IPO Pricing and Equity Return Swap

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Abstract

We propose a total return equity swap between an issuer and an underwriter to mitigate the asymmetric information problem and resulting IPO mispricing modeled by Baron (1982). Under the Baron framework in which underwriters have superior information vis-à-vis issuers, the swap contract gives underwriters incentives to price the IPO at the first-best price. The proposed swap also helps mitigate IPO overpricing attributed to a second information asymmetry when issuers withhold negative information from underwriters. Furthermore, swaps in IPOs provide less well-known or aggressive underwriters a mechanism to enhance their reputation and compete with established underwriters by reducing underpricing.

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1. Introduction

Baron (1982) constructs a theoretical model in which investment bankers serving as underwriters have superior information (relative to issuing firms) pertaining to the expected market price of an initial public offering (IPO). As a result of this asymmetric information, issuers employ investment banks to serve in an advisory capacity and delegate the setting of the offer price. Baron demonstrates the inability of the issuing firm to monitor the distribution efforts of the underwriter and shows how this inability to monitor gives incentives for underwriters to underprice the issue. Baron's model results in the offer price being set below the first-best offer price and is a theoretical explanation for the existence of IPO underpricing (see Ibbotson (1975) for a seminal article on underpricing).

In a related article, Baron and Holmstrom (1980) assume asymmetric information in the bookbuilding process and conclude, "the issuer must design the contract so that the distribution effort and offer price decisions made by the banker, conditional on his private information, will serve the interests of the issuer."

It has been over 25 years since these articles were published and yet the existence of underpricing in IPOs continues to persist.[1] In this article, we propose using a total equity swap as part of the issuing contract called for by Baron and Holmstrom (1980). The use of such a swap has the potential of mitigating the information asymmetries between the investment bank and the issuing firm, encouraging issuers to disclose accurate information and giving incentives to investment banks to price IPOs at the first-best offer price.

In such a derivative agreement, the IPO underwriter agrees to pay the issuer the difference between the mispricing based on a negotiated benchmark and an agreed upon upper bound if the relative mispricing of the IPO exceeds the negotiated upper bound. On the other hand, the issuer pays the underwriter the difference between the mispricing on the IPO and a negotiated lower bound if IPO mispricing is below the negotiated lower bound. Fund availability is ensured via an escrow account.[2] The width of the agreed lower and upper bounds incorporates the information discovered during the book-building process and serves as an additional signal of stock risk.

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[1] The average first-day return of initial public offerings (IPOs) was 18.8% from 1980 to 2001 and reached a record high of 65.0% during the internet bubble period (1999-2000) (Ritter and Welch, 2002). Among the 883 firms that went public from 1999 to 2001, 176 IPOs had a first day return of more than 100%.

[2] We recognize that the escrow account adds an extra burden to both the underwriter and issuing firm. In the case of the underwriter, most investment banks have adequate liquidity. In the case of the issuing firm, such a reserve requirement would have to be planned for to avoid potential financial distress if the firm's return crosses the lower trigger bound. We thank the anonymous referee for this comment.

The swap could be used in either the short- or long-term, depending on the terms negotiated between the issuer and the underwriter. A short-term swap could cover as short as the first day only, or it could cover the first 30-days (after the quiet period and price stabilization) and extend to the period from day 31 to day 180 (through the typical lockup period). A long-term swap could cover one-, two-, or three-years to address the negative abnormal long-run performance of IPOs documented in Ritter (1991) and Loughran and Ritter (1995).[3] We focus on 30-day short-term swaps in the body of our paper and provide a brief discussion of long-term swaps in Appendix A. Other features that might form part of the swap contract include the ability to define the contract as a swaption rather than a binding-from-initiation contract on both parties. We envision most IPO related swaps to be written so that the equity return must exceed an upside limit (up and in) or a downside limit (down and in) as explained in Section 3 of the paper.

Because of the presence of such a swap contract, the issuer has incentives to disclose accurate information to the underwriter so that the offer price does not significantly exceed its intrinsic value. If the offer is significantly overpriced, the issuing firm is committed to pay the investment bank the relevant swap payments to cover the costs incurred by the investment bank such as after-market price support (Benveniste, Busaba, and Wilhelm, 1996; Chowdhry and Nanda, 1996); potential regulatory scrutiny and litigation costs (Beatty, Bunsis and Hand, 1998; Ljungqvist, 2003); and lost relationship capital with the primary market (Beatty and Ritter, 1986; Hanley, Kumar, and Seguin, 1993).

On the other hand, the underwriter has increased incentives to avoid underpricing by accurate price setting and by giving full distribution effort. When significant underpricing exists, the underwriter makes swap payments to the issuer to remunerate the issuer for the money that was left on the table. With the inclusion of the swap in the offering agreement, the first-best offer price is set by the investment bank.

We pool all IPOs offered in the U.S from 1970 to 2006 and compute first-day returns (i.e., the money left on table). About 70% of IPOs are underpriced at initial offering (i.e., the initial return is greater than zero). The initial mispricing measured by the amount of money left on table is $14.38 million on average. To gauge the swap propensity, we compute size- and industry-matched cumulative abnormal returns in various periods after the offering date and up to three-years. When the lower and upper bounds are set at $\pm$ 5% mispricing, 79% of IPOs experience swap payments during the period from day 1 to

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[3] The longer the swap contract, the more uncertain are the factors that could affect stock market performance. Hence, the length of swap contracts, as well as other terms, depends on the nature of the offering and negotiation between the issuer and the underwriter. To the extent that price support and quiet periods (normally 30 days) and lockup (typically 180 days) could distort aftermarket prices, the swap contracts need to cover at least these events. To further reduce the unpredictable long-run performance, we also propose adjustments for the performance bounds and notional principal reduction (see equations A1 through A5 in Appendix A).

day 30. When the lower and upper bounds are extended to $\pm 10\%$, the proportion of IPOs that exchange swap payments declines to 60%.

In the remainder of the paper, we discuss the extant literature on 1) the existence of underpricing, 2) the proposed motivations for underpricing, and 3) the commonly used mechanisms to reduce underpricing in Section 2. We then proceed in Section 3 to develop a model for equity swaps related to IPO underwriting contracts. In Section 4 we empirically document the implications of our swap model using historical data. We provide model implications and discussions in Section 5. We conclude the paper in Section 6.

2. Literature Review

2A. *The uncertain nature of IPO pricing*

The underlying assumption of our proposed equity swap is that underwriters have the ability to price the IPO at the first-best price. In this section, we discuss existing literature that addresses this base assumption.

2A.1. *The difficulty in pricing IPOs*

The well-documented significant positive initial returns of IPOs can be either due to 1) unintentional misvaluation or 2) intentional underpricing. Table 1 summarizes the relevant literature that we discuss in this section.

The base assumption of our swap model is that underwriters have the ability to price IPOs more accurately than they currently do. We acknowledge however, this may not be the case – underwriters may be pricing to the best of their ability, and underpricing may be caused by unintentional misvaluation. The future cash flow of new issues is hard to predict because the typical issuing firm is a young firm, lacks trading history, has only a small portion of its assets as tangible assets, and experiences small or negative net income (see Ibbotson, Sindelar, and Ritter, 1994). Thus, it is possible (and perhaps probable) to incorrectly price IPOs by applying the commonly used discounted cash flow approach (Varaiya, Bergmark and Taylor, 1997; Kim and Ritter, 1999). Using price multiples of comparable firms can result in misvaluation as well. Kim and Ritter (1999) use various accounting ratios of comparable firms and find that the error rate is substantial.

The long-run poor abnormal performance of IPOs also implies misvaluation at the time of the initial public offering (Loughran and Ritter, 1995). Koop and Li (2001) use a stochastic frontier method to examine the pricing of IPOs and seasoned equity offerings (SEOs). They find that IPOs are misvalued, but SEOs are almost efficiently priced.

Table 1
IPO Misvaluation and Motivation to Underprice

IPO Misvaluation	
It is hard to price IPOs because of the large uncertainty of new issuers' future cash flow.	Ibbotson, Sindelar, and Ritter (1994)
Using price multiples of comparable firms lead to large pricing errors.	Kim and Ritter (1999)
The long-run IPO poor performance suggests misvaluation at the time of public offering.	Loughran and Ritter (1995)
IPOs in industries with greater earnings potentials are more highly valued than IPOs in traditional industries.	Koop and Li (2001)
IPOs are significantly overvalued at the offer price relative to valuations based on industry peer price multiples. The overpriced IPOs experience low long-run risk-adjusted returns.	Purnanandam and Swaminathan (2004)
Intentional Underpricing mainly for Investors	
Large underpricing is necessary to reduce winner's curse faced by uninformed investors.	Rock (1986), Beatty and Ritter (1996)
Intentional Underpricing for Issuers	
Signal issue quality.	Allen and Faulhaber (1989), Grinblatt and Hwang (1989)
Avoid potential legal liabilities.	Tinic (1988), Hughes and Thakor (1992)
Improve aftermarket liquidity. Attract large institutional investors to monitor issuing firms' performance.	Booth and Chua (1996) Stoughton and Zechner (1998), Aggarwal (2003)
Increase analyst coverage.	Rajan and Servaes (1997), Aggarwal, Krigman, and Womack (2002)
The surveyed CFOs of issuing firms expect an average of 10% underpricing for investors taking the risk of IPO.	Brau and Fawcett (2006a)
Increase median coverage and generate marketing benefit.	Demers and Lewellen (2003), Perkins and Perkins (1999)
Intentional Underpricing for Underwriters	
Solicit and reward investors for revealing information.	Benveniste and Spindt (1989), Sherman and Titman (2002)
Reduce marketing efforts and costs.	Baron (1982), Habib and Ljungqvist (2001)
Increase aftermarket revenue. Reduce risk associated with firm commitment offerings and aftermarket price support.	Loughran and Ritter (2002) Chen and Mohan (2002)

In the Baron (1982) model, however, underwriters do not price issues at the first-best price for intentional, self-serving reasons. In addition, if underwriters priced IPOs in an unbiased manner using their best models and their best information from the book-building process, why would there be such a strong bias towards underpricing? If mispricing is not intentional one should expect an unbiased estimate of IPO offer prices. The IPO literature is replete with theories that attempt to explain underpricing via intentional and rational actions by underwriters and/or issuers.

2A.2. Intentional underpricing

Large initial returns can be the result of specific strategies employed by underwriters and/or issuers. As listed in Table 1, issues may be underpriced to: 1) reduce the winner's curse problem and reward investors for taking the risk of investing in IPOs (Rock, 1986; Beatty and Ritter, 1986); 2) signal the issue quality (Allen and Faulhaber, 1989; Welch, 1989; Grinblatt and Hwang, 1989); 3) avoid potential legal liabilities (Tinic, 1988; Hughes and Thakor, 1992); 4) improve aftermarket liquidity (Booth and Chua, 1996); 5) attract large institutional investors to monitor firms' performance (Stoughton and Zechner, 1998; Aggarwal, 2003); 6) increase analyst and media coverage (Rajan and Servaes, 1997; Aggarwal, Krigman, and Womack, 2002; Perkins and Perkins, 1999; Demers and Lewellen, 2003); 7) solicit and reward investors for revealing private information (Benveniste and Spindt, 1989; Sherman and Titman, 2002); 8) reduce marketing efforts and costs (Baron, 1982; Habib and Ljungqvist, 2001); 9) allocate hot-IPOs to favored clients and increase revenue in the aftermarket (Loughran and Ritter, 2002); and 10) reduce underwriters' risk associated with firm commitment offerings and aftermarket price support (Chen and Mohan, 2002).

Brau and Fawcett (2006a) surveyed CFOs of IPO firms about their expectation of underpricing. The mean expected underpricing of CFOs is 10%, which approximates the average IPO underpricing in the market. This survey evidence suggests that many issuers have come to accept underpricing as a prima facie component of the IPO process.

The very existence of the more sinister IPO allocation strategies of spinning (Griffith, 2004) and flipping (Aggarwal, 2000; 2003; Fishe, 2002) strongly suggests that (at least some) underwriters intentionally underprice IPOs. In the case of spinning, underwriters allocate shares of hot IPOs to prospective clients who are able to trade the IPO shares on the opening day (for example) and capture the upside of the underpricing. In this case, the term "hot IPO" can be read as an IPO that the investment bank has significantly underpriced. In the case of flipping, underwriters allocate IPO shares to favored clients (oftentimes institutions) with the knowledge that the shares will be quickly flipped to capture the underpricing profit. In cases of spinning and flipping, underwriters may expect quid pro quos as they curry favor with those who receive the underpriced allocations (Ljungqvist and Wilhelm, 2003; Reuter, 2006; Nimalendran, Ritter, and Zhang, 2007).

2B. Mechanisms used to reduce underpricing

We are not the first to propose a potential solution to help mitigate underpricing. The IPO literature offers at least nine mechanisms that may be used to reduce expected underpricing. Table 2 lists each strategy along with supporting citations. In this section, we discuss each mechanism in turn.

Table 2
Mechanisms to Reduce Underpricing

High commissions through compensation contract.	Ljungqvist (2003)
Insider and selling shareholder monitoring of offer price setting.	Ljungqvist and Wilhelm (2003)
Underwriter's leverage on IPO allocation and aftermarket price support.	Benveniste, Busaba, and Wilhelm (1996), Ljungqvist and Wilhelm (2002)
Hiring prestigious underwriter	Titman and Trueman (1986), Carter and Manaster (1990), Carter, Dark and Singh (1998),
Backing by venture capitalists as quality certification.	Megginson and Weiss (1991), Barry, Muscarella, Peavy, and Vetsuypens (1990)
Hiring prestigious auditor	Beatty (1989), Datar, Feltham, and Hughes (1991), Teoh and Wong (1993), Michaely and Shaw (1995)
Hiring prestigious law firm	Beatty and Welch (1996), Barondes, Nyce, and Sanger (2007)
Insiders negotiate for non-integer offer price	Bradley, Cooney, Jordan, Singh (2004)
Insiders refrain from selling shares in IPO	Leland and Pyle (1977)
Use of a Dutch auction system	Brau and Fawcett (2006b)

2B.1. High commissions through compensation contracts

Ljungqvist (2003) suggests that issuers can design a contract to make underwriter compensation more sensitive to issuer valuation, which discourages underpricing. Using UK IPOs as a special sample since spread clustering does not exist in the UK IPOs, he finds that higher commissions are associated with lower underpricing. An increase of one percent excess commission reduces log initial returns from 0.164 to 0.137. This result suggests that commissions can be used as a substitute for underpricing.

2B.2. Monitoring by insiders and selling shareholders

Insider ownership at the time of the IPO and the presence and magnitude of insider selling in the IPO process affect issuer effort and intensity of monitoring and the degree of underpricing. Ljungqvist and Wilhelm (2003) find that: 1) the smaller the CEO ownership, the less incentive there is for issuer monitoring, and the greater the underpricing; 2) the fewer the shares insiders sell in the IPO, the smaller are efforts in monitoring, and the greater is underpricing (also see Habib and Lungqvist, 2001); and 3) fragmented ownership mitigates the collective bargaining power of shareholders and results in less monitoring and greater underpricing.

2B.3. Price stabilization and underwriter's leverage of IPO allocation

Price support is an important part of the underpricing process, especially for weak IPOs. Benveniste, Busaba, and Wilhelm (1996) suggest that underpricing and aftermarket price support act as substitutes in the resolution of the mechanism design. The observed underpricing is less than it would be in the absence of a commitment to price stabilization. In addition, underwriters' commitment to aftermarket price stabilization also serves as a bonding mechanism that prevents underwriters from overpricing new issues since underwriters buy back overpriced shares dumped by IPO investors.

The information solicitation hypothesis suggests that underpricing is necessary because investors who reveal positive information need to be compensated (Benveniste and Spindt, 1989). However, underwriters can use their leverage over IPO allocations to reduce underpricing. This is based on two reasons. First, investors who participate in IPOs regularly earn abnormal returns and want to remain on the allocation list (Benveniste and Spindt, 1989; Cornelli and Goldreich, 2001). Second, underwriters can solicit information from informed investors by threatening to reduce an investor's allocation priority in the future if the investor withholds positive information (Benveniste and Spindt, 1989; Benveniste, Busaba, and Wilhelm, 1996). The inverse relationship between underpricing and institutional allocation documented by Ljungqvist and Wilhemlm (2002) suggests that discretion of IPO allocations allows issuers to set more informed offer prices and to reduce underpricing.

2B.4. Underwriter reputation certification and VC backing

Issuers can select prestigious underwriters to certify firm quality and reduce underpricing (Titman and Trueman, 1986; Carter and Manaster, 1990). Carter, Dark and Singh (1998) provide empirical evidence in support of this argument. They show that IPOs underwritten by investment banks with better reputation are associated with: 1) smaller initial returns and 2) less negative long-run returns than IPOs handled by lower reputation underwriters. The presence of venture capitalists in IPOs also plays a role of certification. Megginson and Weiss (1991) show that VCs attract more prestigious auditors and underwriters, solicit greater interest from institutional investors, and reduce underpricing (also see Barry, Muscarella, Peavy, and Vetsuypens, 1990).

2B.5. Hiring prestigious auditors and law firms

Hiring high-quality auditors and well-known law firms can also help issuers certify issue quality and reduce underpricing. Among many others, Beatty (1989), Datar, Feltham, and Hughes (1991), Teoh and Wong (1993), and Michaely and Shaw (1995) find an inverse relationship between auditor reputation and IPO underpricing. The evidence implies that issuers audited by high quality CPA firms experience less underpricing. Beatty and Welch (1996) investigate how the compensation of experts (the legal counsel, the auditors, and the investment bankers) and IPO underpricing are related to expert quality. These authors find that expert quality is positively correlated to compensation, but negatively related to IPO underpricing. Their finding suggests that either the quality assurance of the law firm makes underpricing unnecessary or the high-quality law firms help issuers negotiate aggressively with underwriters to reduce underpricing. Similar result is also found by Barondes, Nyce, and Sanger (2007).

2B.6. Issuers negotiating non-integer prices

The "negotiation hypothesis" posited by Bradley et al. (2004) suggests that issuers and underwriters negotiate from a set of rounded prices (integer prices) when they anticipate the offer price is high or there is high uncertainty about the stock's market value. On the other hand, when the offer price is anticipated to be low or the uncertainty about stock value is low, issuers and underwriters negotiate from a more precise set of prices (non-integer prices). This argument is also in line with Harris's (1991) costly negotiation model, in which buyers and sellers use a coarse set of prices to reduce the time and cost of negotiation when uncertainty of asset value is high. Consistent with the negotiation hypothesis, Bradley et al. (2004) find that the average underpricing of IPOs with integer prices is 25.5% during the period from 1891 to 2000. In sharp contrast, the corresponding underpricing is only 8.2% for IPOs with non-integer prices.

2B.7. Using Dutch auctions to price IPOs

Brau and Fawcett (2006b) discuss the use of Dutch auctions as a possible mechanism to reduce underpricing. They analyze WR Hambrecht, an underwriter that specializes in auction IPOs who has underwritten such IPOs as Andover.net, Overstock.com, and Morningstar. Brau and Fawcett report that WR Hambrecht had only underwritten 14 IPOs from 1999-2005 and that the evidence on underpricing is mixed. For the 11 IPOs that WR Hambrecht acted as sole or lead underwriter, the auction system averaged 35% underpricing. However, if Andover.net (underpricing of 330%) is removed, the remaining 10 IPOs experienced a 5.8% underpricing.

3. Model Development

In Section A we briefly review the general procedure of total return equity swaps and swaptions. In Sections B and C we propose and develop IPO related swaps.

3A. A brief review of total return equity swaps and swaptions

In a total return equity swap, one party agrees to pay the total return (capital gains plus dividends) for a stated equity index or individual security on a notional principal and the counterparty agrees to pay the return on an appropriate benchmark or security, typically one of the LIBOR rates, plus or minus a spread. The notional principal is established in negotiating the contract and typically the notional principal is not actually exchanged. The notional principal can remain fixed, can decline over time (an *amortizing* swap), or it can grow over time (an *accreting* swap). Swap payments are typically made quarterly. Payments on most swaps are based on conditions three months prior to the payment date and thus the amount of a given payment is known in advance. However, payments on equity swaps are typically made "in arrears" and the amount to be exchanged is not known until the payment date arrives.

Consider this example of a basic equity swap. Suppose an institutional investor desires to increase its exposure to U.S equity markets. The investor enters into a swap contract with a swap bank (most swap dealers are large commercial banks in the U.S.) in which the investor agrees to pay the swap bank LIBOR (or some other reference rate) plus some spread, say five basis points (BPs). The bank, in turn, agrees to pay the investor the total return on the S&P 500 index. The bank might act as counterparty in its own right or, more likely, attempt to enter into a second swap with a different counterparty. In the second swap, the bank agrees to pay LIBOR minus a spread, say 5 BPs, and receive the total return on the S&P 500. Netting the effects of the two contracts, the swap dealer hedges away its exposure to the equity market and profits from the two spreads.

If the notional principal on the above described swap is $10 million, the total return on the S&P 500 is 2.5% (10% annual rate), LIBOR is 1% (4% annual rate), the spread is 1.25 BPs (5 BPs divided by 4), the first quarterly settlement would be the difference,

148.75 BPs times $10,000,000 = $148,750 and would be paid from the bank to the institutional investor. Note that only the net payment is exchanged.

3B. Basic IPO equity swaps

The precise terms of an equity swap contract are subject to negotiation and customized instruments can be designed to meet the needs of the counterparties. This flexibility makes swaps particularly well-suited for IPO contracts. The basic motivation for IPO equity swaps is to encourage the issuer to disclose truthful information about the new issue and for the IPO underwriter to price the IPO at the first-best price. The ultimate result is to reduce the amount of money left on the table from the perspective of the issuer.

If the underwriter uses his/her superior information on market demand and prices the issue artificially low, the issuer is compensated from the swap payments for the money left on the table. In contrast, if the issuer uses his/her superior information on the intrinsic value of the firm and the offer price is set too high, the underwriter is paid through the swap to reimburse price support and other costs.

Given that many special events (such as quiet period, penalty bid, price stabilization, and lockup) are carried out in the early IPO aftermarket, we propose and focus our attention on short-term swap contracts covering the first 30-days after an IPO. Issues relating to the use of longer term swap contracts in IPOs are presented in Appendix A. For purposes of our exposition, suppose the IPO is a computer-related issue. The negotiated benchmark might be the Morgan Stanley HiTech Index or some more complex matching algorithm such as Lyon, Barber, and Tsai (1999). Thus, the IPO would be judged by performance relative to peers (e.g., Purnanandam and Swaminathan, 2004) rather than relative to the broad market. Payments would take place only if the relative performance is above or below the negotiated bands.

3C. Short-term IPO swaps

Many institutional provisions and regulatory agreements are carried out in the early IPO aftermarket, which could distort the aftermarket price. For example, during the quite period (25-days after IPO), affiliated financial analysts are prohibited from making earnings forecasts (Bradley, Jordan, and Ritter, 2003; Bradley, Jordan, Ritter, and Wolf, 2004). Penalty bids and price stabilization are normally carried out by lead underwriters during the first month after IPOs (Ellis and Michaely, 2000). Insiders and venture capitalists are allowed to sell their pre-IPO shares after lockup expiry (typically 180 days). Lockup expiration trading is associated with significant price decline (Field and Hanka, 2001; Bradley et al., 2001). Since the ending of the quiet period is the first planned significant event after the IPO, the first swap payment can be made after the first 30-days (to give a week for the market to incorporate new information). Formally, if the IPO is determined to be underpriced in the first month, the payment to the issuer and

condition for payment at the end of first month can be expressed as follows:

$$\text{Payment to the issuer} = D_0 \times Max\ [0,\ (\ R_{IPO} - R_p\ ) - \delta_0^+\ ], \tag{1}$$

where, D_0 is the initial notional principal, which can be the total IPO proceeds or any amount negotiated by the issuer and the underwriter; $R_{IPO} - R_p$, the difference between the IPO return and the negotiated benchmark portfolio return (measuring the IPO relative underpricing); $\delta_0^+ > 0$ is the agreed initial upper bound of IPO relative pricing; *Max[0, V]* denotes a conditional function, which takes the larger value of either "0" or the conditional variable "V".

In a similar fashion, the issuer agrees to pay the underwriter if the IPO is overpriced relative to the negotiated initial lower bound (δ_0^-). The payment and the condition for the issuer to pay the underwriter at the end of first month are illustrated as follows:

$$\text{Payment to the underwriter} = D_0\ \times Max\ [0,\ \delta_0^- - (\ R_{IPO} - R_p\ )], \tag{2}$$

where, $\delta_0^- < 0$ is the agreed initial lower bound of IPO relative pricing. All other variables are defined the same as in equation (1).

Note that a fair and effective swap contract depends on the three parameters: benchmark return R_p, notional principal D_0, and the lower and upper bounds $\delta_0^-\ \&\ \delta_0^+$. Many factors uncontrollable by either the issuer or the underwriter affect the IPO aftermarket price. As much as possible, the selection of initial values for the three parameters needs to take these multiple factors into consideration. For example, the appropriate benchmark should reflect the issue firm's operating environment and affiliated industry characteristics. Unforeseeable business- or non-business related events can be incorporated into the swap through the adjustment of the notional principal or by expanding or contracting the spread between the lower and upper bounds. The higher the possibility and the larger the magnitude for an unforeseeable event, the smaller the notional principal and wider the bounds are. Furthermore, if more information is revealed during the book-building process, ceteris paribus, the smaller the bounds will be.

If the swap term extends to the period from day 31 to day 180 (typical lockup expiration), the payments and condition for the second payments can be determined using the benchmark adjusted holding period return from day 31 to day 180. If the IPO underpricing is truly only a one- or two-day overreaction, then by the time of the day 180 payment the underlying fundamentals of the issue versus its benchmark should dominate relative returns (Brau, Lambson, and McQueen, 2005). The swap payments would not be based on just a one- or two-day underpricing. Nonetheless, both parties to the swap might be more comfortable with an agreement that swap payments will only be made if mispricing is exceptionally high or exceptionally low. This reflects the fact that even with

the increased incentives the swap gives both parties to set the offer price closer to its fair value, IPO pricing will remain an uncertain business. Furthermore, to ensure that each possible payer will have enough cash to pay the appropriate counterparty, each side of the swap is required to place adequate funds in a trust account.[4]

For example, suppose a swap is incorporated into an IPO and the first payment is to be exchanged after 30 days. The initial notional principal (D_0) is \$100 million and equal to the IPO proceeds. At the end of the first month if the IPO underpricing ($R_{IPO} - R_p$) is 6% (72% annual rate, ignoring compounding) and this exceeds a negotiated upper bound of, say, $\delta_0^+ = 2\%$ (or 24% annual rate), then the underwriter would pay the issuer 4% (the difference between the excess return and the upper bound) of the principal, i.e., \$100,000,000 x 0.04 = \$4,000,000. On the other hand, if the IPO overpricing ($R_{IPO} - R_p$) is -6% (-72% annual rate, ignoring compounding), and falls below the negotiated lower bound of, say, $\delta_0^- = -2\%$ (or -24% annual rate), then the issuer would pay the underwriter 4% [-2% - (-6%)] of the principal, or \$4,000,000.

4. Empirical analyses of hypothetical swap contract propensity

4A. Magnitude of IPO mispricing

To document the bias of underpricing, we compute the amount of money left on the table as the product of the total number of shares offered and the difference between the first day closing price and the offer price. We pool all IPOs issued in the U.S. from the SDC New Issues database from 1970 to 2006. We exclude (1) non-common stock IPOs; (2) IPOs with offer prices less than \$5; and (3) IPOs without valid data on offer price, the number of shares offered, or first day closing price (from CRSP). These screens leave us with 9,329 IPOs.

Table 3 reports the summary statistics of mispricing. The average mispricing is \$14.38 million for the whole sample (Panel A), ranging from -\$1.627 billion (minimum) to \$5.600 billion (maximum). As expected due to the internet bubble, the average mispricing is significantly larger during 2000 and 2001 than in other periods. In addition, there is a clear trend of asymmetry in mispricing. Among the 9,329 IPOs, only 96 IPOs have a negative first day return of less than −15%, whereas 2,569 IPOs have a first day return greater than 15% (Panel B of Table 3). Overall, only 2,846 IPOs (or roughly 30%) are either accurately priced or over priced (i.e., first-day return equals 0 or is negative).

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[4] A consideration in the contract concerns the flow of funds from the escrow account. Should swap payments actually be taken from the trust account periodically or should the payments accrue and then one distribution from the trust be made at the termination of the swap? The latter avoids the possible depletion of the trust fund followed by a reversal in issue performance such that the original losing side becomes the winning side. Details such as this can be handled on a deal-by-deal basis or standardized by the underwriter.

However, the number of IPOs underpriced is 6,483 (about 70% of the IPOs). The preponderance of underpricing demonstrates the bias in mispricing.

Table 3
Amount of money left on table for IPOs from 1970 to 2006

The sample includes 9,329 common stock IPOs listed on the U.S market with available data for offer price, the number of shares offered, and the first day closing pricing from 1970 to 2006. The amount of money left on table (in million $) is calculated as [first day closing price – offer price] x total number of shares offered, where the total number of shares offered does not include over allotment options. IPO data are collected from SDC, and market closing price is retrieved from CRSP.

Panel A: Distribution of amount of money left on table (million $)							
Period	N	Mean	Min	25th Percentile	50th Percentile	75th Percentile	Max
1970-1979	149	0.63	-1.03	-0.07	0.12	0.81	7.53
1980-1989	2,624	1.00	-1,626.6	0.00	0.23	1.18	161.56
1990-1999	5,002	15.48	-503.98	0.00	1.66	8.50	1,982.9
2000, 2001	504	73.80	-277.18	0.37	14.71	57.31	5,600.5
2002-2006	1,050	15.98	-204.00	0.00	1.00	14.85	815.29
Whole sample	9,329	14.38	-1,626.6	0.00	0.83	6.30	5,600.5

Panel B: The number of IPOs (N in parentheses) and the average amount of money left on table (million $) for each initial return group						
	$IR \leq -15$	$-15 < IR \leq -5$	$-5 < IR \leq 0$	$0 < IR \leq 5$	$5 < IR \leq 15$	$IR > 15$
1970-1979	-0.68	-0.52	-0.12	0.16	0.65	2.44
(N)	(2)	(10)	(45)	(30)	(28)	(34)
1980-1989	-1.72	-22.38	-0.32	0.66	3.11	5.83
(N)	(16)	(78)	(735)	(872)	(489)	(432)
1990-1999	-6.37	-5.33	-0.88	2.52	11.66	40.51
(N)	(53)	(202)	(1,209)	(901)	(1,014)	(1,624)
2000, 2001	-27.81	-19.59	-0.55	6.76	41.96	136.06
(N)	(17)	(29)	(61)	(73)	(67)	(257)
2002-2006	-13.81	-14.21	-2.24	3.36	23.16	59.35
(N)	(8)	(58)	(323)	(250)	(190)	(222)
Whole sample (N)	-9.85 (96)	-11.19 (377)	-0.87 (2,373)	1.97 (2,126)	11.51 (1,788)	45.33 (2,569)

4B. Propensity of swap payment

In this section, we provide empirical statistics of the proposed swap payments based on specific lower and upper bounds in various periods. Following the literature, we compute buy-and-hold abnormal returns (BHARs) in various periods after the offering:[5]

$$\text{BHAR}_i = \sum_{t=s}^{S} R_{i,t} - \sum_{t=s}^{S} R_{P,t} \, , \tag{3}$$

Where $R_{i,t}$ and $R_{P,t}$ are the daily returns for stock i and the benchmark portfolio based on firm size and industry affiliation, respectively; s and S are the beginning and ending day for a given period (Ritter, 1991).

Swap payment is computed as the product of total proceeds raised through the IPO and the difference between BHAR and the trigger point (i.e., lower bound δ^- and upper bound δ^+). When BHAR$<\delta^-$ the issuer pays the underwriter, and when BHAR$>\delta^+$ the issuer receives payment from the underwriter. To consider the possible long-run swap contracts we discuss in Appendix A, we require that all IPOs have valid returns data in a three-year period after the offering. Because of this criterion, we truncate our IPO sample at the end of 2002. This also reduces our sample size to 6,838 IPOs.

As discussed in Section 3, we consider the first swap payment at the end of the 30th calendar day after the IPO because of the quiet period and price support. During this period, the average buy-and-hold abnormal return is 1.06% for the whole sample (Panel A of Table 4). To gain a general idea about the propensity of swap payments, we first consider the lower bound of –5% and upper bound of +5% as the trigger points for swap payment. Among the 6,838 IPOs from 1970 to 2002, 2,659 (or 38.9%) IPOs have a buy-and-hold abnormal return less than –5% and trigger the swap payment. For these IPOs, the issuers pay an average of $9.9 million (with a median of $2.5 million) to underwriters because of overpricing. In contrast, 2,753 (or 40.3%) of IPOs have a buy-and-hold abnormal return greater than 5% in the first 30-day period and trigger the upper bound. For these IPOs, the average swap payment received by issuers is $12.5 million, with a median value of $2.7 million. Together, about 80% of IPOs experience swap payments based on $\pm 5\%$ lower and upper bounds during the first 30-day period.

When the lower and upper bounds are extended to $\pm 10\%$, 1,993 IPOs trigger the lower bound of -10% in the first 30-day period. Based on this trigger point, the issuers pay $9.1 million to underwriters on average because of the overpricing, with a median value of $2.2 million. During the same period, 2,061 IPOs have a buy-and-hold abnormal return greater than 10%. The average payment received by the issuers is $12.0 million due to underpricing. Together, when the lower and upper bounds are set at $\pm 10\%$, 60% of the IPOs experience swap payments during the first 30-day period.

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[5] See Lyon, Barber, and Tsai (1999) for detail.

It is obvious that the wider the bounds, the fewer IPOs trigger swap payments. When we extend the lower and upper bounds to $\pm 15\%$ for the first 30-day period, there are only 1,440 IPOs that have a BHAR less than -15%, and 1,546 IPOs that have a BHAR greater than 15%. Together, the number of IPOs that experience swap payments is 2,986, which counts for less than 44% of the whole sample. When the lower and upper bounds are further extended to $\pm 20\%$, the total number of IPOs that experience swap payments is reduced to 2,194, which is about 32% of the whole sample. For brevity, these results are not reported.

Table 4
Size and industry adjusted returns and possible swap payments

For each IPO, we calculate size-and-industry adjusted buy-and-hold abnormal returns (BHARs) in various periods as follows:

$$BHAR_i = \sum_{t=s}^{S} R_{i,t} - \sum_{t=s}^{S} R_{P,t} \, ,$$

Where $R_{i,t}$ and $R_{P,t}$ are the daily returns for stock i and the benchmark portfolio based on firm size and industry affiliation, respectively; s and S are the beginning and ending day for a given period. Swap payment is computed as the product of total proceeds raised through IPO and the difference between BHAR and trigger point (i.e., low bound δ^- and upper bound δ^+). When BHAR$< \delta^-$ the issuer pays the underwriter, and when BHAR$> \delta^+$ the issuer receives payment from the underwriter. We report the number of firms (N) and mean (median) swap payment (in million $) for the selected trigger point category of $\pm 5\%$ and $\pm 10\%$ in each period. The total sample includes 6,838 common stock IPOs with available return data in a three-year period after the offering date from 1970 to 2002.

	Mean	BHAR<-5%		BHAR>5%		BHAR<-10%		BHAR>10%	
Period	BHAR(%)	N	Payment	N	Payment	N	Payment	N	Payment
			Panel A: Whole sample, IPOs from 1970 to 2002 (N = 6,838)						
Day1-30	1.06	2,659	9.90	2,753	12.48	1,993	9.08	2,061	12.01
			(2.51)		(2.73)		(2.19)		(2.65)
Day31-180	-0.44	3,188	29.55	2,976	26.19	2,861	28.31	2,662	25.43
			(6.85)		(6.01)		(6.60)		(5.81)
			Panel B: IPOs from 1970 to 1979 (N = 51)						
Day1-30	-4.05	24	0.91	14	1.98	17	0.80	9	1.07
			(0.51)		(0.15)		(0.49)		(0.60)
Day31-180	6.94	19	4.98	26	3.30	17	4.76	24	2.81
			(1.11)		(1.77)		(1.17)		(1.42)
			Panel C: IPOs from 1980 to 1989 (N = 1,872)						
Day1-30	-0.72	743	2.93	694	5.12	537	2.46	495	4.73
			(1.05)		(0.95)		(0.95)		(0.93)
Day31-180	3.98	826	8.80	854	6.34	726	7.71	756	6.03
			(2.40)		(2.58)		(2.17)		(2.44)
			Panel D: IPOs from 1990 to 1999 (N = 4,423)						
Day1-30	2.16	1,679	9.52	1,839	13.70	1,256	8.21	1,392	13.14
			(3.06)		(3.77)		(2.56)		(3.59)
Day31-180	-0.20	2,035	33.69	1,956	30.07	1,839	32.23	1,755	29.18
			(9.03)		(8.76)		(8.66)		(8.19)

Panel E: IPOs from 2000 to 2002 (N = 492)								
Day1-30	-1.55	216	37.80	206	27.05	183	35.24	165	24.91
			(15.28)		(13.56)		(14.13)		(13.20)
Day31-180	-2.02	308	59.36	140	97.18	279	57.50	127	93.37
			(31.10)		(30.51)		(33.48)		(28.43)

To gain further insight into the changes in mispricing over our sample period, we divide the whole test period into four sub-periods: 1970 to 1979, 1980 to 1989, 1990 to 1999, and 2000 to 2002. The results are reported in Panels B to E of Table 4, respectively. One clear trend is the increase in the mean amount of hypothetical swap payment. As an example, in the 70's, the average swap payment made by issuers (i.e., BHAR <-5%) is only $0.9 million (Panel B), which increases to $37.8 million for the IPOs from 2000 to 2002 (Panel E). The proportion of IPOs triggering swap payments also increases over the period. This evidence implies that both the scope (i.e., the proportion of IPOs) and the magnitude of mispricing have increased over time.

The second swap payment is suggested at the end of 180 days after the offering, which is at the end of the lock-up period for most IPOs (Field and Hanka, 2001). For the whole sample, the average buy-and-hold abnormal return is -0.44% from day 31 to day 180 (Panel A of Table 4). Based on ±5% bounds, 3,188 IPOs have a BHAR less than -5% during this period. The suggested swap payment made by the issuers due to overpricing is $29.6 million on average, with a median of $6.9 million. During the same period, 2,976 IPOs have a BHAR greater than 5%, and the average swap payment received by issuers because of underpricing is $26.2 million. Together, there are 6,129 IPOs (or about 90% of the whole sample) that experience a swap payment based on the ±5% bound.

When the lower and upper bounds are extended to ±10%, respectively, for the period from day 31 to day 180, 2,861 IPOs have a BHAR less than -10%, with an average swap payment of $28.31 million made by issuers. During the same period, 2,662 IPOs have a BHAR greater than 10%, and the average swap payment received by issuers is $25.4 million.

Using the first-day unadjusted initial returns of Table 3 suggests that 70% of IPOs are underpriced. However, using the 30- and 180-day initial returns with a characteristic benchmark matched on size and industry (Table 4), the flow of swap payments from issuer to underwriter and vice versa is essentially the same (approximately 40% for both). Thus, both parties in the offering, issuer and investment bank, have increased incentives to achieve the first-best offering price through the use of equity swaps.

The interaction of initial and longer-run returns raises an interesting point. If our proposed swap contracts were incorporated for short-term mispricing, then long-term mechanisms and contracts may not be needed. That is, if the problem is fixed initially, then subsequent remedies may not be needed. Given that Table 3 shows the well-known phenomenon of first day underpricing and Table 4 shows a fairly symmetric pattern of

over/under pricing over 30 and 180-days, it is possible that initial swaps could induce a bias of downward long-run returns. Although we can acknowledge such a possibility, it is impossible to test as no firms to our knowledge have ever used a swap contract in their IPO.

5. Model implications and discussion

Our primary purpose of proposing the adoption of swap contract in IPO underwriting agreement is to reduce the asymmetric information between the issuer and the underwriter and underpricing problem. However, the implementation of such a contract could affect the current practices seen in the IPO underwriting process. In this section, we discuss the possible impacts on issuers, underwriters, investors, and policy makers and regulators.

5A. The possible effects of IPO related swaps on underwriters

5A.1. Aftermarket price support

IPO swaps are expected to help ameliorate aftermarket price support, which is common for overpriced IPOs (Aggarwal, 2000; Ellis, Michaely, and O'Hara, 2002). Serving as bonding mechanism, a swap contract as part of the IPO agreement could benefit the underwriter in two ways associated with aftermarket price support. First, the IPO equity swap would encourage the issuer to disclose relevant information, reducing the chance of overpricing and price support. Second, even if overpricing is unavoidable given the uncertain nature of IPO valuation, the cost of price support can be reduced by the swap payment received from the issuer for the overpriced issue. A significantly overpriced IPO might find itself facing bankruptcy prior to the expiration of the swap. Along with the protection of the escrow account, a default on a swap payment turns the underwriter (i.e., the swap counterparty) into a general creditor.

5A.2. Hot IPO allocations

The IPO equity swaps could also impact an underwriter's IPO allocation process and upset the "good-ol'-boy" network of underwriters who may use underpricing to favor their special clients. The literature shows that underwriters typically distribute heavily underpriced IPOs to their favored clients in exchange for large commissions or future business (Ljungqvist and Wilhelm, 2002; Ritter and Welch, 2002). Thus, a fair offer price as a result of the IPO swap may reduce IPO underpricing and weaken the underwriter's ability of distributing hot IPOs to favored clients.

The reduced favoritism due to the first-best offer price also reduces the potential of regulatory scrutiny of underwriters' biased distribution of hot IPOs. Several studies find

that regulatory investigations have substantial negative effects on underwriters both in the short- and long-term. For example, Beatty, Bunsis, and Hand (1998) suggest that a formal SEC investigation imposes three types of costs on the underwriter or the associated clients. These costs include: 1) defending against SEC charges; 2) deterioration of reputation capital; and 3) increased client risk resulting from the market's perception of future asymmetric information. The implicit costs of defending against SEC charges are hard to quantify, but Beatty, Bunsis, and Hand (1998) find that the average IPO market share of the underwriters investigated by the SEC declines by at least 50% in the year immediately after the SEC investigation becomes public. The negative impact is more permanent for smaller underwriters than for larger underwriters. The stock prices of current clients and previous clients associated with the sanctioned underwriter also experience significant declines.

5A.3. Fair offer prices and underwriter reputation

An IPO equity swap provides underwriters a great marketing tool, especially for less well-known underwriters. The first-best offer price resulting from an IPO swap could help underwriters establish and enhance their reputations. Beatty and Ritter (1986) argue that underwriters have reputation capital at stake. If underwriters underprice IPOs too much, they may lose subsequent issuers (or if they do not underprice enough, they may lose potential investors). Similarly, Hanley, Kumar, and Seguin (1993) note that an overpriced issue (i.e., with poor aftermarket performance) harms the underwriter's reputation and therefore affects the underwriter's future IPO opportunities. In addition, there is a reputation transfer effect. An underwriter's negative reputation damages the reputation of its client. Beatty, Bunsis, and Hand (1998) show that when the SEC announces investigation of an underwriter, the stock prices of the underwriter's client involved in the current investigation declines by over 15%. The stock prices of client firms associated with small underwriters that have been sanctioned decline by an average of 3%.

Dunbar (2000) also demonstrates that accurate pricing plays an important role in investment banker market share. He shows that initial overpricing has a negative effect on investment banker market share, consistent with the reputation certification hypothesis of Booth and Smith (1986), which states that banks use their reputation to certify that an issue is of high quality. In addition, extreme positive first day returns have a negative effect on underwriter market share changes since future issuers avoid banks that leave too much money on the table (also see Beatty and Ritter, 1986).

5A.4. Entry into the underwriting business or increasing market share

Recall Brau and Fawcett (2006a) results indicating that CFOs of IPO firms expect underpricing of approximately 10%. This suggests that many issuers have come to accept underpricing as a prima facie component of the IPO process. A less well-known or an aggressive investment bank could use swap-enhanced IPOs to convince issuers that

they will not leave that money on the table, or at least not as much money on the table, if the issuer uses their services. Given the value of ancillary services and follow-on business, aggressive investment banks could squeeze the effective spread on IPOs to gain market share and new long-term relationships with issuers. Bankers who have not been able to enter a market would find these swap-enhance contracts to be an effective tool for wedging an opening into the game. Corwin and Schultz (2005) discuss the competitive environment for underwriters and underwriting syndicates. Carter and Manaster (1990) highlight the importance of reputation in IPOs. Swaps provide an aggressive investment bank a mechanism to overcome the exclusionary tactics of the current underwriting process and build a book despite not having a strong reputation.

5B. The effects of IPO equity swaps on issuers

As discussed in Section 2 and Table 1 of this paper, issuers might use underpricing strategically in an attempt to capture benefits such as issue quality certification, improved aftermarket liquidity, or increased analyst coverage in the aftermarket. However, the first-best offer price as a result of IPO equity swaps could also benefit issuers in several ways. The first-best offer price could reduce the amount of money left on the table. In addition, using swaps as part of underwriting agreements reduces issuer efforts and costs of monitoring the underwriting price setting process. For example, Ljungqvist and Wilhelm (2002) find that underpricing is negatively related to insider monitoring efforts and incentives.

Furthermore, the first-best offer prices generated by IPO swap contracts also benefit issuers by: 1) reducing or diminishing the potential of shareholder complaint (and lawsuits), especially those potential shareholders who were shut out of subscribing to a hot IPO;[6] 2) permitting higher prices for secondary offerings (Chemmanur, 1993); 3) mitigating the winner's curse problem, raising expected prices, and increasing stock liquidity (Sherman, 2000; Sherman and Titman, 2002); and 4) attracting more retail investors to participate in the IPO leading to a more liquid aftermarket.

5C. The effects of IPO related swaps on investors

Although the swap contract is between the issuer and the underwriter and does not directly involve investors, the bonding mechanism of first-best pricing as a result of the swap contract would affect both primary market investors who get shares via IPO allocation and secondary market investors who buy the newly issued shares in the secondary market. The IPO equity swap contracts could serve a certification role and signal investors of issue quality. Thus, both primary market investors and general public investors in the secondary market could make more informed decisions in IPO investing

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[6] Beginning in 2000, many issuers and underwriters were sued because of alleged illegal activities in connection with initial public offerings that caused the securities to trade at artificially inflated prices (see IPOSecuritiesLigitation.com http://www.iposecuritieslitigation.com/sched2.pdf for a list of sued issuers). Choi and Pritchard (2004) provide detailed analysis on this issue.

(and could possibly avoid the documented long-run IPO poor performance). In addition, the truthful information disclosure by issuers may discourage informed investors from holding back their private information of market demand, which could reinforce accurate pricing. Furthermore, the adoption of swaps in IPO underwriting agreements may make price support less necessary and the aftermarket price less distorted, leading to speedy price discovery.[7] Finally, the first-best offer price generated by swap contracts theoretically reduces primary market investor gains realized through underpricing, especially those institutional investors who get hot IPOs as favored clients.

5D. The benefit of IPO equity swaps to policy makers and regulators

Given the substantial amount of underpricing and the discretion that underwriters enjoy in distributing IPOs, policy makers and regulators have been concerned about unlawful practices as evidenced by several investigations of IPO allocation.[8] The SEC's $100 million settlement with Credit Suisse First Boston and the $28 million settlement with Robertson Stephens suggest that the benefit that underwriters derive from their unfair IPO allocation is not trivial.[9] The first-best offer price achieved as a result of IPO equity swaps reduces the chance of intentionally mispricing and prevents underwriters from unfair IPO distributions. Thus, IPO equity swaps help reduce regulator efforts in monitoring underwriter unfair IPO distributions.

6. Conclusions and future research implications

Although swaps have been widely used to hedge interest rate risk, exchange rate exposure, and equity return uncertainty, their use in reducing the uncertainty of pricing new share issues has not yet been studied. We propose total equity swaps between an issuer and the underwriter entered into as part of the IPO underwriting contract as a solution to the Baron (1982) asymmetric information and underpricing problem. Adding the IPO swap increases the incentives for both the issuer and the underwriter to generate the first-best offer price.

Along with potentially decreasing underpricing, we discuss various ways the first-best offer price generated by a swap contract can benefit issuers, underwriters, and investors. For issuers, IPO swap contracts offer a low-cost mechanism of signaling the quality of issue and certifying the truthful revelation of information. Other benefits to issuers include less effort and cost in monitoring the underwriter price setting process, fewer lawsuits, possibly higher secondary offering prices, and a more liquid aftermarket due to more retail investors attracted by the reduction in the winner's curse problem.

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[7] Note that our argument on the price discovery is consistent with the work of Bloomfield and O'Hara (2000). These authors indicate that a transparent market enhances price discovery.
[8] See http://www.iposecuritieslitigation.com for a recent list of IPO litigations.
[9] See Hennessey and Plitch (2004), Choi and Pritchard (2004), Ritter and Zhang (2007).

For underwriters, the more accurate pricing of IPOs: 1) mitigates costly price support in the aftermarket (Benveniste, Busaba, and Wilhelm, 1996; Chowdhry and Nanda, 1996); 2) avoids regulatory scrutiny on unfair hot-IPO allocations to favored clients and the related economic costs (Beatty, Bunsis and Hand, 1998; Ljungqvist, 2003); and 3) adds value to investment banks by mitigating moral hazard (Yung, 2005). Swaps also allow underwriters to build high-quality reputations and more stable relationships with issuers (Booth and Smith, 1986; Beatty and Ritter, 1986; Dunbar, 2000).

Our proposed IPO equity swaps have five testable hypotheses. These hypotheses can form the basis for future research in this area. First, we predict that the wider the bands (i.e., the greater the value of $|\delta^+|+|\delta^-|$), the higher the uncertainty of IPO performance, and the larger the possible underpricing. This is because the upper and low bounds (δ^+ and δ^-) directly affect the conditions for payments to take place and the magnitude of payments. Second, at a given level of performance band, we expect the notional principal to be negatively associated with the uncertainty of IPO performance. Intuitively, the larger the notional principal is, the greater the payments to be made by either the underwriter or the issuer. Third, as we discussed early in the paper, IPO swaps could play a signaling and certification role in the IPO process; hence, we expect the IPO swap contract to be a substitute for other signaling mechanisms such as hiring prestigious underwriters, venture capitalist backing, using longer lockup periods, etc. Fourth, given the motivation of the IPO related swap contracts, the use of swap contracts in the IPO process is expected to be positively related to the issue quality. Finally, when pre-IPO owners want to cash out in the IPO process (via secondary share sales in the IPO), the IPO swap contracts are more likely to be adopted to reduce any adverse effects of the secondary share offering on the offer price.

Given this, the proposed IPO swaps, like most new inventions and products, are not one-fit-for-all solutions for all the problems related to IPO underpricing, nor are they expected to be employed in all underwriting events. We recognize also that the adoption of IPO swaps could affect other current underwriting practices such as the use of over-allotment options, flipping, etc., but we do not have clear predictions as to the effect swaps might have on these practices.

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Appendix A
Long-term IPO swaps

Although our primary design of the swap agreement is to mitigate the initial underpricing modeled by Baron (1982), the swap model can be extended to long-term swaps (such as two or three years) to mitigate any possible mispricing that is not captured in the short-run.[10] Obviously, the longer the swap contract, the more uncertain are the factors that could affect stock market performance. Hence, the length of swap contracts, as well as other terms, depends on the nature of the offering and negotiation between the issuer and the underwriter. To reduce the unpredictable long-run performance, we propose that the further in time from issue, the more extreme the movement up or down should be to trigger a payment. This retains the needed element of long-run performance, while reducing "punishment" to one party or the other for changes from the initial conditions at the time of the IPO that neither party had control over. In addition, we propose a gradual reduction of notional principal as the swap-term increases and incorporation of more flexible options such as swaptions in the basic model to cater for issuer and underwriter special needs.

After the first 180 days, we propose that swap payments be made quarterly. The swap contract could last one year, two years, or three years, depending on the negotiation between the issuer and underwriter. To get a rough idea of the number of IPOs that might exchange swap payments and the magnitude of payments based on different trigger points, we repeat our analyses up to three-years after the offering and report the results in Table A1. To save space, we report annual swap payments rather than quarterly payments from years 1 to 2 and from 2 to 3. The general trend is that further away from the offering date, the larger the swap payment. As suggested in the model development section, the principal for the swap contract could decline and the bounds to trigger swap payments could be widened as time passes. The upper bound for the tth payment at the end of quarter t (δ_t^+) will increase the further in time from issue, i.e., δ_t^+ is a function of the original bound and time (t), which can be generalized as:

$$\delta_t^+ = \delta_0^+ + \alpha \times (t-1), \tag{A1}$$

Where, $\alpha \geq 0$ is an agreed upon constant, t = 3, 4, …, 12 (for a three year term). Note that the first two payments are covered in the short-term swap. For example, if the initial upper bound for the first quarter's relative performance is 5% (i.e., $\delta_0^+ = 5$) and $\alpha = 0.5$, the upper bound for the third quarter's relative performance is $\delta_2^+ = 5 + 0.5$ x (3-1) = 6. If the excess performance in the third quarter is 6%, which is the same as the new upper bound of 6%, no payment will be exchanged between the issuer and the underwriter.

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[10] See Ritter (1991) and Loughran and Ritter (1995) for literature reviews on short- and long-run IPO performance.

In contrast, the lower bound for further payments will decrease the further in time from the issue. The lower bound for the tth payment at the end of quarter t is written as:

$$\delta_t^- = \delta_0^- + \beta \times (t-1),$$ (A2)

where, $\beta \leq 0$ is an agreed upon constant, $t = 3, 4, \ldots$, etc.

To further reduce such "punishment," the initial notional principal of the swap (D_0) could be reset to a lower value at each payment date. The notional principal for the tth payment is expressed as:

$$D_t = D_0 (1+d)^{t-1},$$ (A3)

where, $d \leq 0$ is the negotiated decrease rate for the principal amount. For example, if the initial notional principal is \$100 million, and the decrease rate is 10% for each quarter (d = -10%), the notional principal of the swap could be reduced to \$90 million for the second quarter payment. At each subsequent quarterly payment date, the principal would again be reduced by 10%. Thus, the final, twelfth, payment of the swap could be based on a notional principal of \$31.38 million (\$100 * (1-0.1)^{11}).

The increase in the performance bands and the decrease in the notional principal mitigate the potential problem of an issuer "getting lucky." By this we mean the potential for an issuer to perform well due to conditions changing favorably after the IPO, but in a manner that could not have been anticipated at the time of the IPO. By the same token, these controls also mitigate the potential problems that the underwriter could not predict at the time of offering.

To take the controls into consideration, the payment to the issuer and the condition for payment at quarter t can be generalized as:

Payment to the issuer at quarter $t = D_t \times Max\ [0, (R_{IPO} - R_p) - \delta_t^+\ ],$ (A4)

where, δ_t^+ and D_t are defined in equations (A1) and (A3), respectively. And the payment to the underwriter and the condition for payment at quarter t is rewritten as:

Payment to the underwriter at quarter $t = D_t \times Max\ [0, \delta_t^- - (R_{IPO} - R_p)],$ (A5)

Where, δ_t^- and D_t are defined in equations (A2) and (A3), respectively.

Table A1
Size-and-industry adjusted returns and possible swap payments for longer-term swaps

For each IPO, we calculate size-and-industry buy-and-hold abnormal returns (BHARs) in various periods as follows:

$$BHAR_i = \sum_{t=s}^{S} R_{i,t} - \sum_{t=s}^{S} R_{P,t} \,,$$

Where $R_{i,t}$ and $R_{P,t}$ are the daily returns for stock i and the benchmark portfolio based on firm size and industry affiliation, respectively; s and S are the beginning and ending day for a given period. Swap payment is computed as the product of total proceeds raised through IPO and the difference between BHAR and trigger point (i.e., low bound δ^- and upper bound δ^+). When BHAR$<\delta^-$ the issuer pays the underwriter, and when BHAR$>\delta^+$ the issuer receives payment from the underwriter. We report the number of firms (N) and mean (median) swap payment (in million \$) for the selected trigger point category of $\pm 5\%$ and $\pm 10\%$ in each period. The total sample includes 6,838 common stock IPOs with available return data in a three-year period after the offering date from 1970 to 2002.

	Mean	BHAR<-5%		BHAR>5%		BHAR<-10%		BHAR>10%	
Period	BHAR(%)	N	Payment	N	Payment	N	Payment	N	Payment
Panel A: Whole sample, IPOs from 1970 to 2002 (N = 6,838)									
Day181-270	-0.51	3,045	21.52 (4.99)	2,941	17.35 (4.76)	2,650	20.32 (4.67)	2,549	16.31 (4.64)
Day271-360	-2.93	3,196	22.03 (5.20)	2,781	17.67 (4.52)	2,797	20.24 (4.80)	2,369	16.53 (4.40)
Year1-2	-3.61	3,338	47.12 (11.84)	3,139	42.72 (11.08)	3,152	45.69 (11.28)	2,968	41.26 (10.59)
Year2-3	-1.15	3,219	51.68 (11.19)	3,241	44.31 (11.66)	3,025	50.86 (10.81)	3,061	42.76 (11.06)
Panel B: IPOs from 1970 to 1979 (N = 51)									
Day181-270	8.49	13	2.18 (1.45)	26	4.08 (2.00)	12	1.99 (1.23)	21	4.11 (1.67)
Day271-360	7.15	17	4.01 (1.49)	24	4.81 (1.14)	13	4.06 (2.10)	19	5.29 (1.45)
Year1-2	7.02	21	4.46 (1.72)	29	5.44 (2.74)	19	4.33 (1.60)	28	4.88 (2.54)
Year2-3	11.68	21	10.41 (2.67)	27	4.16 (2.18)	19	10.36 (2.39)	25	3.96 (2.97)

Table A1 (continued)

| | Mean | BHAR<-5% | | BHAR>5% | | BHAR<-10% | | BHAR>10% | |
Period	BHAR(%)	N	Payment	N	Payment	N	Payment	N	Payment
Panel C: IPOs from 1980 to 1989 (N = 1,872)									
Day181-270	1.62	804	5.62 (1.79)	826	5.04 (1.82)	671	4.66 (1.64)	696	4.63 (1.70)
Day271-360	-1.06	835	4.26 (1.68)	768	4.75 (1.82)	715	3.87 (1.55)	644	4.27 (1.77)
Year1-2	-0.33	875	20.77 (4.49)	895	12.07 (4.50)	819	20.24 (4.29)	846	11.54 (4.22)
Year2-3	1.90	853	10.22 (4.06)	912	13.19 (5.17)	795	9.88 (3.90)	859	12.03 (4.89)
Panel D: IPOs from 1990 to 1999 (N = 4,423)									
Day181-270	-0.56	1,964	22.76 (6.57)	1,898	19.72 (6.36)	1,728	21.33 (6.04)	1,664	18.43 (5.94)
Day271-360	-3.33	2,091	25.00 (6.69)	1,805	18.78 (6.12)	1,836	22.84 (6.28)	1,551	17.14 (5.96)
Year1-2	-5.19	2,197	50.21 (15.96)	2,004	52.08 (14.70)	2,085	48.51 (15.42)	1,893	50.53 (14.14)
Year2-3	-3.16	2,111	58.06 (15.34)	2,071	54.17 (16.02)	1,995	56.93 (14.59)	1,959	52.58 (15.51)
Panel E: IPOs from 2000 to 2002 (N = 492)									
Day181-270	-9.11	264	61.66 (27.39)	191	48.77 (21.69)	242	57.42 (25.73)	168	45.21 (18.75)
Day271-360	-7.46	253	57.38 (27.59)	184	62.35 (18.18)	233	50.90 (25.33)	155	62.65 (18.51)
Year1-2	-3.00	245	116.78 (38.23)	211	88.88 (46.36)	229	114.49 (38.75)	201	84.20 (42.40)
Year2-3	3.96	234	148.91 (33.45)	231	83.44 (42.12)	216	149.23 (33.55)	218	80.06 (38.80)