Worldwide Short Selling Regulations and IPO Underpricing☆

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Abstract

We study the impact of country-level short selling constraints on initial public offering (IPO) underpricing. Examining 14,964 IPOs from 37 countries, we find that IPO underpricing tends to be greater in countries that ban short selling or security lending and in countries where short selling is not practiced. Non-positive first-day returns are more common in countries where short selling is allowed, security lending is allowed, and short selling is commonly practiced. Additional evidence suggests that higher quality information environments may partially alleviate the effects of short sale constraints on underpricing.

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I. Introduction

Miller (1977) argues that short sale constraints can lead to overpriced securities by preventing pessimistic investors from trading on their beliefs, which results in prices that reflect the views of more optimistic investors. The impact of short sale constraints may be particularly acute for IPOs, which are characterized by severe information asymmetry and divergence of opinion. Existing evidence on whether IPOs suffer from short sale constraints is mixed. Researchers have identified lending costs (Ljungqvist, Nanda, and Singh, 2006), lending restrictions (Houge, Loughran, Suchanek, and Yan, 2001), and share lockups (Ofek and Richardson, 2003) as possible impediments to short selling IPOs. However, Geczy, Musto, and Reed (2002) and Edwards and Hanley (2010) find that short selling is possible and often practiced from the beginning for U.S. IPOs. The same cannot be said for IPOs in many international markets where short selling is expressly prohibited or not commonly practiced. We leverage cross-country variation in the regulation and practice of short selling to study the impact of short sale constraints on IPO outcomes.

The literature provides evidence consistent with Miller's "overpricing hypothesis" both at the individual security level (Jones and Lamont, 2002; Chang, Cheng, and Yu, 2007) and the market level (Bris, Goetzmann, and Zhu, 2007). In addition to overpricing, short sale constraints appear to have a detrimental effect on liquidity and price discovery. Diamond and Verrecchia (1987) argue that this occurs because short-sale constraints alter the mix of informed and uninformed traders. Empirical evidence in support of the notion that short sale constraints damage liquidity and price discovery is abundant. Boehmer, Jones, and Zhang (2013), Boulton and Braga-Alves (2010), and Kolasinski, Reed, and Thornock (2012) find evidence that liquidity suffered as a result of short sale constraints imposed by U.S. regulators during the 2008-2009 financial crisis, while Saffi and Sigurdsson (2011) and Boehmer and Wu (2013) find that stock prices are more informationally efficient when short selling is uninhibited. In addition to these single-country studies, several papers consider impact of short sale constraints on security prices in a multiple-country setting. Bris, Goetzmann, and Zhu (2007) find that country-level short sale constraints are associated with slower incorporation of negative information into stock prices. Beber and Pagano (2013) find that short sale bans during the 2008-2009 crisis are associated with reduced liquidity and slower price

discovery. Notably, the liquidity effects they document are particularly evident for small stocks and in the absence of listed options.

We exploit differences in the regulation and practice of short selling around the world to examine the relation between short selling and IPO underpricing. If, as prior research suggests, short sale constraints promote price uncertainty and contribute to overvalued securities, we expect that underpricing will be greater in countries where short selling is constrained or not practiced as IPO shares in those countries gravitate to those investors with the most optimistic opinions about the prospects of newly public firms. We test our hypothesis using a sample of 14,964 IPOs issued in 37 countries from 1998 through 2014. We utilize several alternative measures of short-sale constraints from the literature and other public sources.[1] These measures capture whether short selling is explicitly legal, whether securities lending is permitted, and whether traders practice short selling in each of our sample countries. To the extent that short sale bans, security lending bans, and the absence of short selling represent short sale constraints, we expect that underpricing will be greater in countries that prohibit short selling, prohibit security lending, and where short selling is not practiced.

Consistent with our hypothesis, we find that IPOs are underpriced more in countries where short selling is banned, security lending is banned, and short selling is not commonly practiced. For example, the average first-day return in countries that ban short selling is 62.9 percent, which compares to an average return of 28.2 percent in countries where short selling is permitted. Our results are robust to the alternative measures of short sale constraints reported in Charoenrook and Daouk (2005), which capture the legality and feasibility of short selling and the existence of put options.

If short sale constraints prevent pessimistic investors from trading on their beliefs, prices will tend to reflect the views of more optimistic investors (Miller, 1977). Such a bias should also decrease the likelihood that an IPO firm experiences a negative first-day return. When we test this conjecture, we find that the likelihood of a non-positive (or negative) first day return is substantially greater in countries where short

[1] Our short selling measures are drawn from Bris, Goetzmann, and Zhu (2007), Jain, Jain, McInish, and McKenzie (2013), and Maffett, Owens, and Srinivasan (2016).

selling is allowed, security lending is allowed, and short selling is practiced. On a univariate basis, the frequency of non-positive (negative) returns in our sample is 26.9 percent (21.6 percent) in countries that allow short selling and 11.3 percent (10.8 percent) in countries that ban short selling. We find similar results when we extend this analysis to a multivariate setting that controls for other factors that influence first-day returns. We interpret these results as additional evidence to support Miller's (1977) supposition that short sale constraints lead to security prices that reflect the beliefs of the most optimistic investors.

We also consider the possibility that the relation between short sale constraints and IPO outcomes is influenced by the information environment within a country. If investors have greater access to high quality information about an upcoming IPO, the opinions of optimistic and pessimistic investors may not diverge as much as would be the case in a country where information is difficult to acquire or is of low quality. We address the link between underpricing and a country's information environment in two ways. First, we control for legal origin, which prior research finds is associated with the quality of accounting information produced within a country (Ball, Kothari, and Robin, 2000), with civil law countries generally having lower quality accounting information compared to common law nations. We find that the relation between short sale constraints and underpricing is strongest in civil law countries. Second, we control for International Financial Reporting Standards (IFRS) adoption, which Horton, Serafeim, and Serafeim (2013) argue improves the information environment within a country. We find that IFRS adoption has a moderating effect on the relation between short selling and underpricing. Specifically, after adoption of IFRS, the relation between short sale constraints and underpricing is substantially weaker and, in many cases, not statistically significant. Together, these results suggest that the relation between short sale constraints and first-day returns is sensitive to the quality of a country's information environment.

Our study contributes to multiple literatures. First, we add to the growing evidence on the impact of short sale constraints on security prices. Our results provide empirical support for Miller's (1977) contention that short sale constraints promote IPO underpricing. Consistent with Miller's (1977) contention that short sale constraints lead to security prices that favor the views of optimistic investors at the expense

of pessimistic opinions, we show that underpricing and the likelihood of non-positive first day returns are exacerbated by short sale constraints.

Second, we contribute to the literature on the determinants of cross-country variation in IPO outcomes. Prior research reports that IPOs tend to be underpriced in all countries and time periods. However, there is substantial variation in average underpricing across countries (e.g., Loughran, Ritter, and Rydqvist, 1994). Factors proposed to explain this cross-country variation in underpricing include investor protections (Boulton, Smart, and Zutter, 2010; Engelen and van Essen, 2010), earnings quality (Boulton, Smart, and Zutter, 2011), regulatory burdens (Loughran, Ritter, and Rydqvist, 1994), and offering mechanisms (Loughran, Ritter, and Rydqvist, 1994). To our knowledge, we are the first to consider the impact of country-level short-selling regulation on firm-level IPO outcomes. Taken in the context of Ritter (1987), which finds that underpricing is the dominant cost of going public for most firms, our results imply that countries that relax short sale constraints may experience positive spillover effects in the new issues market, as the cost of going public decreases for firms seeking to raise equity capital.

The remainder of the paper is organized as follows. In the next section we review the literature on short selling constraints and develop testable hypotheses. We discuss our data and empirical strategy in Section III. In Section IV, we report our empirical results. Section V concludes.

II. Literature review and hypotheses development

Short sale constraints and security prices

Miller's (1977) overpricing hypothesis posits that short sale constraints prevent pessimistic investors from impounding their beliefs into security prices, which results in overpriced securities. Prior research finds evidence consistent with the overpricing hypothesis using a variety of proxies for short sale constraints, including short interest (Figlewski, 1981; Desai, Ramesh, Thiagarajan, and Balachandran 2002; Asquith, Pathak, and Ritter 2005), stock options (Figlewski and Webb, 1993; Danielson and Sorescu, 2001), lending supply and lending fees (D'Avolio, 2002; Geczy, Musto, and Reed 2002; Jones and Lamont, 2002), breadth of ownership (Chen, Hong, and Stein 2002; Asquith, Pathak, and Ritter 2005; Nagel, 2005), and

litigation (Lamont, 2004). However, each of these proxies has limitations. For example, Chen, Hong, and Stein (2002) note that using high short interest to proxy for short sale constraints is problematic because (i) most stocks have little to no short interest outstanding and (ii) low short interest may result from the high cost of short selling.

A more direct way to test the impact of short sale constraints on security prices is to use regulatory policy related to the practice of short selling. For example, Charoenrook and Daouk (2005) and Bris, Goetzmann, and Zhu (2007) use cross-country differences in the regulation and practice of short selling to capture short sale constraints and find evidence consistent with the overpricing hypothesis. Other studies leverage the 2008-2009 financial crisis, a time when many regulators around the world introduced temporary restrictions on investors' ability to short sell securities. Cross-country (Beber and Pagano, 2013) and U.S.-centric studies (Boehmer, Jones, and Zhang, 2009) find that the temporary restrictions were associated with sharp increases in share prices and detrimental effects on market quality.

Short sale constraints and IPOs

Miller (1977) points out that the impact of short sale constraints on security prices should be greater when there is a high divergence of opinion among investors. This is often the case for IPO firms, which are typically young- and small-firms which suffer from substantial uncertainty. Information disparities between issuers and the investment banks they employ (Baron, 1982), between issuers and potential investors (Welch, 1989), and between different investor groups (Rock, 1986) may exacerbate the divergence of opinion among IPO participants. Prior research suggests that these information disparities contribute to IPO offer price revisions (Hanley, 1993), offer price precision (Bradley, Cooney, Jordan, and Singh, 2004), and underpricing (Ljungqvist, 2007).

Prior research posits that lending costs (Ljungqvist, Nanda, and Singh, 2006), lending restrictions (Houge, Loughran, Suchanek, and Yan, 2001), and share lockups (Ofek and Richardson, 2003) are possible impediments to short selling IPOs. However, Geczy, Musto, and Reed (2002) and Edwards and Hanley (2010) find that short selling is possible and often practiced from the beginning for U.S. IPOs, which

indicates that short sale constraints are not binding for most U.S. IPOs. However, many international markets expressly prohibit short selling or security lending for all stocks, which would constrain investors' ability to short sell IPO stocks. For example, Bris, Goetzmann, and Zhu (2007) study 47 equity markets and find that many constrain short selling with outright short selling or security lending bans. Additionally, in some markets where short selling and security lending are legal, short selling is still not practiced.

Of course, underwriters are well aware of the short selling constraints that exist in any given market, and in practice they might set higher offer prices in markets where short selling is difficult, anticipating higher secondary market prices than would prevail in the absence of impediments to short selling. In other words, it is conceivable that short-sale constraints might lead to both higher offer prices and higher secondary market prices, leaving underpricing largely unaffected. However, there is ample evidence that underwriters do not fully adjust offer prices upward in response to favorable information about secondary market prices. Loughran and Ritter (2002) argue that underwriters have a strong incentive to leave money on the table through underpricing because doing so generates revenue streams that are less transparent to issuing firms than is the underwriter's gross spread. Furthermore, they provide a prospect theory explanation for why issuers do not object when investment banks severely underprice new issues. In the most underpriced deals, issuers typically receive good news about the value of their companies between the initial IPO filing and the setting of the final offer. During this period, founders and other pre-IPO shareholders receive favorable information about their personal wealth, and they sum the wealth loss they experience due to underpricing with the much larger wealth gain on the shares that they retain. In the end, issuers are satisfied because they observe a large net increase in wealth, even though that increase could have been larger with a less underpriced offer.

Chang, Chiang, Ritter, and Qian (2017) provide even more compelling evidence that underwriters ignore salient information when setting offer prices and pursue their own interests when underpricing new issues. In Taiwan's Emerging Stock Market (ESM), firms are required to list shares and trade on the ESM for six months prior to doing an IPO. Prices in the ESM are excellent predictors of secondary market prices once the firm conducts its IPO, yet the average IPO in Taiwan is still underpriced by 55%. Given the

informativeness of prices in the ESM, it is hard to justify 55% underpricing based on information asymmetries. Thus, the study concludes that in Taiwan, underpricing is driven by the financial incentives of underwriters.

If underwriters do not fully adjust offer prices toward the expected secondary market price, and if secondary market prices are higher due to short selling constraints, then we expect higher underpricing in markets where short selling is constrained. To the extent that short sale bans, security lending bans, and the absence of short selling represent short sale constraints, we expect that underpricing will be greater in countries that prohibit short selling, prohibit security lending, and where short selling is not practiced. We summarize our predictions in the following three hypotheses:

H1: A country-level ban on short selling is positively correlated with firm-level underpricing.

H2: A country-level ban on security lending is positively correlated with firm-level underpricing.

H3: A country-level lack of short selling practice is positively correlated with firm-level underpricing.

III. Sample construction and descriptive statistics

Sample construction

The construction of our IPO sample begins by retrieving all IPO events reported in the Thomson Financial SDC Platinum New Issues database from 1998 through 2014. Following prior literature, we exclude financial firms, rights offerings, unit offerings, closed-end funds, trusts, limited partnerships, and depository receipts. Secondary market prices are retrieved from Datastream, which we match to our IPO sample using the SEDOL identifier common to both databases. In cases where we cannot match using the SEDOL, we attempt to match by hand. We drop IPOs that do not have a first-day secondary market closing price with positive trading volume that occurs within –3 to +60 days of the SDC IPO issue date in Datastream.[2] We calculate the IPO underpricing as the first-day secondary market closing price divided by the IPO offer price, minus 1. We exclude countries where we were not able to obtain information about

[2] Due to daily volatility limits that may constrain secondary market prices in France and Greece, we use the tenth valid price to calculate underpricing for IPOs in these countries.

short-selling constraints, and we trim the top and bottom one percent of the remaining events based on underpricing to eliminate the extreme observations. Finally, we drop IPO events from countries with fewer than five IPOs during our sample period. These steps result in a final sample of 14,964 IPOs listed in 37 countries.

Descriptive statistics

We report descriptive statistics for our IPO sample in Table 1. Short selling is banned in the country of issue for 14.1 percent of our IPO events. Security lending is banned in the country of issue for 15.9 percent of our IPO events. Finally, 68.5 percent of our IPO events take place in a country where short selling is practiced. Later, we explore the impact of legal origin and IFRS implementation on the relation between short selling and underpricing. IPOs in civil law countries account for 42 percent of our sample, and 22.4 percent of our IPOs are issued in a country that has adopted IFRS at the time of the offering. The average IPO is underpriced by 33.1 percent, with first-day returns ranging from a 34.4 percent loss to a 369 percent gain.

[Place Table 1 about here]

Prior research suggests that reputable underwriters can reduce uncertainty for IPO participants by certifying a new issue (e.g., Carter and Manaster, 1990; Megginson and Weiss, 1991), resulting in a negative correlation between underwriter quality and underpricing. However, more recent studies find a positive relation between underwriter reputation and underpricing beginning in the 1990s (e.g., Beatty and Welch, 1996; Loughran and Ritter, 2004). We use the SDC league tables to identify top-tier underwriters. Specifically, we construct an indicator variable set to 1 for underwriters in the top 25 of the SDC league tables in the issue year, and zero otherwise. We report that 24.3 percent our sample IPOs employ a top-tier underwriter. In addition to their marketing and placement duties, underwriters are expected to facilitate aftermarket trading for IPOs. Price stabilization controls for underwriters' tendency to provide price support in the aftermarket. We measure price stabilization as the difference in the number of IPOs with initial returns between zero and one percent and the number of IPOs with initial returns between zero and negative one

percent, divided by the total number of IPOs in each country. A disproportionate number of first-day returns equal to or slightly greater than zero relative to the number of first-day returns just below zero is indicative of price stabilization. The sample average value for price stabilization is 0.01, which indicates a slight tendency towards stabilization.

We construct two variables to control for "hot market" effects, whereby underpricing tends to be higher when IPO volume and overall stock market returns are high (Ritter, 1984). First, we calculate IPO activity, which equals the number of IPOs in a given country in each year divided by the total number of listed equities in Datastream for that country in 2014. Second, we measure the return on the country-level Datastream index in the three months preceding each IPO. The IPO activity measure indicates that there are 5.7 IPOs for every 100 publicly traded companies each year in the typical sample country and that market returns average 2.8 percent over the three months prior to the typical IPO.

We control for differences in liquidity across national markets by including the ratio of the total value of shares traded divided by the average market capitalization over each calendar year as reported by The World Bank. We control for shareholder rights, which Boulton, Smart, and Zutter (2010) find to be positively correlated with underpricing. Our measure of shareholder rights is the antidirector rights index reported by La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1997) augmented with the value for China reported by Allen, Qian, and Qian (2005).

If information asymmetry is lower for larger IPO firms, underpricing should be negatively correlated with IPO size (Lowry, 2003). We proxy for firm size using inflation-adjusted proceeds raised. The average sample firm raises $124.8 million at the IPO. Bradley, Cooney, Jordan, and Singh (2004) find evidence that IPOs that price on an integer value are more uncertain. If this is indeed the case, the 50.0 percent of our sample IPOs with an integer offer price should exhibit greater IPO underpricing.

Sherman (2005) notes that book building is quickly becoming the method of choice for taking firms public worldwide. Consistent with her findings, we find that 64.4 percent of our IPO sample is book built. Over half (63.0 percent) of our sample IPOs are firm commitment offerings, which Ritter (1987) finds are underpriced less than best efforts IPOs. Equity carveouts, which tend to exhibit less underpricing than

original IPOs (e.g., Schipper and Smith, 1986; Prezas, Tarimcilar, and Vasudevan, 2000), are a mere 6.2 percent of our sample. Ljungqvist and Wilhelm (2003) find that high-tech firms, which make up 22.9 percent of our sample, exhibit greater underpricing than firms in other industries during the dot-com bubble.

In Table 2, we report the number of IPOs and average IPO underpricing for each of the 37 countries in our sample. There is wide variation in the number of IPOs in the sample countries, with a low of 5 offers in Argentina, to a high of 1,790 in the United States. Consistent with prior research, including Loughran, Ritter, and Rydqvist (1994), we find that average IPO underpricing is positive for all countries in our sample, with a range of 1.2% in Argentina to 69.5% in China.[3]

[Place Table 2 about here]

In the last three columns of Table 2, we reproduce details on the regulation and practice of short selling in each sample country first reported in Bris, Goetzmann, and Zhu (2007) and subsequently updated and expanded by Maffett, Owens, and Srinivasan (2016) and Jain, Jain, McInish, and McKenzie (2013). The first column indicates whether short selling is permitted in a given country. We report that short selling is allowed during our entire sample period in all but seven of our sample countries. The exceptions are Argentina, China, Finland, India, Indonesia, Malaysia, and Thailand. The next column indicates whether security lending is allowed in a given country. If security lending is severely limited or prohibited, short selling is not really feasible even when it is permitted. The vast majority of our sample countries permit security lending, with the exceptions being China, Greece, India (prior to 2008), Malaysia, New Zealand, and Thailand (prior to 1999). The final column considers whether short selling is practiced in a given country. There are a number of countries where short selling is allowed (for all or part of our sample period) but not commonly practiced, including Argentina, Brazil, Finland, Greece, India, Indonesia, Israel, Malaysia, New Zealand, Philippines, South Korea, Taiwan, Thailand, and Turkey. We use the information reported in Table 2 to construct the following three indicator variables: *short is selling banned*, *security lending is banned*, and *short selling is not practiced*. These variables are set equal to one for IPOs issued

[3] In unreported robustness tests, we confirm that our primary results are robust to the exclusion of countries with large numbers of IPOs and countries with high levels of underpricing, including China, U.K., and U.S.

in countries where short selling is banned, security lending is banned, and short selling is not routinely practiced, respectively, and zero otherwise. In cases such as Argentina, where short selling was prohibited until 1999, the indicator is set to one for IPOs issued in that country before 1999 and zero thereafter. We consider short selling to be constrained in countries that ban short selling or security lending, and where short selling is not practiced.

In Figure 1, we illustrate the empirical distribution of underpricing for our IPO sample. The average and median first-day returns for our IPO sample are 33.1 percent and 13.0 percent, respectively. The standard deviation of initial returns is 55.9 percent. As expected, the distribution of initial returns is positively skewed, with a skewness equal to 2.454. Finally, the distribution is leptokurtic due to the large number of extreme positive values typical of first-day IPO returns.

[Place Figure 1 about here]

IV. Empirical Results

Country-level short sale constraints and IPO underpricing

Our hypotheses predict a positive relation between country-level short sale constraints and firm-level IPO underpricing. In Figures 2 – 4, we illustrate the empirical distributions of initial returns for our IPO sample based on whether short selling is banned (Figure 2), security lending is banned (Figure 3), and short selling is not practiced (Figure 4). Consistent with our hypotheses, underpricing is higher in countries where short selling is constrained. Average underpricing is 62.9 percent (28.2 percent) in countries that ban (allow) short selling, 59.6 percent (28.1 percent) in countries that ban (allow) security lending, and 45.6 percent (27.4 percent) in countries where short selling is not (is) practiced. Median returns paint a similar picture. The volatility of initial returns is also greater in countries that constrain short selling. Finally, skewness and kurtosis are greater in countries where short selling and security lending are unconstrained, and where short selling is practiced.

[Place Figures 2 – 4 about here]

Of course, the evidence reported in Figures 2 – 4 fails to control for other factors that influence underpricing. We report a more rigorous examination of the relation between short sale constraints and underpricing in Table 3. We report the results of multivariate models that control for other determinants of underpricing discussed in relation to Table 1. The dependent variable in each of the models is underpricing. The primary variables of interest are the indicator variables capturing short sale constraints: *short selling is banned*, *security lending is banned*, and *short selling is not practiced*. All regressions include industry controls based on the classifications reported in Dyck and Zingales (2004) and issue year indicator variables. Statistical significance is based on standard errors clustered at the country level (Rogers, 1993).

[Place Table 3 about here]

In Model 1, we consider whether country-level short sale prohibitions are related to firm-level underpricing. Consistent with H1, we find that underpricing is higher in countries that ban short selling. All else equal, underpricing is 48.5 percentage points higher for IPOs issued in countries that ban short selling, compared to countries that allow short selling. This is consistent with expectations as, in countries that ban short selling, security prices are more likely to reflect the views of more optimistic investors. In the context of IPOs where dispersion of opinion is likely to be high, pessimistic investors should serve to dampen the large, positive first-day returns that are often observed. However, pessimistic investors are unable to establish positions that reflect their beliefs in countries that constrain short selling. We argue that this contributes to the large positive first-day returns exhibited by the typical IPO in these countries.

In Model 2, we replace *short selling is banned* with *security lending is banned* to consider the impact of country-level restrictions on security lending on firm-level underpricing. As discussed above, in countries where security lending is problematic or prohibited, short selling is extremely difficult or even impossible. We expect that security lending constraints will dampen the incorporation of negative information into initial returns. This leads us to predict a positive relation between country-level regulations against security lending and firm-level underpricing in H2. This is indeed what we find, as first-day returns tend to be significantly higher in countries that ban security lending. The magnitude of the effect is similar to that reported for IPOs in countries where short selling is banned. Specifically, a security lending ban is

associated with initial returns that are 44.2 percentage points higher than in countries where security lending is unconstrained.

In Model 3, we replace our controls for the regulation of short selling with the variable, *short selling not practiced*, which captures the practice of short selling. We note in Table 2 that short selling is not practiced in many countries that allow short selling and security lending. Likewise, in some countries where regulators place constraints on short selling or security lending, alternative mechanisms have developed to aid in the practice of short selling. Consistent with H3, we find that first-day returns tend to be higher in countries where short selling is not practiced. This suggests that, in countries where short selling is not commonly practiced, IPO returns tend to reflect the opinions of the more optimistic investors. The magnitude of the effect is smaller than what we observe for IPOs in countries where short selling is banned and security lending is banned. Namely, initial returns are 23.3 percentage points higher in countries where short selling is not practiced than in countries where short selling is practiced. Presumably, in some of the countries where short selling is not practiced, other mechanism are available for pessimistic investors to trade on their beliefs. One possibility is the use of put options. We examine this issue in more detail later.

In Model 4, we simultaneously control for whether short selling is banned, security lending is banned, and short selling is not practiced. Caution should be exercised when interpreting these results as the three variables are certainly correlated. When we include all three, we find a positive coefficient on each, with *security lending is banned*, being the only one that is statistically significant at conventional levels.

The control variables are mostly consistent with expectations based on prior research. Consistent with hot markets effects, underpricing is positively correlated with recent market returns. Consistent with the notion that larger offers suffer less from information asymmetry than smaller offers, we find that offer size and underpricing are negatively correlated. High-tech firms appear to experience greater IPO underpricing than firms in other industries. The R^2 values indicate that our models explain as much as 15 percent of the variation in the international underpricing cross-section.

Country-level short sale constraints and post-stabilization returns

In Table 4, we report a slightly different specification to study the relation between short sale constraints and underpricing. Specifically, we measure the initial return using the closing stock price 22 trading days (one calendar month) after the initial public offering. This accounts for two factors that might impact our results. First, several countries impose daily volatility limits or circuit breakers that may dampen IPO first-day returns. After 22 trading days, the secondary market price should have adjusted fully, even in the presence of daily volatility limits and circuit breakers. Second, this approach controls for price stabilization, which consists of post-IPO trading by underwriters aimed at supporting the secondary market price. Aggarwal (2000) finds that most price stabilization takes the form of demand-stimulating short covering and supply-restricting penalty bids. She finds that these activities typically last for 10-15 days following the IPO and include offerings that initially trade at or slightly above the offer price. Because stabilization activities tend to be short lived, the impact of price stabilization on IPO returns should diminish over time. As in the prior table, the primary variables of interest are *short selling is banned, security lending is banned,* and *short selling is not practiced*. With the exception of the country-level measure of price stabilization, which is excluded from the models reported in Table 4, the remaining control variables mirror those discussed for Table 3.

[Place Table 4 about here]

The results reported in Table 4 provide additional support for our hypotheses. We find a strong relation between country-level measures of the regulation and practice of short selling and firm-level IPO returns measured after 22 trading days. Specifically, first-day returns tend to be higher in countries that ban short selling, ban security lending, and where short selling is not practiced. The magnitude of the effects are in line with those reported in Table 3. For example, Model 1 indicates that returns measured after 22 trading days tend to be 53.4 percentage points higher in countries that ban short selling, compared to countries where short selling is permitted. The control variables are also consistent with Table 3, with smaller offers, offers taking place during hot markets, and high-tech offers all experiencing greater underpricing. Together, Tables 3 and 4 provide strong evidence that in countries where short sale constraints are binding, IPOs tend

exhibit greater underpricing. This is consistent with Miller's (1977) overpricing hypothesis and prior research that finds that security prices tend to be overvalued in the presence of short sale constraints.

Country-level short sale constraints and IPO underpricing – alternative measures

In Table 5 we test the robustness of our results to alternative measures of short sale constraints. Charoenrook and Daouk (2005) consider the regulation and practice of short selling for a large number of countries. They develop three measures designed to capture the climate for short selling within a country, including whether short selling is legal or feasible, and whether put options are available for trading. Put options are an alternative mechanism for investors with pessimistic beliefs as they provide a means to profit from security price declines. Prior research shows that option trading can counteract short sale constraints (Figlewski and Webb, 1993; Danielsen and Sorescu, 2001). For example, when combined with short call options, put options can be used to replicate the payoff of a short position ("synthetic short"). We use the information reported in Charoenrook and Daouk (2005) to construct the following three indicator variables: *short selling not legal*, *short selling not feasible*, and *put options do not exist*. These variables are set equal to one for IPOs issued in countries where short selling is not legal, short selling is not feasible, and where put options do not exist, respectively, and zero otherwise. If short sale constraints result in IPO returns that reflect the beliefs of more optimistic investors, we expect to find that underpricing is higher in countries where short selling is not legal, not feasible, and where put options do not exist.

We also consider the impact of naked short sale constraints on IPO underpricing in our robustness tests. Naked short selling refers to the practice of entering into a short position without first borrowing the security being sold short. In their study of the impact of short selling restrictions on ADRs, Jain, Jain, McInish, and McKenzie (2013) note that naked short selling is prohibited in many countries that allow covered short selling. Prior research shows that constraints on naked short sales can have effects in-line with Miller's (1977) predictions (Boulton and Braga-Alves, 2010). We use the information reported in Jain, Jain, McInish, and McKenzie (2013) to construct the indicator variable *naked short selling prohibited*. This variable is set equal to one for IPOs issued in countries where naked short selling is prohibited, and zero

otherwise. If constraints on naked short sales dampen the incorporation of pessimistic investors' beliefs about IPO firms, we expect to observe higher first-day returns for IPOs in countries that ban naked short selling.

The results provide further support for the notion that short sale constraints are associated with larger initial returns. Models 1 – 3 indicate that first-day returns tend to be higher in countries where short selling is not legal or not feasible, and in countries where put options do not exist. When we consider all three measures together in Model 4, the coefficient on each is positive, with statistically significant higher underpricing in countries where short selling is not legal and where put options do not exist. We find similar results in Model 5, when we consider the impact of naked short sale bans. The coefficient on *naked short selling prohibited* suggests that underpricing is considerably higher in countries that prohibit naked short selling. The impact of a naked short ban is also economically significant, as Model 5 suggests that IPO underpricing is 25.7 percentage points higher in countries that ban naked short selling compared to countries where naked short selling is allowed. The control variables are consistent with prior tables.

[Place Table 5 about here]

Country-level short sale constraints and non-positive initial returns

If short sale constraints prevent pessimistic investors from trading on their beliefs, then they may also decrease the likelihood that an IPO firm experiences a negative first-day return. In Table 6, we consider this possibility by reporting the frequency of non-positive (<= 0) and negative (< 0) initial returns based on whether or not short selling is banned, security lending is banned, and short selling is not practiced. In addition to reporting the percentages of non-positive and negative initial returns, we report differences between the groups and *p*-values from *t*-tests of these differences.

[Place Table 6 about here]

Consistent with the conjecture that short sale constraints decrease the likelihood of a non-positive first-day outcome by excluding the views of pessimistic investors, we find that non-positive and negative first-day returns are less likely to occur in countries that ban short selling, ban security lending, and where short

selling is not practiced. Non-positive first-day returns occur for more than one-fourth of the IPOs issued in countries where short selling is allowed (26.9 percent) versus less than one-eighth of the IPOs in countries that ban short selling (11.3 percent). In countries where security lending is allowed, 26.9 percent of IPOs experience non-positive first-day returns, compared to only 12.9 percent of IPOs in countries where security lending is banned. Finally, initial returns are non-positive 27.0 percent of the time in countries where short selling is practiced, versus 19.6 percent of the time when short selling is not practiced. The results are similar when we focus on initial returns less than zero as negative first-day returns are more common in countries that allow short selling, allow security lending, and where short selling is practiced.

In Table 7, we extend our study of non-positive first-day returns to a multivariate setting. We report logistic regressions where the dependent variable is set equal to one for IPOs that experience a first-day return less than or equal to zero, and zero otherwise. The dependent variables mirror those reported in our earlier underpricing regressions. If short sale constraints result in an upward bias, we expect to find a lower incidence of non-positive first-day returns in countries where short selling is banned, security lending is banned, and short selling is not practiced.

[Place Table 7 about here]

Consistent with the univariate results, we report in Table 7 that non-positive first-day returns are less likely to occur in countries that ban short selling, ban security lending, and where short selling is not practiced when we control for other factors believed to impact first-day returns. When we include the short sale constraints individually in Models 1 – 3, we find negative and statistically significant relations between short sale constraints and the likelihood of a non-positive first day return. In Model 4 we include all three measures and find that each is negatively and significantly correlated with the likelihood of a non-positive first-day outcome. The control variables are generally consistent with our intuition, as non-positive initial returns are less common in the presence of price stabilization, following strong market performance, in more liquid markets, in countries that offer superior investor protections, among smaller IPOs, and for bookbuilt offerings. In unreported tests, we find similar results when the dependent variable identifies negative first-day returns.

Country-level short sale constraints and IPO underpricing – legal origin

Prior research finds substantial differences in investor protections and financial reporting across different legal origins. La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1998) show that common law countries tend to offer better investor protections than their civil law counterparts. Ball, Kothari, and Robin (2000) provide evidence that accounting income tends to be more timely and conservative in common law countries, compared to civil law countries. If investor protections and financial reporting affect the information environment surrounding IPOs, the impact of short sale constraints on first-day returns may be related to the legal origin. To examine this possibility, we introduce the variable *civil law*, which is an indicator variable set to one for IPOs issued in civil law countries, and zero for IPOs issued in common law countries. In Table 8, we include *civil law* and its interaction with the three measures of short sale constraints to determine whether short sale constraints have the same impact in civil and common law countries. At the bottom of Table 8, we report the *p*-value from an *F*-test that considers the joint significance of the short sale constraint measure and its interaction with the civil law indicator variable.

[Place Table 8 about here]

We find that first-day returns tend to be larger in civil law countries. As reported in prior tables, IPO underpricing is greater in countries where short selling is constrained. The interaction terms suggest that the impact of short sale constraints is particularly acute in civil law countries. For example, Model 1 suggests that first-day returns are 4.2 percentage points higher in common law countries that ban short selling, and 63.8 percentage points higher (summing the coefficients on the short sale ban variable and its civil law interaction term) in civil law countries that ban short selling. The effect of a short selling ban is also much stronger in civil law countries. Model 2 suggests that underpricing is 61.1 percentage points higher in civil law countries that ban security lending, compared to common law countries that ban security lending. One potential explanation for these results is that, because the civil law legal origin is associated with greater adverse selection (La Porta, Lopez-de-Silanes, Shleifer, and Vishny, 1998) and opacity (Leuz, Nanda, and Wysocki, 2003), the information provided by short sellers is more valuable for IPOs issued in

these countries. Alternatively stated, because common law countries are generally more transparent than civil law countries, the impact of short sale constraints on underpricing is not as severe.

Country-level short sale constraints and IPO underpricing – IFRS adoption

The results in the previous section suggest that legal origin has an impact on the relation between short sale constraints and underpricing. Based on prior research, we believe that this may be due to the impact that legal origin has on the information environment within a country (e.g., Ball Kothari, and Robin, 2000; Leuz, Nanda, and Wysocki, 2003). In Table 9, we leverage the recent wave of IFRS adoptions around the world to report a more direct test of the information environment's impact on the relation between short sale constraints and underpricing. Consistent with the notion that IFRS adoption improves the information environment, Byard, Li, and Yu (2011) find that analysts' forecast errors and forecast dispersion decrease following mandatory adoption of IFRS in the European Union. To test the impact of IFRS adoption on the relation between short sale constraints and IPO underpricing, we introduce the indicator variable *IFRS*, which is set to one for countries after adoption of the International Financial Reporting Standards (IFRS), and zero otherwise. In addition, we interact this variable with our three measures of short sale constraints. If a strong information environment facilitates the incorporation of both good and bad news into security prices, then we expect to find that the impact of short sale constraints on underpricing is diminished following the adoption of IFRS. At the bottom of Table 9, we report the *p*-value from an *F*-test that considers the joint significance of the short sale constraint measure and its interaction with the IFRS indicator variable.

[Place Table 9 about here]

In Table 9 the coefficient on the IFRS adoption variable is not significant, suggesting that IFRS adoption by itself does not reduce IPO underpricing. However, our results indicate that in countries that impose constraints on short selling, IFRS adoption essentially offsets the effect of short selling constraints on underpricing. In other words, an IPO in a country that imposes restrictions on short selling generally experiences higher underpricing, but not if the country has also adopted IFRS. As in prior tests, the

coefficients on our measures of short sale constraints are positive and significant in each model. However, the interaction terms take the opposite sign, are generally significant, and tend to offset the effect of short sale constraints, as evidenced by the result of *F*-tests of their joint significance. We interpret these results to suggest that IFRS adoption decreases the importance of short sale constraints by improving the quality of financial information and reducing information asymmetry.

V. Conclusion

We exploit differences in the regulation and practice of short selling around the world to examine the relation between short selling and IPO underpricing. Prior research suggests that short sale constraints promote price uncertainty and contribute to security overvaluation. If this is also the case for IPOs, then we expect that underpricing will be greater in countries where short selling is constrained or not practiced. We test this hypothesis using a sample of 14,964 IPOs issued in 37 countries from 1998 to 2014 and measures of short sale constraints drawn from the extant literature and other public sources.

Collectively, our results lend support to Miller's (1977) claim that short sale constraints can lead to overpriced securities by preventing pessimistic investors from trading on their beliefs, which results in prices that reflect the views of more optimistic investors. IPOs are an especially rich setting for studying the impact of short sale constraints on security prices, as they are characterized by a high degree of information asymmetry and heterogeneity in investors' valuations. We find that IPOs tend to experience greater underpricing in countries where short selling is more difficult or costly. Specifically, we find that IPOs are underpriced more in countries that ban short selling, restrict security lending, and where short selling is not practiced. The results are robust to alternative measures of short sale constraints reported in Charoenrook and Daouk (2005) and Jain, Jain, McInish, and McKenzie (2013), including the existence of put option trading and naked short selling bans. The likelihood of a non-positive (or negative) first day return is substantially lower in countries where short selling is constrained by regulators and not commonly practiced. Additional evidence suggests that a commitment to quality disclosure may mitigate the negative impact of short sale constraints. Specifically, we find that the relation between short sale constraints and

underpricing is strongest in civil law countries and that IFRS adoption seems to have a moderating effect on the relation between short selling and underpricing.

Prior research finds that short sale constraints can have negative consequences for publicly traded firms, including temporary overvaluation, subsequent price reversals, and reduced market quality. Our results suggest that the negative consequences of regulatory policies that constrain short selling extend to private firms that seek to enter the public equity markets. Ritter (1987) reports that underpricing is the dominant cost of going public for most IPO firms. If short sale constraints are associated with higher underpricing, policies that support short selling can reduce the cost of capital for firms that go public. Likewise, market mechanisms that allow pessimistic investors to act on their views, including infrastructure that supports short selling and options market trading make it less costly for firms to raise equity capital. Thus, our results support prior research that calls for regulators to rethink policies that constrain short selling.

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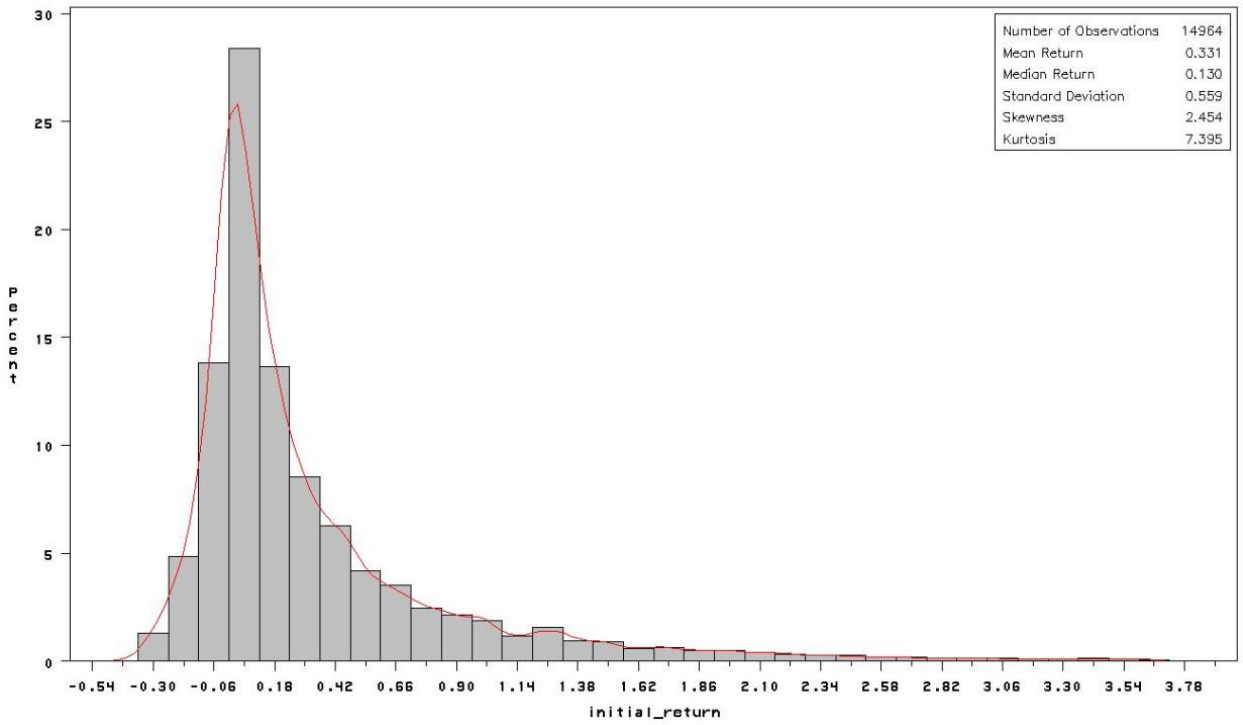

Fig. 1. Histogram of underpricing – full sample. Distribution of first-day returns for the full sample of 14,964 IPOs.

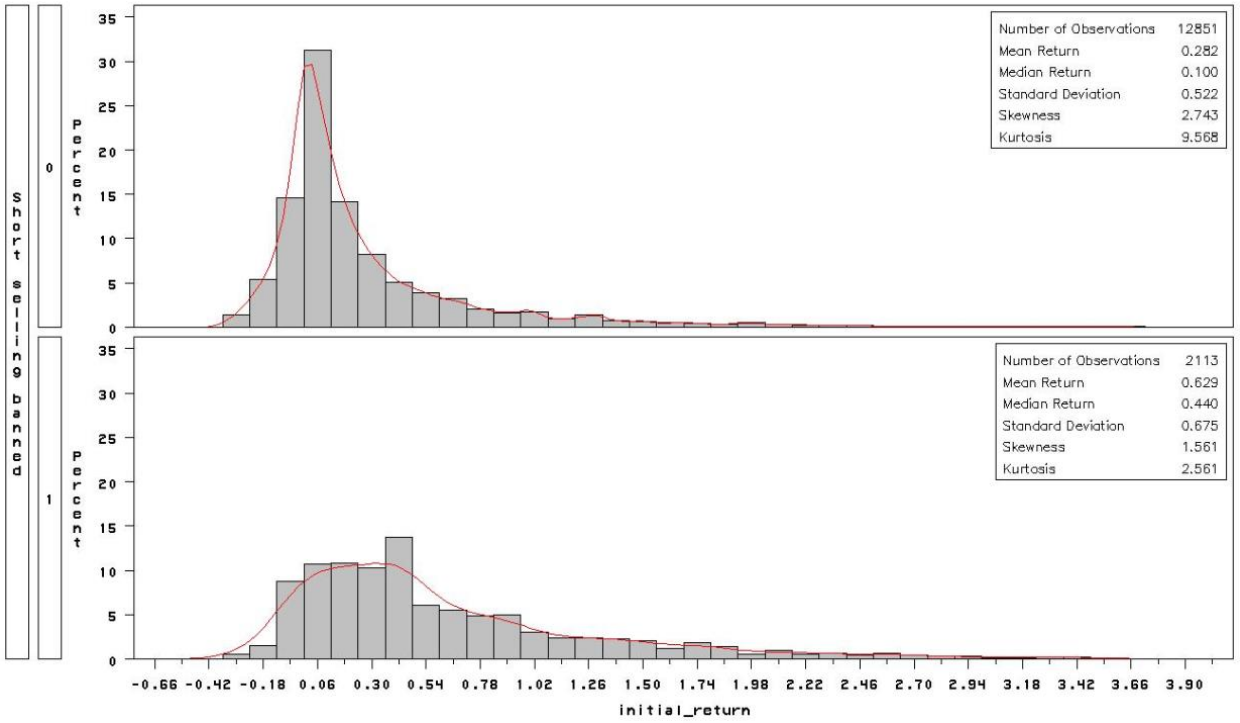

Fig. 2. Histogram of underpricing by short selling is banned. Distribution of first-day returns for subsamples based on whether short selling is banned.

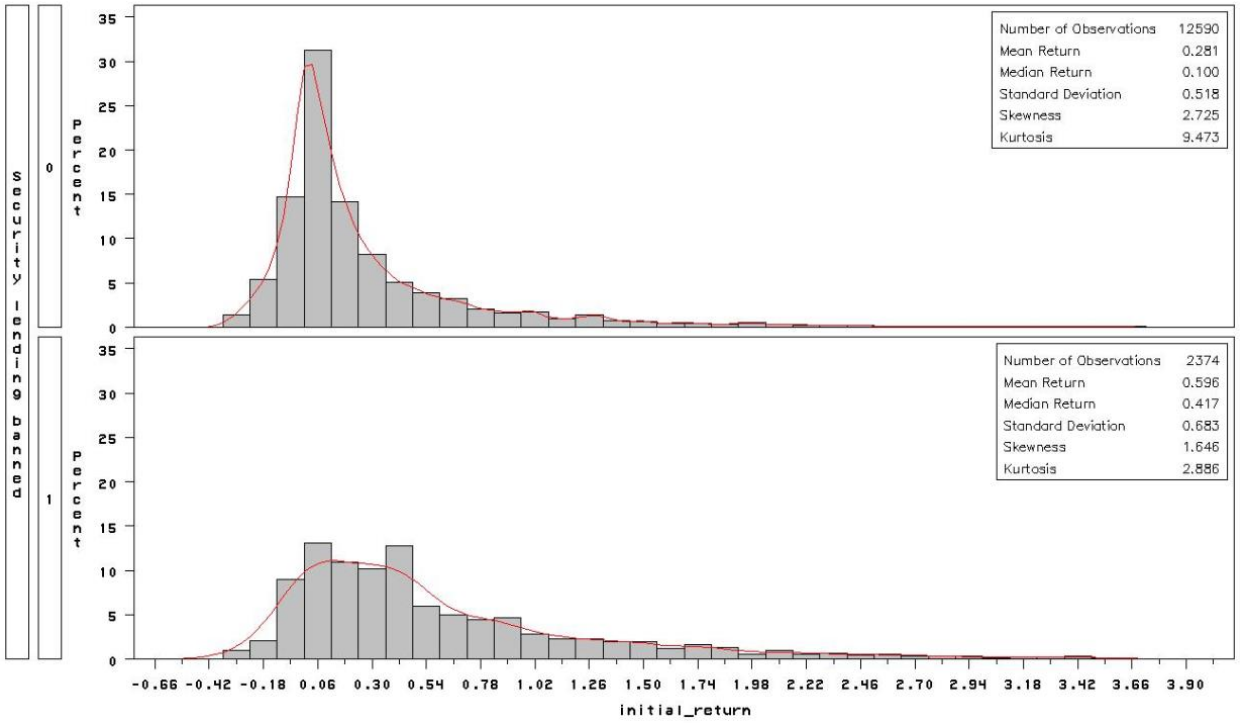

Fig. 3. Histogram of underpricing by security lending is banned. Distribution of first-day returns for subsamples based on whether security lending is banned.

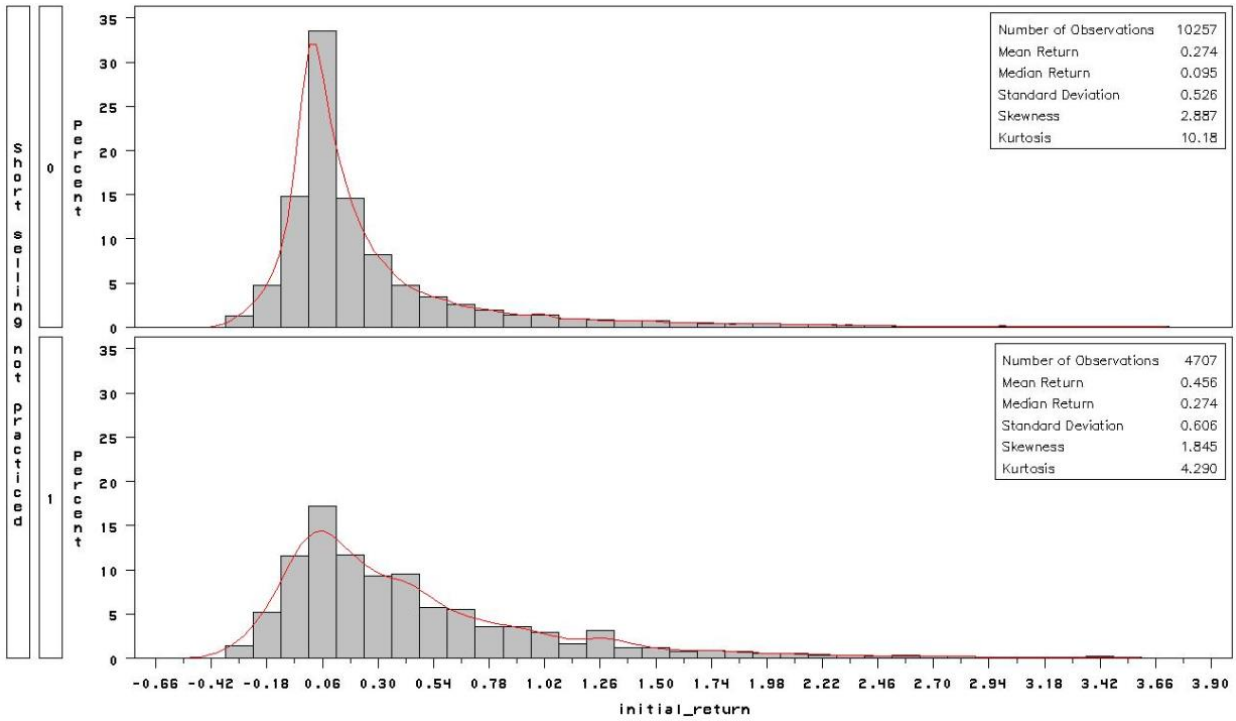

Fig. 4. Histogram of underpricing by short selling is not practiced. Distribution of first-day returns for subsamples based on whether short selling is not practiced.

Table 1. Descriptive statistics.

	N	Mean	Standard deviation	Minimum	Maximum
Short selling is banned	14,964	0.141	0.348	0.000	1.000
Security lending is banned	14,964	0.159	0.365	0.000	1.000
Short selling is not practiced	14,964	0.315	0.464	0.000	1.000
Civil law	14,964	0.460	0.498	0.000	1.000
IFRS	14,964	0.224	0.417	0.000	1.000
Underpricing	14,964	0.331	0.559	-0.344	3.690
Top-tier underwriter	14,959	0.243	0.429	0.000	1.000
Price stabilization	14,964	0.010	0.021	-0.059	0.100
IPO activity	14,855	0.057	0.037	0.000	0.198
Market return	14,964	0.028	0.105	-0.488	1.132
Stock market turnover	14,850	1.157	0.665	0.036	8.003
Antidirector rights	14,964	3.823	1.106	2.000	6.000
Offer size	14,962	124.849	557.786	0.001	26,216.697
Integer offer price	14,964	0.500	0.500	0.000	1.000
Bookbuilt	14,372	0.644	0.479	0.000	1.000
Firm commitment	14,890	0.630	0.483	0.000	1.000
Equity carveout	14,854	0.062	0.240	0.000	1.000
High-tech firm	14,964	0.229	0.420	0.000	1.000

This table presents descriptive statistics for the full sample of 14,964 IPOs. Short selling is banned, security lending is banned, and short selling is not practiced are indicator variables set equal to one for IPOs issued in countries where short selling is banned, security lending is banned, and short selling is not routinely practiced, respectively, and zero otherwise. Civil law and IFRS are indicator variables set equal to one for IPOs issued in Civil law countries and countries that have adopted IFRS, respectively, and zero otherwise. Underpricing is the first-day secondary market closing price divided by the final offer price, minus one. Top-tier underwriter is an indicator variable set to 1 for IPOs underwritten by an investment bank appearing in the top 25 of SDC's league tables in the issue year, and zero otherwise. Price stabilization is the difference in the number of IPOs with initial returns between zero and one percent and the number of IPOs with initial returns between zero and negative one percent, divided by the total number of IPOs in each country. IPO activity is the ratio of the total number of IPOs in the issue year divided by the number of Datastream listed equities for the country of listing as of 2014. Market return is the return on the Datastream index for the country of listing over the three months preceding the offering. Stock market turnover equals the ratio of the total value of shares traded to aggregate market capitalization as reported annually by The World Bank. Antidirector rights is an index measure of the legal protection afforded to corporate shareholders. Offer size is the log of inflation-adjusted offer value in millions of U.S. dollars. Indicator variables are set equal to one for IPOs priced on an integer, bookbuilt, firm commitment, and equity carve-out deals. High-tech firm is an indicator variable set equal to one for firms in one of the high-tech industries identified by Ljungqvist and Wilhelm (2003), and zero otherwise.

Table 2. Country-level short selling.

Country	IPOs	Underpricing	Short selling allowed	Security lending allowed	Short selling practiced
Argentina	7	1.18%	Since 1999	Yes	No
Australia	1,266	20.91%	Yes	Yes	Yes
Austria	33	5.55%	Yes	Yes	Yes
Belgium	68	9.63%	Yes	Yes	Yes
Brazil	73	4.25%	Yes	Yes	No
Canada	569	40.36%	Yes	Yes	Yes
China	1,666	69.47%	No	No	No
Denmark	34	7.10%	Yes	Yes	Yes
Finland	49	23.24%	Since 1999	Yes	No
France	596	13.91%	Yes	Yes	Yes
Germany	410	32.80%	Yes	Yes	Yes
Greece	121	56.99%	Yes	No	No
Hong Kong	971	16.43%	Yes	Yes	Yes
India	303	29.84%	Since 2008	Since 2008	No
Indonesia	158	25.97%	Except 2008-9	Yes	No
Ireland	14	10.90%	Yes	Yes	Yes
Israel	11	19.86%	Yes	Yes	No
Italy	178	12.32%	Yes	Yes	Yes
Japan	1,427	56.47%	Yes	Yes	Yes
Malaysia	395	30.02%	Since 2007	No	No
Mexico	22	4.63%	Yes	Yes	Yes
Netherlands	50	23.91%	Yes	Yes	Yes
New Zealand	58	8.95%	Yes	No	No
Norway	130	2.17%	Yes	Yes	Yes
Philippines	43	9.28%	Yes	Yes	No
Portugal	12	13.14%	Yes	Yes	Yes
Singapore	566	25.38%	Yes	Yes	Yes
South Africa	20	5.29%	Yes	Yes	Yes
South Korea	816	42.75%	Yes	Yes	No
Spain	55	12.74%	Yes	Yes	Yes
Sweden	108	8.25%	Yes	Yes	Yes
Switzerland	74	10.87%	Yes	Yes	Yes
Taiwan	677	28.09%	Yes	Yes	No
Thailand	251	37.87%	Since 2001	Allowed in 1999	No
Turkey	79	11.85%	Yes	Yes	No
United Kingdom	1,242	16.51%	Yes	Yes	Yes
United States	2,412	29.23%	Yes	Yes	Yes

This table presents country-level descriptive statistics for the IPO sample. The first two columns report the number of IPOs and average first-day return for each country. The final three columns report whether short selling is allowed, security lending is allowed, and short selling is practiced, respectively, based on information provided in Bris, Goetzmann, and Zhu (2007).

Table 3. Short selling constraints and IPO underpricing.

	Model 1	Model 2	Model 3	Model 4
Intercept	0.212	0.366	0.177	0.186
Short selling is banned	0.485***			0.327**
Security lending is banned		0.442***		0.175
Short selling is not practiced			0.233*	–0.009
Top-tier underwriter	0.044	0.045	0.045	0.046
Price stabilization	0.655	0.230	0.927	0.834
IPO activity	–0.304	0.432	–0.145	–0.297
Market return	0.883***	0.869***	0.892***	0.887***
Stock market turnover	0.026	0.025	0.047	0.033
Antidirector rights	0.021	–0.025	0.023	0.025
Offer size	–0.048**	–0.037*	–0.046**	–0.048***
Integer offer price	0.073	–0.016	0.067	0.076
Bookbuilt	–0.032	–0.002	–0.035	–0.033
Firm commitment	0.046	0.067	0.055	0.047
Equity carveout	–0.012	–0.023	–0.014	–0.012
High-tech firm	0.103*	0.068	0.094	0.103*
Industry dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
R^2	0.146	0.106	0.142	0.148
Number of observations	14,137	14,137	14,137	14,137

This table presents OLS regressions of IPO underpricing on country-level short sale constraints. The dependent variable is the IPO underpricing calculated as the secondary market closing price divided by the final offer price, minus one. All other variables are defined in the notes to Table 1. Regressions include industry indicators based on the industry classifications reported by Dyck and Zingales (2004) and issue year indicator variables. Respectively, ***, **, and * denote significance of the coefficient at the 1, 5, and 10 percent level based on standard errors clustered at the country level (Rogers, 1993).

Table 4. Short selling constraints and IPO underpricing – 22-day returns.

	Model 1	Model 2	Model 3	Model 4
Intercept	0.355*	0.509*	0.330	0.338
Short selling is banned	0.534***			0.390**
Security lending is banned		0.477***		0.157
Short selling is not practiced			0.261*	–0.006
Top-tier underwriter	0.080	0.079	0.081	0.082
IPO activity	–0.859	0.006	–0.701	–0.869
Market return	0.975***	0.961***	0.985***	0.977***
Stock market turnover	0.058	0.055	0.081	0.065
Antidirector rights	–0.006	–0.053	–0.007	–0.004
Offer size	–0.061***	–0.049***	–0.059***	–0.061***
Integer offer price	0.056	–0.043	0.048	0.058
Bookbuilt	0.007	0.038	0.004	0.007
Firm commitment	0.015	0.037	0.025	0.016
Equity carveout	0.120**	0.005	0.013	0.015
High-tech firm	0.065*	0.080	0.110*	0.120**
Industry dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
R^2	0.117	0.089	0.113	0.118
Number of observations	14,125	14,125	14,125	14,125

This table presents OLS regressions of IPO underpricing on country-level short sale constraints. The dependent variable is the IPO underpricing calculated as the secondary market closing price on the 22nd trading day after the IPO divided by the final offer price, minus one. All other variables are defined in the notes to Table 1. Regressions include industry indicators based on the industry classifications reported by Dyck and Zingales (2004) and issue year indicator variables. Respectively, ***, **, and * denote significance of the coefficient at the 1, 5, and 10 percent level based on standard errors clustered at the country level (Rogers, 1993).

Table 5. Short selling constraints and IPO underpricing – alternative measures.

	Model 1	Model 2	Model 3	Model 4	Model 5
Intercept	0.125	0.401	0.332	0.189	0.264
Short selling not legal	0.487**			0.312*	
Short selling not feasible		0.317**		0.136	
Put options do not exist			0.329*	0.176*	
Naked short selling prohibited					0.257**
Top-tier underwriter	0.050	0.059	0.031	0.072**	0.004
Price stabilization	1.327	–0.054	1.114	2.106*	0.048
IPO activity	–1.391	0.340	–0.209	–1.207	–0.393
Market return	0.894***	0.862***	0.894***	0.874***	0.909***
Stock market turnover	0.061	0.022	0.008	0.017	0.112
Antidirector rights	0.043	–0.023	–0.003	0.032	–0.027
Offer size	–0.046**	–0.048***	–0.041**	–0.055***	–0.028
Integer offer price	0.070	–0.012	0.027	0.047	0.036
Bookbuilt	–0.043	–0.036	–0.020	–0.009	–0.031
Firm commitment	0.049	0.071	0.071	0.039	–0.003
Equity carveout	–0.020	–0.015	–0.024	–0.013	–0.038
High-tech firm	0.113**	0.107**	0.042	0.109*	0.083
Industry dummies	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes
R^2	0.140	0.125	0.116	0.155	0.114
Number of observations	14,137	14,137	14,137	14,137	14,137

This table presents OLS regressions of IPO underpricing on country-level short sale constraints. The dependent variable is the IPO underpricing calculated as the secondary market closing price divided by the final offer price, minus one. Short selling not legal, short selling not feasible, and put options do not exist are indicator variables set equal to one for IPOs issued in countries where short selling not legal, short selling not feasible, and put options do not exist, respectively, and zero otherwise, based on details provided in Charoenrook and Daouk (2005). Naked short selling prohibited is an indicator variable set to one for IPOs issued in countries that prohibit naked short selling, and zero otherwise, based on information in Jain, Jain, McInish, and McKenzie (2013). All other variables are defined in the notes to Table 1. Regressions include industry indicators based on the industry classifications reported by Dyck and Zingales (2004) and issue year indicator variables. Respectively, ***, **, and * denote significance of the coefficient at the 1, 5, and 10 percent level based on standard errors clustered at the country level (Rogers, 1993).

Table 6. Short selling constraints and frequency of non-positive initial returns - univariate.

	N	Initial return <= 0	Initial return < 0
Short selling is allowed	12,851	26.91%	21.59%
Short selling is banned	2,113	11.26%	10.79%
Difference		15.65%	10.80%
p-value		(0.000)	(0.000)

	N	Initial return <= 0	Initial return < 0
Security lending is allowed	12,590	26.93%	21.59%
Security lending is banned	2,374	12.89%	12.01%
Difference		14.04%	9.58%
p-value		(0.000)	(0.000)

	N	Initial return <= 0	Initial return < 0
Short selling is practiced	10,257	27.04%	20.97%
Short selling is not practiced	4,707	19.61%	18.10%
Difference		7.43%	2.87%
p-value		(0.000)	(0.000)

This table presents univariate analysis of the likelihood of a non-positive (negative) return on country-level short sale constraints. Reported are the percentages of sample IPOs that have a first-day return less than or equal to zero (less than zero) based on whether or not short selling is banned, security lending is banned, and short selling is practiced.

Table 7. Short selling constraints and frequency of non-positive initial returns - logistic.

	Model 1	Model 2	Model 3	Model 4
Intercept	–1.316***	–1.663***	–1.233***	–1.289***
Short selling is banned	–1.518***			–1.163***
Security lending is banned		–1.284***		–0.293*
Short selling is not practiced			–0.661***	–0.114
Top-tier underwriter	–0.106*	–0.126**	–0.107*	–0.125**
Price stabilization	–5.855***	–5.010***	–6.184***	–6.600***
IPO activity	1.977***	–0.592	1.336**	1.897***
Market return	–3.377***	–3.072***	–3.327***	–3.385***
Stock market turnover	–0.088**	–0.099**	–0.152***	–0.090**
Antidirector rights	–0.071***	0.045*	–0.071***	–0.071***
Offer size	0.103***	0.076***	0.097***	0.105***
Integer offer price	0.038	0.280***	0.060	0.063
Bookbuilt	–0.064	–0.171***	–0.065	–0.093*
Firm commitment	–0.025	–0.064	–0.048	–0.017
Equity carveout	0.107	0.130	0.114	0.105
High-tech firm	0.113	0.193	0.142	0.117
Industry dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
R^2	0.078	0.058	0.074	0.079
Number of observations	14,137	14,137	14,137	14,137

This table presents logistic regressions examining the determinants of non-positive first-day returns. The dependent variable is an indicator variable set equal to one for IPOs that experience a non-positive first-day return (<= 0), and zero otherwise. All other variables are defined in the notes to Table 1. Regressions include industry indicators based on the industry classifications reported by Dyck and Zingales (2004) and issue year indicator variables. Respectively, ***, **, and * denote significance of the coefficient at the 1, 5, and 10 percent level.

Table 8. Short selling constraints and IPO underpricing – legal origin.

	Model 1	Model 2	Model 3
Intercept	0.285	0.473	0.242
Short selling is banned	0.042		
Short selling is banned x Civil law	0.596***		
Security lending is banned		0.022	
Security lending is banned x Civil law		0.611***	
Short selling is not practiced			0.126**
Short selling is not practiced x Civil law			0.047
Civil law country	0.069	0.210	0.056
Top-tier underwriter	0.051	0.039	0.057
Price stabilization	1.728	1.389	1.955*
IPO activity	–1.154	–0.100	–1.178
Market return	0.893***	0.878***	0.905***
Stock market turnover	–0.022	–0.013	–0.009
Antidirector rights	0.021	–0.056	0.029
Offer size	–0.059***	–0.040***	–0.057***
Integer offer price	0.077*	–0.052	0.074
Bookbuilt	–0.052	–0.045	–0.064
Firm commitment	0.055	0.083	0.065
Equity carveout	–0.010	–0.029	–0.008
High-tech firm	0.110*	0.080	0.109*
Industry dummies	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
F-test (*p*-value)	(0.000)	(0.247)	(0.000)
R^2	0.173	0.126	0.175
Number of observations	14,137	14,137	14,137

This table presents OLS regressions of IPO underpricing on country-level short sale constraints. The dependent variable is the IPO underpricing calculated as the secondary market closing price divided by the final offer price, minus one. Civil law is an indicator variable set equal to one for IPOs issued in a country from the civil law legal tradition, and zero otherwise. All other variables are defined in the notes to Table 1. Regressions include industry indicators based on the industry classifications reported by Dyck and Zingales (2004) and issue year indicator variables. Respectively, ***, **, and * denote significance of the coefficient at the 1, 5, and 10 percent level based on standard errors clustered at the country level (Rogers, 1993).

Table 9. Short selling constraints and IPO underpricing – IFRS adoption.

	Model 1	Model 2	Model 3
Intercept	0.211	0.338	0.171
Short selling is banned	0.484***		
Short selling is banned x IFRS	–0.546***		
Security lending is banned		0.461***	
Security lending is banned x IFRS		–0.495***	
Short selling is not practiced			0.250*
Short selling is not practiced x IFRS			–0.172
IFRS	–0.007	–0.016	0.005
Top-tier underwriter	0.044	0.043	0.046
Price stabilization	0.67	0.579	0.885
IPO activity	–0.299	0.368	–0.209
Market return	0.883***	0.864***	0.886***
Stock market turnover	0.025	0.02	0.043
Antidirector rights	0.021	–0.017	0.024
Offer size	–0.048**	–0.037*	–0.046**
Integer offer price	0.072	–0.016	0.069
Bookbuilt	–0.033	–0.037	–0.036
Firm commitment	0.046	–0.016	0.054
Equity carveout	–0.013	0.001	–0.012
High-tech firm	0.103*	0.062	0.102*
Industry dummies	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
F-test (*p*-value)	(0.280)	(0.608)	(0.584)
R^2	0.147	0.109	0.145
Number of observations	14,137	14,137	14,137

This table presents OLS regressions of IPO underpricing on country-level short sale constraints. The dependent variable is the IPO underpricing calculated as the secondary market closing price divided by the final offer price, minus one. IFRS is an indicator variable set equal to one for IPOs issued in a country that has adopted the International Financial Reporting Standards (IFRS), and zero otherwise. All other variables are defined in the notes to Table 1. Regressions include industry indicators based on the industry classifications reported by Dyck and Zingales (2004) and issue year indicator variables. Respectively, ***, **, and * denote significance of the coefficient at the 1, 5, and 10 percent level based on standard errors clustered at the country level (Rogers, 1993).