Short Selling Before Initial Public Offerings*

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Keywords: IPO underpricing; two-stage offering; short selling; IPO long-run performance.

JEL classifications: G14; G31; G38

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Abstract

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1. Introduction

In this paper we analyze the effect of relaxing short-sale constraints on the market performance of initial public offerings (IPOs). We show that the presence of short sellers before an IPO reduces first-day IPO return and improves long-run stock performance. The average first-day IPO return has been abnormally high in the past five decades (Ibbotson, Sindelar, and Ritter 1994), which is often referred as the IPO underpricing puzzle. IPOs with higher first-day price run-up are associated with lower return in the long-run (Ritter, 1991; Loughran and Ritter, 1995). Theories predict that short-sale constraints and opinion dispersion could lead to the market overvaluation of IPOs in the short-term (Miller, 1977; Derrien, 2005; and Ljungqvist, Nanda, and Singh, 2006). This overpricing would revert back to the fundamental value in the long-run with the gradual relaxation of short-sale constraints. However, since the short-sale supply of stocks does not typically exist before the offering date of an IPO, the effects of short-sale constraints on IPO related issues have not been directly examined.

In this study, we examine how the relaxation of short-sale constraints before the IPO offering day affects the IPO first-day return and subsequent long-run performance. If short-sale constraints reduce the pricing efficiency of IPOs, the presence of stock lending supply would reduce the initial abnormal returns on the public offering day. Further, with the gradual relaxation of short-sale constraints, short sellers could arbitrage away the initial overpricing in the long-run, which leads to poor long-run performance after IPOs. Therefore, if short-sale supply is available before the public offering day, IPOs should experience lower initial return and better long-run performance. Specifically, we posit that the existence of short-sale supply before the IPO offering day is likely to (i) reduce the first-day IPO return and (ii) improve the long-run performance.

To test these conjectures, we obtain a novel sample from the London Stock Exchange (LSE) on which firms could go public via a two-stage IPO strategy (i.e., *introduction*). An introduction, which has the same regulatory requirements as a conventional one-stage IPO, allows issuers to separate the listing (i.e., the first-stage introduction) and equity issuance (i.e., the second-stage offering) into two stages, while in the first-stage introduction, firms are listed on the LSE without raising new capital. In the second-stage offering, listed firms raise capital by issuing new shares. Importantly, existing shares could be borrowed and sold short immediately after the first-stage introduction. When there exists a stock lending supply after the first-stage introduction, the second-stage equity issuance becomes short-sale unconstrained. Short sellers would short existing shares before the second-stage offering day if they believed stocks are overpriced, which in turn would reduce the upward price pressure on the second-stage offering day. Consequently, among two-stage IPO firms, firms with higher security lending supply are expected to have less price run-up on the second-stage offering day and better performance in the long-run.

We start by examining whether relaxing short-sale constraints before IPOs reduces the initial return on the public offering day. Consistent with our conjecture, we find that two-stage IPO firms with higher security lending supply before the second-stage offering day experience lower initial price run-up. This evidence is also consistent with Diamond and Verrecchia (1987) who show that short-sale constraints could reduce the adjustment speed of price to negative information.

In addition, the existing literature suggests that underwriters would intentionally underprice IPOs, which in turn could generate higher initial return (Rock, 1986; Benveniste and Spindt, 1989). However, we find that the effects of short-sale constraints on the first-day IPO return could not be explained by the pricing discount offered by underwriters.

Next, we examine the effects of short-sale constraints on IPO long-run performance. Consistent with our expectation, we find a positive relation between the level of lending supply before the second-stage offering and the subsequent long-run stock performance. This evidence supports Miller (1977), who conjectures that short-sale constraints on the IPO offering day could contribute to the subsequent long-run underperformance. Our findings are also in line with Derrien (2005), Cornelli, Goldreich, and Ljungqvist (2006), and Dorn (2009) who show that the overvaluation of IPOs in the short-run could be associated with subsequent underperformance in the long-run.

Our findings contribute to three different strands of finance literature. First, to the best of our knowledge, this is the first paper that examines short selling before IPOs.[1] Theoretical studies predict that short-sale constraints and opinion dispersion on the IPO offering day could be associated with the initial price run-up and subsequent long-run underperformance (e.g., Miller, 1977). However, in conventional IPOs, short-sale supply is unobservable since data on stock lending supply are only available for publicly listed stocks.[2] Edwards and Hanley (2010) challenge this assumption by looking at the IPO first-day short interest. They find that short-sale is prevalent

[1] There are some papers that examine the pre-IPO (i.e., grey) market (e.g., Dorn, 2009; Aussenegg, Pichler and Stomper, 2006; and Cornelli, Goldreich, and Ljungqvist, 2006). However, in the grey market, security lending supply does not exist and retail investors are restricted from selling short (Dorn, 2009). Therefore, existing studies on grey market still assume that short-sale constraints exist in the grey market as well as the early IPO aftermarket.

[2] Previous studies mainly focus on testing the effects of opinion dispersion on IPO related puzzles and simply take and support the assumption of short-sale constraints in the IPO aftermarket (Geczy, Musto, and Reed, 2002; Ofek and Richardson, 2003; and Houge, Loughran, Suchanek, and Yan, 2001). Their empirical opinion dispersion measures have significant explanatory power for both the short-term IPO overpricing and subsequent long-term underperformance.

on the offering day and is positively correlated with first day return. However, determined by both short-sale supply and demand, short interest does not directly measure short-sale constraints. Using a novel sample with pre-IPO short-sale supply data, we directly test the effects of short-sale constraints and find supporting evidence.

Second, we show that relaxing short-sale constraints improves pricing efficiency (e.g., Boehmer, Jones, and Zhang, 2008; Saffi and Sigurdsson, 2010; Boehmer and Wu, 2013) in a new economic setting. Existing short selling literature mainly focuses on the effects of short-selling bans to examine this relation (e.g., Autore, Billingsley and Kovacs, 2011; Beber and Pagano, 2013). We provide new evidence to support this prediction from the IPO market.

Third, we add to the literature on the benefits of the two-stage IPO strategy and provide a new motivation behind this strategy. Derrien and Kecskés (2007) show that a two-stage IPO strategy is more effective and efficient than a conventional IPO. We further show that a two-stage IPO strategy would reduce short-run overpricing and improve the long-run performance of the newly listed firm, since short-sale constraints could be relaxed. These benefits would be valuable for practitioners and market designers.

The rest of our paper proceeds as follows: Section 2 describes the institutional features of the two-stage IPO strategy. In Section 3, we develop our hypotheses. Section 4 describes our sample selection process and summary statistics. Section 5 presents our methods and empirical results. Section 6 concludes.

2. Institutional features of a two-stage IPO

At the London Stock Exchange, issuers could choose to go public through a conventional IPO process or via an *introduction*. For a conventional IPO, issuers become listed and raise capital

simultaneously. The nominated broker would be responsible for pricing and promoting the newly issued shares. Meanwhile, for an *introduction,* issuers are listed without raising capital in the first-stage introduction. Current shareholders could trade with investors who wish to buy the existing shares, but no new shares are issued at this stage. Further, with a first-stage introduction, issuers could gain access to more institutional investors by increasing their visibility.

After the first-stage introduction, many firms continue with a second-stage offering to raise new capital. The regulatory requirements for the second-stage offering are minimal. In particular, issuers only need to file a prospectus containing updated introduction prospectus, previously disclosed information and terms of the current offering if the additional offering is sold to a large number of investors. Therefore, firms with a two-stage IPO strategy could time the market more effectively than those with a conventional IPO. Following Derrien and Kecskés (2007), we define firms that get listed through a first-stage introduction and complete their second-stage offering within five years as two-stage IPO firms.

The two-stage IPO strategy provides an ideal setting to investigate the effect of short-sale constraints on IPO-related issues. This strategy is highly comparable to a conventional IPO but substantially different from a seasoned equity offering (SEO).[3] Further, for two-stage IPO firms, the market developed for existing shares at the first-stage introduction also helps to reduce the uncertainty for the second-stage new issuance (Derrien and Kecskés, 2007).

[3] The main difference between the second-stage offering and a SEO is whether the firm has conducted public issuance before. Further, Derrien and Kecskés (2007) find that the offering time, market reaction, offering day trading volume, and price run-up before the second-stage offering for two-stage firms are highly comparable to conventional IPOs, but significantly different from SEOs.

3. Hypotheses development

Our first hypothesis focuses on the effects of short-sale constraints on the first-day IPO return. The positive abnormal return on the first trading day following an IPO has attracted interests among scholars over the past decades (e.g., Ibbotson, 1975; Beatty and Ritter, 1986; and Loughran and Ritter, 2004). However, the reason for "money on the table" remains inconclusive. Miller (1977) and Ljungqvist, Nanda, and Singh (2006) suggest that heterogeneous beliefs and short-sale constraints could help to explain the large first-day IPO return.

Further, the short selling literature shows that short-sale constraints could lead to pricing inefficiency. For example, Autore, Billingsley and Kovacs (2011) and Beber and Pagano (2013) show that the 2008 short-sale ban reduces the stock pricing efficiency. Similarly, Saffi and Sigurdsson (2010) find that stocks with limited lending supply experience lower pricing efficiency.

Therefore, if the large IPO initial return is caused by short-sale constraints, the existence of short-sale supply before the public offering day should improve the pricing efficiency and reduce the IPO initial return. We posit that among two-stage IPO firms, those with higher security lending supply before the second-stage offering would experience less market overvaluation on the offering day. To summarize, our first hypothesis states:

H1: Security lending supply before the second-stage offering has a negative effect on the IPO initial return on the offering day.

Our second hypothesis examines the effects of short-sale constraints on the subsequent long-run performance of IPOs. If the price run-up on the IPO first trading day arises from the market overpricing, the stock price should gradually reverse back to its intrinsic value. Previous studies find that firms with a higher first-day IPO return are likely to be associated with poorer subsequent long-run performance (Stern and Bornstein, 1985; Ritter, 1991; and Loughran and Ritter, 1995). Miller (1977) posits that the gradual relaxation of short-sale constraints would allow short sellers

to arbitrage away the initial overpricing in the long-run.[4] Therefore, among two-stage IPO firms, those with higher security lending supply before the second-stage offering should have a better long-run performance. To summarize, our second hypothesis posits:

H2: Security lending supply before the second-stage offering has a positive effect on IPO long-run performance.

4. Data and summary statistics

To test these two hypotheses, we collect data from various sources. In this section, we describe the data sets and present the summary statistics.

4.1. Data sources

We hand collect the introduction information from the LSE new issue data, which are available from 1994. The LSE data provide the following information: date of first-stage introduction, company name, industry classification, and the name of the nominated broker. Since the security lending data are available from January 2002, we consider only introductions that have completed the second-stage offering between January 2002 and December 2013.[5] For each introduction, we hand collect press releases from Factiva. We consider the earliest issuance of primary shares as

[4] There are other explanations for the IPO long-run underperformance, for example, institutional ownership (Brav and Gompers, 1997), underwriter reputation (Carter, Dark and Singh, 1998)), and earnings management (Teoh, Welch, and Wong, 1998). However, our main focus in this paper is to examine the effects of relaxing short-sale constraints on IPO long-run performance.

[5] Following Derrien and Kecskés (2007), we manually check, and if necessary exclude, introductions with initial returns less than 50% or greater than 400%. We also exclude introductions with second-stage offering day market price less than 1.

the second-stage offering, and use the earliest date of news release about this issuance as the second-stage offering announcement day. Importantly, since we examine the role of short-sale constraints on the IPO performances using only two-stage IPO firms, our results are not subject to the potential issue that firms self-select into a two-stage IPO strategy.

We obtain unadjusted closing, bid, and ask prices, trading volume, and shares outstanding from Datastream, net income, operating income and sales data from Datastream and Compustat Global, prospectuses and annual reports from Thomson One Banker and Worldscope. Further, we use Factiva as a supplementary data source if prospectuses and annual reports are missing. Following Derrien and Kecskés (2007), we use the Hoare Govett Smaller Companies (HGSC) index as the market index and obtain the index daily closing price from Datastream.

We use the method in Derrien and Kecskés (2007) to select our sample. First, we match introduction firms with Datastream using company name and listing date. We only keep firms with relevant Datastream information. Next, we eliminate cross-listing stocks, firms that have been traded somewhere else in the world before the introduction, investment trusts and funds, and pure introductions (i.e., firms that were listed at the first-stage introduction but did not complete the second-stage offering within five years after listing). We end up with a sample of 102 introductions.

We obtain security lending supply and number of brokers from Markit, a leading provider of securities borrowing and lending data. The Markit Securities Finance Data are collected from beneficial owners, lending agents, prime brokers and institutional investors, and are available at daily frequency. Markit covers security lending data for more than 20,000 institutional funds for over ten years of history, which accounts for approximately 85% of the global security lending market.

We use the total lendable shares as our proxy for the security lending supply. Specifically, we define *security lending supply* as the average total shares available for lending over the previous

one week ending the second-stage offering day, divided by total outstanding shares on the second-stage offering day.[6] Among the 102 introductions, 24% have positive security lending supply before the second-stage offering. The average security lending supply before second-stage offering is 12.9% for short-sale unconstrained firms (i.e., firms with positive security lending supply before second-stage offering).

4.2. Summary statistics

Table 1 presents the year distributions of the 102 introductions. Columns (1) and (2) show that first-stage introductions are more prevalent during the 2004 - 2008 period, which is consistent with the increasing number of publicly listing firms before the financial crisis. In particular, the total number of public listing firms in the U.K. has more than doubled from 2003 to 2004 and kept increasing until 2008. As a result of the increased number of first-stage introductions during the 2004 – 2008 period, a wave of the second-stage offerings could be observed between 2005 and 2009, as reported in Columns (3) and (4).

Table 2 presents the summary statistics of the 102 introductions. We winsorize variables at the 1st and 99th percentile to mitigate the effects of outliers. Compared to short-sale constrained firms as reported in Column (2), unconstrained issuers in Column (3) tend to have larger market capitalization, higher proceeds, and higher turnover at the first-stage introduction. Following Derrien and Kecskés (2007), we define *pricing discount* as the market price one day before the announcement day of the second-stage offering divided by the offering price, minus one. The

[6] Our results remain similar if we define security lending supply as the average total shares available for lending over the previous one month ending the second-stage offering day divided by total outstanding shares on the second-stage offering day.

average pricing discount for our sample is 18.88%, while there is no significant difference between introductions with and without security lending supply before the second-stage offering.

5. Empirical results

5.1. Univariate analyses

To assess the relation between short-sale constraints and first-day IPO return, we first perform univariate tests. We employ two measures to evaluated the second-stage offering day price run-up, (1) *initial return*, which is the market closing price on the second-stage offering day over the offering price, minus one, (2) *market-adjusted initial return*, which is the difference between *initial return* and the market return on the second-stage offering day. If short-sale constraints before the second-stage offering lead to the market overpricing, we expect short-sale unconstrained introductions to have a lower initial return.

Table 3 presents the univariate test. Consistent with our expectation, the average initial return of introductions with security lending supply before the second-stage offering (14.7%) is lower than that of introductions without security lending supply (24.9%), significant at 10% level. The results remain similar with the market-adjusted initial return. This evidence suggests that the relaxation of short-sale constraints could be associated with less initial overpricing.

To evaluate the long-run performance of introductions, we employ annualized market-adjusted three-year buy-and-hold abnormal return (*market-adjusted-BHAR*) and characteristic-adjusted three-year buy-and-hold abnormal return (*characteristic-adjusted-BHAR*). Specifically, *market-adjusted- (characteristic-adjusted-) BHAR* uses the market index (size and book-to-market matched firms) as the benchmark.

Further, we also perform calendar-time portfolio and report the annualized *four-factor alpha* (Carhart, 1997). Specifically, for each day, we compute the intercept of daily regression based on

the Carhart (1997) four-factor model for each stock that had its first-stage introduction in the last three years. We then estimate equally weighted average abnormal return for portfolios based on the full sample for introductions with and without security lending supply before the second-stage offering, separately. We rebalance each portfolio every day from the 1st March 2005, when the first short-sale unconstrained introduction in our sample had its first-stage introduction, to the end of our sample, i.e., the 31st October 2014. The return difference is then estimated by employing a strategy that longs the portfolio of introductions with security lending supply before second-stage offering, and short the portfolio of introductions without the security lending supply.

Consistent with our prediction, we find that introductions with security lending supply before the second-stage offering have better performance in the long-run by using both buy-and-hold measures. The average *market-adjusted-BHAR* and *characteristic-adjusted-BHAR* for our sample are -6.8% and 0.22% for introductions with security lending supply before the second-stage offering, higher than that for introductions without security lending supply (i.e., -11.8% and -15.3%). The difference of *characteristic-adjusted-BHAR* is significant at 10% level. Results remain similar if we employ the calendar-time portfolio method. The difference of annualized four-factor alpha between the short-sale constrained and unconstrained introduction portfolios is -2.23%, significant at 5% level.

Overall, evidence from univariate tests provides support for our conjectures. The relaxation of short-sale constraints before the second-stage offering is associated with lower initial return and better long-run performance of IPOs.

5.2. Initial returns

In this session, we use multivariate analysis to study whether relaxing short-sale constraints reduces the initial return of two-stage IPO firms. We start with ordinary least squares (OLS) approach. In particular, we estimate the following reduced-form regression:

$$Initial\ return_i = \alpha_i + \beta_1 Security\ lending\ supply_i + \beta_2 Controls_i + \mu_i. \quad (1)$$

Control variables include several factors that are known to predict IPO initial returns (Derrien and Kecskés, 2007). Among these factors, *operating performance at offering* is a dummy variable that equals to one if a firm has positive sales, operating income, and net income on the second-stage offering day, and zero otherwise. It proxies for the quality of issuers. *Proceeds* is the natural log of proceeds (measured in million pounds) on the second-stage offering day. *Market return at offering* is the market index return over the previous three months ending the day before the second-stage offering day. It proxies for the market condition. *Industry return at offering* and *Industry volatility at offering* are the industry return during the 30 days before the second-stage offering and its associated standard deviation. These two variables proxy for the industry performance at the second-stage offering.

Since heterogeneous beliefs could also contribute to the IPO initial price run-up and long-run underperformance (Miller, 1977), we further employ *press coverage* and *relative quoted spread* as additional control variables. We define *press coverage* as the natural log of one plus the number of press releases in Factiva from the first-stage introduction to the announcement day of the second-stage offering day. If *press coverage* captures the level of information production (Derrien and Kecskés, 2007), higher press coverage should be associated with smaller opinion dispersion at offering. Further, the previous literature shows that heterogeneous beliefs among investors would create bid-ask spread, which in turn could proxy for opinion dispersion (Houge, Loughran, Suchanek, and Yan, 2001; Handa, Schwartz, and, Tiwari, 2003). We define *relative quoted spread*

as the difference between the bid and ask prices on the second-stage offering day, divided by the mean of bid and ask prices.

Finally, we control for *years between stages*, which is the number of years between the first-stage introduction and second-stage offering. We also include year dummy variables to account for the time-variation in initial return. We expect the security lending supply to be negatively correlated with the initial return.

Table 4 presents the OLS estimation results of the relation between *security lending supply* and *initial return*. Specifically, Columns (1) and (2) use *initial return* as the dependent variable while Columns (3) and (4) use *market-adjusted initial return* as the dependent variable. We find that, using both dependent variables, security lending supply is negatively associated with the initial return. In economic terms, a one standard deviation increase in security lending supply is associated with a 4.9% decrease in the initial price run-up in both Columns (2) and (4). Collectively, results in Table 4 support our first hypothesis that the security lending supply before the IPO offering day has a negative effect on the initial return.

To account for the potential endogeneity problem, we employ the two-stage ordinary least square (2SLS) estimation using *number of brokers at offering* and *turnover at listing* as instrumental variables for the security lending supply. We define *number of brokers at offering* as the natural log of one plus the average number of securities borrowing and lending brokers for that stock during the 30 days prior to the second-stage offering day , and *turnover at listing* as the mean of daily turnover in the first month following the first-stage introduction.

The existing literature suggests that stock liquidity is positively correlated with the security lending supply (e.g., D'Avolio, 2002; Jones and Lamont, 2002). Further, stocks with more brokers in the securities borrowing and lending market are more likely to have greater security lending supply, hence satisfying the relevance criterion. Since the average duration between the first-stage

introduction and second-stage offering is 1.3 years, *turnover at listing* is unlikely to directly affect the second-stage initial return and subsequent long-run performance. Similarly, the number of brokers in the securities borrowing and lending market has no direct effect on the stock performance, therefore satisfying the exclusion criterion. Moreover, we perform the following two tests to validate our choice of instrumental variables: (i) a Kleibergen-Paap (Kleibergen and Paap, 2006) relevance test to ensure high correlations between instrumental variables and security lending supply, and (ii) a Hansen's J over-identification test to examine the exogeneity of the instrumental variables. Test results suggest that both instrumental variables are relevant and exogenous.

As we have a relative small sample of 102 firms, we also report the results of the limited information maximum likelihood estimation (i.e., LIML) to address the finite-sample bias (Anderson and Rubin, 1949; 1950).[7]

Column (1) of Table 5 reports the instrumental variable estimation results. We find that *both number of brokers at offering* and *turnover at listing* are positively associated with the *security lending supply*. This finding suggests that introduction firms are likely to have larger *security lending supply* if they are more liquid at the first-stage introduction or have more securities borrowing and lending brokers at the second-stage offering.

Columns (2) and (4) use the 2SLS approach, while Columns (3) and (5) implement LIML approach. Consistent with our expectation, we find that relaxing short-sale constraints could significantly reduce the initial return. In economic terms, a one standard deviation increase of *security lending supply* is associated with a 12.6% decrease of initial return with the 2SLS

[7] According to Stock and Yogo (2005), the LIML approach provides the same asymptotic distribution as 2SLS but reduces finite-sample bias. The LIML approach is also claimed to be more resistant to weak instruments problems.

approach (Column (2) of Table 5). Results remain robust if we use the LIML approach or use the *market-adjusted initial return* as the dependent variable. Further, consistent with Derrien and Kecskés (2007), we also find that issuers are more likely to have higher initial returns if the market return is high or firm operational performance is bad.

5.3. Pricing discount

Findings in Section 5.2 indicate that relaxing short-sale constraints could be associated with lower initial return. However, we still need to disentangle the market overpricing effect from the pricing discount effect (i.e., underwriters intentionally underprice IPOs during periods of uncertainty and information asymmetry) (Rock, 1986 and Benveniste and Spindt, 1989). Specifically, Rock (1986) finds that to ensure uninformed investors would buy the issuance, underwriters would intentionally offer pricing discounts for IPOs.

Therefore, an alternative interpretation of our previous finding could be that the low initial return for two-stage IPOs with higher security lending supply simply reflects less pricing discount from underwriters. In this section we examine this alternative interpretation by employing multivariate tests. If introductions with higher security lending supply experience less pricing discounts, we would expect the security lending supply or the dummy variable of short-sale unconstrained firms to be negatively correlated with the pricing discount.

Table 6 reports the effects of the short-sale constraints on the pricing discount. In particular, *short-sale unconstrained firm* is a dummy variable that equals one if the two-stage IPO firm has positive security lending supply before the second-stage offering, and zero otherwise. Control variables include *proceeds, market return at announcement, market level at announcement, operating performance at announcement, capitalization at announcement, years between listing and announcement, press coverage, industry return at announcement* and *industry volatility at*

announcement. The announcement day of the second-stage offering is defined as the earliest date of news release about the second-stage offering we find in Factiva.

Consistent with our prediction, we find no significant relation between pricing discount and short-sale constraints. In Columns (3) and (4) we examine the effect of *security lending supply* on *pricing discount*. Again we do not find any significant relation between *security lending supply* and *pricing discount*. Therefore, pricing discount does not explain our results.[8]

5.4. Long-run performance

Our second hypothesis posits that introductions with higher security lending supply before the second-stage offering would experience better long-run performance. Following Carter, Dark, and Singh (1998), we estimate IPO long-run performance using a three-year horizon. Specifically, the holding period starts from 6 trading days after the second-stage offering day and lasts for 756 days. Since the previous literature shows that IPO long-run performance is sensitive to methodologies (e.g., Barber and Lyon, 1997; Brav and Gompers, 1997), we use different approaches to ensure the robustness of our results.

First, we estimate *market-adjusted-BHAR* using the HGSC Index. Derrien and Kecskés (2007) show that HGSC Index is a standard index for small-cap firms in the U.K. As IPOs are normally small-cap at the offering, the index fits characteristics of issuers. Next, motivated by Brav and Gompers (1997) who show that the long-run IPO underperformance could be largely explained by size and book-to-market effects, we estimate *characteristic-adjusted-BHAR* using size and book-to-market matched firms. Matching firms are non-IPO stocks which have at least five years of listing history but do not have follow-on equity issuance five years before the matching date.

[8] Our results remain similar if we employ 2SLS and LIML estimation approach.

If the best-matching firm is delisted during our three-year estimation window, we use the second-best matching firm instead. Specifically, the three-year long-run performance is calculated as follows:

$$BHAR_i = \left[\left(\prod_{t=offering\ day+6}^{\min[T,end\ of\ sample\ period]}(1+r_{i,t})\right) - \left(\prod_{t=offering\ day+6}^{\min[T,end\ of\ sample\ period]}(1+r_{m,t})\right)\right] \times 100, \quad (2)$$

where $r_{i,t}$ is the return of stock i on day t; T equals to offering date + 762 trading days; $r_{m,t}$ is the corresponding benchmark return (i.e., market index or matching firm return) on day t. Both *market-adjusted-BHAR* and *characteristic-adjusted-BHAR* are annualized after estimation.[9] To further ensure the robustness of our results, we use a third method to measure the long-run performance, i.e., the Carhart (1997) four-factor model:

$$r_{i,t} - R_{f,t} = \alpha_i + \beta_1(R_{m,t} - R_{f,t}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 UMD_t + \varepsilon_{i,t}, \quad (3)$$

where $r_{f,t}$ is the risk free rate on day t; $R_{m,t}$-$R_{f,t}$ is the excess market portfolio return on day t; SMB_t, HML_t, and UMD_t stand for the size, value and momentum factors on day t.[10] The daily excess return α_i is annualized to simplify the interpretation of following regression coefficients.

[9] Among the 102 introductions, no firm is delisted within three years after the second-stage offering. Therefore, our results do not have survival bias. However, three firms completed the second-stage offering later than October 2011 and therefore have a trading history of less than three years. To avoid selection bias, we keep these stocks and use the last day of our sample, 31st October 2014, as the ending day of their holding period. Our results remain similar if we exclude these three stocks.

[10] We use the size, value and momentum factors constructed for the U.K. market by Gregory, Tharyan, and Christidis (2013).

Table 7 presents the simple OLS regression results. We find that the security lending supply has significantly positive influences using all the measurements of IPO long-run performance. In economic terms, a one standard deviation increase in *security lending supply* is associated with a 10.4% (19.2%) increase in *market-adjusted-BHAR* (*characteristic-adjusted- BHAR*). Further, for the Carhart (1997) four-factor alpha, a one standard deviation increase in *security lending supply* is associated with an abnormal return of 11.9%. These results remain robust after the inclusion of additional control variables. In terms of opinion dispersion, we find that the coefficient estimates of press coverage and relative quoted spread are insignificant in all columns.

Table 8 presents the estimation results by using the 2SLS and LIML approaches. In Column (1), we find that the first-stage regression result is similar to the result in the initial return analysis. Stocks with greater number of brokers at offering and higher turnover at the first-stage introduction are more likely to have more security lending supply. The f-statistic is 14.38 for all the models. Further, the Hansen-J statistics suggest that none of our models rejects the null hypothesis of exogeneity of the instruments. Therefore, our instrumental variables are valid in all long-run performance models.

Columns (2) to (7) of Table 7 present the second-stage regression results. Consistent with our expectation, we find that *security lending supply* is positively correlated with IPO long-run performance by using all the three long-run performance measures. Specifically, Columns (2) and (3) report effects of *security lending supply* on *market-adjusted-BHAR*. In economic terms, with the 2SLS approach, a one standard deviation increase in *security lending supply* is associated with a 16.0% increase in *market-adjusted-BHAR*. Results are similar if we use *characteristic-adjusted-BHAR* or the Carhart (1997) four-factor alpha as long-run performance measure. Further, our findings remain robust with the LIML approach, which suggests that our estimations do not suffer small-sample bias.

Overall, these findings indicate that relaxing short-sale constraints improves IPO long-run performance.

5.5. Alternative explanations

In this section, we check the robustness of our results. One alternative explanation of our main results could be that the security lending supply provides liquidity to the market on the second-stage offering day and therefore reduces the illiquidity premium of the new issuance. Amihud (2002) shows that market illiquidity is positively associated with the stock excess return, and this effect is stronger in smaller stocks. If this is the case, then we should observe that the security lending supply promotes the liquidity of introductions on the second-stage offering day.

Table 9 reports our OLS estimation results for this alternative explanation. We use the bid-ask spread and turnover on the second-stage issuance day as two measurements of the IPO liquidity. In Columns (1) and (3), we find that there is no significant difference between the liquidity for short-sale constrained and unconstrained introductions on the second-stage offering day. In Columns (2) and (4), the coefficients of *security lending supply* are statistically insignificant, indicating that short-sale constraints do not have significant influence on IPO liquidity on the second-stage offering day. Therefore, liquidity premium does not explain our results.

6. Conclusion

This study investigates the effects of relaxing short-sale constraints on the first-day IPO return and subsequent long-run performance by using a set of two-stage IPOs, named as introductions. In an introduction, public listing and initial share offering are separated into two stages. This feature enables the security lending supply to exist before the second-stage offering, leaving us a natural design to directly examine the effects of relaxing short-sale constraints on IPO-related

puzzles. We find that IPOs with higher security lending supply before offering experience less initial price run-up and better long-run performance.

Our findings provide new evidence in the debate on the theoretical model developed in Miller (1977) which posits that short-sale constraints could lead to the IPO initial price run-up. In our sample, the short-sale unconstrained IPOs have 12.9% of outstanding shares available for borrowing before the second-stage offering day. We find that two-stage IPOs with higher security lending supply experience less initial price run-up and better long-run performance than their counterparts. Our findings support the assumption that short-sale constraints could be associated with the IPO initial price run-up and subsequent long-run underperformance (Miller 1977; Derrien 2005; Ljungqvist, Nanda, and Singh, 2006).

Our findings also demonstrate that short selling could improve pricing efficiency (Saffi and Sigurdsson, 2010; Boehmer, Jones, and Zhang, 2008; Bohemer and Wu, 2013). We find that relaxing short-sale constraints improves the IPO pricing efficiency on the offering day. This evidence contributes to the short selling literature, and further supports the positive role of short selling in the financial market.

Our findings have important implications for market designers and practitioners. By extending the findings in Derrien and Kecskés (2007), we further show that the two-stage IPO strategy could be an effective way for firms to go public. Investors may consider going public with this strategy to enjoy possible benefits from relaxed short-sale constraints.

References

Amihud, Yakov, 2002, Illiquidity and stock returns: Cross-section and time-series effects, *Journal of Financial Markets* 5, 31-56.

Anderson, T. W., and Herman Rubin, 1949, Estimation of the parameters of a single equation in a complete system of stochastic equations, *The Annals of Mathematical Statistics* 20, 46-63.

Anderson, T. W., and Herman Rubin, 1950, The asymptotic properties of estimates of the parameters of a single equation in a complete system of stochastic equations, *The Annals of Mathematical Statistics* 21, 570-582.

Aussenegg, Wolfgang, Pegaret Pichler, and Alex Stomper, 2006, IPO pricing with bookbuilding and a when-issued market, *Journal of Financial and Quantitative Analysis* 41, 829-862.

Autore, Don M., Randall S. Billingsley, and Tunde Kovacs, 2011, The 2008 short sale ban: Liquidity, dispersion of opinion, and the cross-section of returns of us financial stocks, *Journal of Banking and Finance* 35, 2252-2266.

Barber, Brad M., and John D. Lyon, 1997, Detecting long-run abnormal stock returns: The empirical power and specification of test statistics, *Journal of Financial Economics* 43, 341-372.

Beatty, Randolph P., and Jay R. Ritter, 1986, Investment banking, reputation, and the underpricing of initial public offerings, *Journal of Financial Economics* 15, 213-232.

Beber, Alessandro, and Marco Pagano, 2013, Short-selling bans around the world: Evidence from the 2007–09 crisis, *Journal of Finance* 68, 343-381.

Benveniste, Lawrence M., and Paul A. Spindt, 1989, How investment bankers determine the offer price and allocation of new issues, *Journal of Financial Economics* 24, 343-361.

Boehmer, Ekkehart, Charles M. Jones, and Xiaoyan Zhang, 2008, Which shorts are informed? *Journal of Finance* 63, 491-527.

Boehmer, Ekkehart, and Juan Wu, 2013, Short selling and the price discovery process, *Review of Financial Studies* 26, 287-322.

Brav, Alon, and Paul A. Gompers, 1997, Myth or reality? The long-run underperformance of initial public offerings: Evidence from venture and nonventure capital-backed companies, *Journal of Finance* 52, 1791-1821.

Carhart, Mark M., 1997, On persistence in mutual fund performance, *Journal of Finance* 52, 57-82.

Carter, Richard B., Frederick H. Dark, and Ajai K. Singh, 1998, Underwriter reputation, initial returns, and the long-run performance of IPO stocks, *Journal of Finance* 53, 285-311.

Cornelli, Francesca, David Goldreich, and Alexander Ljungqvist, 2006, Investor sentiment and pre-IPO markets, *Journal of Finance* 61, 1187-1216.

D'Avolio, Gene, 2002, The market for borrowing stock, *Journal of Financial Economics* 66, 271-306.

Derrien, François, 2005, IPO pricing in "hot" market conditions: Who leaves money on the table? *Journal of Finance* 60, 487-521.

Derrien, François, and Ambrus kecskés, 2007, The initial public offerings of listed firms, *Journal of Finance* 62, 447-479.

Diamond, Douglas W., and Robert E. Verrecchia, 1987, Constraints on short-selling and asset price adjustment to private information, *Journal of Financial Economics* 18, 277-311.

Dorn, Daniel, 2009, Does sentiment drive the retail demand for IPOs? *Journal of Financial and Quantitative Analysis* 44, 85-108.

Duffie, Darrell, Nicolae Gârleanu, and Lasse Heje Pedersen, 2002, Securities lending, shorting, and pricing, *Journal of Financial Economics* 66, 307-339.

Edwards, Amy K., and Kathleen Weiss Hanley, 2010, Short selling in initial public offerings, *Journal of Financial Economics* 98, 21-39.

Geczy, Christopher C., David K. Musto, and Adam V. Reed, 2002, Stocks are special too: An analysis of the equity lending market, *Journal of Financial Economics* 66, 241-269.

Gregory, Alan, Rajesh Tharyan, and Angela Christidis, 2013, Constructing and testing alternative versions of the Fama–French and Carhart models in the UK, *Journal of Business Finance and Accounting* 40, 172-214.

Handa, P., Schwartz, R. and Tiwari, A., 2003, Quote setting and price formation in an order driven market, *Journal of financial Markets*, 6, 461-489.

Houge, Todd, Tim Loughran, Gerry Suchanek, and Xuemin Yan, 2001, Divergence of opinion, uncertainty, and the quality of initial public offerings, *Financial Management* 30, 5-23.

Ibbotson, Roger G., 1975, Price performance of common stock new issues, *Journal of Financial Economics* 2, 235-272.

Ibbotson, Roger G., Jody L. Sindelar, and Jay R. Ritter, 1994, The market's problems with the pricing of initial public offerings, *Journal of Applied Corporate Finance* 7, 66-74.

Jones, Charles M., and Owen A. Lamont, 2002, Short-sale constraints and stock returns, *Journal of Financial Economics* 66, 207-239.

Kleibergen, Frank, and Richard Paap, 2006, Generalized reduced rank tests using the singular value decomposition, *Journal of Econometrics* 133, 97-126.

Kolasinski, Adam C., Adam V. Reed, and Matthew C. Ringgenberg, 2013, A multiple lender approach to understanding supply and search in the equity lending market, *Journal of Finance* 68, 559-595.

Kot, Hung Wan, 2007, What determines the level of short-selling activity? *Financial Management* 36, 123-141.

Ljungqvist Alexander, Vikram Nanda, and Rajdeep Singh, 2006, Hot markets, investor sentiment, and IPO pricing, *Journal of Business* 79, 1667-1702.

Loughran, Tim., and Jay R. Ritter, 1995, The new issues puzzle, *Journal of Finance* 50, 23-51.

Loughran, Tim, and Jay R. Ritter, 2004, Why has IPO underpricing changed over time? *Financial Management* 33, 5-37.

Miller, Edward M., 1977, Risk, uncertainty, and divergence of opinion, *Journal of Finance* 32, 1151-1168.

Ofek, Eli, and Matthew Richardson, 2003, Dotcom mania: The rise and fall of internet stock prices, *Journal of Finance* 58, 1113-1138.

Ritter, Jay R., 1991, The long-run performance of initial public offerings, *Journal of Finance* 46, 3-27.

Rock, Kevin, 1986, Why new issues are underpriced, *Journal of Financial Economics* 15, 187-212.

Saffi, Pedro A. C., and Kari Sigurdsson, 2010, Price efficiency and short selling, *Review of Financial Studies* 24, 821-852.

Stern, Richard L, and Paul Bornstein, 1985, Why new issues are lousy investments, *Forbes* 136, 152-190.

Stock, James, and Motohiro Yogo, 2005. *Asymptotic distributions of instrumental variables statistics with many instruments* (Chapter).

Teoh, Siew Hong, Ivo Welch, and T. J. Wong, 1998, Earnings management and the long-run market performance of initial public offerings, *Journal of Finance* 53, 1935-1974.

Table 1
Distribution of introductions

This table presents the distribution of introductions over time. Our sample includes 102 U.K. introductions that completed their second-stage offering between January 2002 and December 2013. Columns (1) and (2) report the year distribution for introductions at the first-stage introduction; Columns (3) and (4) report the year distribution for introductions at the second-stage offering.

	First-stage listing		Second-stage offering	
	(1)	(2)	(3)	(4)
Year	Number	Percentage	Number	Percentage
1999	2	2.0%		
2000	3	2.9%		
2001	4	3.9%		
2002	3	2.9%	7	6.9%
2003	3	2.9%	3	2.9%
2004	17	16.7%	6	5.9%
2005	20	19.6%	18	17.6%
2006	23	22.5%	18	17.6%
2007	11	10.8%	20	19.6%
2008	8	7.8%	5	4.9%
2009	0	0.0%	10	9.8%
2010	4	3.9%	4	3.9%
2011	3	2.9%	7	6.5%
2012	1	1.0%	2	2.0%
2013			2	2.0%
Total	102		102	

Table 2
Summary statistics

This table presents summary statistics for our two-stage introductions. Our sample includes 102 U.K. two-stage IPO firms that complete their second-stage offering between January 2002 and December 2013. Column (1) pertains to our full sample, 102 two-stage introductions, Column (2) to the 78 two-stage introductions without security lending supply before the second-stage offering, and Column (3) to the 24 introductions with security lending supply before the second-stage offering. Column (4) reports the t-statistics for tests of mean difference. *Security lending supply* is the average total lendable shares of each two-stage introduction over one week ending issuing day, divide by corresponding total shares outstanding. *Number of brokers at offering* is defined as the natural log of one plus the average number of securities borrowing and lending brokers for that stock during the 30 days prior to the second-stage offering day. *Turnover at listing* is the mean value of daily turnover over the first-stage introduction month. *Proceeds* is the nature log of the second-stage issuance proceeds measured in million pounds. *Capitalization at offering* is the nature log of market capitalization at second-stage offering measured in million pounds. *Press coverage* is the natural log of one plus the number of press releases in Factiva from the first-stage introduction to the announcement day of the second-stage offering day. *Relative quoted spread* is the difference between offering day bid and ask price, divide by the mean of bid and ask price. *Year between stages* is the number of years between the first-stage introduction and second-stage offering. *Pricing discount* is defined as the market price on the day before the second-stage offering announcement day, divided by the offering price, minus one.

Variables	(1) Full sample	(2) Short-sale constrained introductions	(3) Short-sale unconstrained introductions	(4) t-Statistics for tests of mean difference
Security lending supply (%)				
Mean			12.86	
Median			7.26	
Std. Dev.			16.80	
Number of brokers at offering				
Mean	0.23	0.01	0.96	**-4.06*** **
Median	0.00	0.00	0.00	
Std. Dev.	0.69	0.08	1.15	
Turnover at listing				
Mean	0.49	0.33	0.99	**-2.439** **
Median	0.19	0.14	0.52	
Std. Dev.	0.80	0.47	1.29	
Proceeds				
Mean	0.57	-0.14	2.87	**-6.117*** **
Median	0.59	-0.24	3.24	
Std. Dev.	2.40	2.00	2.14	
Capitalization at offering				
Mean	3.27	2.67	5.19	**-6.170*** **
Median	2.89	2.37	4.94	
Std. Dev.	1.92	1.53	1.81	

Table 2 (cont'd)

Variables	(1) Full sample	(2) Short-sale constrained introductions	(3) Short-sale unconstrained introductions	(4) t-Statistics for tests of mean difference
Press coverage				
Mean	3.12	2.87	3.92	**-2.281****
Median	3.11	2.77	4.08	
Std. Dev.	1.66	1.42	2.11	
Relative quoted spread (%)				
Mean	11.99	14.64	3.35	**5.755*****
Median	7.74	9.52	1.33	
Std. Dev.	14.52	15.52	4.29	
Years between stages				
Mean	1.25	1.16	1.54	**-1.282**
Median	0.90	0.82	1.04	
Std. Dev.	1.20	1.16	1.32	
Pricing discount (%)				
Mean	18.88	19.37	17.07	**0.349**
Median	11.40	12.50	8.75	
Std. Dev.	33.61	35.94	23.64	

Table 3
Univariate test

This table presents univariate test for our two-stage introductions. Our sample includes 102 U.K. two-stage IPO firms that complete their second-stage offering between January 2002 and December 2013. Column (1) pertains to our full sample, 102 two-stage introductions, Column (2) to the 78 two-stage introductions without security lending supply before the second-stage offering, and Column (3) to the 24 introductions with security lending supply before the second-stage offering. Column (4) reports the t-statistics for tests of mean difference. *Initial return* is the difference between the offering price and the second-stage offering day closing price, divide by the offering price. *Market-adjusted initial return* is the raw initial return minus offering day market index return. *Market-adjusted-BHAR* is the annualized adjusted three year buy-and-hold abnormal return using market index as the benchmark. *Characteristic-adjusted-BHAR* is the annualized adjusted three year buy-and-hold abnormal return using size and book-to-market ratio matched firm with at least five years of LSE listing and no follow-on equity issues in the prior five years as the benchmark. *Four-factor-alpha* is annualized excess return of equal-weight calendar-time portfolio, measured as the intercept of daily return regressions by using the Carhart (1997) four-factor model as the benchmark.

Variables	(1) Full sample	(2) Short-sale constrained introductions	(3) Short-sale unconstrained introductions	(4) t-Statistics for tests of mean difference
Initial return (%)				
Mean	22.51	24.90	14.73	**1.786***
Median	14.58	16.14	5.48	
Std. Dev.	33.74	36.89	18.97	
Market-adjusted initial return (%)				
Mean	22.40	24.82	14.56	**1.801***
Median	14.12	16.09	4.74	
Std. Dev.	33.73	36.87	18.99	
Market-adjusted-BHAR (%)				
Mean	-10.65	-11.83	-6.84	**-0.820**
Median	-13.02	-13.02	-7.17	
Std. Dev.	24.62	24.03	26.60	
Characteristic-adjusted- BHAR (%)				
Mean	-11.62	-15.26	0.22	**-1.796***
Median	-12.05	-11.80	-12.52	
Std. Dev.	44.80	47.43	33.05	
Calendar time equal-weighted portfolio				
Four-factor-alpha (%)	-10.88	-12.77	-9.43	
t-Value	-13.67	-12.00	-8.12	**-2.23****
Std. Error	0.80	1.06	1.16	

Table 4
Initial return and security lending supply before IPOs – OLS estimations

This table presents the difference in raw initial returns between two-stage introductions with short-sale constraint and without short-sale constraint. The sample comprises 102 U.K. two-stage IPO firms that complete their second-stage offering between January 2002 and December 2013. We use ordinary least squares (OLS) regressions as our estimation method. *Industry return at offering* is the industry return during the 30 days before the second-stage offering. *Industry volatility at offering* is the standard deviation of the industry return during the 30 days before the second-stage offering. Other variables are as defined in Tables 2 and 3. All Columns include offering year dummies. Standard errors are clustered by industry and are presented below each coefficient estimate in parentheses. ***indicates significance at the 1% level, **indicates significance at the 5% level, and *indicates significance at the 10% level.

Variable	(1) Initial return	(2) Initial return	(3) Market-adjusted initial return	(4) Market-adjusted initial return
Security lending supply	**-0.65*** **	**-0.29***	**-0.65*** **	**-0.29***
	(0.05)	(0.13)	(0.05)	(0.14)
Proceeds		**-3.47**		**-3.51**
		(2.01)		(2.02)
Operating performance at offering		**-7.38**		**-7.80**
		(4.20)		(4.26)
Market return at offering		**1.02**		**1.02**
		(0.61)		(0.61)
Press coverage		**-3.25**		**-3.23**
		(3.11)		(3.14)
Relative quoted spread		**0.04**		**0.02**
		(0.30)		(0.30)
Industry return at offering		**-0.94**		**-0.95**
		(2.72)		(2.73)
Industry volatility at offering		**-0.05**		**-0.06**
		(0.39)		(0.39)
Years between stages		**9.33*** **		**9.38*** **
		(2.30)		(2.26)
Constant	**15.06**	**18.68**	**15.15**	**19.09**
	(9.71)	(17.84)	(9.66)	(17.76)
Number of obs. used	102	102	102	102
R^2	0.104	0.251	0.103	0.250

Table 5
Initial return and security lending supply before IPOs – IV estimations

This table presents the difference in initial returns between two-stage introductions with short-sale constraint and without short-sale constraint. The sample comprises 102 U.K. two-stage firms that complete their second-stage offering between January 2002 and December 2013. We use two-stage ordinary least squares regressions (2SLS) to control for endogeneity problem, and also report limited-information maximum likelihood (LIML) estimation results for robustness. Column (1) reports the first-stage regression results. Exogenous instrumental variables are discussed in Section 5. Columns (2) to (5) report the second-stage regression results. . All the variables are as defined in Tables 2 and 3. All columns include offering year dummies. Standard errors are clustered by industry and are presented below each coefficient estimate in parentheses. ***indicates significance at the 1% level, **indicates significance at the 5% level, and *indicates significance at the 10% level.

Variable	(1) Security lending supply First-stage	(2) Initial return 2SLS	(3) Initial return LIML	(4) Market-adjusted initial return 2SLS	(5) Market-adjusted initial return LIML
Number of brokers at offering	**2.77****				
	(1.15)				
Turnover at listing	**2.71*****				
	(0.29)				
Security lending supply		**-0.75****	**-0.75****	**-0.80*****	**-0.80*****
		(0.30)	(0.30)	(0.29)	(0.29)
Proceeds	**1.06**	**-2.68**	**-2.68**	**-2.62**	**-2.62**
	(0.64)	(1.97)	(1.97)	(1.96)	(1.96)
Operating performance at offering	**2.45**	**-5.40*****	**-5.40*****	**-5.55*****	**-5.55*****
	(2.67)	(1.00)	(1.00)	(0.95)	(0.95)
Market return at offering	**-0.01**	**0.92***	**0.92***	**0.91***	**0.91***
	(0.05)	(0.54)	(0.54)	(0.54)	(0.54)
Press coverage	**0.13**	**-3.47**	**-3.47**	**-3.46**	**-3.46**
	(1.28)	(3.16)	(3.16)	(3.22)	(3.22)
Relative quoted spread	**0.02**	**0.15**	**0.15**	**0.14**	**0.14**
	(0.03)	(0.32)	(0.32)	(0.31)	(0.31)

Table 5 (cont'd)

Industry return at offering	**-0.13**	**-1.02**	**-1.02**	**-1.01**	**-1.02**
	(0.11)	(2.32)	(2.32)	(2.32)	(2.32)
Industry volatility at offering	**0.10**	**-0.08**	**-0.08**	**-0.09**	**-0.09**
	(0.09)	(0.28)	(0.28)	(0.28)	(0.28)
Years between stages	**-0.97**	**8.86*** **	**8.86*** **	**8.82*** **	**8.82*** **
	(1.41)	(2.39)	(2.39)	(2.37)	(2.37)
Constant	**-3.05**	**17.69**	**17.69**	**17.96**	**17.95**
	(4.88)	(17.85)	(17.86)	(17.96)	(17.97)
Number of obs. used	98	98	98	98	98
Kleibergen-Paap rk Wald F statistic	57.30***				
Hansen's J over-identification test (p-value)	0.85				

Table 6
Pricing discount and security lending supply before IPOs – OLS estimations

This table presents the difference in raw initial returns between two-stage introductions with short-sale constraint and without short-sale constraint. The sample comprises 102 U.K. two-stage IPO firms that complete their second-stage offering between January 2002 and December 2013. We use ordinary least squares (OLS) regressions as our estimation method. *Pricing discount* is defined as the market price on the day before the second-stage offering announcement day, divided by the offering price, minus one. *Short-sale unconstrained firm* is a dummy variable that equals one if the two-stage IPO firm is short-sale unconstrained, and zero otherwise. Other variables are as defined in Tables 2 and 3. All columns include offering year dummies. Standard errors are clustered by industry and are presented below each coefficient estimate in parentheses. ***indicates significance at the 1% level, **indicates significance at the 5% level, and *indicates significance at the 10% level.

Variable	(1) Pricing discount	(2) Pricing discount	(3) Pricing discount	(4) Pricing discount
Short-sale unconstrained firm	**3.17**	**14.87**		
	(8.19)	(8.20)		
Security lending supply			**-0.23**	**0.05**
			(0.13)	(0.21)
Years between listing and announcement		**13.42****		**12.41****
		(5.02)		(4.94)
Proceeds		**-2.07**		**-1.71**
		(1.93)		(1.95)
Operating performance at announcement		**-12.54**		**-11.48**
		(7.23)		(6.99)
Market return at announcement		**-0.04**		**-0.06**
		(0.43)		(0.47)
Capitalization at announcement		**-3.27**		**-2.76**
		(4.82)		(4.94)
Press coverage		**1.88**		**2.85**
		(2.46)		(2.74)
Market level at announcement		**0.03**		**0.03**
		(0.02)		(0.02)
Industry return at announcement		**-1.41**		**-1.24**
		(0.87)		(0.96)
Industry volatility at announcement		**-0.63**		**-0.56**
		(0.66)		(0.67)
Constant	**11.62**	**-46.65**	**11.62**	**-54.96**
	(7.91)	(42.41)	(7.91)	(38.74)
Number of obs. used	99	99	99	99
R^2	0.04	0.30	0.05	0.29

Table 7
Long-run performance and security lending supply before IPOs – OLS estimations

This table presents the difference in long-run returns between two-stage introductions with short-sale constraint and without short-sale constraint. The sample comprises 102 U.K. two-stage IPO firms that complete their second-stage offering between January 2002 and December 2013. We use ordinary least squares (OLS) regression as our estimation method. *Four-factor-alpha* is the annualized excess return measured as the intercept of daily return regressions by using the Carhart (1997) four-factor model as benchmark. *B/M* is the book-to-market ratio at the second-stage offering. *Volatility* is the volatility of stock return during the year after the second-stage offering, excluding the first trading week. Other variables are as defined in Tables 2 and 3. All columns include offering year dummies. Standard errors are clustered by industry and are presented below each coefficient estimate in parentheses. ***indicates significance at the 1% level, **indicates significance at the 5% level, and *indicates significance at the 10% level.

Variable	(1) Market-adjusted-BHAR	(2) Market-adjusted-BHAR	(3) Characteristic-adjusted-BHAR	(4) Characteristic-adjusted-BHAR	(5) Four-factor-alpha	(6) Four-factor-alpha
Security lending supply	**0.62*** **	**0.49*** **	**1.14** **	**1.26*** **	**0.71*** **	**0.73*** **
	(0.17)	(0.14)	(0.41)	(0.28)	(0.20)	(0.12)
Proceeds		**-0.35**		**-3.56**		**0.89**
		(1.57)		(2.32)		(1.88)
Operating performance at offering		**8.26**		**10.44**		**11.92**
		(6.94)		(9.87)		(9.67)
B/M		**13.49**		**8.20**		**20.64** **
		(8.17)		(11.40)		(6.76)
Volatility		**-2.12**		**-9.11*** **		**2.72**
		(1.15)		(2.29)		(2.17)
Press coverage		**-1.50**		**-2.38**		**-5.53*** **
		(1.24)		(2.10)		(1.09)
Relative quoted spread		**-0.09**		**0.27**		**0.37**
		(0.26)		(0.27)		(0.41)
Industry return at offering		**1.05**		**-1.33**		**1.17*** **
		(0.72)		(2.23)		(0.32)
Industry volatility at offering		**0.48**		**-0.22**		**1.02** **
		(0.44)		(0.64)		(0.29)
Years between stages		**4.38** **		**7.10***		**5.71***
		(1.60)		(3.12)		(2.65)
Constant	**-15.98**	**-22.57***	**-19.12**	**4.59**	**-3.81**	**-32.60** **
	(10.45)	(10.23)	(19.18)	(13.73)	(12.35)	(11.50)
Number of obs. used	102	95	102	95	102	95
R^2	0.18	0.42	0.11	0.30	0.09	0.33

Table 8
Long-run performance and security lending supply before IPOs – IV estimations

This table presents the difference in long-run returns between two-stage introductions with short-sale constraint and without short-sale constraint. The sample comprises 102 U.K. two-stage firms that complete their second-stage offering between January 2002 and December 2013. We use two-stage ordinary least squares regressions (2SLS) to control for endogeneity problem, and also report limited-information maximum likelihood (LIML) estimation results for robustness. Column (1) reports the first-stage regression results. Exogenous instrumental variables are discussed in Section 5. Columns (2) to (5) report the second-stage regression results. All the variables are as defined in Tables 2, 3 and 7. All columns include offering year dummies. Standard errors are clustered by industry and are presented below each coefficient estimate in parentheses. ***indicates significance at the 1% level, **indicates significance at the 5% level, and *indicates significance at the 10% level.

Variable	(1) Security lending supply First-stage	(2) Market-adjusted-BHAR 2SLS	(3) Market-adjusted-BHAR LIML	(4) Characteristic-adjusted-BHAR 2SLS	(5) Characteristic-adjusted-BHAR LIML	(6) Four-factor-alpha 2SLS	(7) Four-factor-alpha LIML
Number of brokers at offering	**2.21***						
	(1.29)						
Turnover at listing	**2.72*****						
	(0.65)						
Security lending supply		**0.95****	**0.98****	**3.47****	**3.47****	**1.45*****	**1.58****
		(0.42)	(0.45)	(1.53)	(1.53)	(0.52)	(0.65)
Proceeds	**1.31**	**-1.17**	**-1.23**	**-8.03****	**-8.03****	**-0.01**	**-0.25**
	(0.82)	(1.65)	(1.68)	(3.73)	(3.73)	(1.64)	(1.78)
Operating performance at offering	**3.28**	**9.54****	**9.40****	**2.91**	**2.89**	**14.71****	**14.11****
	(3.41)	(4.05)	(4.12)	(12.58)	(12.59)	(6.03)	(6.13)
B/M	**-1.40**	**13.41***	**13.45***	**9.58**	**9.58**	**19.72*****	**19.89*****
	(1.94)	(7.72)	(7.76)	(13.03)	(13.04)	(6.90)	(7.00)
Volatility	**0.03**	**-1.60**	**-1.60**	**-9.20*****	**-9.20*****	**3.37***	**3.36***
	(0.38)	(1.15)	(1.16)	(1.63)	(1.62)	(1.93)	(1.94)
Press coverage	**-0.01**	**-2.42****	**-2.41****	**-3.78***	**-3.78***	**-6.37*****	**-6.35*****
	(1.16)	(0.97)	(0.97)	(2.00)	(2.00)	(1.15)	(1.19)

Table 8(Cont'd)

Relative quoted spread	**0.04**	**0.02**	**0.02**	**0.30**	**0.30**	**0.69*** **	**0.69*** **
	(0.10)	(0.21)	(0.21)	(0.36)	(0.36)	(0.25)	(0.25)
Industry return at offering	**-0.27**	**0.54**	**0.55**	**-2.10**	**-2.10**	**0.58**	**0.62**
	(0.21)	(0.37)	(0.37)	(1.80)	(1.80)	(0.66)	(0.68)
Industry volatility at offering	**0.06**	**0.30**	**0.30**	**-0.59***	**-0.59***	**0.79*** **	**0.79*** **
	(0.13)	(0.31)	(0.31)	(0.36)	(0.36)	(0.20)	(0.20)
Years between stages	**-1.13**	**5.61*** **	**5.63*** **	**11.75*** **	**11.75*** **	**6.21*** **	**6.31*** **
	(1.48)	(0.89)	(0.88)	(1.41)	(1.41)	(0.89)	(0.76)
Constant	**-2.21**	**-22.74*** **	**-22.68*** **	**11.54**	**11.55**	**-34.14*** **	**-33.90*** **
	(4.50)	(8.82)	(8.80)	(11.79)	(11.80)	(8.05)	(7.89)
Number of obs. used	91	91	91	91	91	91	91
Kleibergen-Paap rk Wald F statistic	14.38***						
Hansen's J over-identification test (p-value)	0.37						

Table 9
Stock liquidity and security lending supply before IPOs

This table presents the difference in offering day liquidity between two-stage introductions with short-sale constraint and without short-sale constraint. The sample comprises 102 U.K. two-stage IPO firms that complete their second-stage offering between January 2002 and December 2013. We use ordinary least squares (OLS) regressions as our estimation method. *Bid-ask spread* is the bid-ask spread on the second-stage offering day, measured in percentage. *Turnover* is calculated as trading volume divide by shares outstanding on the second-stage offering day. Other variables are as defined in Tables 2 and 3. All columns include offering year dummies. Standard errors are clustered by industry and are presented below each coefficient estimate in parentheses. ***indicates significance at the 1% level, **indicates significance at the 5% level, and *indicates significance at the 10% level.

Variable	(1) Bid-ask spread	(2) Bid-ask spread	(3) Turnover	(4) Turnover
Short-sale unconstrained firm	**-9.21**		**0.47**	
	(5.58)		(0.72)	
Security lending supply		**-0.19**		**0.00**
		(0.17)		(0.02)
Capitalization at offering	**0.07**	**-0.42**	**-0.15**	**-0.12**
	(0.64)	(0.58)	(0.22)	(0.22)
Market return at offering	**0.09**	**0.06**	**0.06**	**0.06**
	(0.10)	(0.09)	(0.04)	(0.04)
Proceed	**0.68**	**0.62**	**0.21**	**0.22***
	(0.53)	(0.44)	(0.11)	(0.10)
Industry return at offering	**0.13**	**0.10**	**0.15***	**0.14**
	(0.82)	(0.72)	(0.07)	(0.07)
Industry volatility at offering	**0.19**	**0.16**	**0.09**	**0.09**
	(0.10)	(0.11)	(0.05)	(0.05)
Constant	**4.74**	**6.92**	**-0.11**	**-0.34**
	(3.34)	(3.86)	(1.36)	(1.14)
Number of obs. used	102	102	71	71
R^2	0.15	0.12	0.51	0.51