41×10^{-2}	0.02×10^{-2}	0.30×10^{-2}	0.3304	-0.72	-0.04×10^{-2}	0.87×10^{-2}	0.3789
	Obs.num $\neq Mu_0$		510				400				392		
	Obs.num $> Mu_0$		266				193				203		
	Obs.num $< Mu_0$		244				207				189		

Quarter	Coefficient	IPOs 25%	MED	75%	*Wilcoxon p-value*	Non-IPOs 25%	MED	75%	*Wilcoxon p-value*	DIFF. 25%	MED	75%	*Wilcoxon p-value*
Q12	**ALPHA**	-0.33 $\times10^{-2}$	0	0.39 $\times10^{-2}$	0.7332	-0.32 $\times10^{-2}$	-0.03 $\times10^{-2}$	0.33 $\times10^{-2}$	0.7761	-0.71	-0.03 $\times10^{-2}$	0.70 $\times10^{-2}$	0.7506
	Obs.num ≠ Mu_0		488				379				365		
	Obs.num > Mu_0		249				179				175		
	Obs.num < Mu_0		239				200				190		
Overall Period	**ALPHA**	-0.99 $\times10^{-3}$	-0.06. 10^{-3}	1.50 $\times10^{-3}$	0.1498	-1.73 $\times10^{-3}$	-0.10 10^{-3}	0.93 $\times10^{-3}$	**0.0054**	-2.81 $\times10^{-3}$	-0.08 $\times10^{-3}$	3.14 $\times10^{-3}$	0.6670
	Obs.num ≠ Mu_0		571				559				559		
	Obs.num > Mu_0		276				265				288		
	Obs.num < Mu_0		295				294				271		

Table IV. 7: Wilcoxon test for $BETA_{MKT}$: IPOs vs. non-IPOs

This table reports the first, the second and the third quartiles of the $BETA_{MKT}$ coefficients from the three factors model of Fama and French (2003) with the GARCH-M extension for IPOs' versus non-IPOs' equities and the p-value of the Wilcoxon signed-rank test over the 12 first quarters of the IPOs' offerings. This non-parametric statistical hypothesis test is used to: (1) focus on the significance of the $BETA_{MKT}$ coefficients, which measure the firm's return sensitivity to the market factor, on each sample (IPO and non-IPO), and (2) compare matched samples (IPOs versus non-IPOs). The non-IPOs equities are selected basing on industry, sales, profitability and growth similar to those of the IPOs equities using the propensity score matching method. The location counts produce the number of observations greater than, not equal to, and less than zero. We are interested in testing the null hypothesis that the mean of $BETA_{MKT}$ (Mu_0) is equal to zero.

Quarter	Coefficient	IPOs 25%	MED	75%	*Wilcoxon p-value*	Non-IPOs 25%	MED	75%	*Wilcoxon p-value*	DIFF. 25%	MED	75%	*Wilcoxon p-value*
Q1	**$BETA_{MKT}$**	0.19	0.65	1.22	**<.0001**	0.16	0.69	1.36	**<.0001**	-0.75	-0.01	0.76	0.8486
	Obs.num ≠ Mu_0		571				554				554		
	Obs.num > Mu_0		470				453				273		
	Obs.num < Mu_0		101				101				281		
Q2	**$BETA_{MKT}$**	0.21	0.75	1.26	**<.0001**	0.15	0.71	1.26	**<.0001**	-0.74	-0.11	0.82	0.2296
	Obs.num ≠ Mu_0		571				544				545		
	Obs.num > Mu_0		480				449				298		
	Obs.num < Mu_0		91				95				247		
Q3	**$BETA_{MKT}$**	0.32	0.78	1.26	**<.0001**	0.13	0.66	1.26	**<.0001**	-0.67	0.11	0.79	0.1124
	Obs.num ≠ Mu_0		569				530				530		
	Obs.num > Mu_0		491				426				291		
	Obs.num < Mu_0		78				104				239		
Q4	**$BETA_{MKT}$**	0.28	0.79	1.32	**<.0001**	0.11	0.67	1.21	**<.0001**	-0.58	0.09	0.79	**0.0140**
	Obs.num ≠ Mu_0		567				511				512		
	Obs.num > Mu_0		481				409				273		
	Obs.num < Mu_0		86				102				239		
Q5	**$BETA_{MKT}$**	0.31	0.79	1.33	**<.0001**	0.20	0.76	1.29	**<.0001**	-0.64	0.03	0.82	0.2275
	Obs.num ≠ Mu_0		563				496				496		
	Obs.num > Mu_0		496				412				255		
	Obs.num < Mu_0		67				84				241		
Q6	**$BETA_{MKT}$**	0.30	0.86	1.35	**<.0001**	0.13	0.69	1.27	**<.0001**	-0.58	0.13	0.89	**0.0038**
	Obs.num ≠ Mu_0		555				482				482		
	Obs.num > Mu_0		487				398				276		
	Obs.num < Mu_0		68				84				206		
Q7	**$BETA_{MKT}$**	0.41	0.90	1.40	**<.0001**	0.21	0.77	1.29	**<.0001**	-0.57	0.10	0.86	**0.0158**
	Obs.num ≠ Mu_0		550				469				467		
	Obs.num > Mu_0		486				392				252		
	Obs.num < Mu_0		64				77				215		
Q8	**$BETA_{MKT}$**	0.39	0.88	1.35	**<.0001**	0.20	0.81	1.42	**<.0001**	-0.59	-0.04	0.84	0.3741
	Obs.num ≠ Mu_0		540				446				445		
	Obs.num > Mu_0		476				363				215		
	Obs.num < Mu_0		64				83				230		
Q9	**$BETA_{MKT}$**	0.42	0.90	1.34	**<.0001**	0.16	0.80	1.28	**<.0001**	-0.60	0.07	0.82	0.0570
	Obs.num ≠ Mu_0		528				423				421		
	Obs.num > Mu_0		466				342				231		
	Obs.num < Mu_0		62				81				190		
Q10	**$BETA_{MKT}$**	0.40	0.86	1.31	**<.0001**	0.24	0.71	1.25	**<.0001**	-0.49	0.10	0.71	**0.0183**
	Obs.num ≠ Mu_0		518				410				403		
	Obs.num > Mu_0		466				348				226		
	Obs.num < Mu_0		52				62				177		
Q11	**$BETA_{MKT}$**	0.40	0.89	1.33	**<.0001**	0.19	0.78	1.23	**<.0001**	-0.51	0.20	0.87	**0.0007**
	Obs.num ≠ Mu_0		510				400				392		
	Obs.num > Mu_0		465				328				228		

Quarter	Coefficient	IPOs 25%	IPOs MED	IPOs 75%	IPOs *Wilcoxon p-value*	Non-IPOs 25%	Non-IPOs MED	Non-IPOs 75%	Non-IPOs *Wilcoxon p-value*	DIFF. 25%	DIFF. MED	DIFF. 75%	DIFF. *Wilcoxon p-value*
	Obs.num < Mu_0			45				72				164	
Q12	**$BETA_{MKT}$**	0.47	0.97	1.39	**<.0001**	0.24	0.83	1.23	**<.0001**	-0.50	0.17	0.76	**0.0067**
	Obs.num ≠ Mu_0			487				378				364	
	Obs.num > Mu_0			445				324				204	
	Obs.num < Mu_0			42				54				160	
Overall Period	**$BETA_{MKT}$**	0.53	0.84	1.15	**<.0001**	0.23	0.70	1.12	**<.0001**	-0.36	0.12	0.65	**<.0001**
	Obs.num ≠ Mu_0			571				559				559	
	Obs.num > Mu_0			552				509				321	
	Obs.num < Mu_0			19				50				238	

Table IV. 8: Wilcoxon test for $BETA_{SMB}$: IPOs vs. non-IPOs

This table reports the first, the second and the third quartiles of the $BETA_{SMB}$ coefficients from the three factors model of Fama and French (2003) with the GARCH-M extension for IPOs' versus non-IPOs' equities and the p-value of the Wilcoxon signed-rank test over the 12 first quarters of the IPOs' offerings. This non-parametric statistical hypothesis test is used to: (1) focus on the significance of the $BETA_{SMB}$ coefficients, which measure the firm's return sensitivity to the size factor, on each sample (IPO and non-IPO), and (2) compare matched samples (IPOs versus non-IPOs). The non-IPOs equities are selected basing on industry, sales, profitability and growth similar to those of the IPOs equities using the propensity score matching method. The location counts produce the number of observations greater than, not equal to, and less than zero. We are interested in testing the null hypothesis that the mean of $BETA_{SMB}$ (Mu_0) is equal to zero.

Quarter	**Coefficient**	**IPOs**				**Non-IPOs**				**DIFF.**			
		25%	**MED**	**75%**	***Wilcoxon p-value***	**25%**	**MED**	**75%**	***Wilcoxon p-value***	**25%**	**MED**	**75%**	***Wilcoxon p-value***
Q1	**$BETA_{SMB}$**	-0.18	0.47	1.48	**<.0001**	-0.05	0.62	1.41	**<.0001**	-1.32	-0.10	0.99	0.2168
	Obs.num ≠ Mu_0			571				554				554	
	Obs.num > Mu_0			387				405				264	
	Obs.num < Mu_0			184				149				290	
Q2	**$BETA_{SMB}$**	-0.09	0.69	1.69	**<.0001**	-0.14	0.50	1.36	**<.0001**	-1.14	0.15	1.40	0.0975
	Obs.num ≠ Mu_0			571				544				545	
	Obs.num > Mu_0			409				374				295	
	Obs.num < Mu_0			162				170				250	
Q3	**$BETA_{SMB}$**	-0.06	0.72	1.43	**<.0001**	-0.06	0.62	1.39	**<.0001**	-1.09	-0.04	1.14	0.7276
	Obs.num ≠ Mu_0			569				530				530	
	Obs.num > Mu_0			414				387				262	
	Obs.num < Mu_0			155				143				268	
Q4	**$BETA_{SMB}$**	-0.03	0.72	1.52	**<.0001**	-0.08	0.51	1.43	**<.0001**	-1.02	0.13	1.25	0.1624
	Obs.num ≠ Mu_0			567				512				512	
	Obs.num > Mu_0			420				369				273	
	Obs.num < Mu_0			147				143				239	
Q5	**$BETA_{SMB}$**	0.05	0.73	1.49	**<.0001**	-1.41	0.64	1.38	**<.0001**	-0.92	0.12	1.16	0.1131
	Obs.num ≠ Mu_0			563				495				496	
	Obs.num > Mu_0			432				359				265	
	Obs.num < Mu_0			131				136				231	
Q6	**$BETA_{SMB}$**	0.06	0.74	1.56	**<.0001**	-0.15	0.51	1.16	**<.0001**	-0.88	0.30	1.48	**0.0006**
	Obs.num ≠ Mu_0			555				483				482	
	Obs.num > Mu_0			426				334				279	
	Obs.num < Mu_0			129				149				203	
Q7	**$BETA_{SMB}$**	0.06	0.84	1.67	**<.0001**	-0.05	0.63	1.35	**<.0001**	-0.98	0.20	1.24	**0.0405**
	Obs.num ≠ Mu_0			550				469				467	
	Obs.num > Mu_0			426				346				256	
	Obs.num < Mu_0			124				123				211	
Q8	**$BETA_{SMB}$**	0.05	0.67	1.55	**<.0001**	-0.09	0.59	1.34	**<.0001**	-0.90	0.09	1.22	0.1786
	Obs.num ≠ Mu_0			540				447				445	
	Obs.num > Mu_0			414				327				233	
	Obs.num < Mu_0			126				120				212	
Q9	**$BETA_{SMB}$**	-0.01×10^{-2}	0.72	1.34	**<.0001**	-0.47×10^{-2}	0.61	1.35	**<.0001**	-1.10	0.04	1.18	0.3973
	Obs.num ≠ Mu_0			528				423				421	
	Obs.num > Mu_0			395				314				219	

Quarter	Coefficient	IPOs 25%	IPOs MED	IPOs 75%	IPOs Wilcoxon p-value	Non-IPOs 25%	Non-IPOs MED	Non-IPOs 75%	Non-IPOs Wilcoxon p-value	DIFF. 25%	DIFF. MED	DIFF. 75%	DIFF. Wilcoxon p-value
	Obs.num < Mu_0			133				109				202	
Q10	**$BETA_{SMB}$**	0.17	0.81	1.53	**<.0001**	-0.02	0.61	1.34	**<.0001**	-0.94	0.16	1.31	**0.0093**
	Obs.num ≠ Mu_0			518				410				403	
	Obs.num > Mu_0			422				302				218	
	Obs.num < Mu_0			96				108				185	
Q11	**$BETA_{SMB}$**	0.02	0.68	1.45	**<.0001**	0.01	0.70	1.32	**<.0001**	-1.00	-0.10	1.14	0.6843
	Obs.num ≠ Mu_0			509				399				391	
	Obs.num > Mu_0			386				303				184	
	Obs.num < Mu_0			123				96				207	
Q12	**$BETA_{SMB}$**	0.20	0.82	1.50	**<.0001**	-0.09.10^{-2}	0.72	1.35	**<.0001**	-0.74	0.20	1.20	**0.0130**
	Obs.num ≠ Mu_0			487				378				364	
	Obs.num > Mu_0			394				283				203	
	Obs.num < Mu_0			93				95				161	
Overall Period	**$BETA_{SMB}$**	0.35	0.77	1.12	**<.0001**	0.12	0.59	1.05	**<.0001**	-0.44	0.20	0.15	**<.0001**
	Obs.num ≠ Mu_0			571				559				559	
	Obs.num > Mu_0			518				467				326	
	Obs.num < Mu_0			53				92				233	

Table IV. 9: Wilcoxon test for $BETA_{HML}$: IPOs vs. non-IPOs

This table reports the first, the second and the third quartiles of the $BETA_{HML}$ coefficients from the three factors model of Fama and French (2003) with the GARCH-M extension for IPOs' versus non-IPOs' equities and the p-value of the Wilcoxon signed-rank test over the 12 first quarters of the IPOs' offerings. This non-parametric statistical hypothesis test is used to: (1) focus on the significance of the $BETA_{HML}$ coefficients, which measure the firm's return sensitivity to the book-to-market factor, on each sample (IPO and non-IPO), and (2) compare matched samples (IPOs versus non-IPOs). The non-IPOs equities are selected basing on industry, sales, profitability and growth similar to those of the IPOs equities using the propensity score matching method. The location counts produce the number of observations greater than, not equal to, and less than zero. We are interested in testing the null hypothesis that the mean of $BETA_{HML}$ (Mu_0) is equal to zero.

Quarter	**Coefficient**	**IPOs**				**Non-IPOs**				**DIFF.**			
		25%	**MED**	**75%**	***Wilcoxon p-value***	**25%**	**MED**	**75%**	***Wilcoxon p-value***	**25%**	**MED**	**75%**	***Wilcoxon p-value***
Q1	**$BETA_{HML}$**	-0.83	0.12	1.10	**0.0223**	-0.65	0.16	1.00	**0.0018**	-1.38	-0.04	1.27	0.6318
	Obs.num ≠ Mu_0			571				554				554	
	Obs.num > Mu_0			305				300				275	
	Obs.num < Mu_0			266				254				279	
Q2	**$BETA_{HML}$**	-0.94	0.02	1.04	0.9966	-0.78	0.00	0.95	0.5519	-1.51	-0.06	1.44	0.5330
	Obs.num ≠ Mu_0			571				542				545	
	Obs.num > Mu_0			289				274				264	
	Obs.num < Mu_0			282				268				281	
Q3	**$BETA_{HML}$**	-1.10	-0.03	0.93	0.2883	-0.62	-0.01	0.77	0.8207	-1.54	0.02	1.43	0.9304
	Obs.num ≠ Mu_0			569				530				530	
	Obs.num > Mu_0			278				263				268	
	Obs.num < Mu_0			291				267				262	
Q4	**$BETA_{HML}$**	-0.97	0.04	0.91	0.7226	-0.79	0.00	0.87	0.9857	-1.43	-0.05	1.28	0.5416
	Obs.num ≠ Mu_0			567				511				512	
	Obs.num > Mu_0			286				257				249	
	Obs.num < Mu_0			281				254				263	
Q5	**$BETA_{HML}$**	-0.97	-0.08	0.76	0.1384	-0.86	0.05	1.01	0.5706	-1.48	-0.09	1.24	0.2312
	Obs.num ≠ Mu_0			563				496				496	
	Obs.num > Mu_0			267				258				237	
	Obs.num < Mu_0			296				238				259	
Q6	**$BETA_{HML}$**	-1.04	0.05	0.79	0.6684	-0.91	0.03	0.85	0.8133	-1.37	0.05	1.09	0.8472
	Obs.num ≠ Mu_0			555				482				482	
	Obs.num > Mu_0			287				246				249	
	Obs.num < Mu_0			268				236				233	
Q7	**$BETA_{HML}$**	-0.77	0.06	0.92	0.2440	-0.87	0.01	0.87	0.7080	-1.46	-0.05	1.38	0.9874
	Obs.num ≠ Mu_0			550				469				467	
	Obs.num > Mu_0			287				235				227	
	Obs.num < Mu_0			263				234				240	
Q8	**$BETA_{HML}$**	-0.98	-0.40	0.74	0.2090	-0.75	0.11	0.90	0.0935	-1.43	-0.16	1.15	0.0566
	Obs.num ≠ Mu_0			540				447				445	
	Obs.num > Mu_0			258				245				204	

	Obs.num < Mu_0			282				202				241	
Q9	**$BETA_{HML}$**	-0.84	-0.07	0.68	0.1555	-0.78	0.06	0.89	0.3734	-1.28	-0.00	1.11	0.4578
	Obs.num ≠ Mu_0			528				422				421	
	Obs.num > Mu_0			247				215				210	
	Obs.num < Mu_0			281				207				211	
Q10	**$BETA_{HML}$**	-0.79	0.03	0.85	0.6792	-0.70	0.07	0.82	0.1880	-1.17	-0.06	1.03	0.7911
	Obs.num ≠ Mu_0			518				410				403	
	Obs.num > Mu_0			265				219				196	
	Obs.num < Mu_0			253				191				207	
Q11	**$BETA_{HML}$**	-0.87	-0.00	0.73	0.4479	-0.68	0.18	0.99	**0.0094**	-1.46	-0.25	1.15	0.0797
	Obs.num ≠ Mu_0			509				399				391	
	Obs.num > Mu_0			253				231				176	
	Obs.num < Mu_0			256				168				215	
Q12	**$BETA_{HML}$**	-0.79	-0.05	0.86	0.8527	-0.66	0.07	0.89	0.0552	-1.41	-0.03	1.20	0.4773
	Obs.num ≠ Mu_0			487				378				364	
	Obs.num > Mu_0			236				200				179	
	Obs.num < Mu_0			251				178				185	
Overall Period	**$BETA_{HML}$**	-0.40	-0.01	0.31	0.1409	-0.26	0.05	0.35	**0.0162**	-0.64	-0.06	0.44	**0.0098**
	Obs.num ≠ Mu_0			571				559				559	
	Obs.num > Mu_0			281				307				255	
	Obs.num < Mu_0			290				252				304	

Table IV. 10: Wilcoxon test for DELTA: IPOs vs. non-IPOs

This table reports the first, the second and the third quartiles of the DELTA coefficients from the three factors model of Fama and French (2003) with the GARCH-M extension for IPOs' versus non-IPOs' equities and the p-value of the Wilcoxon signed-rank test over the 12 first quarters of the IPOs' offerings. This non-parametric statistical hypothesis test is used to: (1) focus on the significance of the DELTA coefficients, which measure the firm's return sensitivity to the conditional idiosyncratic volatility, on each sample (IPO and non-IPO), and (2) compare matched samples (IPOs versus non-IPOs). The non-IPOs equities are selected basing on industry, sales, profitability and growth similar to those of the IPOs equities using the propensity score matching method. The location counts produce the number of observations greater than, not equal to, and less than zero. We are interested in testing the null hypothesis that the mean of DELTA (Mu_0) is equal to zero.

Quarter	**Coefficient**	**IPOs**				**Non-IPOs**				**DIFF.**			
		25%	**MED**	**75%**	***Wilcoxon p-value***	**25%**	**MED**	**75%**	***Wilcoxon p-value***	**25%**	**MED**	**75%**	***Wilcoxon p-value***
Q1	**DELTA**	-0.30	1.00 $\times 10^{-6}$	2.10	**0.0089**	-2.61 $\times 10^{-2}$	1.01 $\times 10^{-6}$	1.22	**0.0037**	-5.55	0	7.47	0.5355
	Obs.num ≠ Mu_0			571				554				554	
	Obs.num > Mu_0			349				332				282	
	Obs.num < Mu_0			222				222				272	
Q2	**DELTA**	-3.47 $\times 10^{-3}$	1.01 $\times 10^{-6}$	2.38	**<.0001**	-3.04 $\times 10^{-3}$	1.15 $\times 10^{-6}$	0.95	**0.0013**	-4.89	0	8.78	0.1462
	Obs.num ≠ Mu_0			571				542				545	
	Obs.num > Mu_0			368				342				286	
	Obs.num < Mu_0			203				200				256	
Q3	**DELTA**	-1.70 $\times 10^{-3}$	1.01 $\times 10^{-6}$	1.03	**0.0015**	-0.24	1.00 $\times 10^{-6}$	1.54	**0.0144**	-5.47	0	7.36	0.3715
	Obs.num ≠ Mu_0			569				530				530	
	Obs.num > Mu_0			344				319				275	
	Obs.num < Mu_0			225				211				259	
Q4	**DELTA**	-7.49 $\times 10^{-3}$	1.01 $\times 10^{-6}$	1.68	**0.0015**	-0.18	1.00 $\times 10^{-6}$	0.93	0.0793	-3.40	0	6.42	0.1748
	Obs.num ≠ Mu_0			567				511				512	
	Obs.num > Mu_0			345				310				264	
	Obs.num < Mu_0			222				201				248	
Q5	**DELTA**	-5.24 $\times 10^{-2}$	1.01 $\times 10^{-6}$	0.59	**0.0088**	-8.55 $\times 10^{-3}$	1.05 $\times 10^{-6}$	2.117	**0.0008**	-4.75	0	4.86	0.9707
	Obs.num ≠ Mu_0			562				494				495	
	Obs.num > Mu_0			356				304				251	
	Obs.num < Mu_0			206				190				244	
Q6	**DELTA**	-1.26 $\times 10^{-3}$	1.08 $\times 10^{-6}$	0.69	**0.0010**	-4.33 $\times 10^{-2}$	1.05 $\times 10^{-6}$	0.92	**0.0148**	-5.99	0	4.94	0.8237

	Obs.num ≠ Mu_0			555				482				482	
	Obs.num > Mu_0			360				299				244	
	Obs.num < Mu_0			195				183				238	
Q7	**DELTA**	-0.26	0.99×10^{-6}	0.06	0.4374	-0.19	1.00×10^{-6}	1.87	**0.0127**	-9.46	0	7.37	0.3005
	Obs.num ≠ Mu_0			550				469				467	
	Obs.num > Mu_0			324				281				220	
	Obs.num < Mu_0			226				188				247	
Q8	**DELTA**	-1.87×10^{-4}	1.15×10^{-6}	1.33	**<.0001**	-0.17	1.00×10^{-6}	1.89	**0.0133**	-6.33	0	6.18	0.8534
	Obs.num ≠ Mu_0			540				446				445	
	Obs.num > Mu_0			339				275				232	
	Obs.num < Mu_0			201				171				213	
Q9	**DELTA**	-1.99×10^{-2}	1.00×10^{-6}	0.78	**0.0404**	-0.41	1.00×10^{-6}	1.38	0.1102	-4.59	0	5.86	0.9140
	Obs.num ≠ Mu_0			528				422				421	
	Obs.num > Mu_0			315				257				211	
	Obs.num < Mu_0			213				165				210	
Q10	**DELTA**	-1.48×10^{-3}	1.07×10^{-6}	0.77	**0.0025**	-0.73	1.00×10^{-6}	0.10	0.9716	-4.12	0	5.90	0.5962
	Obs.num ≠ Mu_0			518				410				403	
	Obs.num > Mu_0			312				226				214	
	Obs.num < Mu_0			206				184				189	
Q11	**DELTA**	-3.79×10^{-3}	1.02×10^{-6}	0.31	**0.0197**	-0.02	1.00×10^{-6}	0.71	**0.0356**	-5.93	0	5.71	0.6446
	Obs.num ≠ Mu_0			508				398				390	
	Obs.num > Mu_0			315				237				197	
	Obs.num < Mu_0			193				161				193	
Q12	**DELTA**	-4.09×10^{-3}	1.00×10^{-6}	0.22	**0.0113**	-4.40×10^{-3}	1.00×10^{-6}	0.74	0.0846	-4.16	0	4.37	0.7490
	Obs.num ≠ Mu_0			487				378				364	
	Obs.num > Mu_0			303				228				175	
	Obs.num < Mu_0			184				150				189	
Overall Period	**DELTA**	-0.44	0.25	1.47	**<.0001**	-0.21	0.30	1.64	**<.0001**	-2.06	-2.58×10^{-3}	1.85	0.3148
	Obs.num ≠ Mu_0			571				559				559	
	Obs.num > Mu_0			370				372				278	
	Obs.num < Mu_0			201				187				281	

Hence, market participants increase their level of risk aversion associated with IPO systematic risk factors (Beta) over time, which leads to the upward trend in the IPO systematic risk. This increase in the IPO systematic risk occurs as IPO idiosyncratic risk continues to be higher than that of their matched non-IPOs. This result is consistent with Ang et al. (2006) who show that high idiosyncratic risk stocks are more sensitive to market volatility risk. We believe that this additional premium on systematic risk factors used to offset the idiosyncratic risk disappears as soon as the idiosyncratic risk of IPOs equalizes that of their peers.

5- Long-run performance and IPO profile

Previous studies such us Loughran and Ritter (2000) show that unlike issues in cold-issue market, issues in hot-issue market significantly underperform in the long-run. Since Ritter (1998) shows that issues in periods of high IPO volume are more likely to be overvalued than IPOs in other periods, we suggest that IPOs long-run abnormal performance might be related to IPO pricing in the early aftermarket as well as to some specific characteristics of the issue before its launching. Ritter (1991) examines three-year aftermarket performance of IPOs categorized by initial returns, year of issuance as well as industry. This authors show that unlike the initial return, the volume of IPOs in the year of issuance and IPO industry are among the IPO attributes that have a significant impact on the IPO long-run performance. Lowry et al. (2010) note that the value of technology firms is difficult to estimate because of their growth options. We then suggest that technology firms which the most of them went public during the "IPO internet bubble" are more likely to underperform in the long-run, especially if growth perspectives are not realized. Moreover, Ang et al. (2006) find a negative cross-section relationship between the idiosyncratic risk and returns of equities. Our findings show that IPOs exhibit higher idiosyncratic risk than their peer, especially during the early aftermarket stage and their idiosyncratic risks continue to be higher even after three years of seasoning in spite of their downward trend over time. Therefore, we suggest that the magnitude of IPO long-run underperformance could be related to the level of the issuing firm’s idiosyncratic risk. Hence, in this section, we focus on IPO long-run abnormal performance controlling for some characteristics of the issues related to its pre-IPO valuation during the registration period, its industry, its period of issuance and its idiosyncratic risk level during the early aftermarket stage.

5.1- Overvalued versus undervalued IPOs’ long-run performance

We suggest that the pre-IPO valuation during the IPO registration period could affect how both risk components (systematic and idiosyncratic) are involved in the issuing firm pricing in the long-run. Therefore, we split our IPO’s sample into two portfolios: (1) undervalued IPOs and (2) overvalued IPOs. Since IPO closing prices during the first days of trading could be affected by the underwriters' stabilization practices and market overreaction, we compare each IPO to its peer to estimate its intrinsic value on the day before the offering. Hence, we use the Price-to-Value ratio[51] as proposed by Zheng (2007) to separate undervalued IPOS from overvalued ones. If the Price-to-Value ratio is greater (smaller) than one, then the IPO offer price is higher (lower) than the fair value of the issue and classified as overvalued (undervalued) by the underwriter.

Table IV. 11 shows standard and modified 3FF regressions for overvalued versus undervalued calendar-time IPOs' portfolios. We find no significant value for the standard 3FF intercept for either over- and undervalued IPOs, suggesting no abnormal returns in the long-run. However, we point out a positive and significant three-year abnormal return for the portfolio of undervalued issues when it is assessed on the basis of the modified 3FF. Results for the (over-under) IPO portfolio show a negative and significant intercept for both standard and modified 3 FF regressions. This suggests that overvalued issues tend to underperform undervalued IPOs in the long-run. We show that the magnitude of the difference in IPO abnormal performance between overvalued and undervalued issues decreases from -0.08% (standard 3FF) to -0.03% (modified 3FF) when we consider the volatility factor in the mean equation of IPOs' portfolio returns. The significance level of the intercept associated with (over-under) IPO portfolio also decreases from 1% (standard 3FF) to 5% (modified 3FF). We infer that a part of the difference in IPO abnormal performance between over- and undervalued issues might be attributed to the over- versus undervalued issuing firm's risk difference. However, we find no statistical significance for δ which measures the sensitivity of returns to volatility. We cannot present evidence that supports a significant relationship between the volatility and expected returns for both IPO portfolios (over- and undervalued IPOs). Nevertheless, it is important to clarify that the volatility factor is only associated with the systematic risk component in the portfolio. The idiosyncratic component vanishes through portfolio diversification. We also present in Figure IV. 4 the time variation in each risk component (idiosyncratic and systematic) for over versus undervalued

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[51] The pre-IPO valuation is approximated by the Price-to-Value ratio as computed by Zheng (2007) as follows:

$$\left(\frac{P}{V}\right)^{Z}_{EBITDA} = \frac{\left[\dfrac{Offer\ Price \times (CRSPSharesOutstanding - NewPrimaryShares) - Cash + TotalDebt}{EBITDA(PriorOfferingQuarter)}\right]_{IPO}}{\left[\dfrac{Market\ Price(OneDayPriortheIPOOfferDate) \times CRSPSharesOutstanding - Cash + TotalDebt}{EBITDA(PriorOfferingQuarter)}\right]_{Match}}$$

IPOs over three years of seasoning. We suggest that that the time pattern of each issuing firm's risk components helps to explain the difference in IPO abnormal performance between over- and undervalued issues.

Figure IV. 4 shows that overvalued IPOs exhibit higher idiosyncratic risk than undervalued IPOs. In addition, the downward trend in the idiosyncratic risk is greater (in absolute value) for overvalued IPOs than for undervalued IPOs. This temporal behavior of the overvalued IPOs idiosyncratic risk suggests that this risk has an important role in the pricing of overvalued IPOs in the long-run. Figure IV. 4 also shows that the magnitude of the difference in risk between over- and undervalued IPOs is larger for the idiosyncratic component, especially during the early aftermarket stage. We find that overvalued IPOs present higher idiosyncratic risk than undervalued IPOs. These high idiosyncratic risk overvalued IPOs also exhibit higher systematic risk than undervalued IPOs, especially during the two first years of the offering. Figure IV. 4 (b) shows an upward trend in systematic risk of undervalued and overvalued IPOs. Note that overvalued IPOs exhibit a slightly higher systematic risk than undervalued IPOs during the first quarters of offering. However, the difference in systematic risk between over- and undervalued IPOs seems to be less important towards the end of the period of study. Therefore, we suggest that the difference in IPO long-run abnormal performance between over- and undervalued IPOs' portfolios could be better explained by the difference in the idiosyncratic risk component between these two types of issues than by the systematic one.

Table IV. 12 presents a comparison between over-and undervalued issues in terms of abnormal performance, risk and risk aversion assessed on the basis of individual returns over the IPO event-time. The precedent abnormal returns are assessed on the basis of IPO's portfolio returns and are only adjusted by systematic risk factors (see Table IV. 11). This calendar-time portfolio method does not allow us to highlight the potential role of the firm-level idiosyncratic risk in the abnormal portfolio's return measure. This firm-level idiosyncratic risk component is neutralized in the aggregate volatility of the IPO portfolio's returns. Therefore, we use in Table IV. 12 the event-time method which allows us to assess individual abnormal returns, both risk components (systematic and idiosyncratic) and risk aversion to both risk components (Betas and

Delta) for each stock. Hence, this approach allows us to investigate whether both risk components (systematic and idiosyncratic) affect the abnormal performance measurement for over-versus undervalued IPOs.

When we use the standard 3FF, we find that unlike the overvalued IPOs which present no significant median abnormal returns, the undervalued IPOs exhibit positive and significant median abnormal return. The Wilcoxon two-sample and Khi-2 tests (Table IV. 12) show a significant difference in abnormal returns between the over-and undervalued IPOs' samples, suggesting that initially undervalued IPOs outperform overvalued IPOs in the long-run. We note that overvalued IPOs are characterized by a significantly higher level of idiosyncratic risk than undervalued IPOs. However, the difference in systematic risk is not significant between these two samples. We argue that abnormal return assessed on the basis of the standard 3FF could be unreliable based on the absence of an adjustment for firm idiosyncratic risk.

When we use the modified 3FF, which incorporates the idiosyncratic risk, we find that the difference in abnormal returns between the over-and undervalued IPOs' samples loses its significance. Besides, we show that the presence of idiosyncratic risk lowers abnormal returns for both IPOs samples. Undervalued as well as overvalued IPOs exhibit zero abnormal performance when performance is assessed on the basis of the modified 3FF. It seems that when we ignore the idiosyncratic risk pricing, we capture the difference in long-run abnormal performance between over-and undervalued IPOs. In reality, this difference disappears when we consider idiosyncratic risk. This finding is consistent with Beaulieu and Mrissa Bouden (2015, b) who attribute IPO mispricing in the pre-offer period to the idiosyncratic risk component. We add that the idiosyncratic component continue to affect the issuing firm's valuation in post-IPO. Therefore, it is interesting to assess an unbiased abnormal return which should be adjusted for idiosyncratic risk.

Moreover, Table IV. 12 shows the risk aversion for both risk-components (systematic and idiosyncratic), measured respectively by the Betas and Delta for over- versus undervalued IPOs. We find that the sensitivity of individual IPO returns to systematic risk factors is significantly positive for both samples (over-and undervalued IPOs). The Wilcoxon two-sample and Khi-2 tests show no significant difference in Betas between over-and undervalued IPOs' samples. There is no significance difference in Delta between both samples. Despite its high level, the idiosyncratic risk is not significantly priced for overvalued issues. This finding reveals that there is an asymmetric information problem around overvalued issues which did not lead market participants to require a risk premium for that risk. We believe that the disclosure of more specific information about the issue might help market participants to better adjust their risk aversion according to the firm idiosyncratic risk level. We conclude that the difference in long-run abnormal performance between IPOs depending on their pre-IPO valuation (overvalued or undervalued) is mainly due to the omission of the firm-level idiosyncratic risk.

5.2- High-risk versus low-risk IPOs' long-run performance

We suggest that the risk level of a new issue in the first quarter of the offering could affect the role of both risk components (systematic and idiosyncratic) in the issuing firm pricing in the long-run. We split our IPO sample into two portfolios on the basis of their level of idiosyncratic risk in the first quarter of IPO trading: (1) high-risk IPOs that exhibit an idiosyncratic risk level above the median and (2) low-risk IPOs that exhibit an idiosyncratic risk level below the median.

First, we assess abnormal returns for both types of IPOs on the basis of the calendar-time portfolio method (see Table IV. 13). Second, we measure individual abnormal performance for each IPO and its peer in the same risk category over the IPO event time (see Table IV. 14) in order to emphasize the impact of firm-level idiosyncratic risk which is neutralized in the portfolio's aggregate volatility from the calendar-time portfolio method.

Table IV. 13 shows that the high-risk IPOs' portfolio exhibits a negative (positive) but insignificant intercept for the standard (modified) 3FF suggesting no long-run abnormal performance. The low-risk IPOs' portfolio has a positive intercept for both models, but it is significant at 1% only for the modified 3FF. The low-risk IPOs' portfolio has a higher long-run abnormal performance than the high-risk IPOs' portfolio. However, the insignificant intercepts for the (HIGH-LOW) portfolio from both models (standard and modified 3FF) show that the difference in abnormal returns between high and low-risk IPOs is not significant. Although the calendar-time portfolio method does not allow us to find evidence that high idiosyncratic risk IPOs underperform significantly low idiosyncratic risk IPOs, we point out that the difference in abnormal returns between the two portfolios decreases from -0.028% to -0.015% when we consider the aggregate volatility risk factor in the modified 3FF. It is important to note that this aggregate volatility only corresponds to the systematic risk of the portfolio. It seems that pricing including only systematic volatility risk does not help to explain the difference in abnormal returns between high and low-risk IPOs' portfolios. Since the idiosyncratic risk component vanishes in the aggregate volatility risk obtained from the modified 3FF according to the calendar-time portfolio method, we suggest that one should include both firm-level risks (systematic and idiosyncratic) to better evaluate the difference in long-run abnormal performance between high and low-risk IPOs .

Figure IV. 5 shows the time variation in idiosyncratic risk (a) versus systematic risk (b) for high versus low-risk IPOs. We note higher idiosyncratic and systematic risks over the first 12 quarters of IPOs characterized by a high level of idiosyncratic risk in the first quarter of IPO trading. This finding is consistent with Ang et al. (2006) results for overall stocks in the asset pricing literature in general. These authors note that high idiosyncratic risk firms are more sensitive to market risk factors. Ang et al. (2006)'s findings are consistent with the IPO's framework; especially that it is well known that IPO market is characterized by high level of asymmetric information. We suggest that market participants require an additional premium for idiosyncratic risk, especially for high idiosyncratic risk IPOs, to avoid the shortfall with respect to their investment in low idiosyncratic risk IPOs during the first three-year of seasoning. Furthermore, Figure IV. 5 shows that idiosyncratic and systematic risks associated with high-risk IPOs exhibit a downward trend over time and tend to reach the level of idiosyncratic and systematic risks associated with low-risk IPOs. We believe that only when the difference in IPOs versus matched non IPOs long-run systematic and idiosyncratic risks vanishes over time, the market participants will not require an additional risk premium for high idiosyncratic risk IPOs (during the early aftermarket stage).

Table IV. 14 presents a comparison between high versus low idiosyncratic-risk IPOs (and their matched non-IPOs) in terms of abnormal performance, risk and risk aversion assessed on the basis of individual returns over the IPO event-time (three-year of seasoning). When abnormal performance is measured with the standard 3FF model, high and low idiosyncratic-risk stocks, (IPOs and their peers) exhibit positive and significant intercepts. However, the difference in abnormal returns between high and low idiosyncratic-risk stocks is significant only for matched non-IPOs stocks. We also show that high idiosyncratic-risk stocks (IPOs and matched non-IPOs) are characterized by high systematic risk, which is consistent with Ang et al. (2006) findings. Moreover, we find that high idiosyncratic-risk stocks (during the first quarter of the offering) continue to exhibit higher idiosyncratic-risk over three-year of seasoning for both IPOs and their peers. When abnormal performance is measured with the modified 3FF model which includes firm-level idiosyncratic volatility risk, intercepts become significantly negative for high idiosyncratic-risk stocks (IPOs and matched non-IPOs). However, high idiosyncratic-risk IPOs exhibit more negative abnormal returns (-0.47%) than their peers in the same risk category (-0.14%). Furthermore, we note that intercepts from the modified 3FF become not significant for low idiosyncratic-risk stocks (IPOs and matched non-IPOs). We infer that firm-level idiosyncratic volatility risk mostly affects high-risk IPOs' abnormal performance. The difference in abnormal returns between high and low idiosyncratic-risk stocks is significant for IPOs, but not significant for matched non-IPOs. We conclude that the negative relationship between the firm-level idiosyncratic volatility risk and abnormal performance shown by Ang et al. (2006) is primarily derived by the IPO market and it is not necessarily valid for the overall established stocks in the market. We could explain Ang et al. (2006) results that show lower returns for high idiosyncratic risk stocks by the new issues bias. The IPO market is well recognized for its high level of asymmetric information which further increases the level of IPO idiosyncratic risk with respect to matched established firms. In fact, one should distinguish between IPOs and established firms when we focus on the relationship between the firm-level idiosyncratic risk and abnormal performance.

Table IV. 14 highlights another interesting result tied to the risk aversion associated with the systematic risk factors for both IPOs and similar non-IPOs. We show that the difference in Betas, used as a proxy for risk aversion associated with the systematic risk factors, between high and low idiosyncratic-risk stocks is significant only for IPOs. We note that market participants are more averse towards new issues, especially when these latter are riskier. Ang et al. (2006) attribute the negative impact of the firm-level idiosyncratic risk on the abnormal returns to the high sensitivity of high idiosyncratic risk stocks to systematic risk. Our findings support this explanation only for IPOs because the difference in Betas between high and low idiosyncratic-risk matched non-IPOs is not significant.

Furthermore, we previously showed in Table IV. 13 that the Delta coefficient, which measures the sensitivity of the calendar-time portfolio returns to aggregate volatility risk, is not significant. When we measure individual abnormal returns based on the IPO event-time method (Table IV. 14), we note that the Delta coefficient, which measures the sensitivity of individual returns to firm-level idiosyncratic volatility risk, is positive and significant for both high and low idiosyncratic-risk stocks (IPOs and their peers). We infer that we cannot ignore the pricing of the firm-level idiosyncratic risk which significantly affects stock expected returns. Table IV. 14 shows that high idiosyncratic risk stocks (IPOs and their peers) exhibit higher Delta than low idiosyncratic risk stocks (IPOs and their peers). However, the difference in this measure of risk aversion on idiosyncratic risk factors between the two stock's risk categories is not significant for IPOs and matched non-IPOs.

5.3- HITEC versus OTHERS IPOs' long-run performance

We investigate whether the pricing of both risk components (systematic and idiosyncratic) is different depending on a firm industrial classification. Therefore, we split our IPOs' (and matched non-IPOs') sample into five portfolios on the basis of the firm industry[52]: (1) CNMR includes sustainable and unsustainable consumption, wholesale, retail, and some services (laundries, repair shops), (2) MANUF includes manufacturing, energy and utilities, (3) HITEC includes business facilities, telephone and television transmission, (4) HLTH includes health

[52]The industrial classification is based on the classification by K French available at (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/).

care, medical equipment and medicines and (5) OTHER includes mining, construction, transportation, hotels, services, entertainment and financial sector.

Figure IV. 6 shows that HITEC IPOs exhibit the highest idiosyncratic risk which tends to decrease over the IPO event time. This finding is consistent with Lowry et al. (2010) who note that the value of a technology issue depends on their important growth option which makes these issues riskier firms. Furthermore, the degree of information asymmetry is higher for IPOs in the high-tech industry. Figure IV. 6 also shows that HITEC IPOs exhibit the highest systematic risk and that it is stable over the IPO event time. However, an upward trend is observed for IPO systematic risk in CNSMR, HLTH, MANUF and OTHER industries. As technology issues appear to be riskier in terms of idiosyncratic and systematic risks, we separate the high-tech IPO from the other IPOs to construct two IPO portfolios: (1) IPOs from HITEC industry, and (2) IPOs from other industries (CNMR, MANUF, HLTH and OTHER). We expect that the long-run abnormal performance of technology issues will be more affected by the volatility factor than issues from other industries, and more specifically by the firm-level idiosyncratic volatility risk.

Table IV. 15 reports the three-year abnormal performances of both IPOs' portfolios (HITEC and OTHERS) using the calendar-time portfolio method. When abnormal performance is measured using the standard 3FF model, we show that neither of the two IPOs' portfolios (HITEC and OTHERS) exhibit significant intercepts, suggesting zero three-year abnormal returns for technology and non-technology issues. When abnormal performance is measured on the basis of the modified 3FF model including the aggregate volatility risk factor, we find that only the intercept of non-technology issues becomes positively significant (at 5%). However, the difference in abnormal returns between both IPOs' portfolios (HITEC and OTHERS) remains insignificant. It seems that the new factor associated with aggregate volatility risk does not affect significantly expected returns and that its inclusion does not lead to a significant change in the difference of abnormal performance between the two IPO portfolios (HITEC and OTHERS).

Since the aggregate volatility of IPO portfolio ignores the idiosyncratic risk component at the firm-level, we could not conclude that technology issues do not significantly underperform other industries. Hence, we need to focus on the firm-level idiosyncratic risk effect on abnormal performance using individual returns over the IPO event-time as shown in Table IV. 16. We report a comparison between high-tech versus other industries IPOs as well as their matched non-IPOs in terms of abnormal performance, risk and risk aversion. When abnormal performance is measured using the standard 3FF model, we find positive and significant intercepts for both technology and non-technology firms (IPOs and non-IPOs). However, only the difference in abnormal returns between technology and non-technology non-issuing firms is significant, suggesting that technology non-issuing firms outperform other industries in the long-run. Moreover, we show that both issuing and non-issuing firms from HITEC industry are characterized by higher systematic and idiosyncratic risks with respect to firms from other industries. Nonetheless, IPOs have higher level of risks than similar non-IPOs, especially for technology firms. In fact, when we consider the firm-level idiosyncratic volatility risk factor in the modified 3FF model, we find that: (1) only technology firms (IPOs and similar non-IPOs) underperform the market (negative and significant intercepts), (2) non-technology firms (IPOs and similar non-IPOs) exhibit zero abnormal returns and (3) the difference in abnormal returns between HITEC and OTHERS is only significant for IPOs (on the basis of the one-tailed Wilcoxon test), suggesting that technology issues underperform other industries.

Results in Table IV. 16 show positive and significant Beta coefficients associated with systematic risk factors for both IPOs and similar non-IPOs regardless of the industry. In spite of the high sensitivity of technology issuing firms to systematic risk factors (1.61 for HITEC IPOs with respect to 1.47 for other IPOs) the difference in Betas is not significant between HITEC and other industries for IPOs as well as matched-non IPOs. We also note that issuing firms tend to be more sensitive to systematic risk factors than non-issuing firms. It seems that market participants require a higher premium on systematic risk for IPOs, especially HITEC IPOs which exhibit higher systematic risk than IPOs in other industries.

Furthermore, unlike the insignificance of the Delta coefficient in Table IV. 15, we show that the Delta coefficient associated with firm-level idiosyncratic risk is positive and significant for IPOs and non-IPOs regardless of their industry. Although technology firms appear to be more sensitive to firm-level idiosyncratic risk, the difference in Delta is not significant between HITEC and other industries for both IPOs and matched-non IPOs. We believe that market participants are more averse towards IPOs which would explain the increased premium on idiosyncratic risk especially for HITEC IPOs which are characterized by a high level of idiosyncratic risk.

5.4- Long-run performance and IPO's issuance period

The impact of the volatility risk factor (systematic and idiosyncratic) on abnormal performance measurement could be different depending on the period of study. Therefore, instead of looking only at the period from January 2000 to December 2009, we assess IPO abnormal performance throughout three sub-periods: (1) the hot-issue market in 2000, (2) the IPO quiet period between 2001 and 2007 and (3) the financial crisis period between 2008 and 2009.

Figure IV. 7 shows that firms that went public in 2000 are characterized by the highest idiosyncratic and systematic risks in the IPO event time (12 first quarters of the offering). Nevertheless, both risk components (systematic and idiosyncratic) associated to hot period IPOs tend do decrease over time (with a large negative slope trend). The idiosyncratic risk of issues in IPO quiet and crisis sub-periods exhibits a slight downward trend. However, the systematic risk of issues in both sub-periods (IPO quiet and crisis) exhibits a slight upward trend. Given these different time-variation in IPOs' systematic and idiosyncratic risks, we examine how both IPO risks affect the long-run abnormal performance measurement throughout these three issuance sub-periods.

We first focus on the impact of the aggregate volatility risk factor on three-year abnormal returns based on calendar-time portfolio returns. Table IV. 17 shows that when we use the standard 3FF model, the null hypothesis of no abnormal returns could not be rejected regardless of the issuance period of the IPOs (Hot, Quiet and Crisis). When we include the aggregate volatility risk factor in the modified 3FF model, we find positive and significant abnormal returns only in the IPO quiet period. Although the latter appear to outperform the market, our findings show that there is not a significant difference in long-run abnormal performances between (Hot-Quiet) as well as (Crisis-Quiet) IPO portfolios. Given that this aggregate volatility risk only represents the systematic volatility risk of the IPOs' portfolio, we need to focus on individual IPO returns to determine the idiosyncratic volatility risk impact on the long-run abnormal performance.

Previous findings (see sub-section 5.2) show that it is firm-level idiosyncratic risk that accounts for significantly lower IPO abnormal returns. This significant pricing of the firm-level idiosyncratic risk may be due to a specific period of hot-issue market which is characterized by the highest level of idiosyncratic risk. Therefore, we conduct a comparative analysis in terms of individual abnormal performances, firm-level risks and risk aversion between IPOs in hot, quiet and crisis sub-periods in Table IV. 18. When abnormal performances are measured using the standard 3FF model, we show that the null hypothesis of no abnormal returns is only rejected for IPOs in quiet sub-period. In this sub-period (2001-2007), we find a positive and significant intercept using the standard 3FF model. However, the differences in three-year individual abnormal returns between (Hot-Quiet) as well as (Crisis-Quiet) IPOs are not significant. We suggest that IPOs in quiet periods tend to outperform the market, which is not the case for hot market IPOs or issues launched during a crisis.

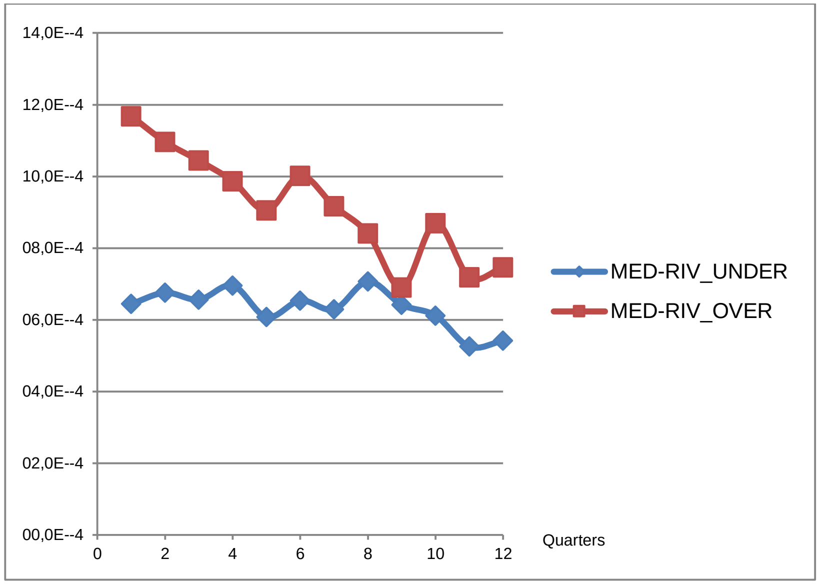
Table IV. 18 shows that IPO systematic risk is significantly higher only for hot IPOs when compared to issues in the quiet sub-period. There is not a significant difference in IPO systematic risk between quiet and crisis sub-periods. However, we find a positive (negative) and a significant difference in the issuing firm-level idiosyncratic risk between IPOs in hot (crisis) and quiet sub-periods. Hot IPOs (in crisis sub-period) exhibit a higher (lower) firm-level idiosyncratic risk than IPOs in quiet sub-period. It seems that many risky firms choose to go public in a hot-issue period because it is easier to market their issue without leaving much money on the table (Beaulieu and Mrissa Bouden, 2015 (a)). As a result, when we consider the firm-level idiosyncratic risk factor in the modified 3FF model, we show that hot-IPOs significantly underperform the market as well as the issues in quiet sub-period in the long-run. Furthermore, a crisis is a less favorable period for IPO timing. It seems that high idiosyncratic risk firms avoid going public not to be constrained to leave a lot of money, which could explain that IPOs in the crisis sub-period exhibit a lower level of idiosyncratic risk. As a result, when we consider the firm-level idiosyncratic risk factor in the modified 3FF model, we show that issues in the crisis sub-period significantly outperform the market in the long-run, which is not the case for issues in the quiet sub-period.

Moreover, we note that unlike the aggregate volatility risk factor which does not affect IPO portfolios' returns, the firm-level idiosyncratic risk factor affects significantly IPO individual's returns and leads to lower abnormal performance not only for hot IPOs but also for issues in the quiet sub-period. We infer that the pricing of idiosyncratic risk is not due to the hot-issue period. Nevertheless, its impact is more important for periods characterized by high IPO idiosyncratic risk; the sensitivity of IPOs' individual returns to firm-level idiosyncratic risk factor, measured by the Delta coefficient, is 0.60 for hot-IPOs against 0.14 for IPOs in quiet period. However, in the crisis sub-period which is characterized by the lowest level of IPO idiosyncratic risk, we find an insignificant Delta. It seems that the level of risk aversion towards idiosyncratic risk gradually decreases as the firm-level idiosyncratic risk decreases over the issuance periods.

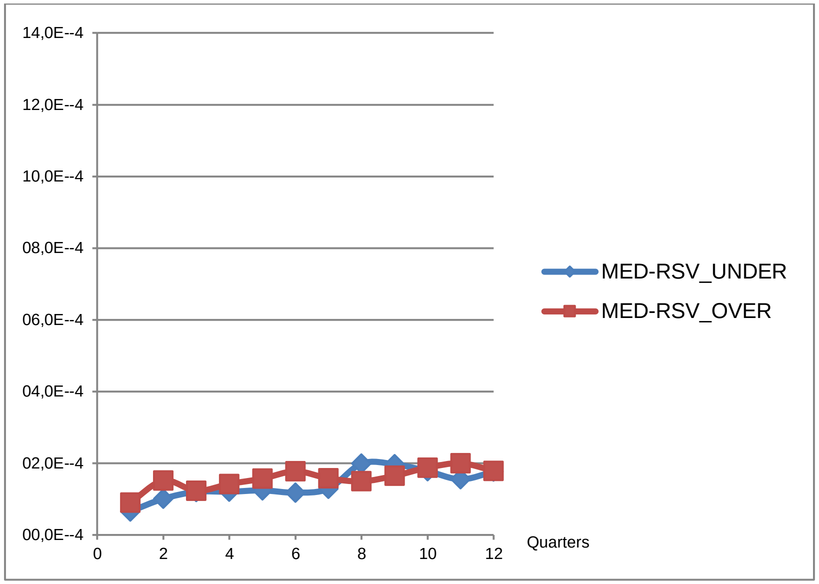
With respect to the "Betas", our results show positive and significant values for the three issuance sub-periods. However, the sensitivity of IPO returns to systematic risk factors is significantly higher for hot market IPOs compared to the quiet as well as the crisis sub-periods. We infer that the level of risk aversion associated with systematic as well as with idiosyncratic risk varies depending on the risk characteristics of the issues during the issuance period.

Figure IV. 4: Time variation in the idiosyncratic and systematic risk components for undervalued versus overvalued IPOs over the 12 first quarters of offering.

(a) Idiosyncratic risk



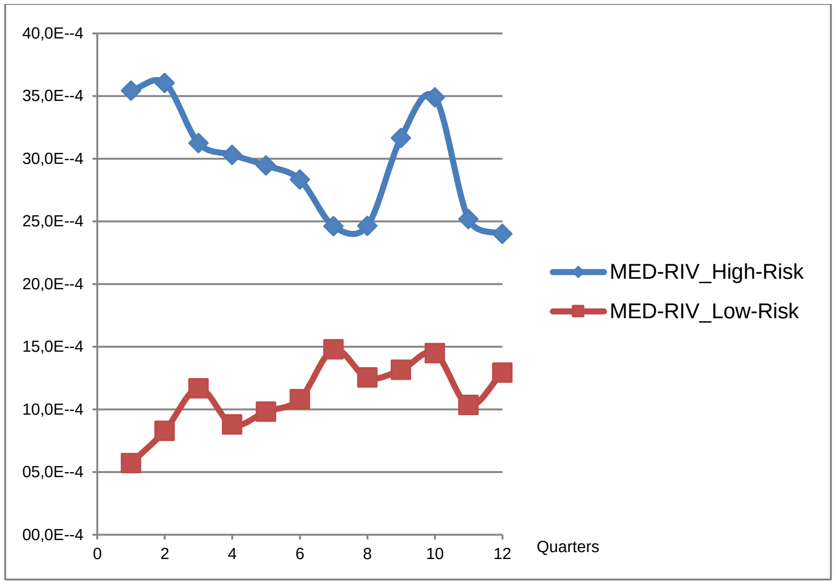
(b) Systematic risk



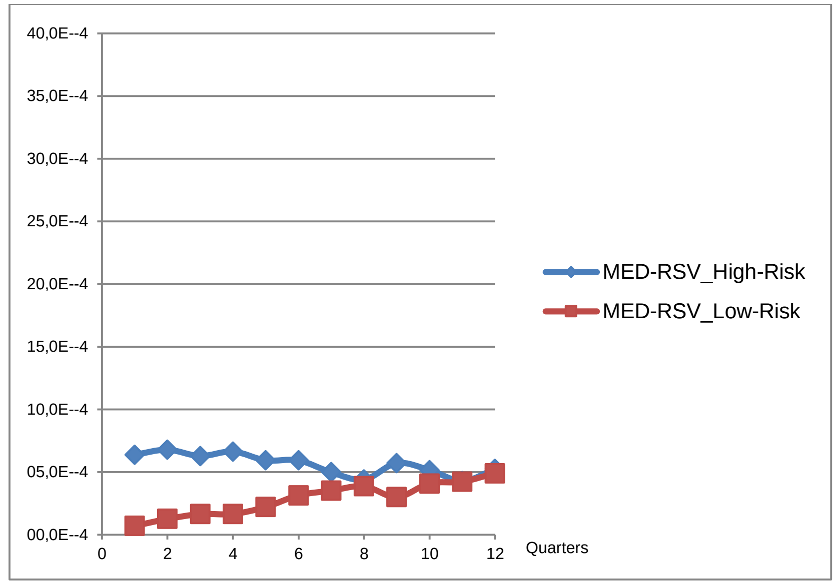
These figures report the time variation of the median of the idiosyncratic (a) and systematic risks (b) for undervalued versus overvalued IPOs' portfolios. The realized idiosyncratic (RIV) and systematic (RSV) volatilities are computed on the basis of the three factors model of Fama and French (2003) for IPOs over the 12 first quarters of IPO trading. IPOs are classified into two groups (undervalued and overvalued) on the basis of the Price-to-Value ratio as measured by Zheng (2007). If the Price-to-Value ratio is greater (smaller) than one, then the IPO is overvalued (undervalued) by the underwriter.

Figure IV. 5: Time variation in the idiosyncratic and systematic risk components for high- versus low-risk IPOs over the 12 first quarters of offering.

(a) Idiosyncratic risk



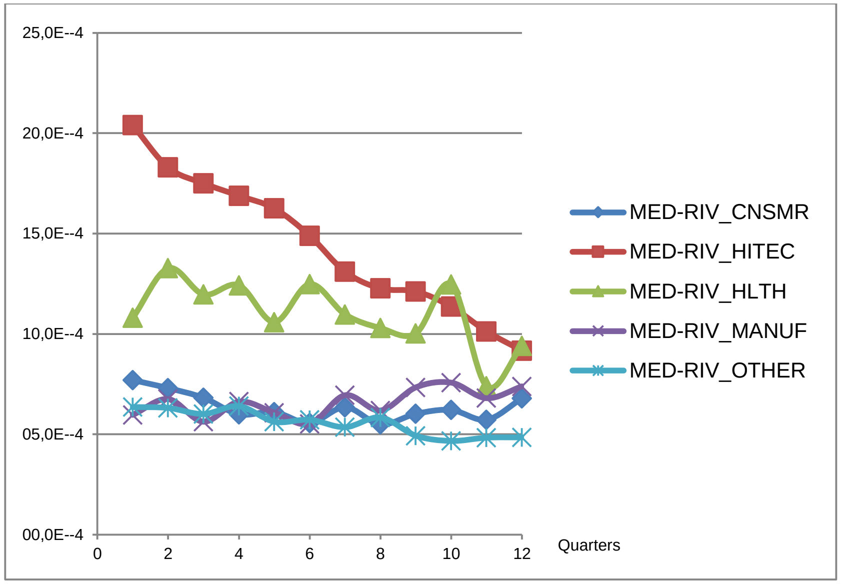
(b) Systematic risk



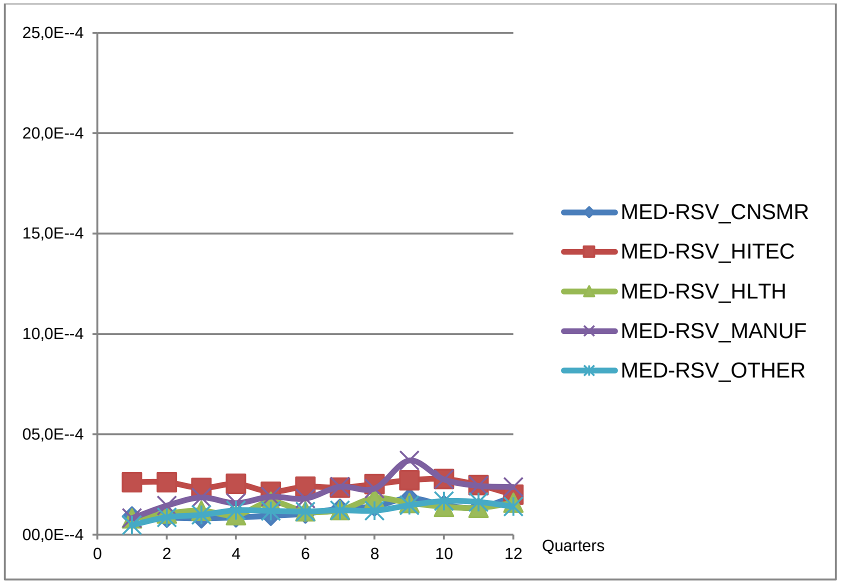
These figures report the time variation of the median of the idiosyncratic (a) and systematic risks (b) for high-risk versus low-risk IPOs' portfolios. The realized idiosyncratic (RIV) and systematic (RSV) volatilities are computed on the basis of the three factors model of Fama and French (2003) for IPOs over the 12 first quarters of IPO trading. IPOs are classified into two groups on the basis of their level of idiosyncratic risk in the first quarter of IPO trading: (1) high-risk IPOs that exhibit an idiosyncratic risk level above the median and (2) low-risk IPOs that exhibit an idiosyncratic risk level below the median.

Figure IV. 6: Time variation in the idiosyncratic and systematic risk components according to IPO's industrial classification over the 12 first quarters of offering.

(a) Idiosyncratic risk



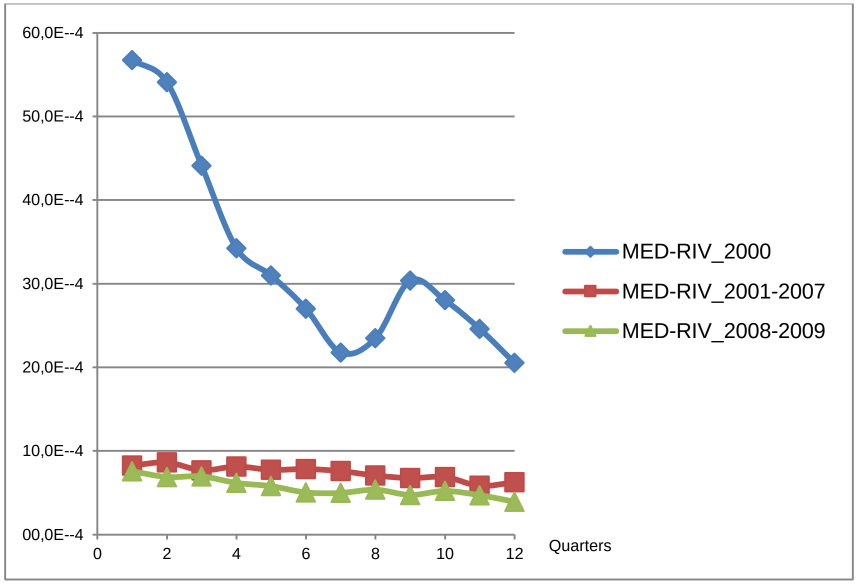
(b) Systematic risk



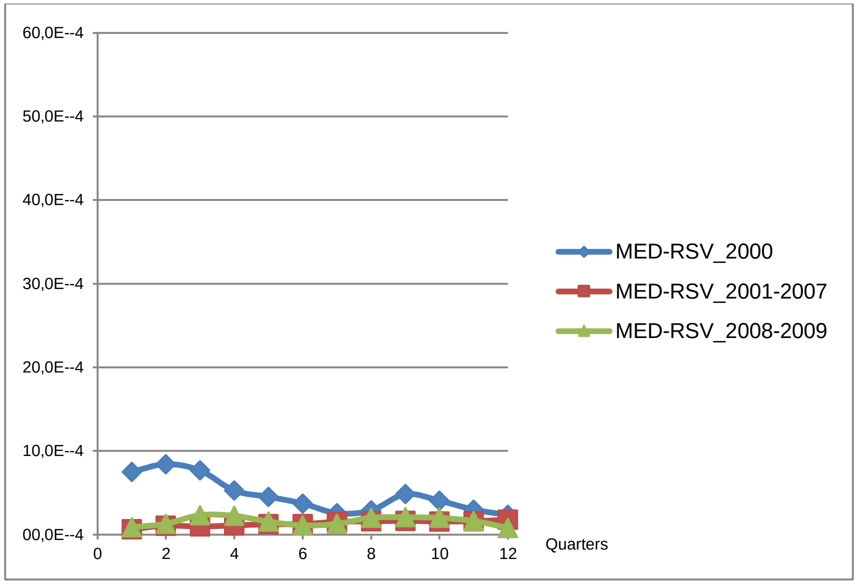
These figures report the time variation of the median of the idiosyncratic (a) and systematic risks (b) for IPOs' portfolios classified according to their industry. The industrial classification is based on a webpage for Kenneth R. French (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/). The realized idiosyncratic (RIV) and systematic (RSV) volatilities are computed on the basis of the three factors model of Fama and French (2003) for IPOs over the 12 first quarters of IPO trading.

Figure IV. 7: Time variation in the IPO idiosyncratic and systematic risk components over the 12 first quarters of offering according to the period of issuance

(a) Idiosyncratic risk



(b) Systematic risk



These figures report the time variation of the median of the idiosyncratic (a) and systematic risks (b) for IPOs' portfolios classified according to their period of issuance: (1) hot-issue market in 2000, (2) IPO quiet period between 2001 and 2007 and (3) financial crisis period between 2008 and 2009. The realized idiosyncratic (RIV) and systematic (RSV) volatilities are computed on the basis of the three factors model of Fama and French (2003) for IPOs over the 12 first quarters of IPO trading.

Table IV. 11: Standard and modified Fama-French three-factor regressions for overvalued versus undervalued IPOs' calendar-time portfolios

This table shows results of standard and modified 3FF regressions for overvalued versus undervalued calendar-time IPOs' portfolios. IPOs are classified into two groups (undervalued and overvalued) on the basis of the Price-to-Value ratio as measured by Zheng (2007). If the Price-to-Value ratio is greater (smaller) than one, then the IPO is overvalued (undervalued) by the underwriter. The values between brackets present the p-value.

Portfolio	**Three-year of seasoning**								
	α	β_{MKT}	β_{SMB}	β_{HML}	δ	γ	θ	η	R^2
Model A	**Standard 3FF for overvalued versus undervalued IPOs' portfolios**								
OVER	-0.4280×10^{-3}	1.0024	0.9082	-0.3273					0.5544
	(0.0862)	(<0.0001)	(<0.0001)	(<0.0001)					
UNDER	0.4120×10^{-3}	0.9912	0.7842	-0.0090					0.5434
	(0.0877)	(<0.0001)	(<0.0001)	(0.8026)					
OVER-UNDER	-0.8200×10^{-3}	0.0114	0.1334	-0.3251					0.0196
	(0.0084)	(0.6198)	(0.0082)	(<0.0001)					
Model B	**Modified 3FF for overvalued versus undervalued IPOs' portfolios**								
OVER	-6.927×10^{-6}	0.8988	0.7129	-0.1008	-0.5531	2.016×10^{-7}	0.9471	0.0540	0.5395
	(0.9641)	(<0.0001)	(<0.0001)	(<0.0001)	(0.7002)	(0.0029)	(<0.0001)	(<0.0001)	
UNDER	0.4090×10^{-3}	0.8940	0.6301	0.1448	0.9417	6.2046×10^{-8}	0.9659	0.0352	0.5329
	(0.0002)	(<0.0001)	(<0.0001)	(<0.0001)	(0.5057)	(0.0003)	(<0.0001)	(<0.0001)	
OVER-UNDER	-0.3650×10^{-3}	-0.0367	0.0536	-0.2445	-1.0225	7.9517×10^{-8}	0.9634	0.0387	0.0186
	(0.0317)	(0.0058)	(0.0400)	(<0.0001)	(0.3683)	(0.0992)	(<0.0001)	(<0.0001)	

Table IV. 12: Long-run abnormal performance, risk and risk aversion for overvalued versus undervalued IPOs over the IPO event-time

This table shows the median of the three-year abnormal returns, systematic and idiosyncratic risks and risk aversion measures for overvalued versus undervalued IPOs. The IPOs are classified into two groups (undervalued and overvalued) on the basis of the Price-to-Value ratio as measured by Zheng (2007). If the Price-to-Value ratio is greater (smaller) than one, then the IPO is overvalued (undervalued) by the underwriter. The long-run abnormal performance is measured by the intercepts from the standard ($ALPAH_{FF}$) and modified ($ALPHA_{FF\_GARCH-M}$) Fama-French model. The realized idiosyncratic (RIV) and systematic (RSV) risks are computed on the basis of the three factors model of Fama and French (2003) for IPOs over the 12 first quarters of IPO trading. The risk aversion associated with the systematic risk in measured by the sum of Betas coefficients tied to the market, size and book-to-market factors from the modified Fama-French model. The risk aversion associated with the idiosyncratic risk in measured by Delta coefficient tied to the idiosyncratic volatility risk factor from the modified Fama-French model. We use the non-parametric Wilcoxon and the Khi-2 tests for the difference between overvalued and undervalued IPOs. We test the null hypothesis that two groups of IPOs have the same continuous distribution.

	$ALPHA_{FF}$	$RSV \times 10^4$	$RIV \times 10^4$	$ALPHA_{FF\_GARCH-M}$	Betas	Delta
OVER	0.2700×10^{-3}	1.65	13.01	-0.3100×10^{-3}	1.4206	0.0246
(Wilcoxon p-value)	(0.1801)	(<0.0001)	(<0.0001)	(0.4653)	(<0.0001)	(0.1750)
UNDER	0.4750×10^{-3}	1.37	9.07	0.208×10^{-3}	1.6892	0.4441
(Wilcoxon p-value)	(<0.0001)	(<0.0001)	(<0.0001)	(0.8561)	(<0.0001)	(0.0001)
OVER vs. UNDER						
Z	-2.4442	0.9223	3.6515	-0.6208	-1.4746	-1.7193
(Pr > Z)	(0.0073)	(0.1782)	(0.0001)	(0.2674)	(0.0702)	(0.0428)
(Pr > $\lvert Z \rvert$)	(0.0145)	(0.3564)	(0.0003)	(0.5347)	(0.1403)	(0.0856)
Khi-2	5.9769	0.8518	13.3377	0.3861	2.1760	2.9581
(Pr > Khi-2)	(0.0145)	(0.3560)	(0.0003)	(0.5343)	(0.1402)	(0.0854)

Table IV. 13: Standard and modified Fama-French three-factor regressions for high- versus low idiosyncratic-risk IPOs' calendar-time portfolios

This table shows results of standard and modified 3FF regressions for high-risk versus low-risk IPOs' portfolios. IPOs are classified into two groups on the basis of their level of idiosyncratic risk in the first quarter of IPO trading: (1) high-risk IPOs that exhibit an idiosyncratic risk level above the median and (2) low-risk IPOs that exhibit an idiosyncratic risk level below the median. The values between brackets present the p-value.

Portfolio	Three-year of seasoning								
	α	β_{MKT}	β_{SMB}	β_{HML}	δ	γ	θ	η	R^2
Model A	**Standard 3FF for high- versus low idiosyncratic-risk IPOs' portfolios**								
HIGH-RISK	-0.0140×10^{-3} (0.9448)	1.0396 (<0.0001)	0.9631 (<0.0001)	-0.2213 (<0.0001)					0.6647
LOW-RISK	0.2720×10^{-3} (0.2119)	0.8015 (<0.0001)	0.5553 (<0.0001)	0,2727 (<0.0001)					0.2884
HIGH-LOW	-0.2820×10^{-3} (0.3014)	0.2311 (<0.0001)	0.1320 (<0.0001)	-0.4837 (<0.0001)					0.0959
Model B	**Modified 3FF for high- versus low idiosyncratic-risk IPOs' portfolios**								
HIGH-RISK	-6.9270×10^{-6} (0.9641)	0.8988 (<0.0001)	0.7129 (<0.0001)	-0.1008 (<0.0001)	-0.5531 (0.7002)	2.0160×10^{-7} (0.0029)	0.9471 (<0.0001)	0.0540 (<0.0001)	0.5395
LOW-RISK	0.3110×10^{-3} (0.0002)	0.7939 (<0.0001)	0.6098 (<0.0001)	0.0885 (<0.0001)	-0.0017 (0.9991)	6.0600×10^{-8} (0.0040)	0.9484 (<0.0001)	0.0536 (<0.0001)	0.4827
HIGH-LOW	-0.1560×10^{-3} (0.3202)	0.1563 (<0.0001)	0.1970 (<0.0001)	-0.1874 (<0.0001)	0.2571 (0.8383)	2.3747×10^{-8} (0.0040)	0.9506 (<0.0001)	0.0494 (<0.0001)	0.0752

Table IV. 14: Long-run abnormal performance, risk and risk aversion for high- versus low idiosyncratic-risk IPOs (matched non-IPOs) over the IPO event-time

This table reports the median of the three-year abnormal returns, systematic and idiosyncratic risks and risk aversion measures for high-risk versus low-risk IPOs (and their matched non-IPOs). IPOs are classified into two groups on the basis of their level of idiosyncratic risk in the first quarter of IPO trading: (1) high-risk IPOs that exhibit an idiosyncratic risk level above the median and (2) low-risk IPOs that exhibit an idiosyncratic risk level below the median. The long-run abnormal performance is measured by the intercepts from the standard ($ALPAH_{FF}$) and modified ($ALPHA_{FF\_GARCH-M}$) Fama-French model. The realized idiosyncratic (RIV) and systematic (RSV) risks are computed on the basis of the three factors model of Fama and French (2003) for IPOs over the 12 first quarters of IPO trading. The risk aversion associated with the systematic risk in measured by the sum of Betas coefficients tied to the market, size and book-to-market factors from the modified Fama-French model. The risk aversion associated with the idiosyncratic risk in measured by Delta coefficient tied to the idiosyncratic volatility risk factor from the modified Fama-French model. We use the non-parametric Wilcoxon and the Khi-2 tests for the difference between high-risk and low-risk stocks. We test the null hypothesis that two groups of IPOs have the same continuous distribution.

Variables	**$ALPHA_{FF}$**		**RSV×10^4**		**RIV×10^4**		**$ALPHA_{FF\_GARCH-M}$**		**Betas**		**Delta**	
Stocks	**IPOs**	**non-IPOs**	**IPOs**	**non-IPOs**	**IPOs**	**non-IPOs**	**IPOs**	**non-IPOs**	**IPOs**	**non-IPOs**	**IPOs**	**non-IPOs**
HIGH-RISK	0.4330×10^{-3}	0.6330×10^{-3}	2.35	1.26	20.34	15.19	-0.4700×10^{-3}	-0.1400×10^{-3}	1.7023	1.1630	0.4007	0.4662
(Wilcoxon p-value)	(0.0003)	(0.0003)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)	(0.0055)	(0.0110)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)
LOW-RISK	0.3780×10^{-3}	0.2800×10^{-3}	1.03	0.85	7.71	8.01	0.2000×10^{-3}	-0.070×10^{-3}	1.3808	1.3178	0.0435	0.1246
(Wilcoxon p-value)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)	(0.2306)	(0.1646)	(<0.0001)	(<0.0001)	(0.0024)	(<0.0001)
HIGH vs. LOW												
Z	0.2590	3.5951	7.3504	2.5700	13.6402	6.6663	-2.8012	-1.3349	3.2071	-0.3695	1.1783	1.1945
(Pr > Z)	(0.3978)	(0.0002)	(<0.0001)	(0.0051)	(<0.0001)	(<0.0001)	(0.0025)	(0.0910)	(0.0007)	(0.3559)	(0.1193)	(0.1161)
(Pr > $\|Z\|$)	(0.7956)	(0.0003)	(<0.0001)	(0.0104)	(<0.0001)	(<0.0001)	(0.0051)	(0.1819)	(0.0013)	(0.7117)	(0.2387)	(0.2323)
Khi-2	0.0672	12.9266	54.0320	6.6060	186.0626	44.4435	7.8481	1.7825	10.2869	0.1367	1.3889	1.4274
(Pr > Khi-2)	(0.7954)	(0.0003)	(<0.0001)	(0.0102)	(<0.0001)	(<0.0001)	(0.0051)	(0.1818)	(0.0013)	(0.7115)	(0.2386)	(0.2322)

Table IV. 15: Standard and modified Fama-French three-factor regressions for HITEC versus OTHERS IPOs' calendar-time portfolios

This table shows results of standard and modified 3FF regressions for HITEC versus NO-HITEC IPOs' portfolios. IPOs are classified into two groups on the basis of their industry: (1) HITEC IPOs and (2) OTHERS (including non-technology firms). The values between brackets present the p-value.

Portfolio	Three-year of seasoning								
	α	β_{MKT}	β_{SMB}	β_{HML}	δ	γ	θ	η	R^2
Model A	**Standard 3FF for HITEC versus OTHERS IPOs' portfolios**								
HITEC	0.3180×10^{-3} (0.1721)	1.0704 (<0.0001)	0.9777 (<0.0001)	-0.3153 (<0.0001)					0.6179
OTHERS	0.2090×10^{-3} (0.2421)	0.9023 (<0.0001)	0.7971 (<0.0001)	-0.0041 (0.8778)					0.6505
HITEC-OTHERS	-0.1250×10^{-3} (0.6157)	-0.1690 (<0.0001)	-0.1785 (<0.0001)	0.3128 (<0.0001)					0.0591
Model B	**Modified 3FF for HITEC versus OTHERS IPOs' portfolios**								
HITEC	0.1600×10^{-3} (0.4130)	1.0059 (<0.0001)	0.8104 (<0.0001)	-0.1721 (<0.0001)	1.9082 (0.2696)	6.0746×10^{-8} (0.2087)	0.9702 (<0.0001)	0.0318 (<0.0001)	0.6103
OTHERS	0.2440×10^{-3} (0.0108)	0.8273 (<0.0001)	0.6578 (<0.0001)	0.0688 (<0.0001)	0.3625 (0.8552)	7.2599×10^{-8} (0.0068)	0.9408 (<0.0001)	0.0635 (<0.0001)	0.6418
HITEC-OTHERS	-0.0750×10^{-3} (0.7012)	-0.1426 (<0.0001)	-0.1426 (<0.0001)	0.2522 (<0.0001)	-0.0871 (0.9568)	7.6463×10^{-8} (0.1807)	0.9640 (<0.0001)	0.0386 (<0.0001)	0.0571

Table IV. 16: Long-run abnormal performance, risk and risk aversion for HITEC versus OTHERS IPOs (matched non-IPOs) over the IPO event-time

This table reports the median of the three-year abnormal returns, systematic and idiosyncratic risks and risk aversion measures for HITEC versus NO-HITEC IPOs (and their matched non-IPOs). IPOs are classified into two groups on the basis of their industry: (1) HITEC IPOs and (2) OTHERS (including non-technology firms). The long-run abnormal performance is measured by the intercepts from the standard ($ALPAH_{FF}$) and modified ($ALPHA_{FF\_GARCH-M}$) Fama-French model. The realized idiosyncratic (RIV) and systematic (RSV) risks are computed on the basis of the three factors model of Fama and French (2003) for IPOs over the 12 first quarters of IPO trading. The risk aversion associated with the systematic risk in measured by the sum of Betas coefficients tied to the market, size and book-to-market factors from the modified Fama-French model. The risk aversion associated with the idiosyncratic risk in measured by Delta coefficient tied to the idiosyncratic volatility risk factor from the modified Fama-French model. We use the non-parametric Wilcoxon and the Khi-2 tests for the difference between HITEC and NO-HITEC stocks. We test the null hypothesis that two groups of IPOs have the same continuous distribution.

Variables	**$ALPHA_{FF}$**		**$RSV\times10^4$**		**$RIV\times10^4$**		**$ALPHA_{FF\_GARCH-M}$**		**Betas**		**Delta**	
Stocks	**IPOs**	**non-IPOs**	**IPOs**	**non-IPOs**	**IPOs**	**non-IPOs**	**IPOs**	**non-IPOs**	**IPOs**	**non-IPOs**	**IPOs**	**non-IPOs**
HITEC	0.5050×10^{-3}	0.6620×10^{-3}	2.49	1.57	19.05	16.91	-0.3900×10^{-3}	-0.2500×10^{-3}	1.6159	1.2428	0.3867	0.3460
(Wilcoxon p-value)	(0.0005)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)	(0.0400)	(0.0223)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)
OTHERS	0.3430×10^{-3}	0.3468×10^{-3}	1.24	0.93	10.75	9.71	0.0100×10^{-3}	-0.0500×10^{-3}	1.4698	1.2437	0.1765	0.2389
(Wilcoxon p-value)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)	(0.8314)	(0.0803)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)
HITEC vs. OTHERS												
Z	1.2224	2.6884	6.6171	3.4405	7.7881	5.8151	-1.6770	-0.9504	1.6264	-0.2881	0.5647	-0.5280
(Pr > Z)	(0.1108)	(0.0036)	(<0.0001)	(0.0003)	(<0.0001)	(<0.0001)	(0.0468)	(0.1709)	(0.0519)	(0.3866)	(0.2861)	(0.2987)
(Pr > $\lvert Z \rvert$)	(0.2216)	(0.0074)	(<0.0001)	(0.0006)	(<0.0001)	(<0.0001)	(0.0935)	(0.3423)	(0.1039)	(0.7732)	(0.5723)	(0. 5977)
Khi-2	1.4249	7.2289	43.7900	11.8386	60.6583	33.8183	2.8132	0.9039	2.6459	0.0832	0.3192	0.2791
(Pr > Khi-2)	(0.2215)	(0.0072)	(<0.0001)	(0.0006)	(<0.0001)	(<0.0001)	(0.0935)	(0.3417)	(0.1038)	(0.7730)	(0.5791)	(0.5973)

Table IV. 17: Standard and modified Fama-French three-factor regressions for IPOs' calendar-time portfolios in hot-issue, quiet and crisis periods

This table shows results of standard and modified 3FF regressions for IPOs' calendar-time portfolios in hot-issue (2000), quiet (2001-2007) and crisis (2008-2009) periods. The values between brackets present the p-value.

Portfolio	Three-year of seasoning								
	α	β_{MKT}	β_{SMB}	β_{HML}	δ	γ	θ	η	R^2
Model A	**Standard 3FF for IPOs' portfolios in hot-issue, quiet and crisis periods**								
HOT	-0.0730×10^{-3} (0.8935)	1.1630 (<0.0001)	1.4283 (<0.0001)	-0.1509 (0.1223)					0.6186
QUIET	0.1620×10^{-3} (0.4060)	0.9142 (<0.0001)	0.6942 (<0.0001)	0.1780 (<0.0001)					0.6553
CRISIS	0.1350×10^{-3} (0.6102)	0.7554 (<0.0001)	0.4858 (<0.0001)	-0.0993 (0.0143)					0.6719
HOT-QUIET	0.4920×10^{-3} (0.5286)	0.2176 (0.0029)	0.5476 (0.0001)	-0.4530 (0.0023)					0.0858
CRISIS-QUIET	-0.1630×10^{-3} (0.6916)	-0.3213 (<0.0001)	-0.4271 (<0.0001)	-0.0400 (0.4704)					0.2892
Model B	**Modified 3FF for IPOs' portfolios in hot-issue, quiet and crisis periods**								
HOT	-0.1520×10^{-3} (0.8283)	1.1173 (<0.0001)	1.2831 (<0.0001)	-0.1800 (0.0160)	0.6116 (0.8642)	4.6345×10^{-6} (0.0101)	0.8720 (<0.0001)	0.1172 (<0.0001)	0.6164
QUIET	0.2960×10^{-3} (0.0033)	0.8655 (<0.0001)	0.6838 (<0.0001)	0.1046 (<0.0001)	0.0603 (0.9795)	2.5369×10^{-7} (<0.0001)	0.8985 (<0.0001)	0.1021 (<0.0001)	0.6525
CRISIS	0.0702×10^{-3} (0.8027)	0.8031 (<0.0001)	0.6443 (<0.0001)	-0.1244 (0.0005)	-0.0069 (0.9987)	4.8277×10^{-7} (0.0189)	0.9206 (<0.0001)	0.0770 (<0.0001)	0.6645
HOT-QUIET	-0.2630×10^{-3} (0.7263)	0.2943 (<0.0001)	0.4926 (<0.0001)	-0.2796 (0.0132)	0.9045 (0.7649)	7.7773×10^{-6} (0.0001)	0.8228 (<0.0001)	0.1634 (<0.0001)	0.0795
CRISIS-QUIET	0.2740×10^{-3} (0.6551)	-0.2569 (<0.0001)	-0.3619 (<0.0001)	-0.0188 (0.7090)	-4.8552 (0.4113)	6.2537×10^{-7} (0.1287)	0.9450 (<0.0001)	0.0518 (<0.0001)	0.2772

Table IV. 18: Long-run abnormal performance, risk and risk aversion over the IPO event-time for IPOs in hot-issue, quiet and crisis periods

This table shows the median of the three-year abnormal returns, systematic and idiosyncratic risks and risk aversion measures for IPOs in hot-issue (2000), quiet (2001-2007) and crisis (2008-2009) periods. The long-run abnormal performance is measured by the intercepts from the standard ($ALPAH_{FF}$) and modified ($ALPHA_{FF\_GARCH-M}$) Fama-French model. The realized idiosyncratic (RIV) and systematic (RSV) risks are computed on the basis of the three factors model of Fama and French (2003) for IPOs over the 12 first quarters of IPO trading. The risk aversion associated with the systematic risk in measured by the sum of Betas coefficients tied to the market, size and book-to-market factors from the modified Fama-French model. The risk aversion associated with the idiosyncratic risk in measured by Delta coefficient tied to the idiosyncratic volatility risk factor from the modified Fama-French model. We use the non-parametric Wilcoxon and the Khi-2 tests for the difference between IPOs' groups. We test the null hypothesis that two groups of IPOs have the same continuous distribution.

	$ALPHA_{FF}$	**$RSV\times10^4$**	**$RIV\times10^4$**	**$ALPHA_{FF\_GARCH-M}$**	**Betas**	**Delta**
HOT	0.2510×10^{-3}	4.11	45.96	-1.2200×10^{-3}	1.8666	0.6021
(Wilcoxon p-value)	(0.3024)	(<0.0001)	(<0.0001)	(0.0002)	(<0.0001)	(<0.0001)
QUIET	0.4310×10^{-3}	1.16	10.92	0.0290×10^{-3}	1.5068	0.1434
(Wilcoxon p-value)	(<0.0001)	(<0.0001)	(<0.0001)	(0.9576)	(<0.0001)	(<0.0001)
CRISIS	0.2140×10^{-3}	1.67	7.24	0.5310×10^{-3}	1.2872	0.0001
(Wilcoxon p-value)	(0.0689)	(<0.0001)	(<0.0001)	(0.0355)	(<0.0001)	(0.6157)
HOT vs. QUIET						
Z	-1.0944	8.6488	13.5177	-3.8763	2.3065	1.7690
(Pr > Z)	(0.1369)	(<0.0001)	(<0.0001)	(<0.0001)	(0.0105)	(0.0384)
(Pr >|Z|)	(0.2738)	(<0.0001)	(<0.0001)	(<0.0001)	(0.0215)	(0.0769)
Khi-2	1.1985	74.8085	182.7365	15.0284	5.3217	3.1305
(Pr > Khi-2)	(0.2736)	(<0.0001)	(<0.0001)	(0.0001)	(0.0211)	(0.0768)
CRISIS vs. QUIET						
Z	-0.9291	1.4867	-3.0642	1.4545	-1.6561	-1.8168
(Pr > Z)	(0.1764)	(0.0686)	(0.0011)	(0.0729)	(0.0489)	(0.0346)
(Pr >|Z|)	(0.3528)	(0.1371)	(0.0022)	(0.1458)	(0.0977)	(0.0693)
Khi-2	0.8644	2.2120	9.3933	2.1175	2.7446	3.3029
(Pr > Khi-2)	(0.3525)	(0.1369)	(0.0022)	(0.1456)	(0.0976)	(0.0692)

6- Conclusion

This paper revisits the long-run abnormal performance of IPOs and their comparable non-IPOs equities based on individual as well as portfolio's measures. While previous research often use stock returns' volatility as a risk proxy, we distinguish in the paper between two risk measures (systematic and idiosyncratic) to reveal how each risk component is involved in the IPO pricing during the first three-year of IPO trading. In fact, we compare IPOs with respect to their peers in terms of long-run performance, systematic and idiosyncratic risk.

First, we find that contrarily to non-IPOs equities that show no idiosyncratic risk trend over time, IPOs' idiosyncratic risk exhibit a significant downward trend during the first three years of the offering. The magnitude of the downward trend in IPO idiosyncratic risk is larger for: (1) firms that go public in hot-issue period in 2000, (2) high-tech IPOs, (3) overvalued IPOs with respect to their peers in pre-IPO market and (4) issuing firms characterized by high idiosyncratic risk during the early aftermarket stage. However, the systematic risk component has a slight upward trend over time especially for IPOs equities. Our tests show that both risk components (idiosyncratic and systematic) remain higher for IPOs with respect to their peers over the three-year of seasoning. Our findings are consistent with Ang et al. (2006) who show that high idiosyncratic risk IPOs are more sensitive to market risk factors. Our results also show that as the IPO idiosyncratic risk decreases over time, contrarily to the IPO systematic risk which tends to increase, suggesting that market participants continue to be compensated for the higher level of IPO idiosyncratic risk with respect to their peers by an additional premium for IPO systematic risk.

Second, we conduct a time series analyze to focus on the impact of each type of risk (systematic and idiosyncratic) on the IPOs versus non-IPOs' three-year abnormal returns through the calendar-time portfolio and the IPO event time methods. The use of the a

GARCH-M (in mean) extension to the standard three-factor model of Fama and French allows us to assess the sensitivity of returns not only to the market, size and market-to-book factors, but also to the aggregate volatility (firm-level idiosyncratic) risk in the calendar-time portfolio (IPO event-time) method. Our results are consistent with Brav and Gompers (1997) who do not find evidence to support that IPOs underperform their peers in the long-run. We add that the difference in long-run abnormal returns between IPOs and comparable non-IPOs' portfolios loses its significance when abnormal returns are adjusted for the volatility risk factor in the modified three-factor model of Fama and French including the GARCH-M extension. These findings are robust to individual measures of abnormal returns. We also find that IPOs do not significantly underperform their peers when we consider paired individual measures of abnormal returns. Since the idiosyncratic risk is neglected in the portfolio's volatility as a result of diversification, the assessment of abnormal performance based on individual returns emphasizes the role of the conditional idiosyncratic risk component in IPO valuation through the Delta coefficient in the modified 3FF model. We show that when we consider the conditional idiosyncratic risk in the mean equation of individual stock returns, abnormal returns tend to be lower for both IPOs and their peers. We infer that abnormal returns assessed on the basis of the standard 3FF model are upwardly biased because time-variation in idiosyncratic risk and its effect on expected returns are not modeled. Nevertheless, the difference in individual abnormal returns between both types of stocks (IPOs and their comparable non-IPOs) is still not significant regardless of the model (standard 3FF or modified 3FF) employed to measure abnormal performance.

Third, we study the aggregate as well as the firm-level idiosyncratic volatility risk impact on long-run performance according to the IPO profile. Unlike aggregate volatility risk which represents only the systematic risk in the calendar-time portfolio method, we show that the firm-level idiosyncratic volatility risk is significantly priced and leads to lower individual long-run abnormal performance, especially for IPOs with high idiosyncratic risk, technology firms and hot new issues. Our findings show that when we use the modified 3FF model that includes the firm-level idiosyncratic volatility risk factor, high idiosyncratic risk IPOs, technology firms and hot new issues respectively underperform low idiosyncratic risk IPOs, no-technology firms and issues in quiet period. Moreover, we show that the difference in the firm-level idiosyncratic risk-adjusted abnormal returns between high and low idiosyncratic risk stocks as well as technology and non-technology firms is significant only for IPOs. Therefore, we conclude that the negative pricing of the idiosyncratic risk in the cross-section for overall assets shown by Ang et al. (2006) is probably due to IPOs stocks.

Finally, this paper contributes to the literature by providing some additional evidence for the mixed evidence in the literature on IPOs long-run performance. In our context, we show that the risk impact on long-run abnormal returns is mainly due to the firm-level idiosyncratic risk which should be priced especially for IPOs. Market participants require an additional risk premium for IPOs, especially for high idiosyncratic risk IPOs, technology firms and hot new issues that are characterized by the high level of idiosyncratic risk over the three-year of seasoning. We conclude that the mixed findings in the literature on long-run IPO underperformance might be due to the omission of the firm-level idiosyncratic risk in the abnormal return assessment on the one hand, and the omission of controlling for some specific IPO characteristics on the other hand.

Chapter V: General conclusion

This thesis examines the IPO activity and the IPO pricing process from a new perspective based on the risk decomposition into systematic and idiosyncratic components. Unlike previous studies that do not use this risk decomposition to analyze IPO cycles or IPO evaluation, our study highlight the role of each type of risk in the IPO process from the registration period to the aftermarket stage. We suggest that the asymmetric information which characterizes the IPO market could be measured at different levels (firm and market levels) and in different periods (pre-and post-IPO) of the IPO process. In addition, we recognize that the main source of the asymmetric information in the IPO market arises from firms' intrinsic risk factors which are not fully disclosed by the issuer during the registration period. Therefore, we emphasize the relevance of isolating the variance of shocks in the individual IPO returns from its total variance to measure the level of information asymmetry between the issuing firm and market participants. Since the decision to go public depends not only on the issuing firm's conditions but also on market conditions, we also suggest that stock market price movements help issuers to decide about the optimal timing of their issue. We then use the market volatility index as a proxy for market-wide risk. This risk decomposition into different components and different levels[53] allows us to evaluate the impact of each type of risk on the IPO cycles and the IPO pricing process.

In the second chapter of this thesis, IPO cycles are redefined in terms of IPO volume, IPO initial returns and IPO systematic as well as idiosyncratic risks. Previous authors often focus on the lead-lag relationship between the IPO initial returns and the IPO activity, but they not investigate whether risk is involved to explain this relationship. Our findings show that the positive relationship between initial returns and the subsequent IPO volume is significant only for high-risk IPOs, suggesting that risk matters in the determination of the

[53] (1) Systematic and idiosyncratic risks at the firm-level, (2) systematic and idiosyncratic risks at the IPO market-level and (3) market-wide risk measured by the VIX.

IPO cycle. Hence, the question which arises in this study is on the type of risk that is involved in the determination of the IPO cycle. Therefore, using VAR modeling, we analyze the predictability power of the IPO systematic and idiosyncratic risks versus the market implied volatility on the IPO activity in the IPO cycle.

Our second chapter shows that the systematic risk of recent issues and market-wide risk help predict IPO waves. We show that periods of high market uncertainty are followed by small numbers of IPOs. However, periods of high systematic risk of recent issues lead to a large number of IPOs. We infer that both the market volatility index and the systematic risk component of previous issues contain relevant information for firms that intend to go public. First, periods of high market implied volatility induces a drop in market prices which leads issuer to leave more money on the table to market their issues. For this reason, many issuers may choose to cancel or to postpone their IPO for more favorable market conditions in the future. Then, a small number of issues will be observed following high market-wide uncertainty. Second, since market conditions are linked to firm conditions through firms' systematic risk, our results show that systematic components are positively correlated across IPOs. As a consequence, high level of systematic risk among recent issues leads to more IPOs in the subsequent period because firms whose values are more sensitive to systematic factors expect to profit from higher valuation of their newly issued equities.

We conclude that IPO volume change over time in response to time variation in the market-wide risk as well as systematic component risk at the IPO market level. Unlike systematic risk, idiosyncratic risk components are not correlated across IPOs, suggesting that periods of high asymmetric information level do not lead more firms to enter the market because they are constrained to compensate investors for their risk characteristics by underpricing their issues. For this reason, high-idiosyncratic risk firms which intend to achieve higher proceeds are likely to wait for more favorable market conditions. Therefore, we find that these risky firms are motivated to go public following periods of hot-issue market which is characterized by a great dispersion in firm quality.

In the third chapter of this thesis, we focus on the risk impact on IPO valuation not only during the early aftermarket stage as often documented in previous studies, but also during the registration period. The majority of previous authors (Ibbotson, 1975, Ritter, 1984, etc) show that IPOs are underpriced when IPO offer price is compared to the IPO first-day market price. However, other authors such us Purnanandam and Swaminathan (2004) find that IPOs are overvalued with respect to their peers. This research reexamines the IPO valuation in relation with risk at different levels and different periods of the IPO pricing process in order to understand these mixed findings in the IPO literature.

In this third chapter, we do not only consider the IPO initial return which is used as an underpricing measure by the majority of previous authors but we also compute a Price-to-Value ratio to compare IPO value (at the offer price) to a matched non-IPO value (at the market price prior to the offer date). We underscore that the previous measure of underpricing is biased because IPO prices during the early aftermarket stage are affected by the underwriters' stabilization practices and the overreaction of some optimistic investors and all of which might make it differ from the fundamental value of the issuing firm. Therefore, this study distinguishes between: (1) the pre-IPO valuation by the underwriters in the registration period and (2) the post-IPO valuation by the market participants in the first day of IPO trading.

Since IPO initial returns could be subject to noisy trading, the distinction between overvalued and undervalued IPOs is based on the IPO value with respect to the value of its peer in pre-IPO. We use propensity score match for the nearest neighbor matching method in order to select matched non-issuing firms based on firm's fundamentals (net sales, EBITDAM, EPS percentage change and leverage). This approach selects control firms that are the closet to our IPO sample. In addition, we choose Zheng's (2007) method to compute Price-to-Value ratio because unlike P&S's (2004) method, it allows us to obtain unbiased measures.

In general, we find that IPOs are correctly valued compared to their peers. However, it appears that underwriters overvalue IPO equities during hot-issue market and crisis periods which are characterized by high levels of asymmetric information. Therefore, we suggest that risk could explain the issuing firm's valuation in pre-and post-IPO. Since we examine pre- and post-IPO valuation in relation to risk, we use pre- and post- risk measures to proxy for IPO ex- ante and ex-post uncertainty. Besides, we decompose IPO total risk into systematic and idiosyncratic risks. We isolate the variance of shocks on individual returns to measure the idiosyncratic risk at the firm level which is used to proxy for the asymmetric information in post-IPO. The idiosyncratic risk of issues in the month before the offering is used as a proxy for the asymmetric information in pre-IPO. We find that pre-IPO valuation is negatively affected by the idiosyncratic risk component at the IPO market level, suggesting that high levels of asymmetric information in the IPO market lead underwriters to undervalue the offering to stimulate investors' demand during the IPO registration period. Nevertheless, IPOs are correctly priced by the underwriters in pre-IPO when we consider the systematic risk at the IPO market level.

For post-IPO valuation, our results show that only the issuing firm's idiosyncratic risk significantly affects IPO initial returns. We add that this positive relationship is supported only for overvalued IPOs. It seems that when underwriters overvalue (undervalue) the issues, information about the risk characteristics of the issuer is partially (fully) incorporated into the IPO offer price. In addition, we show that idiosyncratic risk at the firm-level during the first month of trading is positively related to the idiosyncratic risk at the IPO market level during the IPO registration period. This result is found only for overvalued IPOs. We conclude that the degree of asymmetric information around recent issues is transferred to overvalued IPOs in the subsequent period through their idiosyncratic risk component, which is not fully incorporated into the offer prices. We contribute to the IPO literature by showing that: (1) the relationship between IPO valuation and risk mainly depends on the risk component (systematic or idiosyncratic) at the issuing firm as well as IPO market levels and (2) the IPO mispricing is mainly due to the idiosyncratic risk component that is not fully incorporated on the IPO prices.

In the fourth chapter of this thesis, we focus on the IPO long-run abnormal performance given that it presents mixed evidence in the previous literature. Some authors (Ritter, 1991, Loughran and Ritter, 1995, etc) show that IPOs underperform the market in the long-run, while others (Brav and Gompers, 1997, Gompers and Lerner, 2003, etc) do not support the evidence of long-run IPO underperformance. The IPO literature provides different approaches to measure long-run abnormal returns, but there is no consensus in the literature on the best one to use. Some empirical studies (Barber and Lyon, 1997, Kothari and Warner, 1997, etc) recognize that IPO long-run performance depends on the methodology used to assess abnormal returns. Based on this debate in the IPO literature, this paper examines the IPO long-run abnormal performance using a new perspective controlling for the issuing firm risk. We conduct a comparative study between IPOs and comparable non-IPOs equities not only in term of long-run performance, but also in terms of systematic and idiosyncratic risks. We use the same approach (the propensity score match) as in the third chapter to select matched non-issuing firms based on firm's fundamentals. We aim to reveal how different risk components affect the long-run performance measure for IPOs versus similar non-IPO equities.

The comparative study between IPOs and similar non-IPO equities in terms of risks reveals that IPOs equities exhibit a higher risk than their peers in terms of their risk components (idiosyncratic and systematic) over the three-year of seasoning. Nevertheless, unlike matched non-issuing firms that show no trend in their idiosyncratic risk, issuing firms exhibit a significant downward trend during the first three years of the offering, with larger magnitude for hot-IPOs, high-tech issuing firms, overvalued IPOs and high-idiosyncratic risk issuing firms. Moreover, we find that as IPO idiosyncratic risk decreases over time, IPO systematic risk tends to increase. It seems that market participants continue to require additional premium on IPO systematic risk in order to compensate for the IPO idiosyncratic risk that remains higher than that of their peers, despite its decrease over time.

To highlight the risk effect on long-run abnormal performance measurement, we use modified approaches based on the standard calendar-time portfolios and event-time methods, namely a GARCH-M extension to the three-factor model of Fama and French. These new approaches measure long-run abnormal returns adjusted by the portfolios' volatility risk (when we consider the modified calendar-time portfolios method) on the one hand, and the individual idiosyncratic risk of the firm (when we consider the modified event-time method) on the other hand. Since idiosyncratic risk vanishes in the portfolios' volatility because of the diversification effect, the aggregate volatility of the portfolio presents only systematic risk components. Hence, our modified approach allows us to control for both firms' risk components (systematic and idiosyncratic) in order to retrieve a more accurate measure of long-run abnormal returns which will be adjusted not only by the Fama-French three-factor (market, size and book-to-market), but also by the aggregate firms' systematic risk or the individual firm's idiosyncratic risk. When we control for these new firms' risk factors, our results do not support that IPOs underperform their peers in the long-run. We infer that abnormal returns computed on the basis of standard approaches are biased because time-variation in firms' risk (systematic or idiosyncratic) and its effect on expected returns are not considered.

This study about IPO long-run performance also focus on the firm's risk-adjusted abnormal returns according to the IPO profile (its pre-IPO valuation, its idiosyncratic risk level during the early aftermarket stage, its industry and its period of issuance). We find that high idiosyncratic risk IPOs, technology firms and hot new issues respectively underperform low idiosyncratic risk IPOs, non-technology firms and issues in quiet period, when we control for firm-level idiosyncratic volatility risk. Moreover, as we note that the difference in firm-level idiosyncratic risk-adjusted abnormal returns between high and low idiosyncratic risk stocks is only significant for IPOs and not for their matched non-IPOs; we conclude that the negative pricing of the idiosyncratic risk in the cross-section shown by some previous authors could be attributed to IPOs stocks.

Overall, the third and the fourth chapters of this thesis allow us to conclude that the mixed findings in the IPO literature over short as well as long-run IPO performance could be attributed to the non-incorporation of the idiosyncratic risk component in the IPO pricing process from the registration period to the aftermarket stage. Therefore, investors should require an additional risk premium, especially for high idiosyncratic risk IPOs, technology firms and hot new issues that are characterized by the high level of idiosyncratic risk.

We intend to conduct future researches on the IPO market to study other issues in this market which are still a "puzzle". Although our research emphasizes the risk impact on the three IPO market’s anomalies throughout the IPO process from the registration period of the IPO candidate until three years of seasoning, this thesis does not provide any insight as to when we could consider IPOs as non-IPOs equities. Further research is needed in order to deepen the IPO risk analysis over even longer horizons to reveal when IPOs will exhibit risk characteristics similar to their peers. It is also interesting to show for how much time, investors require an additional risk premium for IPOs. In addition, as seasoned equity offerings (SEOs) present similar patterns than IPOs, we think that it would be interesting to focus on the role of different risk components (systematic and idiosyncratic) in SEO activity and SEO pricing. That evidence would shed light on how asymmetric information is processed in the IPO market versus in the SEO market. Further researches are needed to check if there are cycles in SEOs as in IPOs in terms of volume, initials returns and risks.

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