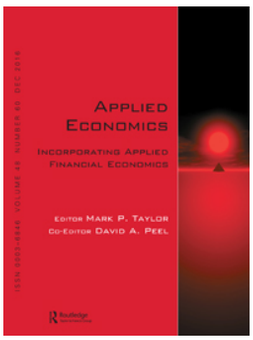

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IPO underpricing in supply and demand framework: evidence from a market of retailers

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ABSTRACT

How do supply, demand and allocation of shares on the underpricing of initial public offerings (IPOs) affect the shape and steepness of supply and demand curves? Theoretical studies posit that subscribers 'flip' in IPOs immediately on the listing day to capture instantaneous profits. Consistent with this hypothesis, we find that both curves of the market listing day of IPOs are significantly negatively sloped with the supply curve being much steeper and above the demand curve. The excess demand that occurs during the subscription period becomes excess supply once the shares start to float on the listing day. Overall, we establish a strong empirical link between the underpricing puzzle and the aftermarket interaction of IPOs.

KEYWORDS

Initial public offerings; supply and demand; underpricing; allocation

JEL CLASSIFICATION

G32; G39; G30; G24

I. Introduction

The underpricing of initial public offerings (IPOs) is documented worldwide. Although the initial returns vary among countries, the consensus is that IPOs reward the first-day sellers. However, explanations for such a phenomenon remain unclear. As complete data are unavailable, fully documenting IPO underpricing is a challenge. Ritter and Welch (2002) propose examining demand, supply, allocation of shares and other trading-related issues to solve the underpricing puzzle. They state that 'The solution to the underpricing puzzle has to lie in focusing on the setting of the offer price, where the normal interplay of supply and demand is suppressed by the underwriters' (p.1803). The lack of sufficient disclosure on IPOs in industrial economies except Singapore (see Koh and Walter 1989; Lee, Taylor, and Walter 1999; Hopp and Dreher 2013) limits empirical research.

This article makes new contributions to the IPO literature. It is the first to test underpricing in supply and demand framework using unique real data datasets that are collected from Saudi Arabia that allows us to conduct experimental tests on the price movement of IPOs under a supply and demand framework. In fact, Saudi IPOs possess unique characteristics as Saudi IPOs are offered exclusively to Saudi citizens (retailers) that make partial identification of potential subscribers (demanders). In other countries, eligible subscribers are rarely identified, which limits researchers to the use of oversubscription as the only measure of demand that is unnecessarily an accurate measure. Additionally, data on the number of subscribers (NOS) to each IPO in Saudi Arabia are available. Subscribers to an IPO who receive shares become the major suppliers on the listing day (Fishe 2002; Aggarwal 2003). In the Saudi market, 85% of the IPOs are offered solely to individuals (retailers) at a pre-announced fixed price (Alanazi and Al-Zoubi 2015).

Furthermore, information about the methods used to allocate the shares and the number of shares allocated to the subscribers are also available. In general, the data on the methods of allocation are not available in most other markets. Prior papers discuss the discretionary policies and the obstacles associated with obtaining the data on allocation (e.g. Ritter and Welch 2002). Some countries, such as France, reveal the distribution of shares whereas others follow the U.S. in not disclosing such information. Our data on the allocation of shares are different as we know the number of shares allocated to the retailers. This particular feature of our data allows us to test the supply and demand.

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Our results yield a statistically significant relationship between the underpricing of the IPO and the supply and demand for its shares. We construct two simultaneous equations, one using the opening price and another by using the closing price. Using the opening price, we find that the pre-listing excess demand immediately converts into excess supply, which stops the price from continuing to rise. The same process should occur in all markets. Otherwise, the price has no reason to reach an equilibrium. This is the shooting-up phenomenon widely understood in literature but rarely examined accurately. The phenomenon mainly results from the excess demand for the quantity in the pre-listing period and the investors' price expectations. Empirically, we document this result.

Using the closing price with the volume of the listing day, we also find that both curves are significantly negatively sloped with the supply curve being steeper, which lies above the demand curve. This finding is not surprising in a market composed mainly of flippers in the emerging market.

The rest of the article is organized as follows. Section II presents the data. Section III explains the theoretical framework and discusses the supply and demand simultaneous equations. Section IV presents and discusses the empirical findings and we conclude in Section V.

II. Data

Data sources

To identify Saudi Arabian IPOs[1], we inspected the Saudi Capital Market Authority (CMA) prospectuses from 2003 to 2010. Two reasons for choosing this period are now in order. First, this period represents the hot market of IPOs where oil prices sharply increased and investment in the Gulf region plunged, accordingly. Second, the Saudi market transferred from fixed-price procedure to book-building procedure in 2011 resulting in more price efficiency.

A total of 76 IPOs were located during this period. The first-day closing and opening prices were gathered from the Saudi stock exchange market 'Tadawul database'. Because there was a 5-to-1 stock split in the middle of 2006 for all Saudi companies, we review the unadjusted prices for the companies that went public prior to the stock split to compare their offer price with their actual first-day prices. We also use the market index – Tadawul All Share Index (TASI) – for return adjustment purposes.

Data on the NOS, the allocation of shares and the percentage of oversubscription for each company were collected from domestic and regional press releases. Saudi newspapers publish the results of each IPO from the first day that the company is open to subscription until the closure of the subscription period. We double check the accuracy of the data by reviewing the Argaam, Gulfbase and Alzawya databases that contain most of these data.[2]

Descriptive statistics

As shown in Table 1, because of the variation in the size of the IPO, the number of offered shares by each company is positively skewed. Some IPOs have offered as many as a billion shares and some have offered only a 1 million shares, as shown by the maximum and minimum figures. In general, the median shows that the IPOs offered approximately 8 million shares. The maximum and minimum numbers of subscribers is 10 million and 0.315 million, respectively, although the average seems to be less skewed. About 15% (2.2 million people) of the Saudi population actively participated in all the IPOs. The large demand for IPO shares (represented by the NOS) and the low supply of shares (represented by the number of shares) led to the low allocation. Only 1 share was distributed to subscribers in 5 out of the 76 IPOs. The maximum allocation was 100 shares from the IPO of Alinma Bank, which offered 1.050 billion shares in 2008. In addition, we observe that the under-establishment IPOs take longer time than the established IPOs because the former requires the approval of the Ministry of Commerce and other legal requirements. Oversubscription as measured by the ratio of the

[1]To save space we do not include the background and IPO institutional settings of this country. On request, its details will be provided.
[2]Arqam is a research platform for all corporations operating in GCC with more than 10,000 subscribers. Gulfbase is a free platform providing financial market data for all stocks trading in the GCC. Zawya is a research platform provides business intelligence and news focusing on the Middle East and North Africa regions developed by Thomson-Reuters.

Table 1. Descriptive statistics of Saudi Arabian IPOs.

Variable	Mean	75th percentile	Median	25th percentile	Maximum	Minimum
Offered shares (millions)	63	29.8	8	4.6	1050	1.2
Subscribers (millions)	2.3	2.6	1.2	0.8	10.2	0.32
Subscribers allocation	14.1	14.5	7	4	100	1
Delay	39.4	57.5	37	12	117	5
Oversubscription (%)	608	743.7	481.8	293.3	5100	74
Size (SAR millions)	2,702	1,051	310	200	63,000	80
Offer price (SAR)	41	46.5	10	10	512	10
Low price (SAR)	97.5	86	46.2	28.9	775	10.2
Closing price (SAR)	103.2	91.3	51.1	30.5	782	10
Opening price (SAR)	111.8	109.8	57	35.3	870	10.8
High price (SAR)	122	109.8	60	38	950	11.1

This table reports the descriptive statistics for 76 Saudi IPOs from 2003 to 2010. Offered shares are the number of shares offered by the IPO company to the public (in millions); subscribers are the number of individuals who apply for IPO shares; subscribers allocation is the number of shares that has been allocated to individuals; delay is the number of calendar days between the end of the subscription period and the exchange listing; oversubscription is calculated as the total capital offered by all subscribers divided by the capital requested by the IPO (%); size is the IPO's authorized capital (measured in Saudi Riyal local currency SAR); the offer price is the IPO fixed-price offer (price per share) determined before the subscription and reported in the IPO's prospectus; low price is the lowest quotation of the IPO shares on the listing day; closing price is the last quotation of the IPO shares on the listing day when the exchange ends; opening price is the first quotation of the IPO shares on the listing day when the exchange starts; high price is the highest quotation of the IPO shares on the listing day

The Saudi Riyal (SAR) currency has been pegged to the U.S.$ since 1986 at a rate of U.S.$1 = SAR3.75.

capital offered from the subscribers to the IPO gross proceeds shows similar results in other markets around the world. The average size of the 76 IPOs as measured by the authorized capital is the median SAR310 million.

The median offer price is SAR10, which is the price of all 40 under-establishment IPOs. The variation in the price only exists within the established IPOs group with a maximum of SAR512 and a minimum of SAR10. The opening price is higher than the closing price under all of the statistical measures. The mean opening price is SAR112 whereas the mean closing price is SAR103. Additionally, the median opening price is SAR57 whereas the median closing price is SAR51. This is a distinguishing feature of hot IPOs where the price on the listing day is much higher than the IPO offer price.

With regard to the fluctuations on the listing day, we also observe that the largest fluctuation occurs on the listing day that is the first price jump from the offer price to the opening price. The average difference between the opening price and the offering price is SAR71. This difference is even larger than that between the high and the low of the listing day (i.e. SAR24.5). This has a motivation for our analysis of the open price as well.

III. Literature, theoretical framework and methodology

Measures of underpricing

We measure underpricing using the opening and the closing prices, respectively, as follows:

$$R_i = \frac{(\mathrm{P_i} - \mathrm{O_i})}{\mathrm{O_i}} * 100 \tag{1}$$

where R_i is the raw return of the IPO (percentage). The difference between the IPO market price $\mathrm{P_i}$ on the listing day and the IPO offering price $\mathrm{O_i}$ is calculated, and then divided by the offering price.

We adjust the raw return with the Saudi stock market index 'TASI' as doing so will cancel out macro factors (see Tran and Jeon 2011). Moreover, because transaction costs might also influence this return, we adjust the underpricing for these costs as well. We follow Keloharju (1993) and Al-Hassan, Delgado and Omran (2010) by employing the following formula:

$$AR_i = \left[\frac{(\mathrm{P_i} - \mathrm{O_i} - TC)}{\mathrm{O_i}} - \left(\frac{(TASI_{it} - TASI_{i0})}{TASI_{i0}}\right)\right] * 100 \tag{2}$$

where AR_i is the IPO-adjusted return; $\mathrm{P_i}$ is the IPO market price (the opening and closing prices respectively); $\mathrm{O_i}$ is the IPO offering price and TC is the transaction cost of the individual investors (i.e. the selling fees), which is fixed by all banks (brokers) in Saudi Arabia by SAR12 for any transactions that are below SAR10 K. Thus, the transaction cost is calculated as 12/allocation, where the allocation is the number of shares allocated to individual investors. $TASI_{it}$ is the value of the Saudi stock market index on the day of listing and $TASI_{i0}$ is the value of the index at the end of the subscription.

Thus, the average underpricing for a sample of IPOs is:

$$\text{Average Underpricing} = \frac{\sum_{i=1}^{n} \text{IPO underpricing}_i}{n} \quad (3)$$

where n is the number of IPOs that are included in the sample.

Theoretical framework and models setup

Considerably, the Saudi Arabia stock exchange is the largest stock market in the MENA region, with a market capitalization of U.S.$466 billion at the end of 2013. This makes Saudi Arabia stock exchange one of the top 30 markets in the world in terms of market capitalization. An average daily trading volume of U.S.$1.46 billion also makes Saudi Arabia stock market the most liquid in GCC. The majority of the currently listed corporations went public in the late 1970s and early 1980s. The Saudi stock market is heavily regulated since 1985 when the Saudi Arabian Monetary Authority (SAMA) authorized 12 domestic commercial banks to act as brokers. The IPO allocation system motivates small investors heavily by allocating 40% of newly issued shares to them. The system is aiming to benefit individuals from the so profitable state-owned enterprises. One unique property to Saudi stock exchange is that it is closed to foreign investors. The low degree of openness of the Saudi stock market may lead to high inefficiencies resulting from high number of uniformed traders who consistently flip more of the IPOs with good long-run average returns (see Bayley, Lee and Walter (2006) for details).

IPO underpricing is one of the main features documented in Saudi stock market. For example, Alanazi and Al-Zoubi (2015) find that underpricing in the GCC is of the largest in the world at 227.4%. The over 200% underpricing that has occurred in the Saudi market is mainly related to weak institutional framework adopted by regulators (Alanazi, Liu, and Forster 2010; Alanazi and Al-Zoubi 2015). Also, literature suggests that countries that adopt fixed-price offerings have a larger degree of underpricing than those that use book-building procedures (Cornelli and Goldreich 2001). Engelen and Essen (2010) find that the level of underpricing is higher in countries with weak institutional legal frameworks (also see Yong and Isa 2003; Hopp and Dreher 2013; Chen et al. 2015; Alanazi and Al-Zoubi 2015).[3]

As explained in Rock (1986), informed investors have superior knowledge over the uninformed investors. Due to the information variation of the true value of the company, uninformed investors receive a full allocation of overpriced IPOs and only a partial allocation of the underpriced IPOs. To compensate the uninformed investors for this adverse selection dilemma, the issuer discounts the issue to guarantee the participation of the uninformed. Koh and Walter (1989) find support for the winner's curse argument based on rationing information from Singapore.

For GCC, ownership structure plays a central role in IPO pricing (Kim, Kitsabunnarat, and Nofsinger 2004), perhaps more so than in developed markets. For example, Alanazi and Al-Zoubi (2015) examine corporate ownership for GCC and document that owners utilize significant control over the firms they own, which is not astonishing given that managers and owners are often the same government entities. In addition, due to the relatively weak market regulations of GCC markets, the degree of information asymmetry among market participants is relatively significant, which allows powerful manager–owners superior opportunity to engage in and act upon their desires. Consequently, substantial managerial ownership in an emerging country may boost both managerial alignment effects and entrenchment effects. In our article, we estimate underpricing in demand and supply framework using Saudi Arabia IPO firms. Studying Saudi Arabia IPOs will be insightful because, as mentioned by Alanazi and Al-Zoubi (2015), Saudi shareholders have significant cash flow and wealth as compared with other shareholders from around the world. Therefore, it will be interesting to see how significant IPO market behaves especially in an environment where we assume high information asymmetry

[3]Tinic (1988) applies symmetric information and argues that underpricing is necessary to avoid any potential lawsuits in the IPO aftermarket. Also, Lin, Pukthuanthong and Walker (2013) find that the level of litigation risk in a given country positively associated with the degree of underpricing for firms in that country (see also Walker et al. (2015)). This argument is also not valid in Saudi environment where it is characterized by a weak legal framework. The IPO issuer clarifies in the distributed prospectus that the firm is not liable for any adverse price movement, and the decision of whether to buy the shares is the sole responsibility of the investors. Given the strong demand in Saudi Arabia, IPOs are offered in a 'take it or leave it' manner.

(Kim, Kitsabunnarat, and Nofsinger 2004), low degree of market openness (Hopp and Dreher (2013)), extreme underpricing (Liu and Ritter 2011), weak regulation (Ekkayokkaya and Pengniti 2012) and high shareholders wealth (Alanazi and Al-Zoubi (2015).

In Saudi Arabia, almost all IPOs are oversubscribed (a minimum of 74%) and the majority (approximately 91%) of our sample is substantially underpriced. Only 7 IPOs are overpriced after adjusting by the market and transaction costs. We notice that rationing, which is measured by oversubscription among the overpriced IPOs, is as strong as those among underpriced IPOs, which indicates that investors in Saudi Arabia blindly subscribe to new issues in the hope of a quick profit. Thus, large underpricing still may support Rock's theory.[4]

Model setting for IPO market supply and demand

Given the severe underpricing in the Saudi market, we explain underpricing within the market microstructure and other trading-related issues. These issues are related to the behaviour of the investors under a supply and demand framework and how their behaviours are managed, influenced and controlled by the regulator.

Examining the phenomenon in supply and demand framework is a challenging task. Wurgler and Zhuravskaya (2002) state that an understanding of the practical limits of arbitrage will greatly enhance our understanding of how supply and demand forces affect the actual determinants of security prices. Rong and Zhou (2011) state that the market demand in early stages of IPOs may depart significantly from the sustainable demand resulting from the learning process about the new IPOs. We believe that to understand underpricing requires a full analysis of how the IPO market operates and identification of the key players that influence the IPO market price.

Literature suggests that the demand curve of stocks is negatively sloped. Gao and Ritter (2010) examine the role of marketing effort on SEOs and find that marketing flattens the demand curve and makes it more elastic than the ex-ante demand curve. Generally, securities market demand is not observable because it can originate from any agents in the market who are not under authority control. On the contrary, supply is observable because it is limited by the number of outstanding shares, which the IPO firm cannot increase without legal permission. Thus, most studies examine the demand curve by assuming a fixed supply. Gao and Ritter (2010) fixed the supply curve for the SEOs by utilizing the total number of offered shares after the issuance. However, the assumption of fixed supply may be far from reality, and how it fits within the IPO market is unclear.

During the subscription period, the supply is fixed by the number of shares that are offered by the IPO, and a vertical, perfectly inelastic supply curve develops. Thus, the price should be entirely determined by demand, that is, higher demand typically leads to higher prices. However, in the IPO market, the price is also fixed and does not correspond to the increasing or decreasing demand during the subscription period, which creates disequilibrium between supply and demand at the fixed offer price.

On the listing day, the scenario changes dramatically and instantaneously, and the supply of shares and the price are no longer fixed. Therefore, the IPO price is simultaneously determined by supply and demand forces. Supply can be less than the pre-listing supply if a holding is present, or it can exceed the original number of offered shares if a re-buying and/or re-selling occur (speculation). Also, the demand can be less or more than the subscription period demand. We observe that the average liquidity (the volume that is scaled by the offered shares) for the entire sample is 1.6, which suggests that the quantity that is supplied in the post-listing period is greater than the quantity that was originally supplied by the IPOs. Yet, the underpricing is still high, which indicates an additional strong demand.

The key players on the listing day are the sellers (flippers) and buyers (speculators). In the Saudi

[4]Furthermore, signalling models suggest that high-quality IPOs deliberately underprice their offerings to distinguish themselves from poor-quality IPOs. The former demonstrates their quality by throwing money away and by recovering this loss at a later stage through follow-on offerings (Welch 1989). This argument seems not valid in Saudi Arabia because of the extreme over-valuation of the IPOs in this market. The aggregated gross proceeds for only 76 Saudi IPOs amount to U.S.$26 billion. In other words, Saudi IPOs were priced excessively high, which may rule out the possibility of the signalling intention (see Chen, Jhou, and Yeh 2007).

market, IPO shares are distributed equally among retailers (individuals) as the majority of investors. This distribution creates excess (artificial) demand and pre-listing rationing, which lead to the small allocation. This small allocation in turn does not encourage long-term investments, which cause most investors to flip their shares by exploiting the sharp increase in price on the listing day. Aggarwal (2000) documents that 60–70% of IPO shares are flipped on the listing day. Ritter and Welch (2002) discuss the underwriter's conflicting views towards flipping. On the one hand, flipping establishes a liquid post-listing market and allows investors to make quick profits. On the other hand, if the post-listing demand is weak, underwriters will discourage flipping by imposing penalty bids or by excluding those flippers from future allocations. In the Saudi market, there is no penalty bid or punishment in the form of altering allocations against flippers.

Fishe (2002) sheds light on how stock flippers affect IPO pricing and stabilization. He defines two types of participants, flippers and investors. The former turn quickly into suppliers after the listing, whereas the latter hold their shares for a longer period of time. Our framework differs from Fishe's study, in that we analyse a market in which all of IPO participants are assumed to be flippers. There are three possible reasons for assuming that all investors are flippers in the Saudi market: (1) heavy trading volume during the aftermarket trades is largely believed to be due to flippers (Aggarwal 2000), (2) the extreme underpricing in the Saudi market that motivates flipping activities (see Alanazi and Al-Zoubi 2015 for more details) and (3) the small allocation in the market resulting in little (if any) institutional investors in Saudi IPOs. As a result, there is a huge supply on the listing day that might impose downward pressure on the price.

To overcome the issue with the huge supply created by the flippers, the regulator has to create a market for the post-listing demand. One method to create a market is to allow the stock price of the IPO on the listing day to freely fluctuate to invite buyers (i.e. speculators). While the Saudi market regulator justifies the policy of free fluctuation by the need to establish a market price for a newly listed company, this policy actually motivates speculation. All the companies that are listed in the Saudi market are restricted to 10% fluctuations in either direction after the listing day.

Most of the stabilization practices employed by the underwriters in the U.S., who are actively involved in the aftermarket, are not used in the Saudi market. For example, Aggarwal (2000) discuss the role of the underwriters in price stabilization. If underwriters anticipate weak demand, they allocate up to 135% taking a naked short position such that they can have flexibility when responding to the post-listing weak demand and price. Also, Carey, Fang and Zhang (2016) show that good news is negatively associated with IPO underpricing and this association is strong in smaller IPOs.

In contrast, if the post-listing demand is in hot IPOs, the underwriters exercise the over-allotment option. In the Saudi market, there is no over-allotment option in which the underwriters and issuers cannot sell more shares. This also contributes to the extreme jump in Saudi IPOs price since no extra shares can be injected into the market to cool down the strong demand.

Another point we need to consider is the allocation procedure, and how IPO shares are distributed among subscribers. Allocation methods are still not a well-understood topic because of a lack of data disclosures (see Ritter and Welch 2002; Ljungqvist and Wilhelm 2002; Peng and Wang (2007)).

Supply and demand and IPO underpricing

In all oversubscribed IPOs, excess demand occurs during the subscription period, which is when the quantity of shares that are demanded by the subscribers is always larger than the shares that are offered through the IPO. The excess demand leads to low allocation and a wide dispersion of shares among the subscribers. At the market, those subscribers become the shareholders (the major suppliers) instead of the company's original stockholders. Obviously, the suppliers have different expectations and behave differently. Decisions of IPO subscribers whether to sell or hold are the major determinant of the supply, demand and price.

The offering price of the IPO becomes the subscribers' reserve price (RES). Given the fair split of shares in the Saudi market, all of the subscribers for an IPO have the same RES, because there is also a transaction cost involved when flippers sell their shares, which is fixed by SAR12. This cost increases the RES depending on the quantity of shares that

investors receive as a larger allocation results in a lower transaction cost.

The opening price has been widely ignored in the literature because there is no statistical significance difference between the closing price and the opening price (Ritter and Welch 2002). However, one noticeable feature of Saudi IPOs is that the opening price (average SAR111.8) is usually higher than the closing price (average SAR103.2). Though there is no statistically significant difference between these two prices, it is vital to distinguish between the two prices to identify shapes of supply and demand curves.

We assume that the first equilibrium exists at the intersection between the opening price and the excess quantity that is demanded during the subscription period. We do not know exactly how many shares are exchanged at the opening price because this event is instantaneous. However, we know the difference between the quantity that is demanded during the subscription period and the number of offered shares, which we can use with the opening price to model the initial supply and demand equations. The excess demand is observable by all participants before the admission; therefore, the participants hold expectations about the future opening price. Investors learn from their past experience, as suggested by Welch (1992) and Chiang et al. (2011). The difference between the quantity that is demanded and the quantity that is offered at the fixed offer price represents a disequilibrium that requires a higher price to bring the situation back to normal. This factor is the oversubscription variable that has been used in literature to proxy the informed demand.

Furthermore, we assume that the shareholders are flippers who immediately sell their shares. In the Saudi market, it is reasonable to make this assumption given the tiny allocation that subscribers receive and the severe rationing that occurs. In 5 of the 75 IPOs, investors receive only 1 share and the average number of shares allocated for all of the IPOs is only 14.

An econometric model that explains market price and quantity should consist of two simultaneous equations, one for supply and the other for demand, working together to determine the price and the quantity. We propose the following model:

Supply:

$$\begin{aligned}\mathrm{Log(P)} = {} & \beta_1 + \beta_2 \mathrm{Log(Q)} + \beta_3 \mathrm{Log(NOS)} \\ & + \beta_4 \mathrm{Log(RES)} + \beta_5 \mathrm{ALLO} + \varepsilon_s \end{aligned} \tag{4}$$

Demand:

$$\begin{aligned}\mathrm{Log(P)} = {} & \alpha_1 + \alpha_2 \mathrm{Log(Q)} + \alpha_3 \mathrm{Log(Excess)} \\ & + \alpha_4 \mathrm{MS} + \alpha_5 SPE + \alpha_5 Delay + \varepsilon_d \end{aligned} \tag{5}$$

where the two equilibrium values of price (P) and quantity (Q) are determined at the same time. These variables are called endogenous variables because their values are determined within the system that we created. They are both dependent variables and there is feedback between them. The dependent variables are the natural logarithm of the opening price (P) and the natural logarithm of the difference between the quantities demanded during the subscription period and the offered shares (Q). If all subscribers choose to hold onto their shares, there will be no supply at all, and consequently no trading will occur. We posit that the opening price, in this case, is more important than the closing price because it is a reflection of the pre-listing demand.

A question arises as to whether the quantity (the excess demand) during the subscription period is a real or artificial demand? In the Saudi case, it is a real demand because the capital is already paid by investors during the subscription period. In support of this, Fishe (2002) states that if there is sufficient excess demand at the offer price to absorb the shares of flippers, the after-market price is likely to rise. Agarwal, Liu and Rhee (2008) find that the underpricing magnitude in Hong Kong is associated with the level of demand of the pre-listing period.

The values of the independent variables are determined outside of this system (or exogenous variables). In the supply equation (Equation 4), the first independent variable is the natural logarithm of the NOS. On the listing day, the subscribers become the only suppliers for new shares (Fishe 2002; Aggarwal 2003). Therefore, we expect a negative relationship between the opening price and the NOS. The RES comprises two components: the cost incurred during the subscription period and the transaction cost on the listing day. This price is the conditional estimate of the aftermarket price. Thus, the RES restricts the supply of shares on the listing

day because the subscribers require a certain amount of compensation.

The demanders also observe the RES, which compels them to bid higher to obtain shares. Therefore, we expect the RES to affect the opening price positively. Finally, we include the allocation (ALLO) in the supply equation (Equation 4) because allocation represents the quantity of shares held by each supplier. Therefore, the larger the allocation is, the lower the opening price should be.

In the demand equation (Equation 5), we calculate the natural logarithm of the excess capital as the first independent variable that represents the capital with no shares refunded fully to subscribers before the listing day. We expect it to influence the demand positively because the investors might attempt to purchase the quantity that they desired during the subscription period. We expect this refunded capital to affect the opening price positively. The market sentiment (MS) is a dummy variable that takes a value of 1 if the market is a bull market between the closure date of the subscription and the listing day and 0 if it is a bear market. Although the MS might influence both the supply and the demand, we expect the impact to be stronger on the demand because the flippers (the suppliers) are more than likely to behave the same (i.e. continue to flip) under any market situations, whereas the demanders' behaviour might change based on the market situation. We do not know the exact association but expect a positive relationship between the MS and the opening price.

Additionally, we include the speculation (SPE). We expect small IPOs to be more speculative than large IPOs and as a result to have a higher opening price. We measure speculation by scaling the IPO total turnover during the listing day by the IPO gross proceeds to control for the variation in size among the IPOs as follows:

$$\text{Speculation} = \frac{\text{Turn over}_{ipo}}{\text{Gross proceeds}_{ipo}} \tag{6}$$

where Turnover_{ipo} is the total capital traded during the listing day and $\text{Grossproceeds}_{ipo}$ is the total amount of capital raised by the IPO.

The last variable in the demand equation (Equation 5) is the delay, which is the number of calendar days between the end of the subscription and the listing date. Because under-establishment IPOs in our sample took on average a longer time (average of 58 days) to admission than the established IPOs (average of 18 days), we include this variable to capture the differences. Under-establishment IPOs have distinguishing features because they are usually cheaper and smaller in size. Therefore, we expect a positive relationship between the delay and opening price.

As trading continues towards the end of the listing day, we will obtain the total quantity exchanged and the closing price. Figure 1 illustrates the movement of the supply and demand curves from the opening price to the closing price. We posit that both curves to have negative slopes that move from the opening price down towards the closing price. They both decrease, but the supply decreases at a greater and quicker rate than the demand because flippers exit the market and leave it for other interested parties. Of course, there are many other adjustments that might occur during trading hours as is shown by the stochastic price movement from the opening price to the closing price in Figure 1. However, we do not have data on the price movement during trading hours. Understanding the interaction between supply and demand on the first day requires a full analysis of intra-day price data, and perhaps a minute-by-minute analysis would be reasonable. For the sake of simplicity and the lack of sufficient data, we only use the opening and closing prices to identify these slopes.

Regarding a negative supply curve, we refer to the cobweb theorem of Kaldor (1934). Kaldor shows a model that is based on a time lag between supply and demand decisions in some markets in which, similar to our IPO market, the demanded quantity is observed before the price is established. Two outcomes of the cobweb model have been proposed: (i) the convergent case (stable) and (ii) the divergent case (unstable). In the convergent case, the supply curve is steeper than the demand curve, where the fluctuation decreases in magnitude. Therefore, the plot of supply and demand would look like an inward spiral as shown in Figure 1 (see Schultz 2008). Figure 1 is to illustrate an approximation of the hot IPOs in Saudi Arabia, where most IPOs are substantially underpriced.

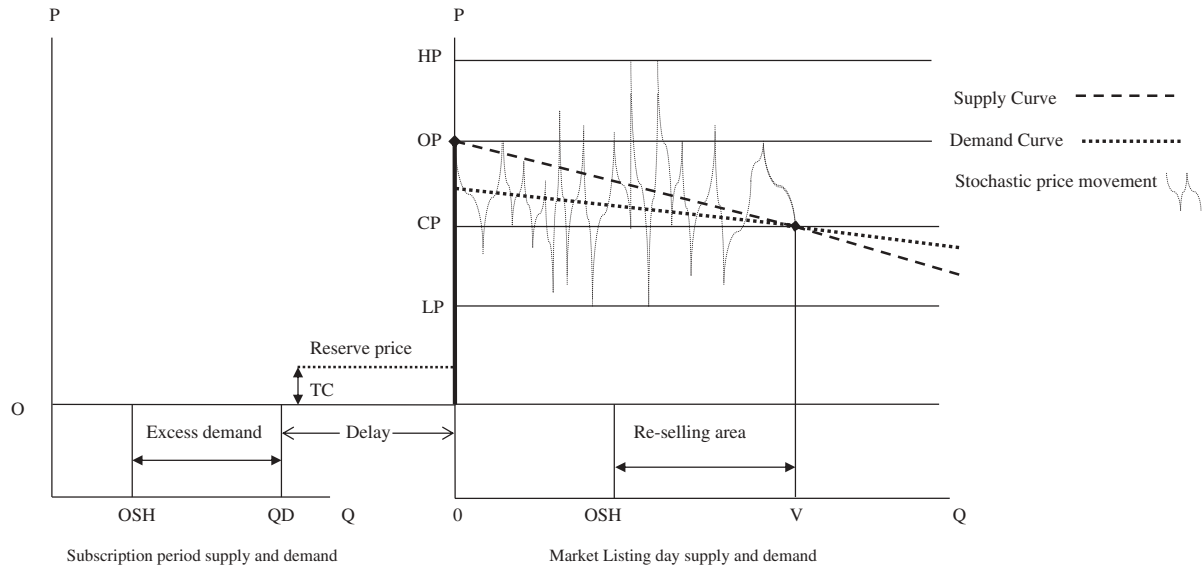

Figure 1. An illustration of the IPOs in equilibrium.P on the y-axis and Q on the x-axis are the price and quantity of shares, respectively. O is the pre-announced IPO fixed-price offer. OSH is the number of shares offered by the IPO. QD is the quantity of shares demanded during the subscription period. TC is the transaction cost calculated as the selling fees of SAR12 divided by the individuals' allocation. Reserve price is equal to the IPO offering price plus the transaction cost. Excess demand is the difference between the quantity of shares demanded during the subscription period and the total shares offered by the IPO. Delay is the number of calendar days between the end of subscription and the listing day. Re-selling area is the area where the number of shares exchanged during the listing day exceeds the original number of shares offered by the IPO. OP is the opening price, which is the first quotation of the IPO share when the exchange begins. The thick solid line between the offer price and the opening price represents the shooting-up phenomenon in the IPO market. HP and LP represent the highest and lowest quotations, respectively, that appear during the listing day. CP is the closing price, which is the last quotation of the IPO shares on the listing day. Volume represents the total number of shares exchanged between the buyers and sellers during the listing day. The stochastic price movement illustrates the price movements of the IPO stock during the listing day.

Additionally, it is essential to understand that this analysis is a cross-sectional examination of supply and demand. We propose the following model to test the supply and demand using the volume equilibrium for the closing price:

Supply:

$$\text{Log(P)} = \beta_1 + \beta_2\text{Log(Q)} + \beta_3\text{Log(NOS)} + \beta_4\text{Log(RES)} + \beta_5\text{ALLO} + \varepsilon_s \quad (7)$$

Demand:

$$\text{Log(P)} = \alpha_1 + \alpha_2\text{Log(Q)} + \alpha_3\text{Log(Excess)} + \alpha_4\text{MS} + \alpha_5\text{SPE} + \alpha_5\text{Delay} + \varepsilon_d \quad (8)$$

This is the same model that we used to test the first equilibrium of the opening price and the excess demand in the pre-listing period. In Equations 7 and 8, we use the volume of the listing day and the closing price. Thus, the dependent variables here are the following: (1) the natural logarithm of the difference between the closing price and the offer price (P) and (2) the natural logarithm of the volume of trade on the listing day. Ritter and Welch (2002) suggest that it is important to incorporate the IPO trading volume in the empirical work of the market microstructure because of its large magnitude on the listing day.

IV. Empirical evidence

Underpricing

Panel A of Table 2 reports the underpricing for 76 Saudi IPOs using the opening price. We report the raw and adjusted returns, respectively. Consistent with the global evidence on underpricing, Saudi IPOs are significantly underpriced but at a much larger magnitude than other markets. The average IPO's first-day raw and adjusted returns are 297% and 285%, respectively. Additionally, the median reveals the same observations of large raw and adjusted underpricing of 134% and 123%, respectively, which is very large for IPOs that were originally offered at high prices. Our overall result on large

Table 2. Underpricing for Saudi Arabian IPOs.

Panel A: underpricing using opening price

Underpricing	Mean	25th percentile	Median	75th percentile	Maximum	Minimum	Std. dev.	*t*-Statistic
Raw return %	296.8	42	133.6	395.6	1400	−7.3	347	7.5***
Adjusted return %	284.96	33.1	122.7	378.44	1374.39	−101.46	343	7.1***

Panel B: Underpricing using closing price

Underpricing	Mean	25th percentile	Median	75th percentile	Maximum	Minimum	Std. dev.	*t*-Statistic
Raw return %	264.5	35.2	118	336	1770	−17.6	347	6.5***
Adjusted return %	252.64	33.26	116.46	328.53	1737.56	−80.63	343.3	6.3***

The sample is 76 Saudi IPOs went public between 2003 and 2010. The raw underpricing is calculated by taking the difference between the IPO market price on the listing day and the IPO offer price and divided by the offer price as in Equation 1. The adjusted return is the IPO raw return adjusted with the Saudi market 'TASI' return and for the transaction cost as in Equation 2. Panel A shows various statistics for the full sample of 76 Saudi IPOs using the market listing day opening price. Panel B shows various statistics using the market listing day closing price. *t*-Statistic that the mean return equals zero.
*** Significant at the 1 % level.

Table 3. 2SLS simultaneous equations of IPO supply, demand and the open price.

2SLS estimates for the supply of IPO shares

Variable	Coefficient	*t*-Stat.	*p* value
Intercept	1.44**	2.07	0.04
Quantity	0.14	1.45	0.15
Number of subscribers	−0.26**	−2.37	0.01
Allocation	−0.01**	−2.59	0.01
Reserve price	0.78***	8.26	0.00
f-Stat.	21.43***		
Adjusted R^2	52%		

2SLS estimates for the demand of IPO shares

Variable	Coefficient	*t*-Stat.	*p* value
Intercept	−0.29	−0.53	0.59
Quantity	−1.01***	−12.12	0.00
Excess capital	1.05***	11.67	0.00
Market sentiment	−0.25***	−4.49	0.00
Speculation	0.01***	3.09	0.00
Delay	0.01***	5.52	0.00
f-Stat.	38***		
Adjusted R^2	72%		

The sample consists of 76 Saudi IPOs issued from 2003 to 2010. The table reports the estimates of the supply and demand for the IPO using the opening price adjustment. We use the following simultaneous equations:
Supply:

$$\mathrm{Log(P)} = \beta_1 + \beta_2 \mathrm{Log(Q)} + \beta_3 \mathrm{Log(NOS)} + \beta_4 \mathrm{Log(RES)} + \beta_5 \mathrm{ALLO} + \varepsilon_s$$

Demand:

$$\mathrm{Log(P)} = \alpha_1 + \alpha_2 \mathrm{Log(Q)} + \alpha_3 \mathrm{Log(Excess)} + \alpha_4 \mathrm{MS} + \alpha_5 \mathrm{SPE} + \alpha_6 \mathrm{Delay} + \varepsilon_d$$

The dependent variables are the natural logarithm of the opening price and the quantity of excess demand in the pre-listing period. The supply side of the system has 3 independent variables: the natural logarithm of the number of subscribers, the number of shares held by each subscriber (allocation) and the reserve price, which is the IPO offering price plus the transaction cost. In the demand side of the system, the independent variables are the natural logarithm of the excess capital, which is the capital with no allocation that has been fully refunded to the subscribers in the pre-listing period; the market sentiment dummy variable, which takes on a value of 1 if the market is a bull market from the end of the subscription period to the listing day and 0 if it is a bear market; speculation, which measures how speculative the IPO is by scaling the total turnover of the IPO shares on the listing day by the IPO gross proceeds and the delay to listing, which is the number of calendar days between the closure of the subscription period and the admission to the stock exchange.
*,**,*** Significant at the 10%, 5% and 1% levels, respectively.

magnitude underpricing is consistent with that of Al-Hassan, Delgado and Omran (2010) who report 290% underpricing for 47 IPOs in the GCC region.

The aggregated amount of capital that was left on the table in the Saudi market is about U.S.$43 billion. Loughran and Ritter (2002) report that the underpricing of IPOs in the U.S. was the highest during the Internet bubble, which had an average of 65% and an aggregate amount of U.S.$66 billion left on the table. Ritter (2011) reports that IPOs in the Chinese market were extremely underpriced by more than 200% on average. Engelen and Essen (2010) find that the level of underpricing is higher in countries with weak institutional legal frameworks. Our evidence is consistent with prior findings in other markets.

In Panel B Table 2, we report underpricing by using the market listing day closing price. The results are slightly lower, and they show an adjusted underpricing of 253%. It is clear that the underpricing that results from using the opening price is

higher than from using the closing price. 51 IPOs of the 76 (approximately 67%) follow this pattern and 8 IPOs close at the same price with which they opened (also see Figure 1).

When we differentiate the underpricing between large and small IPOs, and old and new firms's IPOs, we find that, on an average, established, old IPOs are underpriced by 63%, whereas new IPOs are underpriced by 423.5%. Similarly, large IPOs have an adjusted return of 149%, whereas small IPOs have a return of 357%. We believe that because large IPOs have a potential for a greater supply of shares and liquidity in the post-listing market, these IPOs tend to be less underpriced. Likewise, old IPOs were initially offered at higher prices than new IPOs, and thus, we anticipated that any variation observed in this study would follow the laws of supply and demand.

Supply and demand for the open price

Table 3 reports the 2SLS estimates of the initial supply and demand for IPO shares. At the opening price, the supply curve is above the demand curve and positively sloped. This finding indicates that the pre-IPO excess demand converts immediately into excess supply mainly because of the flippers who rush to sell their shares. Consequently, the demand will decrease in response to the sharp price increase. Ritter and Welch (2002) and Fishe (2002) assume that the demand curve is negatively sloped in response to the IPO price jump. Our findings support this assumption.

Examining the supply side of the system, we find that all of the variables are giving the expected signs to a significant level. The NOS (flippers) and the quantity of shares that each subscriber holds before the exchange begins (the allocation) are both negatively associated with the opening price. The results are expected according to the economic laws of supply and demand (i.e. large supply leads to a low price and low supply leads to a high price). In contrast, the RES is positively associated with the opening price. As hypothesized, the RES of Benveniste and Spindt (1989) restricts the supply side because of the compensation that the shareholders require. Therefore, the higher the RES, the higher the expected opening price should be.

With respect to the demand side of the system, we find that the capital refunded to the shareholders without allocation in the pre-listing period is positively linked with the opening price. The larger pool of refunded capital was, the higher the opening price would be. MS is unexpectedly negatively associated with the opening price. As we suggested before, sellers are expected to behave in the same manner (continue to flip), regardless of the market situation, whereas the buyers might be influenced by the MS. Our result suggests that those IPOs who went public during a bull market have achieved a lower opening price than those during a bear market. We also observe that the opening price is positively associated with the speculation variable, which indicates as anticipated that the speculative IPOs showed higher opening prices than other IPOs. Finally, the delay to listing variable suggests that the IPOs that took longer waiting period to be listed showed higher opening prices. As indicated before, while this result is in line with Beatty and Ritter (1986) ex-ante uncertainty explanation, our interpretation of this is different. We link this to the fact that under-establishment IPOs were priced initially lower than old IPOs. Consequently, they show larger underpricing. Thus, the delay variable reflects the variation between the two types of IPOs in that new IPOs have higher opening price than old IPOs.

The system has strong explanatory power for both equations of supply and demand at 52% and 72%, respectively. Similar results (not reported here) are obtained using various combinations of the model. We also use (results are not reported) the natural logarithm of the difference between the opening price and the offer price as the dependent variable, instead of the opening price alone and obtain similar results and association between variables.

Supply and demand for the closing price

In Table 4, we report the 2SLS estimates of the supply and demand equations using the closing price and the IPO volume on the listing day. The intercept of the supply equation in model 1 is 5.4, which is higher than the demand equation intercept of 0.76. This finding suggests that the supply curve is above the demand curve. The intercepts for both equations are different from the ones we observed while using the opening price, which indicates that

Table 4. 2SLS simultaneous equations of IPO supply, demand and the close price.

	2SLS estimates for supply of IPO shares					
Model	1	2	3		4	5
Variable				Variable		
Intercept	5.35	2.06	3.46	Intercept	6.27	6.27
t-Stat.	(2.9)***	0.06	(2.15)**	*t*-Stat.	(4.93)***	(4.93)***
Quantity	−0.56	0.06	−0.38	Price	−0.43	−0.43
t-Stat.	(−2.23)***	0.21	(−1.89)*	*t*-Stat.	(−2.18)**	(−2.18)**
Number of subscribers	−0.09	−0.33		Number of subscribers	0.23	0.23
t-Stat.	−0.42	−1.24		*t*-Stat.	1.15	1.15
Allocation	0.01	−0.01		Allocation	0.02	0.02
t-Stat.	0.75	−0.96		*t*-Stat.	(4.67)***	(4.67)***
Reserve price	0.41	0.70	0.46	Reserve price	−0.17	−0.17
t-Stat.	(1.88)*	(2.70)***	(2.22)**	*t*-Stat.	−0.79	−0.79
f-Stat.	(6.31)***	(4.34)***	(9.07)***	*f*-Stat.	(15.5)***	(15.52)***
Adjusted-R^2	25%	13%	29%	Adjusted-R^2	47%	47%
Intercept	0.76	1.11	3.26	Intercept	1.66	2
t-Stat.	0.49	0.80	(2.6)**	*t*-Stat.	0.95	1.14
Quantity	−0.72	−0.63	−0.81	Price	−1.08	−1.3
t-Stat.	(−4.92)***	(−4.10)***	(−3.34)***	*t*-Stat.	(−5.12)***	(−4.38)***
Excess capital	0.60	0.51	0.32	Excess capital	0.73	0.72
t-Stat.	(3.81)***	(3.35)***	(2.21)**	*t*-Stat.	(3.78)***	(3.67)***
Market sentiment	−0.04	−0.08	0.02	Market sentiment	0.05	−0.02
t-Stat.	−0.25	−0.49	0.12	*t*-Stat.	0.26	−0.11
Speculation	0.04	0.03		Speculation	0.04	0.05
t-Stat.	(2.96)***	(2.98)***		*t*-Stat.	(3.16)***	(3.07)***
Delay	0.00			Delay	0	
t-Stat.	1.05			*t*-Stat.	0.71	
f-Stat.	(7.52)***	(6.57)***	(5.36)***	*f*-Stat	(8.26)***	(7.52)***
Adjusted-R^2	31%	33%	15%	Adjusted-R^2	26%	−6%

The sample is composed of 76 Saudi IPOs issued from 2003 to 2010. The table reports the estimates of the supply and demand for the IPO using the last adjustment of the closing price and the volume of the listing day. The dependent variables are the natural logarithm of the difference between the closing price and the offer price and the IPO volume on the listing day. The supply side of the system has three independent variables: the natural logarithm of the number of subscribers; the allocation, which is the number of shares held by each subscriber and the reserve price, which is the IPO offer price plus the transaction cost. In the demand side of the system, the independent variables are the natural logarithm of the excess capital, which is the capital with no allocation that has been fully refunded to the subscribers in the pre-listing period; the market sentiment, which is a dummy variable that takes on a value of 1 if the market is a bull market from the closure of the subscription period to the listing day and 0 if it is a bear market; the speculation, which measures how speculative the IPO is by scaling the total turnover of the IPO shares on the listing day by the IPO gross proceeds and the delay, which is the number of calendar days between the end of the subscription period and the listing day. Models 1, 2 and 3 are estimated as in Equations 7 and 8. In models 4 and 5, the volume for the same system transformed into the left-hand side and the price transformed into the right-hand side.

*, **, *** Significant at the 10%, 5% and 1%, respectively

both curves shift during the trading hours. All of the other models from 2 to 5 suggest the same observation; the supply curve is above the demand curve. Furthermore, when we swap the price and quantity in models 4 and 5 by moving the volume to the left-hand side of the equations, we obtain similar results. In model 5, the supply curve is above the demand curve (6.3 > 2).

The slopes of both the supply and demand curves are significantly negative, with the supply curve being steeper than the demand curve. In the first model, the slope of the supply is −0.56, whereas the slope of the demand is −0.72. The variation is much larger in the other models, except for model 2 which shows positive supply curve, but insignificant. This finding is consistent with our conjecture that the supply decreases at a quicker and greater rate than the demand. We interpret this result that the flippers are exiting the market, but that other interested parties are entering (perhaps speculators exploiting the freely fluctuating price of the listing day). Moreover, this finding suggests that, although the demand is decreasing, it is still strong enough to resist the price pressure caused by slippers. If this is not true, then we expect a sharp decrease in the price, as the IPOs may become overpriced and the IPO's market price should fall below the offer price.

We now investigate the exogenous variables impacts on and interactions with the supply and demand. We notice that the NOS and the allocation are both insignificant. However, as expected, they both have negative impacts on the closing price. In models 4 and 5, when we replace the left-hand side of the system with the volume, we find that the allocation is significantly positive, which suggests that when the allocation is large, the quantity supplied in the market (volume) is large. In turn, the large quantity supplied would negatively affect the

price. We need to keep in mind that this is a simultaneous one, in which both the price and quantity variables affect each other. As we expected the RES has a positive association. When we examine their impact on the volume in models 4 and 5, the signs became negative as we expected because of the compensation required on these expensive IPOs.

In the demand side of the system, the excess capital returned to investors is positively linked to both the closing price and volume variables. A large amount of capital refunded to subscribers increases the demand for IPO shares at market. Hence, the closing price should be higher. Additionally, the volume and the power of exchange will be larger when the refunded capital is large. In the same vein, the speculation variable suggests that those speculative IPOs have achieved higher closing prices and have enjoyed larger volumes. The delay to listing is positive, which indicates that under-establishment IPOs have higher closing prices. To better understand our structural system, we explore the reduced form estimates of the system (with similar results that are not reported here).

V. Conclusion

We examine IPO underpricing in a supply and demand framework using 76 Saudi IPOs from 2003 to 2010. The IPOs are significantly underpriced with an adjusted underpricing of 253%. This large figure mainly results from the unique institutional framework adopted by the market regulators, which drives severe demand during the subscription period and aggressive speculation during the listing day.

The results of the first system indicate that the first adjustment in the IPO market occurs at the opening price, where the pre-IPO excess demand converts instantaneously into excess supply. The implications of this are not restricted to Saudi Arabia but are relevant to understanding the underpricing phenomenon in other emerging markets. Possibly, this immediate conversion always occurs when the IPOs are 'hot'. As the market absorbs the opening price information, the price changes are under the forces of supply and demand. The results indicate that the demand curve is negatively sloped, as expected but that the supply curve is also negatively sloped. The supply remains above the demand curve and is much steeper as well. This finding suggests that the supply decreases at a greater rate than the demand mainly because the flippers may exit the market.

The findings have some practical implications including underpricing being primarily related to the supply and demand. Therefore, underpricing is not a question of the variation in the magnitude of underpricing among the explanatory power of particular theories regarding the underpricing observed in a particular market. Rather, the question is how the underpricing phenomenon is managed and governed in a particular market. Given that underpricing is a global phenomenon, the reasons causing it may be common as well. Underpricing primarily depends on how regulatory body controls the supply and demand of IPO shares by imposing regulations. This process begins in the subscription period, continues until the listing day and may even last afterwards for a longer period of time. In the post-listing market, regulators also greatly influence the supply and demand. In the Saudi market, given the huge supply expected on the listing day, the regulator successfully creates market demand on the listing day by giving the IPOs the ability to freely fluctuate their prices. This unique feature attracts speculation.

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