



Modeling the Subscription Ratio and IPO Returns Non-Linear Relationship: Evidence from the Tunisian Stock Market

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ABSTRACT

To capture the herd behavior of initial public offering (IPO) investors, the relationship binding IPO underpricing and the subscription ratio is often assumed to represent a straight line in the relevant literature, due mainly to recurrent general linear modeling in the data analysis process. In Tunisia, however, and following the subscription result declaration, all IPOs are usually met with noticeable success owing to over subscription issues, resulting in persistent herd behavior. In this context, the present paper is designed to highlight how Tunisian investors tend to mimic each other on setting out to make trading decisions. More particularly, we attempt to specify the non-linear relationship binding the subscription ratio and IPO returns within a quantile regression, highlighting the investors' noticeable sensitivity to high subscription, thereby, easily inducing the spread of herd behavior and increasing IPO returns.

Keywords: Initial Public Offerings, Tunisian IPO, IPO Returns, Investors' Herd Behavior, Subscription Demand

JEL Classifications: C21, G1, G3

1. INTRODUCTION

Investor demand represents the primary factor that predict initial public offering (IPO) return which, in turn represents the primary result of the cost of offering shares through the primary market in order to encourage investors to participate in the issue. It is worth recalling that IPO returns is commonly expressed in the form of percentage difference between the price at which shares are subsequently traded on the market (the 1st day closing price) and the price at which the IPO shares were originally sold to investors (the offer price set by issuers), and at which the offering is introduced. Actually, the underpricing issue represents a subject of exhaustive research and intensive debate in the world of finance. Indeed, investor demand is a critical component in IPO success and it is frequently measured by IPO subscription demand. It is worth mentioning that the impact of IPO subscription demand on IPO return has been subject of intense research among academics and practitioners Low and Yong (2011), Alqahtani and

Boulanouar (2017), Wang et al. (2017) and Tsukioka et al. (2018), Albada et al. (2019), Ariyanto et al. (2020), Yan and Wang (2021). Dierkes et al. (2022) and Deng et al. (2023).

As stated by the traditional finance theory, IPO subscription demand helps predict initial returns, and plays a significant role in affecting post-IPO performance. In fact, this subscription ratio is an indicator of the investors' expectations and demand of IPO shares after their listing. Therefore, when the subscription demand is high, investors continue to pursue IPO shares after they are issued leading to the increase of IPO initial returns Derrien (2005); Agarwal et al. (2008); Marisetty and Subrahmanyam (2010), Bubna and Prabhala (2011), Jeribi and Jarboui (2015b) and Alqahtani and Boulanouar (2017). Noteworthy, however, is that, on making such decisions, investors often tend to be subject to their proper sentiments. In effect, the bias, seemingly related to IPO returns, turns out to be the outcome of IPO investors associated herd behavior, whereby, investors tend to make non-rational decisions that traditional finance cannot explain.

Actually, behavioral finance related studies generally maintain that investors tend to imitate and follow each other in matters of trading decision Chang et al. (2000); Kumar and Lee (2006) and Wang et al. (2017), thereby, rendering the IPO investors' herd behavior remarkably influential on IPO returns.

Empirically, such a market bias could be directly or indirectly captured through subscription demand distribution Jiang and Leger (2010); Shen et al. (2013), Wang et al. (2017), Arisanti and Asri (2018), Arivanto and Haryetti (2020) and Xuan et al. (2023).

Today, most IPOs are priced by means of book building method, whereby, the IPO price is but the result of the law of supply, with no allocation details being provided. Unfortunately, however, testing the herd behavior turns out to be unfeasible. Still, firms going public on the tunisian stock exchange (TSE) are required to publish a prospectus including the valuation methods enabling to determine the fixed offer price. It is worth noting that, in Tunisia, and following the subscription result declaration, all IPOs usually turn out to succeed in their deals mainly because issues are most often oversubscribed.

Following the success, shares are transferred from the primary market to the secondary market, and the subscription ratio is used as an indicator of the investors' share-price level expectations after the IPO conclusion. More specifically, however, is that the Tunisian IPO stock market proves to demonstrate a typical setting example, wherein, herd behavior is noticeably obvious. It is in this context that the present work can be set, with the aim of reexamining the classic issue of IPO underpricing from such a novel perspective.

Hence, investigating such a relationship from an emerging market perspective, such as the Tunisian context, seems worth considering. Moreover, despite the existence of a wide range of traditional finance related studies that treat the IPO return and subscription demand ratio binding relationship, the present paper's contribution lies in capturing the herd behavior relying on the basic theoretical principles initially proposed by Jiang and Leger (2010), Shen et al. (2013) and Wang et al. (2017). Using TSE relevant data, concerning the period ranging from 2005 to 2020, we propose examining the channel factors lying behind and determining the IPO returns' subscription-demand ratio. Actually, our objective lies in investigating in Tunisia as a emerging market the initial returns as observed and estimated at various subscription demand intervals. More specifically, by applying a quantile-regression approach, we consider estimating the non-linear relationship binding subscription demand and initial returns. The empirical investigation, involving a preliminary comprehensive analysis concerning the IPO returns and investor herd behavior interactions, revealed that investor herd behavior has been perceived as liable to affect IPO returns through subscription demand. Additionally, the results highlighted Tunisian investors tend to mimic one another in matters of trading decision-making, thereby, generating high initial returns not only on the first listing day, but also following their issue.

In effect, the present study is intended to provide certain recommendations for both institutional and retail investors as

to prevalent behavioral decisions, while providing meaningful insights regarding rather effective economic and financial policies. The remainder of this work is organized as follows. Section 2 provides an overview of the relevant literature, while section 3 is devoted to depict the selected study sample and applied methodology. As to the results and relevant analyses, they make subject of section 4, with section 5 enclosing the main concluding remarks and suggestions for future research venues.

2. LITERATURE REVIEW

In the IPOs market, demand for new issues has long stood as an important criterion of IPO returns. In this regard, Marisetty and Subrahmanyam (2010) noted that the subscription demand coefficient proves to be positive and highly significant with IPO returns, while Bubna and Prabhala (2011) stated that such a demand turns out to be closely correlated with high initial returns. As for Jeribi and Jarbouï (2015), they discovered a positive relationship to persist between the subscription ratio and IPO aftermarket performance.

With respect to Welch (1992), Amihud et al. (2003), Tajuddin et al. (2015), and Alqahtani and Boulanouar (2017), the subscription demand effect proves to be either extremely high or low, with very few cases lying in between. For Welch (1992), the pricing decisions could well reflect informational cascades, thereby, avoiding or attenuating the winner's curse theory. Worth recalling at this level, also, is the cascading information, originally initiated by Welch (1992), which is noticeably maintained by Ljungqvist (2008) to stand as an appropriate behavioral framework, whereby, IPO underpricing could be effectively explained. Such a consideration implies that the investor's herd behavior, resulting in either a high or a low demand, could well affect the post-IPO performance. As to Chang et al. (2000), Kumar and Lee (2006) and Wang et al. (2017), they highlighted that the investors' irrational behavior reveals well that investors tend to follow each other when deciding on trading decisions, which makes IPO underpricing liable to investigation via the herding strategy. In this respect, and to help capture the IPO investors associated herd behavior, Wang et al. (2017) undertook to determine the initial returns under various subscription demand intervals. They noted the predominance of a nonlinear relationship binding subscription demand and initial return.

Actually, one could well note that most of the previously conducted studies appear to be exclusively devoted to treating the issue of IPO herd behavior effect on IPO returns by merely considering subscription ratio as a major indicator of the investors' expectations of the IPO shares' price level, following their listing, on the ground that it helps significantly in predicting initial returns.

As regards the present work, we consider examining the subscription demand distribution along with the subscription demand and initial returns binding relationship to help capture the investors' herd behavior in Tunisia, as an emerging market, using a quantile regression.

3. RESEARCH METHODOLOGY

3.1. Sample Selection

In a bid to capture the TSE related IPO underpricing, a selection of 35 TSE listed IPOs has been collected and observed over the period ranging from January 2005 to December 2020. Financial institutions and firms displaying missing information (listing prospectuses, share price and subscription results etc.) have been eliminated. The relevant subscription results and the listing prospectuses have been drawn from the financial market council.

3.2. The Dependent Variable

In our study case, the dependent variable, IPO underpricing, is measured by IPO initial return (IR), under the form of closing price and offer price difference to offer price ratio.

In this context, the initial IPO returns are calculated in relevance to its initial listing-day achievement, while the initial IPO returns are computed based on the 8th week following the first listing day achieved results. This 8-week period option has been intentionally applied, as it helps reflect the most effective trading days.

3.3. The Independent Variable

In this respect, the over-subscription ratio is used to represent investor demand, as it represents an appropriately fit corporate value indicator. Accordingly, this ratio can be represented by the investors' demand for the IPO throughout the subscription period, and measured by the IPO oversubscription frequencies. Noteworthy, also, is that the subscription demand is computed on the basis of the total number of all-investor shares requested in the subscription period to the number of shares offered.

Accordingly, subscription demand issued to capture the IPO investors' herd behavior (Wang et al., 2017). Actually, high-demand IPOs are more likely to induce a herd behavior than low-demand IPOs.

3.4. Control Variables

The firms' return on equity (ROE) is used to refer to company profitability. It is designated by the last pre-issuing year net profit to stockholder equity ratio.

In addition, firm size and book-to-market (BTM) are used to describe firm characteristics, wherein, size is defined by market value and the book-to-market ratio is used to retrieve corporate value by comparing the company's book value to its market value.

It is worth highlighting, in this respect, that a major event characterizing our selected study period consists in the Tunisian revolution of the early 2011.

Actually, the possibility that such an event could well influence the study's main variables in is justified by the noticeable changes or fluctuations marking the IPO underpricing level following this crucial landmark event (Figure 1).

The variables' detailed denotations, as applied in this paper, are depicted on Table 1.

3.5. Regression Model

To capture the IPO investors relating herd behavior, we undertake to examine the initial returns under various subscription demand intervals. More specifically, we consider applying a quantile regression to observe the nonlinear relationship binding subscription demand and initial returns. The complete relevant empirical models are depicted as follows:

$$IR_{i,d} = a_0 + a_1 SD_i + a_2 \ln(SIZE_i) + a_3 \ln(BTM_i) + a_4 \ln(ROE_i) + a_5 REV_i + \epsilon_i \quad (1)$$

$$IR_{i,8w} = a_0 + a_1 SD_i + a_2 \ln(SIZE_i) + a_3 \ln(BTM_i) + a_4 \ln(ROE_i) + \alpha_5 REV_i + \epsilon_i \quad (2)$$

Whith:

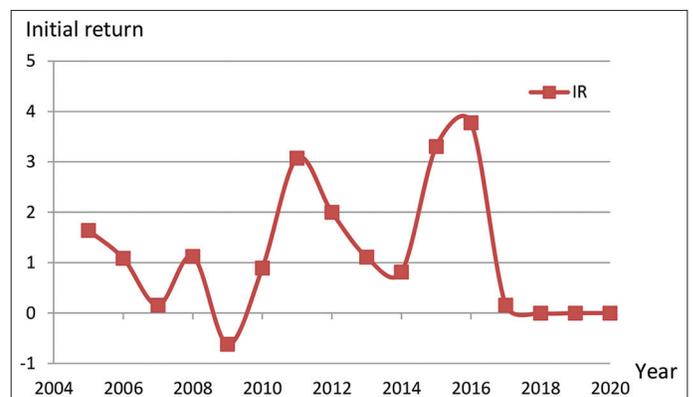
$i=1$ until 35 ; $IR_{i,d}$: The share initial returns of the firms i at the end of the first listing day; $IR_{i,8w}$: The IPO underpricing rate during the 8th week following the first listing day; SD_i : The indicator inducing IPO irrational behavior; $SIZE_i$: the market value; BTM_i : The book-to-market; ROE_i : The return on equity; REV_i : A dummy variable that takes the value one if IPOs are issued prior to the Revolution, 0 otherwise; ϵ_i : An error term.

Table 1: Variables' description

Variables	Description
$IR_{d }$	The IPO underpricing rate on the first listing day
$IR_{8w }$	The IPO underpricing rate during the 8 th week following the initial listing day
SD	The subscription demand computed as the total number of shares requested by all investors throughout the subscription period to the number of offered shares ratio, to stand as an indicator of the IPO investor associated herd behavior
$\ln(SIZE)$	Firm size, measured through logarithmic market value
$\ln(BTM)$	Book-to-market, measured by logarithmic book-to-market
ROE	Return on equity, measured by logarithmic book-to-market
REV	Designates the Tunisian revolution, a dummy variable that takes the value one if the IPOs are issued prior to the Revolution, and 0 otherwise

IR: Initial return, SD: Standard deviation, BTM: Book-to-market, ROE: Return on equity, REV: Revolution

Figure 1: Average yearly underpricing (or initial returns)



4. RESULTS AND DISCUSSION

4.1. Descriptive Statistics

Table 2 depicts the descriptive statistics relevant to the study main variables. Both of the $IR_{i,d}$ (IPO return at the first listing day) and $IR_{i,8w}$ (IPO return following the 8th week of the first listing day) associated means are: 0.3156656 and 2.624453, respectively, slightly larger than the relevant median values of: 0.0588235 and 0.896, respectively.

Additionally, the SD_i (subscription demand) mean turns out to be: 9.773269, denoting that the subscription period requested quantity is nearly ten times the quantity offered, which is in turn larger than its median 3.921. The SD_i 75th quantile is 13.9, indicating a right-skewed distribution. In other words, some of the IPOs demand data is noticeably high, rendering the average increasingly increased.

As regards the other variables' characteristics, the $SIZE_i$ (company size) associated mean and median are: 17.2853 and 17.8228, respectively. In addition, 75% of the $SIZE_i$ (19.08543) variable is of greater worth than the mean, indicating that most of the firms associated size proves to be above the average.

As to the sample companies' BTM, it turns out to display a mean of: 7337592, while the relevant standard deviation mean is of the rate of 0.5236867, highlighting a minor difference in size between the equity-book value and the equity-market value. As to the company profitability measurement, we consider applying the ROE, as an indicator of the management's ability to generate income from the equity at hand. Accordingly, it turns out that the ROE mean value is of the rate of -0.121713, while the standard deviation rate proves to be 1.655039.

Analysis of the dichotomous variable appears to reveal that 63% of the sample IPOs are discovered to be issued following the revolution (REV) event, implying that most of the IPOs have been listed in the TSE after revolution.

4.2. The IPO Subscription Effect Demand on Initial Returns

For the purpose of observing the investor herd behavior from different perspectives, we consider examining the impact of IPO subscription demand on two-tailed initial returns (the lowest and highest initial-return quantiles) using a quantile regression

method. The relevant regression results are reported on Table 3, below.

As Table 3 indicates, the subscription demand (SD) coefficients relevant to the various initial-return quantiles are significantly positive. This result seems to coincide with our prediction stating that owing to prevalent herd behavior, investors tend to mimic each other with regard to trading decisions, thereby, affecting initial returns.

More particularly, the quantile regression results appear to reflect well the investors' responses to the various subscription demand degrees. Indeed, the first and second panel SD coefficients tend to increase with increased initial returns. On the other hand, investors tend to respond differently to these quantiles' increased or decreased subscription demand. In effect, the initial returns prove to be superior to the right-tailed quantile, indicating that, actively, investors tend to purchase stocks with high subscription demand. In the 0.90 quantile, for instance, the initial returns' SD coefficient are 0.054 and 0.820 for the first and second panels, respectively, indicating that initial returns tend to increase by either 0.054 or 0.820, as subscription demand proves to increase by one. Conversely, however, the left-tailed quantile initial returns are low, suggesting that investors tend to consider the low subscription-demand IPOs as negative, therefore, refraining from purchasing them. In the case of 0.05 quantile, however, initial returns appeared to decrease by 0.015 regarding the first panel, and by 0.134 concerning the second panel, with a decrease in subscription demand by one, an effect that seems less noticeable than that of the SD on initial returns regarding the 0.90 percentile.

A comparison of the SD coefficients relevant to the right and left-tailed quantiles (Figure 2) reveals well that investors tend to be rather sensitive to high subscription demand, thereby, easily kindling and inducing a herd behavior, resulting in a predominant non-linear relationship between subscription demand and initial returns.

Both of the sub-models relevant results appear to indicate that even when the study involved control variables and IPO returns turn out to be negatively or positively significant, still the SD tends to display a significantly strong positive relationship with IPO returns.

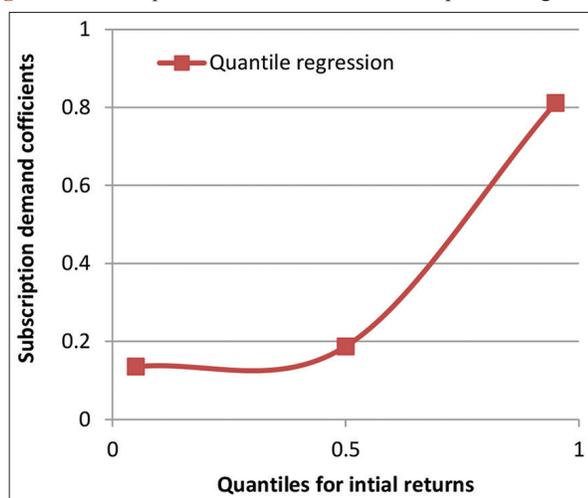
Table 2: Descriptive statistics

	Mean	Std. Dev	25%	50%	75%
$IR_{i,d}$	0.3156656	0.681507	0.166667	0.0588235	0.2584705
$IR_{i,8w}$	2.624453	6.832085	0.0011765	0.896	5.887892
SD	9.773269	11.72982	1.8	3.921	13.9
Ln(SIZE)	17.2853	1.382382	17.2853	17.82284	19.08543
Ln(BTM)	0.7337592	0.5236867	0.3727415	0.6029072	0.9667006
ROE	-0.121713	1.655039	0.056797	0.1297487	0.2591947
Dichotomous variable	Modality		Proportion		Std.Err.
Rev	1: IPOs are issued before the revolution		0.3714286		0.0828658
	0: IPO are issued after the revolution.		0.6285714		0.0828658

Table 3: Quantile regression analysis of IPO initial returns on demand indicator

Variables	First-day initial return		
	5 th quantile	50 th quantile	90 th quantile
SD	0.01535*** (0.000)	0.01525*** (0.000)	0.05429*** (0.000)
Ln (SIZE)	-0.0183*** (0.000)	-0.1799 (0.598)	0.14368** (0.018)
Ln (BTM)	0.25987*** (0.000)	0.14642 (1.52)	1.02869*** (0.000)
ROE	-0.02503*** (0.000)	-0.11303 (0.273)	-0.01081 (0.973)
REV	-0.2090*** (0.000)	0.21765 (0.063)	0.14711 (0.645)
Constant	-0.03602 (0.220)	0.12343 (0.851)	-3.1002*** (0.003)
Adj R-squared	0.32991	0.3151	0.6524
SD	0.133658*** (0.000)	0.184244*** (0.001)	0.81953*** (0.000)
Ln(SIZE)	-0.35038*** (0.000)	-0.195517 (0.605)	-0.2806 (0.172)
Ln(BTM)	1.002922*** (0.000)	2.17492* (0.069)	4.33379*** (0.000)
ROE	-0.42897*** (0.000)	-0.09758 (0.397)	-0.07414 (0.581)
REV	3.16977*** (0.000)	1.22635 (0.325)	2.38579* (0.023)
Constant	1.4506 (0.000)	1.257591 (0.861)	0.90823 (0.847)

$IR_{i,t}$: The share initial returns of the firms i at the end of the first listing day; $IR_{i,8w}$: The IPO underpricing rate during the 8th week following the first listing day; SD: the indicator inducing IPO irrational behavior; SIZE _{i} : the market value; BTM _{i} : The book-to-market; ROE _{i} : the return on equity; REV _{i} : a dummy variable that takes the value one if IPOs are issued prior to the Revolution, 0 otherwise; *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 levels, respectively.

Figure 2: Subscription demand coefficients for quantile regression

5. CONCLUSION AND IMPLICATION

The present study is conducted to examine the major mechanism lying behind the IPO subscription demand's noticeable effect on IPO stock returns, regarding thirty-five TSE concluded IPOs, observed over the period ranging from 2005 to 2020. The aim has been to estimate the herd behavior associated with the investors' sensitivity to subscription demand, through a quantile regression analysis. In effect, the possibility to capture and the investor related herd behavior, as recorded on the Tunisian market, has been made feasible and enhanced mainly by the fact that the IPO market usually releases subscription demand information prior to listing.

Under the theoretical framework, investor herd behavior has been perceived as liable to affect IPO returns through subscription demand. As our empirical results highlight, Tunisian investors tend to mimic one another in matters of trading decision-making, thereby, generating high initial returns not only on the first listing day, but also throughout the following 8th week. Subsequently, as subscription demand grows high, investors continue pursuing the IPOs following their issue, thus, noticeably increasing initial returns.

Actually, a thorough review of relevant literature reveals well that, predominantly, the previously elaborated studies, conducted in this respect, seem to overlook the Tunisian investors' responses to various degrees of subscription demand intervals. Only few among them, however, appear to consider that the subscription ratio could exclusively stand as a major indicator of the investors' price-level expectations of IPO shares, immediately following their listing (Jeribi and Jarboui, 2015b). With regard to the present study, however, the investors' different responses are treated to vary as to the subscription demand increasing or decreasing right and left quantiles. Indeed, the right-tail quantile initial returns turn out to be higher than the left-tail quantile returns, indicating that investors tend to be rather sensitive to high subscription demand, thereby, noticeably inducing and kindling the persistent herd behavior.

In effect, our achieved findings provide evidence as to the behavioral factors' implications, namely, the critical role the investors' herd behavior plays in explaining the initial-return statuses, particularly in emerging markets. Noteworthy, also, are the information cascades likely to emanate from the prevalent herd behavior. Worth highlighting, in this respect, is that investors are requested to allot greater attention on interpreting IPO subscription demand, and to handle the investors associated herd behavior with tremendous care, as it could well culminate in noticeably increasing the IPO returns' performance, thereby, significantly fueling and kindling speculative bubbles.

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